EUROPEAN ORGANISATION FOR NUCLEAR RESEARCH (CERN)

Submitted to: Phys. Lett. B

CERN-EP-2026-076
20th March 2026

Combined effective field theory interpretation of measurements sensitive to quartic gauge boson couplings in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector

The ATLAS Collaboration

A combination of measurements sensitive to anomalous quartic electroweak gauge boson couplings is presented using proton–proton collision data collected by the ATLAS detector at $\sqrt{s} = 13$ TeV at the LHC. Contributing analyses include measurements of vector-boson scattering in numerous final states as well as a tri-boson measurement. The combined measurement is used to constrain anomalous electroweak boson quartic self-couplings that result from dimension-8 operators in the Éboli model using an effective field theory. Results are presented as 68% and 95% confidence level intervals parameterised by one or two Wilson coefficients, both with and without unitarity constraints applied. Theoretical bounds from unitarity and positivity are overlaid where relevant. Confidence intervals obtained from simultaneous profiled fits to all Wilson coefficients are also presented.

Contents

1 Introduction

The Large Hadron Collider (LHC) has enabled a rigorous study of the Standard Model (SM) up to the electroweak scale and beyond. Numerous dedicated analyses searching for new TeV-scale particles have been conducted by both the ATLAS and CMS collaborations, see for example Ref. [1, 2], without finding any significant excess above the SM background prediction. In the absence of direct evidence of new physics, a complementary program is to search for small deviations from SM predictions that can arise from new physics with energy scales beyond that of direct production at the LHC. The SM effective field theory (EFT) [3] is a theoretical framework that describes potential new physics at or above a scale Λ in terms of SM gauge invariant operators of dimension-d, which are suppressed by the scale $\frac{E^{d-4}}{\Lambda^{d-4}}$, where E is the energy scale of the process. Wilson coefficients, denoted f_i, parameterise the size of each potential operator contribution.

Constraints on dimension-6 operators were extracted from combinations of results from Higgs boson, electroweak, top-quark, and jet related measurements using 13 TeV LHC data from both the ATLAS and CMS collaborations [4, 5], and electroweak precision observables at the Z mass performed at LEP and SLC [6]. Such results are truncated at dimension-6 since these are the leading-order new-physics contributions to most processes, excluding odd-dimension operators that violate baryon and lepton number conservation. Many potential beyond the SM scenarios predict direct anomalous Quartic-Gauge Couplings (aQGCs) [7, 8]. Others predict resonant new physics beyond the TeV scale that could be experimentally observed at current collider experiments as aQGCs, for example composite Higgs boson models [9], warped extra-dimension models [10], gravitons [11], two-Higgs-doublet models [12] and unified models [13]. While dimension-6 operators can indirectly affect processes sensitive to aQGCs through diagrams with triple-gauge boson vertices, operators affecting only quartic-gauge couplings begin to appear at dimension-8. Thus, such models are potentially not well constrained by dimension-6 results.

At dimension-8 there are tens of thousands of new operators along with multiple insertions of dimension-6 operators, making probing all operators experimentally impractical. The effects of dimension-8 operators that give rise to aQGCs are most experimentally prevalent in the vector-boson-scattering (VBS) process and tri-boson production. Representative Feynman diagrams for the VBS and tri-boson processes are shown in Figure 1. The results presented here use the Éboli model [8] as the basis for the dimension-8 operators that predict aQGCs. The dimension-6 operators that cause anomalous triple gauge couplings that

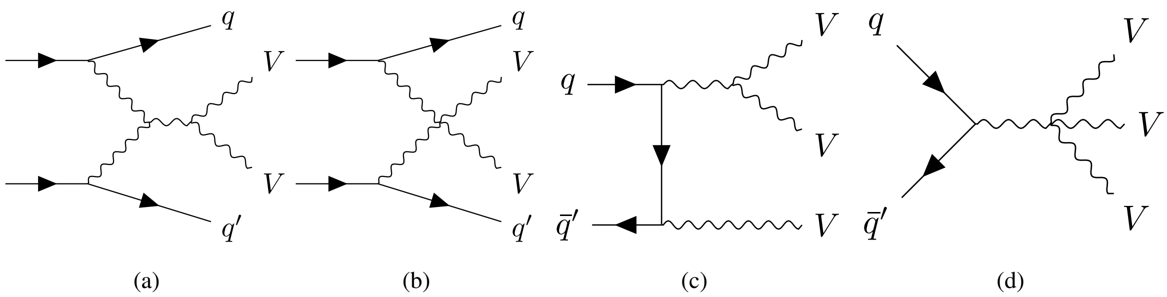


Figure 1: Representative Feynman diagrams for a) vector-boson scattering with triple-gauge vertices, b) vector-boson scattering with quartic-gauge vertices, c) tri-boson production with triple-gauge vertices, and d) tri-boson production with quartic-gauge vertices. The aQGCs act only on diagrams b) and d) through anomalous values or vertices forbidden in the SM.

would contribute to the analyzed VBS and tri-boson channels (Figure 1(a) and 1(c)) are assumed to be sufficiently well constrained by dedicated searches such that their contributions are negligible.

Measurements of VBS production have been reported by the ATLAS and CMS collaborations using the full Run 2 13 TeV data in numerous experimental channels [14–28]. Similarly, tri-boson production has been measured in several experimental channels by the ATLAS [29–31] and CMS [32–35] collaborations.

This Letter presents a combination of measurements from seven VBS analyses [14, 18, 20, 22, 24, 25, 27] and one tri-boson analysis [29], each performed using 140 fb^{-1} of pp collision data recorded by the ATLAS detector during Run 2 of the LHC. A combined likelihood is built from the likelihoods of the input measurements and a likelihood fit is performed to extract constraints on dimension-8 Wilson coefficients. Constraints on the Wilson coefficients of 17 of the Éboli basis operators are presented when considering one or two operators at a time, with and without unitarity constraints. Profiled confidence intervals obtained from simultaneous fits to the 17 operators are also presented.

2 Theoretical framework

The SM Effective Field Theory provides a model-independent description of effects beyond the SM that introduce new particles at a mass scale Λ, which is large in comparison to the electroweak scale. At energies significantly below the scale Λ, the effect of new physics can be described by additional operators $O_i^{(d)}$ of energy dimension $d > 4$ that extend the SM Lagrangian in orders of E/Λ, where E is the energy exchanged in the process. These operators are build from combinations of SM fields that obey the symmetries of the SM such as gauge invariance. Ignoring odd-dimensional operators, which introduce lepton and baryon number violation, and dimension-6 terms, which are highly constrained by existing results, the leading terms in this effective Lagrangian become

$$\mathcal{L}_{\text{Eff}} \approx \mathcal{L}_{\text{SM}}^{(4)} + \sum_j \frac{f_j^{(8)}}{\Lambda^4} O_j^{(8)} \tag{1}$$

where $\mathcal{L}_{SM}^{(4)}$ is the SM Lagrangian, which contains dimension-2 and dimension-4 operators. The remaining terms $O_i^{(8)}$ denote the new dimension-8 operators, and $f_i^{(8)}$ are the corresponding dimensionless Wilson coefficients.

With the Lagrangian given in Equation 1, scattering cross-sections can be approximated as

$$\sigma = |\mathcal{M}_{\rm SM}|^2 + \sum_i \frac{f_i^{(8)}}{\Lambda^4} 2{\rm Re}\left(\mathcal{M}_i^{(8)}\mathcal{M}_{\rm SM}^*\right) + \sum_i \frac{\left(f_i^{(8)}\right)^2}{\Lambda^8}\left|\mathcal{M}_i^{(8)}\right|^2 + \sum_{i<j} \frac{f_i^{(8)} f_j^{(8)}}{\Lambda^8} 2{\rm Re}\left(\mathcal{M}_i^{(8)}\mathcal{M}_j^{(8)*}\right) \tag{2}$$

where $\mathcal{M}_{\rm SM}$ is the matrix element as it occurs in the SM, and $\mathcal{M}_i^{(8)}$ are the new matrix elements calculated from the operators $O_i^{(8)}$. The first and third terms refer to the SM and the dimension-8 squared amplitude contributions to the cross-section, respectively. The second term, which is of order Λ^{-4}, is the interference between the SM and the dimension-8 operators. Due to the scaling behavior of the SM-interference and the dimension-8 squared amplitude contributions to the cross-section relative to the Wilson coefficients, the second and third terms are referred to as the linear and quadratic contributions of the expansion, respectively. The last term represents the interference of dimension-8 operators with one another, and is referred to as the cross-term.

In this work, confidence intervals on dimension-8 operator couplings are set using the Éboli model [8], which provides a subset of the total dimension-8 operators satisfying the SM $SU(2)_L \times U(1)_Y$ symmetry and specifically producing aQGCs. In this model, the 21 new C-even P-even dimension-8 operators can be categorized into: scalar-types that only contain derivatives of the scalar Higgs field (O_{S0}, O_{S1}, O_{S2}), tensor-types that only contain electroweak boson field strengths (O_{T0}, ..., O_{T9}), and mixed-type operators (O_{M0}, ..., O_{M7}). The O_{M6} term was found to be redundant in Ref. [36] and is not considered in this work. Similarly, the O_{T3} and O_{T4} operators are excluded due to the fact this MadGraph5_aMC@NLO simulation implementation was not available in many of the individual analysis publications. Following Ref. [14, 18, 27] the operators O_{S0} and O_{S2} are varied simultaneously with equal coefficient values f_{S02}. This leaves 17 independent Wilson coefficients, all of which are considered in this work. It is worth noting that due to the helicity structure of the Éboli operators, the SM-interference term in Equation 2 is highly suppressed in the Éboli basis.

Theoretical constraints limit the regime of validity of the EFT operator expansion, and are considered in the result. Operators with mass dimension greater than four can lead to interaction probabilities that increase until unitarity is violated. Theoretical bounds are thus obtained by requiring that perturbative partial-wave unitarity is satisfied as derived in Ref [37, 38]. In addition, assuming the new high-energy physics obeys the low-scale principles of unitarity, locality, and causality, cross-sections on the helicity-amplitude must be positive definite at all scales. Positivity bounds are computed for the Éboli dimension-8 basis in Ref [39].

Simulated samples of VBS and tri-boson production under the effect of the Éboli model were simulated using MadGraph5_aMC@NLO (v3.5.5) [40] at leading-order in quantum chromo-dynamcis (QCD) with the NNPDF30_nlo_as_0119 parton distribution function set [41]. Decays of the vector bosons were handled with MadSpin [42]. Parton showering, hadronisation, and underlying event modeling were performed using Pythia 8 with the dipole recoil scheme enabled [43]. The total cross-section in Equation 2 was decomposed, with the linear, quadratic, and cross-term EFT contributions simulated separately. The SM component of the expansion uses the original simulated samples from the individual analyses that may be at higher-orders in QCD. The total process including the EFT effects for a given Wilson coefficient value is then reproduced by adding the EFT contributions, scaled appropriately by the Wilson coefficients, to the predicted SM contribution.

Table 1: Summary of input analyses in the combination. Full, Partial, and None refer to whether all relevant operators a subset of them, or no dedicated interpretation were explored in the original publication.

Analysis	Input type	Éboli operator results	Luminosity [fb^{-1}]	Reference
$VVjj \to (\ell\ell jj/\ell\nu jj/\nu\nu jj)jj$	Reco-level Differential	Full	140	[27]
$WZjj \to l^+l^-l^\pm\nu jj$	Reco-level Differential	Partial	140	[18]
$W^\pm W^\pm jj \to l^\pm\nu l^\pm\nu jj$	Reco-level Differential	Full	139	[14]
$ZZjj \to l^+l^-l^+l^- jj$	Unfolded Differential	None	140	[20]
$W\gamma jj \to l^\pm\nu\gamma jj$	Unfolded Differential	Full	140	[22]
$Z\gamma jj \to \nu\bar{\nu}\gamma jj$	Reco-level Inclusive	Partial	139	[24]
$Z\gamma jj \to l^+l^-\gamma jj$	Unfolded Differential	None	140	[25]
$W\gamma\gamma \to l^\pm\nu\gamma\gamma$	Reco-level Differential	None	140	[29]

3 Input measurements

All measurements included in the combination were performed using 140 fb^{-1} of $\sqrt{s}$ = 13 TeV pp collision data recorded with the ATLAS detector at the LHC. The input measurements used to constrain aQGC parameters are summarized in Table 1. The individual measurements provide either reconstruction-level (reco-level) results in a differential distribution, unfolded results of a differential distribution, or a reconstruction-level inclusive cross-section. Several analyses were published with an earlier measured integrated luminosity value of 139 fb^{-1} with a larger uncertainty. For this result, these inputs were adjusted to reflect the more precise, updated measured values.

To facilitate the statistical interpretation, it is preferable that each included analysis region has no statistical overlap so that each data event is only counted once in the combined result. There is a non-negligible overlap found between the control region of the $W^\pm W^\pm jj$ measurement that is used to determine the shape of the $WZjj$ background, and the signal region of the $WZjj$ measurement. This overlapping control region is dropped from the combination to avoid double counting events. This choice has a negligible effect on the results. The overlap between analyses is at the sub-percent level in all other cases.

Several adjustments are made to the input results to facilitate full coverage of the operator parameter space across experimental channels. In the $Z(\nu\nu)\gamma jj$ aQGC results, only a single overflow bin in leading photon p_T was used in the original EFT interpretation, with a threshold value varying as function of the operator and of the clipping value. For this analysis the full leading photon p_T distribution is used in eight bins, as it facilitates the combination with the other analyses and allows probing several operators at the same time. This change improves the confidence intervals by 1%. For $W\gamma\gamma$, the reco-level result was used, splitting the final observable of leading photon p_T into three bins $[25, 45, 80, \infty]$ GeV, as opposed to the single-bin result used in the publication. The data-driven background estimation procedure was reproduced and validated, as was done in the original publication, with this finer binning. This finer binning improves the constraints by up to 40%. In its original publication, the $W\gamma jj$ result used a different kinematic observable for each operator under consideration. For simplicity in this combination, the unfolded p_T of the leading lepton distribution is used as the final observable, which at most degrades the confidence intervals on a subset of operators by 20%.

In several of the individual measurement publications, either none or only a subset of the operators were probed. For completeness, this result considers the potential impact of all operators in all channels. The published $Z(\ell\ell)\gamma jj$, $ZZ(4\ell)jj$ and $W\gamma\gamma$ measurements do not provide a dedicated Éboli model result, and so in this Letter a dedicated interpretation is conducted for each of these analyses. For the $Z(\ell\ell)\gamma jj$

($ZZ(4\ell)jj$) result, the publicly available one(two)-dimensional unfolded distribution of the p_{T} of the $Z\gamma$ system (invariant masses of the ZZ and dijet systems), are reinterpreted in this context. For the $W\gamma\gamma$ analysis, the full reconstruction level template was generated for all samples, and is used for reinterpretation. In the initial publication of $Z(\nu\nu)\gamma jj$ and $WZjj$, which used reco-level results, only a subset of operators was probed, so a template replacement procedure is developed to derive the kinematic shapes of the missing operators. In this procedure, the histogram template of the differential yields of the missing operator in the observable of interest is approximated using the reco-level template of an existing operator that has the lowest χ^2 difference between corresponding templates at particle-level. Differences between cross-sections are accounted for in the replacement procedure. Dedicated non-closure studies on this procedure are conducted by applying the replacement in situations where the original templates exist. The difference in the confidence intervals obtained from the two templates is found to be at the percent level in all cases, except for the $Z(\nu\nu)\gamma jj$ analysis that found an impact of 9% on the intervals for the f_{M1} and f_{T9} coefficients. When the template difference is added as an additional source of uncertainty in these cases, the corresponding confidence intervals widened by at most 4%, whereas the effect on confidence intervals of some other coefficients is at a sub-percent level. No non-closure uncertainty is included for the complete set of final results presented here. Cross-terms were not considered in the original publications except for the $WZjj$ and $W^{\pm}W^{\pm}jj$ analyses in several specific cases. As such, cross-term effects at reco-level are simulated through the same replacement procedure.

4 Statistical model

The combination of the individual channels proceeds via a joint simultaneous likelihood model of the discriminating variables across all of the channels. The Wilson coefficients f_i are treated as parameters of interest of the fit model. Systematic uncertainties are treated as nuisance parameters, denoted by $\boldsymbol{\theta}$. A likelihood ratio test statistic λ, is built from the likelihood to evaluate 68% and 95% confidence level intervals for the Wilson coefficients:

$$\lambda = -2\log\frac{L(\boldsymbol{\mu_i}, \hat{\hat{\boldsymbol{\theta}}})}{L(\hat{\boldsymbol{\mu}}_{\boldsymbol{i}}, \hat{\boldsymbol{\theta}})} \tag{3}$$

where $\mu_i = f_i/\Lambda$, $L(\boldsymbol{\mu_i}, \hat{\hat{\boldsymbol{\theta}}})$ is the maximum of the likelihood for a given μ_i, and $L(\hat{\boldsymbol{\mu}}_{\boldsymbol{i}}, \hat{\boldsymbol{\theta}})$ is the absolute maximum of the likelihood. The total likelihood is the product of the individual likelihoods from the individual channels, which have not been changed relative to the original publications except for details mentioned earlier in this Letter. For each given set of Wilson coefficients, a maximum-likelihood fit is performed by setting other coefficients to zero and maximizing the likelihood relative to the nuisance parameters. Confidence intervals are derived using Wilks' theorem, assuming that the profile likelihood test statistic is χ^2-distributed [44] with degrees of freedom matching the number of fitted Wilson coefficients. The validity of Wilks' theorem, which holds asymptotically in the large sample limit, is tested against a full pseudo-experiment procedure in several cases, and the reported 68/95% confidence level intervals are validated within 5%. Expected confidence intervals are computed from synthetic data constructed such that the estimators of all parameters match the true parameters of the SM-only hypothesis [44].

Since each analysis is statistically limited, the choice of correlation scheme between nuisance parameters of the input analysis has negligible impact on the final result, with the total confidence intervals changing by less than one percent in the extreme case where all systematic effects are removed. None the less, all systematic uncertainties are treated as correlated across analyses if they originate from the same source. Thus all experimental uncertainties in the reconstruction and identification of final state jets, electrons, photons, muons, and missing transverse momentum, and the luminosity and pile-up uncertainties, are treated as fully correlated across all analyses. There is an exception for jet-based systematic uncertainties in the $Z(\nu\nu)\gamma jj$ analysis that are uncorrelated from the other analyses as a different jet definition is used. Similarly heavy-flavor identification uncertainties are only correlated across analysis using the same algorithm definition and identification working point and uncorrelated otherwise. Modeling uncertainties on the various background processes of each analysis are treated as uncorrelated due to the specific phase space of each analysis. On the other hand, modeling uncertainties on the signal EFT processes, originating from QCD scale and parton distribution functions, are treated as correlated across all VBS analyses, with the $W\gamma\gamma$ process left uncorrelated due to the different initial parton contributions and relevant energy scales. For the $Z(\nu\nu)\gamma jj$ and $W\gamma\gamma$ analyses, all systematic uncertainties were re-evaluated using the finer discriminant binning explored in this work.

Several fits are performed for different interpretations of the data. One-dimensional fits are performed for each operator allowing only its matching Wilson coefficient to vary in the fit, while the remaining are set to zero. Two-dimensional confidence intervals are presented for pairs of operators using a similar fit model where only the respective Wilson coefficients are non-zero and allowed to vary. Profiled likelihood confidence intervals are also presented where all Wilson coefficients are allowed to float simultaneously. Profiled results enable the interpretation of the results with phenomenological models that predict simultaneous changes to multiple Wilson coefficients.

5 Results

The 68% and 95% confidence level intervals for each Wilson coefficient are shown in Figure 2 (middle panel), which are obtained from fits where all but the relevant coefficient are fixed to zero. The contribution of each input channel on the combined confidence intervals is shown in Figure 2 (top-panel) and is calculated as in Equation 4, where σ_i is the 68% confidence level intervals obtained in channel i for a given Wilson coefficient:

$$\text{Contribution(chan.)} = \frac{\frac{1}{\sigma^2_{\text{chan.}}}}{\sum_i^{N_{\text{chan.}}} \frac{1}{\sigma_i^2}} \tag{4}$$

The sensitivity reach in terms of the new physics scale Λ for each Wilson coefficient is shown at the 95% confidence level intervals in Figure 2 (bottom-panel) and compared to bounds set by unitarity constraints. The best individual constraint on the f_{S02}, f_{S1}, f_{M0}, f_{M1}, and f_{M7} Wilson coefficients originate from the $VV-$semileptonic analyses, while the best individual result on the f_{M2}, f_{M3}, f_{M4}, f_{M5}, and all tensor-type Wilson coefficients come from the $Z(\nu\nu)\gamma jj$ channel. The intervals on the scalar and mixed-type operators are tightened by up to 20% in the combined fit relative to those derived using individual channels. Due to the dominant sensitivity in the $Z(\nu\nu)\gamma jj$ analysis, the tensor-type operator constraints are negligibly improved in the combined fit.

As discussed in Section 2, operators with mass dimension greater than four can lead to interaction probabilities that increase until unitarity is violated. Following Ref [45], the confidence intervals are recalculated for cases where the EFT contributions are zeroed for energy scales above a selected value, known as the clipping threshold. This method provides an easily reproducible result, and provides a conservative limit as any deviations above the energy-scale are not considered consistent with the EFT. The energy scale is given by the diboson invariant mass for VBS analyses and by the largest of the three possible diboson invariant masses for the tri-boson analysis. The confidence intervals are recalculated for clipping

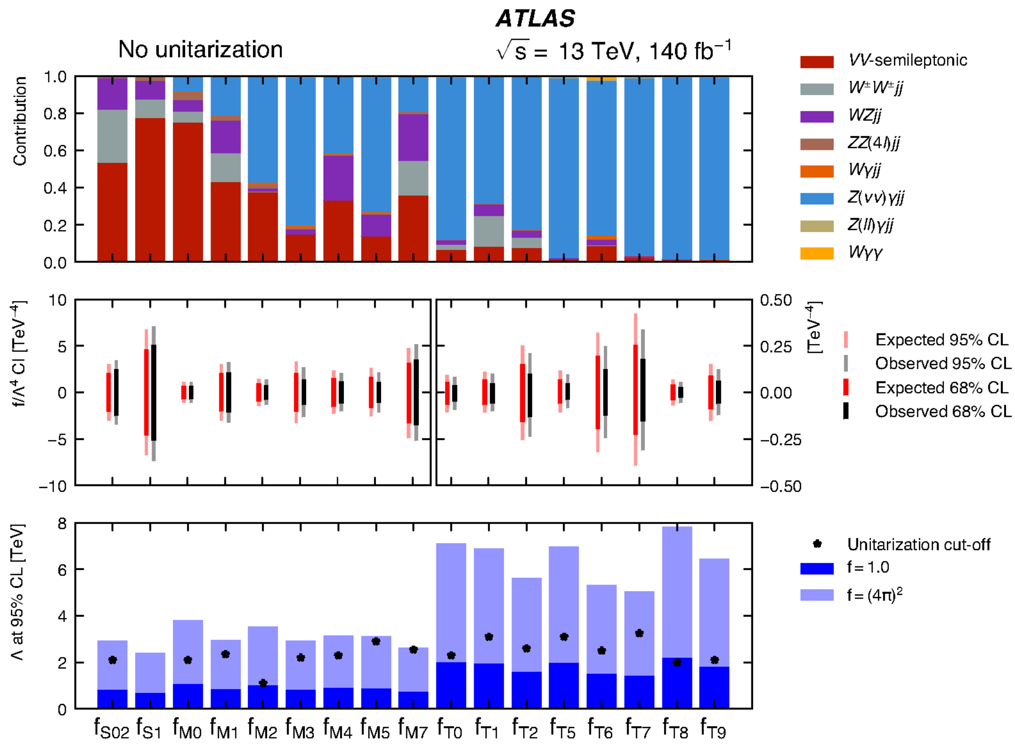


Figure 2: Contributions of the individual channels to the combination (top), expected and observed 68% and 95% confidence level intervals from the combined fit (middle) and the probed energy scale for two illustrative values of the Wilson coefficients (bottom). No constraints from unitarity bounds are applied. The energy scale of the observed unitarization cut-off as evaluated through a clipping procedure is overlaid on the bottom panel. No unitarization cut-off is found for the f_{S1} operator where the experimental interval is always weaker than the unitarity constraint.

thresholds of 0.7, 1, 1.5, 2 and 3 TeV, with the results for the 1.5 TeV clipping threshold shown in Figure 3. It can be seen that the combined intervals on the Wilson coefficients at the 1.5 TeV clipping threshold are approximately an order of magnitude wider than the non-unitarized intervals. The input channels most sensitive to the clipping threshold are the $VV-$semileptonic and $Z(\nu\nu)\gamma jj$ channels, where the fitted observables have a large reach in energy. Consequently, it can be seen at the 1.5 TeV clipping threshold that the contribution to the interval of some coefficients is more distributed across the input channels, with the $WZjj$ channel providing a similar contribution to previously-dominant $VV-$semileptonic and $Z(\nu\nu)\gamma jj$ channels.

Unitarized confidence intervals are chosen as the intersection between the interpolated confidence intervals as a function of clipping threshold and the theoretical unitarity bounds provided in Ref [37, 38]. The clipping threshold at the unitarized point is designated as the unitarization cut-off. Examples of the confidence intervals scans across clipping thresholds for the combined fit on the f_{S02}, f_{M0}, and f_{T0} Wilson coefficients are shown in Figure 4. Where applicable, positivity bounds from Ref [39] are shown. A unitarization cut-off is found in all cases except for the f_{S1} coefficient, where the theory bound is tighter than the derived experimental interval at all clipping thresholds.

The combined expected and observed unitarized confidence intervals, along with the energy threshold

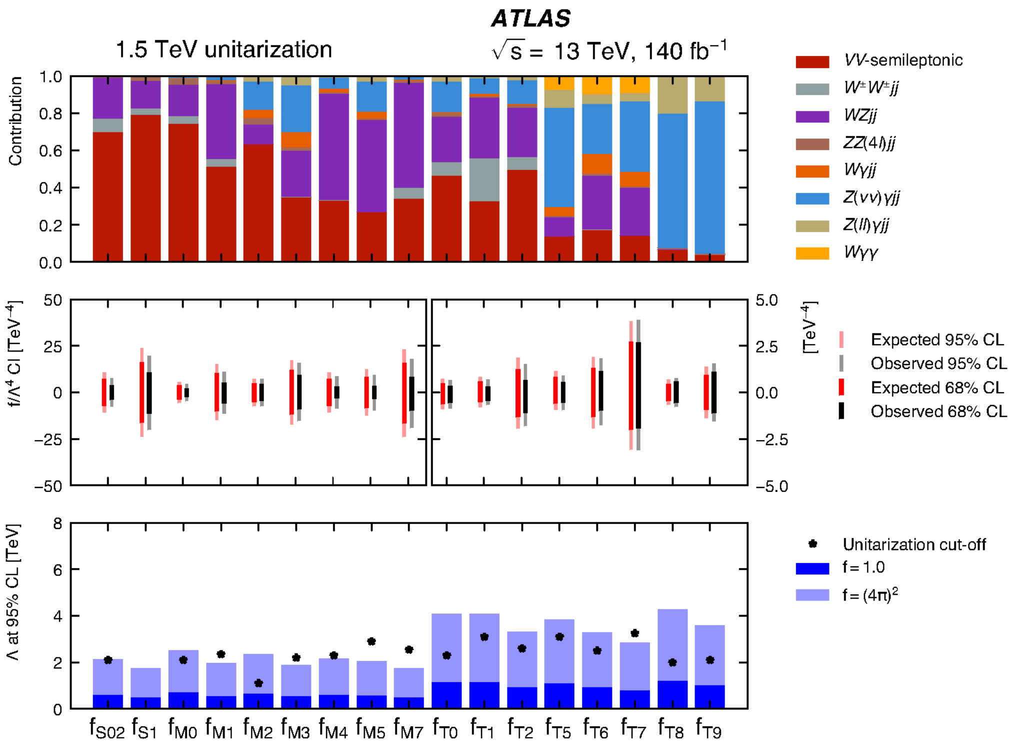
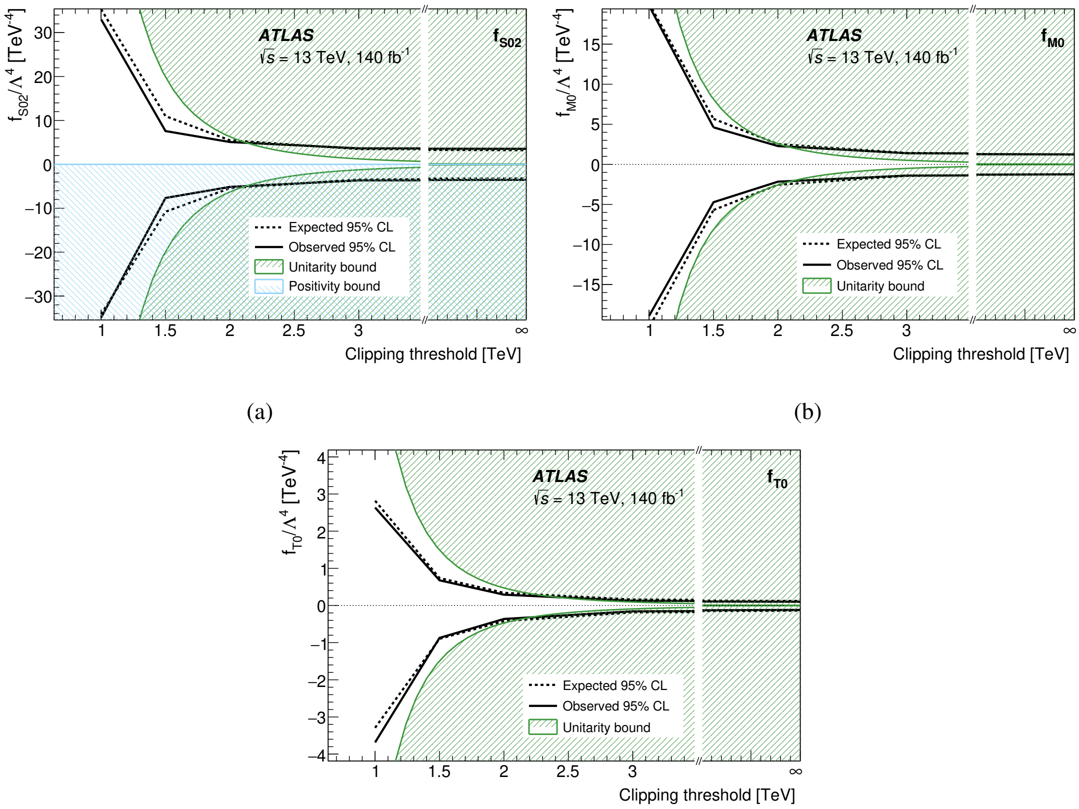


Figure 3: Contributions of the individual channels to the combination (top), expected and observed 68% and 95% confidence level intervals from the combined fit (middle) and the probed energy scale for two illustrative values of the Wilson coefficients (bottom). Unitarity is preserved by setting higher dimension operator contributions to zero above a clipping threshold of 1.5 TeV. The energy scale of the observed unitarization cut-off as evaluated through a clipping procedure is overlaid on the bottom panel. No unitarization cut-off is found for the f_{S1} coefficient where the experimental interval is always weaker than the unitarity constraint.

that maintains unitarity, are displayed in Table 2. These combined results improve upon the previous published confidence intervals on these Wilson coefficients by 17–96% depending on the coefficient. The improvements in the unitarized results are larger than for the results without unitarity, due to steep trend in the theoretical unitarity bounds as a function of clipping threshold seen in Figure 4, which favors sensitivity at low clipping threshold. In this regime more analyses have a non-negligible contribution to the combined results, which illustrates the merit of such a combination. The confidence intervals are competitive with existing results from CMS [21, 26, 33, 45–47].

Results were investigated for pairs of Wilson coefficients that have an appreciable cross-term, while keeping the others set to zero. The size of cross-terms is highly correlated with the structure of the Éboli operator basis, with high-suppression between scalar, mixed, and tensor type families, and block-structure within each. For instance, the operators associated with the f_{M0}, f_{M1}, and f_{M7} coefficients form a mostly orthogonal subset relative to the f_{M2}, f_{M3}, f_{M4} and f_{M5} in the mixed-type family. Two dimension exclusion contours at 68% and 95% confidence level for the f_{M2}, f_{M3}, f_{M4}, and f_{M5} pairings can be seen in Figure 5, without clipping, alongside with the individual negative-log likelihood scans projections along each coefficient direction in the fit. Two dimensional results are obtained for each clipping threshold. Positivity bounds are shown where applicable, and reduce the constrained phase space drastically in such



(a) (b) (c)

Figure 4: Expected and observed 95% confidence level confidence intervals on the a) f_{S02}, b) f_{M0} and c) f_{T0} Wilson coefficients as a function of clipping threshold. Unitarity and positivity bounds are shown in green and blue respectively. Unitarized intervals are taken to be the intersection between the interpolated confidence intervals and the unitarity bound.

cases.

Fits are also performed allowing all Wilson coefficients to float in the fit. Cross-term contributions are relevant in this fit, which, as explained above, are highly suppressed between operators of different scalar/mixed/tensor type, but can be sizeable within the types. The expected and observed 95% confidence level intervals from these profiled fits with no clipping applied are shown in Table 3. For coefficients without sizeable cross-term pairs, the profiled results differ by only a few percent relative to those obtained with the individual Wilson coefficient fits presented earlier. More significant changes can be seen for f_{M7}, f_{T0}, f_{T1}, f_{T5}, f_{T6}, f_{T7}, f_{T8}, and f_{T9} that have non-negligible cross terms with other operators.

Table 2: Expected and observed 95% confidence level intervals from the combined fit within the constraints of unitarity for each Wilson coefficient considered. Unitarity is preserved using the clipping procedure where the abscissa and ordinate of the intersection point of the unitarity bound and the confidence intervals as a function of clipping threshold is taken as the unitarization cut-off and interval respectively. No unitarized confidence interval is found for the f_{S1} coefficient where the experimental interval is always weaker than the unitarity constraint.

Coefficient	Expected		Observed	
	Confidence interval [TeV $^{-4}$]	Unitarization cut-off [TeV]	Confidence Intervals [TeV $^{-4}$]	Unitarization cut-off [TeV]
f_{S02}/Λ^4	[-5.25, 5.30]	2.1	[-4.96, 4.90]	2.1
f_{S1}/Λ^4	–	–	–	–
f_{M0}/Λ^4	[-2.55, 2.52]	2.0	[-2.08, 2.22]	2.1
f_{M1}/Λ^4	[-5.72, 5.78]	2.3	[-5.44, 5.18]	2.3, 2.4
f_{M2}/Λ^4	[-15.8, 15.7]	1.2	[-23.7, 22.8]	1.1
f_{M3}/Λ^4	[-8.49, 8.49]	2.0	[-6.56, 6.63]	2.2
f_{M4}/Λ^4	[-4.78, 4.76]	2.1	[-3.59, 3.63]	2.3
f_{M5}/Λ^4	[-4.79, 4.79]	2.5	[-3.04, 3.10]	2.9
f_{M7}/Λ^4	[-8.50, 8.04]	2.5	[-7.90, 7.65]	2.5, 2.6
f_{T0}/Λ^4	[-0.40, 0.30]	2.1, 2.3	[-0.32, 0.22]	2.2, 2.4
f_{T1}/Λ^4	[-0.18, 0.18]	3.0	[-0.16, 0.16]	3.1
f_{T2}/Λ^4	[-0.71, 0.67]	2.4	[-0.61, 0.42]	2.5, 2.7
f_{T5}/Λ^4	[-0.26, 0.39]	2.5, 2.7	[-0.15, 0.17]	3.0, 3.2
f_{T6}/Λ^4	[-0.87, 0.85]	2.2	[-0.55, 0.57]	2.5
f_{T7}/Λ^4	[-0.69, 1.05]	2.7, 3.0	[-0.52, 0.56]	3.2, 3.3
f_{T8}/Λ^4	[-0.50, 0.50]	1.8	[-0.28, 0.28]	2.0
f_{T9}/Λ^4	[-0.65, 0.65]	2.0	[-0.53, 0.53]	2.1

Table 3: Expected and observed 95% confidence level intervals allowing all Wilson coefficients to be fitted simultaneously

Coefficient	Profiled expected confidence intervals [TeV $^{-4}$]	Profiled observed confidence intervals [TeV $^{-4}$]
f_{S02}/Λ^4	[-4.06, 4.08]	[-4.87, 4.88]
f_{S1}/Λ^4	[-8.72, 8.73]	[-9.82, 9.82]
f_{M0}/Λ^4	[-1.67, 1.68]	[-1.68, 1.65]
f_{M1}/Λ^4	[-8.13, 7.52]	[-9.05, 8.58]
f_{M2}/Λ^4	[-1.91, 1.91]	[-1.97, 1.99]
f_{M3}/Λ^4	[-4.16, 4.16]	[-3.89, 3.92]
f_{M4}/Λ^4	[-3.15, 3.15]	[-2.55, 2.56]
f_{M5}/Λ^4	[-3.48, 3.49]	[-2.77, 2.77]
f_{M7}/Λ^4	[-16.6, 15.7]	[-12.4, 12.9]
f_{T0}/Λ^4	[-0.33, 0.24]	[-0.34, 0.22]
f_{T1}/Λ^4	[-0.199, 0.211]	[-0.254, 0.283]
f_{T2}/Λ^4	[-0.578, 0.639]	[-0.665, 0.599]
f_{T5}/Λ^4	[-0.405, 0.384]	[-0.319, 0.289]
f_{T6}/Λ^4	[-0.658, 0.642]	[-0.490, 0.370]
f_{T7}/Λ^4	[-1.51, 1.58]	[-1.17, 1.13]
f_{T8}/Λ^4	[-0.196, 0.181]	[-0.163, 0.147]
f_{T9}/Λ^4	[-0.360, 0.384]	[-0.281, 0.280]

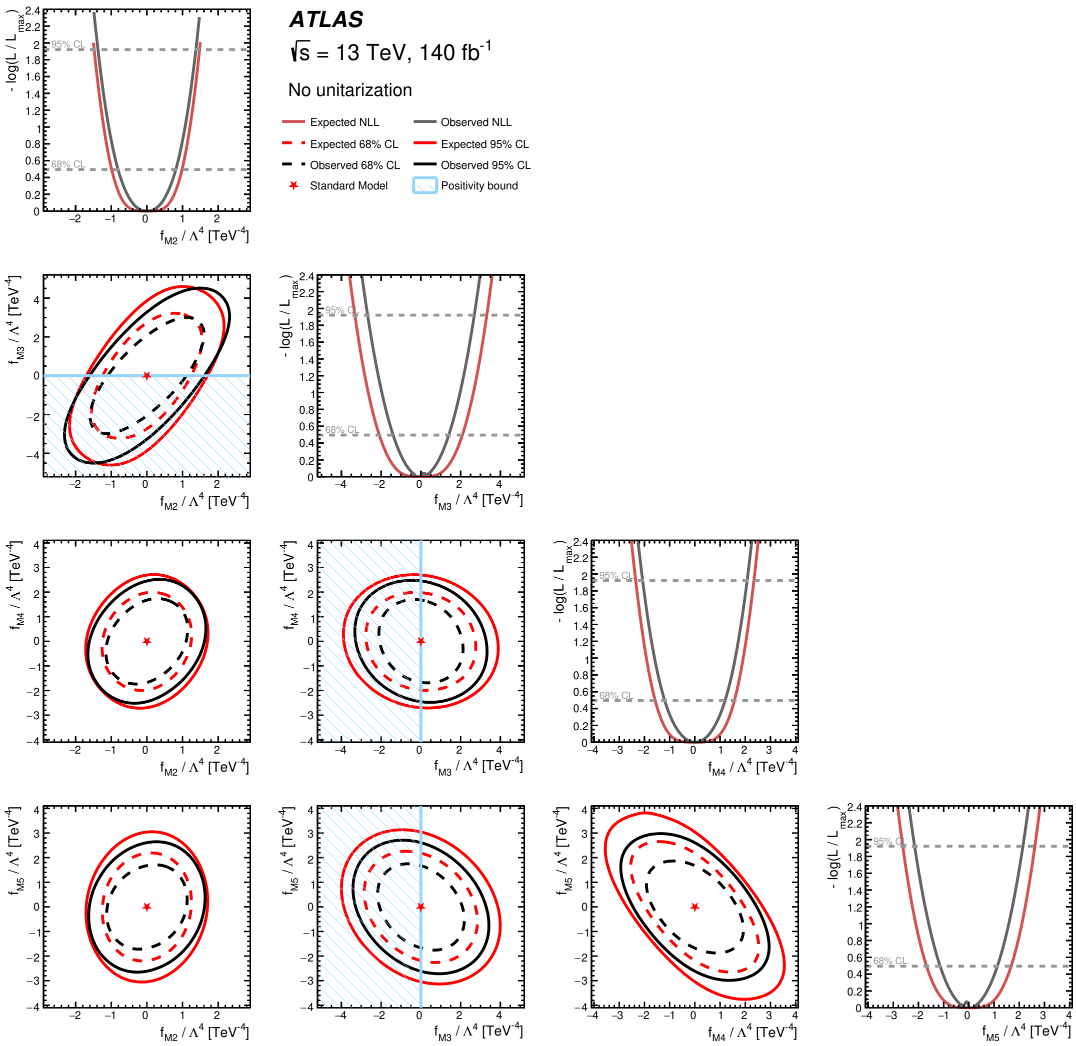


Figure 5: Expected (red) and observed (black) 68% (dashed) and 95% (solid) confidence level contours when considering two of the f_{M2}, f_{M3}, f_{M4}, and f_{M5} coefficients simultaneously alongside the relevant cross-term. The expected (greyed-red) and observed (grey) negative log-likelihood (NLL) curve for each of the operators when considering just one coefficient at a time is also shown. Unitarity constraints are not visible and positivity bounds are overlaid as a blue filled region.

6 Conclusions

This Letter details a combination of VBS and tri-boson measurements performed using pp collision data collected by the ATLAS detector at $\sqrt{s} = 13$ TeV at the LHC to optimally constrain dimension-8 effective field theory operators producing aQGCs. This is the most comprehensive set of aQGC EFT results to date and the confidence intervals are competitive with similar results from CMS.

Results are presented in the form of 68% and 95% confidence level intervals, from fits to single Wilson coefficients with others set to zero, and from two dimensional fits for operator pairs with non-negligible cross terms. It is found that the 68% and 95% confidence level intervals on the coefficients without unitarization applied are mainly driven by the $Z\gamma jj \rightarrow \nu\bar{\nu}\gamma jj$ and $VVjj \rightarrow (\ell\ell jj/\ell\nu jj/\nu\nu jj)jj$ channels, depending on the operator, with the combination bringing up to a 20% improvement on individual results. Results respecting unitarity constraints are presented following the clipping method. At a clipped energy threshold of 1.5 TeV the relative contributions of each input analysis are more even, and the combined bounds are found to improve the published results by up to 96%. Confidence intervals are also presented from profiled fits where all Wilson coefficients are free to vary simultaneously.

Acknowledgements

We thank CERN for the very successful operation of the LHC and its injectors, as well as the support staff at CERN and at our institutions worldwide without whom ATLAS could not be operated efficiently.

The crucial computing support from all WLCG partners is acknowledged gratefully, in particular from CERN, the ATLAS Tier-1 facilities at TRIUMF/SFU (Canada), NDGF (Denmark, Norway, Sweden), CC-IN2P3 (France), KIT/GridKA (Germany), INFN-CNAF (Italy), NL-T1 (Netherlands), PIC (Spain), RAL (UK) and BNL (USA), the Tier-2 facilities worldwide and large non-WLCG resource providers. Major contributors of computing resources are listed in Ref. [48].

We gratefully acknowledge the support of ANPCyT, Argentina; YerPhI, Armenia; ARC, Australia; BMWFW and FWF, Austria; ANAS, Azerbaijan; CNPq and FAPESP, Brazil; NSERC, NRC and CFI, Canada; CERN; ANID, Chile; CAS, MOST and NSFC, China; Minciencias, Colombia; MEYS CR, Czech Republic; DNRF and DNSRC, Denmark; IN2P3-CNRS and CEA-DRF/IRFU, France; SRNSFG, Georgia; BMFTR, HGF and MPG, Germany; GSRI, Greece; RGC and Hong Kong SAR, China; ICHEP and Academy of Sciences and Humanities, Israel; INFN, Italy; MEXT and JSPS, Japan; CNRST, Morocco; NWO, Netherlands; RCN, Norway; MNiSW, Poland; FCT, Portugal; MNE/IFA, Romania; MSTDI, Serbia; MSSR, Slovakia; ARIS and MVZI, Slovenia; DSI/NRF, South Africa; MICIU/AEI, Spain; SRC and Wallenberg Foundation, Sweden; SERI, SNSF and Cantons of Bern and Geneva, Switzerland; NSTC, Taipei; TENMAK, Türkiye; STFC/UKRI, United Kingdom; DOE and NSF, United States of America.

Individual groups and members have received support from BCKDF, CANARIE, CRC and DRAC, Canada; CERN-CZ, FORTE and PRIMUS, Czech Republic; COST, ERC, ERDF, Horizon 2020 and Marie Skłodowska-Curie Actions, European Union; Investissements d'Avenir Labex, Investissements d'Avenir Idex and ANR, France; DFG and AvH Foundation, Germany; Herakleitos, Thales and Aristeia programmes co-financed by EU-ESF and the Greek NSRF, Greece; BSF-NSF and MINERVA, Israel; NCN and NAWA, Poland; La Caixa Banking Foundation, CERCA and AGAUR programs from Generalitat de Catalunya and PROMETEO and GenT Programmes Generalitat Valenciana, Spain; Göran Gustafssons Stiftelse, Sweden;

The Royal Society and Leverhulme Trust, United Kingdom; Eric and Wendy Schmidt Fund for Strategic Innovation, United States of America.

In addition, individual members wish to acknowledge support from Chile: Agencia Nacional de Investigación y Desarrollo (ANID FONDECYT reg. 1230987, FONDECYT 1230812, FONDECYT 1240864, Fondecyt 3240661, Fondecyt Regular 1240721); China: Chinese Ministry of Science and Technology (MOST-2023YFA1605700, MOST-2023YFA1609300), National Natural Science Foundation of China (NSFC 12275265, NSFC-W2543005); Czech Republic: Czech Science Foundation (GACR - 24-11373S), Ministry of Education Youth and Sports (ERC-CZ-LL2327, FORTE CZ.02.01.01/00/22_008/0004632), PRIMUS Research Programme (PRIMUS/21/SCI/017); EU: H2020 European Research Council (ERC - 101002463); European Union: European Research Council (BARD No. 101116429, ERC - 948254, ERC 101089007), European Regional Development Fund (HE COFUND GA No.101081355, ERDF), Marie Sklodowska-Curie Actions (GAP-101168829); France: Agence Nationale de la Recherche (ANR-21-CE31-0013, ANR-22-EDIR-0002, ANR-24-CE31-0504-01); Germany: Deutsche Forschungsgemeinschaft (DFG - 469666862); China: Research Grants Council (GRF); Italy: Ministero dell'Università e della Ricerca (NextGenEU 153D23001490006 M4C2.1.1, NextGenEU I53D23000820006 M4C2.1.1, NextGenEU I53D23001490006 M4C2.1.1, SOE2024_0000023); Japan: Japan Society for the Promotion of Science (JSPS KAKENHI JP25H0063, JSPS KAKENHI JP22H01227, JSPS KAKENHI JP22H04944, JSPS KAKENHI JP22KK0227, JSPS KAKENHI JP24K23939, JSPS KAKENHI JP24KK0251, JSPS KAKENHI JP25H00650, JSPS KAKENHI JP25H01291, JSPS KAKENHI JP25K01023); Poland: Polish National Science Centre (NCN 2021/42/E/ST2/00350, NCN OPUS 2023/51/B/ST2/02507, NCN OPUS nr 2022/47/B/ST2/03059, NCN UMO-2019/34/E/ST2/00393, UMO-2022/47/O/ST2/00148, UMO-2023/49/B/ST2/04085, UMO-2023/51/B/ST2/00920, UMO-2024/53/N/ST2/00869); Spain: Agència de Gestió d'Ajuts Universitaris i de Recerca. (AGAUR - 2023 BP 00141), Ministry of Science and Innovation (RYC2019-028510-I, RYC2020-030254-I, RYC2021-031273-I, RYC2022-038164-I), Ministerio de Ciencia, Innovación y Universidades/Agencia Estatal de Investigación (PID2022-142604OB-C22); Sweden: Carl Trygger Foundation (Carl Trygger Foundation CTS 22:2312), Swedish Research Council (Swedish Research Council 2023-04654, VR 2021-03651, VR 2022-03845, VR 2022-04683, VR 2023-03403, VR 2024-05451, VR 2025-05940), Knut and Alice Wallenberg Foundation (KAW 2023.0366); Switzerland: Swiss National Science Foundation (SNSF - PCEFP2_194658); United Kingdom: The Binks Trust, Royal Society (NIF-R1-231091); United States of America: U.S. Department of Energy (ECA DE-AC02-76SF00515), John Templeton Foundation (John Templeton Foundation 63206), Neubauer Family Foundation.

References

[1] ATLAS Collaboration, *Combination of searches for heavy spin-1 resonances using 139 fb^{-1} of proton–proton collision data at $\sqrt{s}$ = 13 TeV with the ATLAS detector*, JHEP **04** (2024) 118, arXiv: 2402.10607 [hep-ex].

[2] CMS Collaboration, *Combination of CMS searches for heavy resonances decaying to pairs of bosons or leptons*, Phys. Lett. B **798** (2019) 134952, arXiv: 1906.00057 [hep-ex].

[3] I. Brivio and M. Trott, *The standard model as an effective field theory*, Phys. Rept. **793** (2019) 1, arXiv: 1706.08945 [hep-ph].

[4] ATLAS Collaboration, *Interpretations of the ATLAS measurements of Higgs boson production and decay rates and differential cross-sections in pp collisions at $\sqrt{s} = 13$ TeV*, JHEP **11** (2024) 097, arXiv: 2402.05742 [hep-ex].

[5] CMS Collaboration, *Combined effective field theory interpretation of Higgs boson, electroweak vector boson, top quark, and multi-jet measurements*, (2025), arXiv: 2504.02958 [hep-ex].

[6] ALEPH Collaboration, DELPHI Collaboration, L3 Collaboration, OPAL Collaboration, SLD Collaboration, LEP Electroweak Working Group, and SLD electroweak and heavy flavour groups, *Precision electroweak measurements on the Z resonance*, Phys. Rept. **427** (2006) 257, arXiv: hep-ex/0509008.

[7] O. J. P. Éboli, M. C. Gonzalez-Garcia and S. Lietti, *Bosonic quartic couplings at CERN LHC*, Phys. Rev. D **69** (2004) 095005, arXiv: hep-ph/0310141.

[8] O. J. Éboli, M. Gonzalez-Garcia and J. Mizukoshi, *$pp \to jje^{\pm}\mu^{\pm}\nu\nu$ and $jje^{\pm}\mu^{\mp}\nu\nu$ at $O(\alpha_{em}^6)$ and $O(\alpha_{em}^4\alpha_s^2)$ for the study of the quartic electroweak gauge boson vertex at CERN LHC*, Phys. Rev. D **74** (2006) 073005, arXiv: hep-ph/0606118.

[9] R. Contino, D. Pappadopulo, D. Marzocca and R. Rattazzi, *On the effect of resonances in composite Higgs phenomenology*, JHEP **10** (2011) 081, arXiv: 1109.1570 [hep-ph].

[10] L. Randall and R. Sundrum, *Large mass hierarchy from a small extra dimension*, Phys. Rev. Lett. **83** (1999) 3370, arXiv: hep-ph/9905221.

[11] K. Agashe, H. Davoudiasl, G. Perez and A. Soni, *Warped gravitons at the CERN LHC and beyond*, Phys. Rev. D **76** (2007) 036006, arXiv: hep-ph/0701186.

[12] G. C. Branco et al., *Theory and phenomenology of two-Higgs-doublet models*, Phys. Rept. **516** (2012) 1, arXiv: 1106.0034 [hep-ph].

[13] H. Georgi and S. L. Glashow, *Unity of all elementary-particle forces*, Phys. Rev. Lett. **32** (1974) 438.

[14] ATLAS Collaboration, *Measurement and interpretation of same-sign W boson pair production in association with two jets in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, JHEP **04** (2024) 026, arXiv: 2312.00420 [hep-ex].

[15] CMS Collaboration, *Observation of Electroweak Production of Same-Sign W Boson Pairs in the Two Jet and Two Same-Sign Lepton Final State in Proton–Proton Collisions at $\sqrt{s} = 13$ TeV*, Phys. Rev. Lett. **120** (2018) 081801, arXiv: 1709.05822 [hep-ex].

[16] ATLAS Collaboration, *Observation of electroweak production of W^+W^- in association with jets in proton–proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS Detector*, JHEP **07** (2024) 254, arXiv: 2403.04869 [hep-ex].

[17] CMS Collaboration, *Observation of electroweak W^+W^- pair production in association with two jets in proton–proton collisions at $\sqrt{s} = 13$ TeV*, Phys. Lett. B **841** (2023) 137495, arXiv: 2205.05711 [hep-ex].

[18] ATLAS Collaboration, *Measurements of electroweak $W^{\pm}Z$ boson pair production in association with two jets in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, JHEP **06** (2024) 192, arXiv: 2403.15296 [hep-ex].

[19] CMS Collaboration, *Measurement of electroweak WZ boson production and search for new physics in WZ+ two jets events in pp collisions at $\sqrt{s} = 13$ TeV*, Phys. Lett. B **795** (2019) 281, arXiv: 1901.04060 [hep-ex].

[20] ATLAS Collaboration, *Differential cross-section measurements of the production of four charged leptons in association with two jets using the ATLAS detector*, JHEP **01** (2024) 004, arXiv: 2308.12324 [hep-ex].

[21] CMS Collaboration, *Evidence for electroweak production of four charged leptons and two jets in proton–proton collisions at $\sqrt{s} = 13$ TeV*, Phys. Lett. B **812** (2021) 135992, arXiv: 2008.07013 [hep-ex].

[22] ATLAS Collaboration, *Fiducial and differential cross-section measurements of electroweak $W\gamma jj$ production in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Eur. Phys. J. C **84** (2024) 1064, arXiv: 2403.02809 [hep-ex].

[23] CMS Collaboration, *Measurement of the electroweak production of $W\gamma$ in association with two jets in proton–proton collisions at $\sqrt{s} = 13$ TeV*, Phys. Rev. D **108** (2023) 032017, arXiv: 2212.12592 [hep-ex].

[24] ATLAS Collaboration, *Measurement of electroweak $Z(\nu\bar{\nu})\gamma jj$ production and limits on anomalous quartic gauge couplings in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, JHEP **06** (2023) 082, arXiv: 2208.12741 [hep-ex].

[25] ATLAS Collaboration, *Measurement of the cross-sections of the electroweak and total production of a $Z\gamma$ pair in association with two jets in pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Phys. Lett. B **846** (2023) 138222, arXiv: 2305.19142 [hep-ex].

[26] CMS Collaboration, *Measurement of the electroweak production of $Z\gamma$ and two jets in proton–proton collisions at $\sqrt{s} = 13$ TeV and constraints on anomalous quartic gauge couplings*, Phys. Rev. D **104** (2021) 072001, arXiv: 2106.11082 [hep-ex].

[27] ATLAS Collaboration, *Electroweak diboson production in association with a high-mass dijet system in semileptonic final states from pp collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, (2025), arXiv: 2503.17461 [hep-ex].

[28] CMS Collaboration, *Evidence for WW/WZ vector boson scattering in the decay channel $\ell\nu qq$ produced in association with two jets in proton–proton collisions at $\sqrt{s} = 13$ TeV*, Phys. Lett. B **834** (2022) 137438, arXiv: 2112.05259 [hep-ex].

[29] ATLAS Collaboration, *Observation of $W\gamma\gamma$ triboson production in proton–proton collisions at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Phys. Lett. B **848** (2024) 138400, arXiv: 2308.03041 [hep-ex].

[30] ATLAS Collaboration, *Observation of WWW Production in pp Collisions at $\sqrt{s} = 13$ TeV with the ATLAS Detector*, Phys. Rev. Lett. **129** (2022) 061803, arXiv: 2201.13045 [hep-ex].

[31] ATLAS Collaboration, *Observation of VVZ production at $\sqrt{s} = 13$ TeV with the ATLAS detector*, Phys. Lett. B **866** (2025) 139527, arXiv: 2412.15123 [hep-ex].

[32] CMS Collaboration, *Observation of the production of three massive gauge bosons at $\sqrt{s} = 13$ TeV*, Phys. Rev. Lett. **125** (2020) 151802, arXiv: 2006.11191 [hep-ex].

[33] CMS Collaboration, *Measurements of the $pp \to W^{\pm}\gamma\gamma$ and $pp \to Z\gamma\gamma$ cross sections at $\sqrt{s} = 13$ TeV and limits on anomalous quartic gauge couplings*, JHEP **10** (2021) 174, arXiv: 2105.12780 [hep-ex].

[34] CMS Collaboration, *Observation of $WW\gamma$ Production and Search for $H\gamma$ Production in Proton–Proton Collisions at $\sqrt{s} = 13$ TeV*, Phys. Rev. Lett. **132** (2024) 121901, arXiv: 2310.05164 [hep-ex].

[35] CMS Collaboration, *Observation of $WZ\gamma$ production and constraints on new physics scenarios in proton–proton collisions at $\sqrt{s} = 13$ TeV*, Phys. Rev. D **112** (2025) 012009, arXiv: 2503.21977 [hep-ex].

[36] O. J. P. Éboli and M. Gonzalez-Garcia, *Mapping the genuine bosonic quartic couplings*, Phys. Rev. D **93** (2016) 093013, arXiv: 1604.03555 [hep-ph].

[37] E. d. S. Almeida, O. J. P. Éboli and M. C. Gonzalez–Garcia, *Unitarity constraints on anomalous quartic couplings*, Phys. Rev. D **101** (2020) 113003, arXiv: 2004.05174 [hep-ph].

[38] O. J. P. Éboli and M. C. Gonzalez–Garcia, *Unitarity limits on triple gauge boson production*, (2026), arXiv: 2601.07920 [hep-ph].

[39] G. N. Remmen and N. L. Rodd, *Consistency of the standard model effective field theory*, JHEP **12** (2019) 32, arXiv: 1908.09845 [hep-ph].

[40] J. Alwall et al., *The automated computation of tree-level and next-to-leading order differential cross sections, and their matching to parton shower simulations*, JHEP **07** (2014) 079, arXiv: 1405.0301 [hep-ph].

[41] NNPDF Collaboration, R. D. Ball et al., *Parton distributions for the LHC run II*, JHEP **04** (2015) 040, arXiv: 1410.8849 [hep-ph].

[42] P. Artoisenet, R. Frederix, O. Mattelaer and R. Rietkerk, *Automatic spin-entangled decays of heavy resonances in Monte Carlo simulations*, JHEP **03** (2013) 015, arXiv: 1212.3460 [hep-ph].

[43] T. Sjöstrand et al., *An introduction to PYTHIA 8.2*, Comput. Phys. Commun. **191** (2015) 159, arXiv: 1410.3012 [hep-ph].

[44] G. Cowan, K. Cranmer, E. Gross and O. Vitells, *Asymptotic formulae for likelihood-based tests of new physics*, Eur. Phys. J. C **71** (2011) 1554, arXiv: 1007.1727 [physics.data-an], Erratum: Eur. Phys. J. C **73** (2013) 2501.

[45] CMS Collaboration, *Measurements of production cross sections of WZ and same-sign WW boson pairs in association with two jets in proton–proton collisions at $\sqrt{s} = 13$ TeV*, Phys. Lett. B **809** (2020) 135710, arXiv: 2005.01173 [hep-ex].

[46] CMS Collaboration, *Vector boson scattering and anomalous quartic couplings in final states with $\ell\nu qq$ or $\ell\ell qq$ plus jets using proton–proton collisions at $\sqrt{s} = 13$ TeV*, (2025), arXiv: 2510.00118 [hep-ex].

[47] CMS Collaboration, *Search for high-mass exclusive $\gamma\gamma \rightarrow WW$ and $\gamma\gamma \rightarrow ZZ$ production in proton–proton collisions at $\sqrt{s} = 13$ TeV*, JHEP **07** (2023) 229, arXiv: 2211.16320 [hep-ex].

[48] ATLAS Collaboration, *ATLAS Computing Acknowledgements*, ATL-SOFT-PUB-2026-001, 2026, URL: https://cds.cern.ch/record/2952666.

The ATLAS Collaboration

G. Aad [102], E. Aakvaag [17], B. Abbott [122], S. Abdelhameed [118a], K. Abeling [54], N.J. Abicht [48], S.H. Abidi [30], M. Aboelela [44], A. Aboulhorma [36e], H. Abramowicz [155], B.S. Acharya [68a,68b,m], A. Ackermann [62a], C. Adam Bourdarios [4], L. Adamczyk [85a], S.V. Addepalli [147], M.J. Addison [101], J. Adelman [117], A. Adiguzel [22c], T. Adye [136], A.A. Affolder [138], Y. Afik [39], M.N. Agaras [13], A. Aggarwal [100], C. Agheorghiesei [28c], A. Ahmad [83a], F. Ahmadov [38,ad], S. Ahuja [95], S. Ahuja [166], X. Ai [113c], G. Aielli [75a,75b], A. Aikot [166], M. Ait Tamlihat [36e], T.P.A. Åkesson [98], D. Akiyama [171], N.N. Akolkar [25], S. Aktas [169], G.L. Alberghi [24b], J. Albert [168], U. Alberti [20], P. Albicocco [52], S. Alderweireldt [51], Z.L. Alegria [123], M. Aleksa [37], I.N. Aleksandrov [38], C. Alexa [28b], T. Alexopoulos [10], F. Alfonsi [24b], M. Algren [55], M. Alhroob [170], B. Ali [134], H.M.J. Ali [91,v], S. Ali [32], S.W. Alibocus [92], M. Aliev [34c], G. Alimonti [70a], C. Allaire [65], B.M.M. Allbrooke [150], D.R. Allen [123], J.S. Allen [101], J.F. Allen [51], C.S. Alley [1], E.R. Almazan [138], A. Aloisio [71a,71b], F. Alonso [90], C. Alpigiani [141], A. Alvarez Fernandez [100], M. Alves Cardoso [55], M.G. Alviggi [71a,71b], M. Aly [101], Y. Amaral Coutinho [81b], C. Amelung[37], M. Amerl [101], T. Amezza [129], B. Amini [53], K. Amirie [159], A. Amirkhanov [38], D. Amperiadou [156], S. An[82], C. Anastopoulos [143], T. Andeen [11], J.K. Anders [92], A.C. Anderson [58], A. Andreazza [70a,70b], S. Angelidakis [9], A. Angerami [41], A.V. Anisenkov [38], A. Annovi [73a], C. Antel [37], E. Antipov [149], M. Antonelli [52], F. Anulli [74a], M. Aoki [82], T. Aoki [157], M.A. Aparo [13], L. Aperio Bella [47], M. Apicella[31], C. Appelt [155], A. Apyan [27], M. Arampatzi [10], S.J. Arbiol Val [86], C. Arcangeletti [52], A.T.H. Arce [50], M. Arcuri [43b,43a], J-F. Arguin [108], S. Argyropoulos [156], J.-H. Arling [47], O. Arnaez [4], H. Arnold [149], G. Artoni [74a,74b], H. Asada [111], S. Asatryan [176], N.A. Asbah [37], R.A. Ashby Pickering [170], A.M. Aslam [95], J. Assahsah [36d], K. Assamagan [30], R. Astalos [29a], K.S.V. Astrand [98], S. Atashi [163], R.J. Atkin [34a], H. Atmani[36f], P.A. Atmasiddha [130], K. Augsten [134], A.D. Auriol [40], V.A. Austrup [101], A.S. Avad [94], G. Avolio [37], A. Azzam [13], D. Babal [29b], H. Bachacou [137], K. Bachas [156,p], A. Bachiu [35], E. Bachmann [49], M.J. Backes [62a], A. Badea [39], T.M. Baer [106], M. Bahmani [19], D. Bahner [53], K. Bai [125], L. Baines [94], O.K. Baker [175], D. Bakshi Gupta [8], L.E. Balabram Filho [81b], V. Balakrishnan [122], R. Balasubramanian [4], P. Balek [85a], E. Ballabene [24b,24a], F. Balli [137], L.M. Baltes [62a], W.K. Balunas [128], I. Bamwidhi [118b], E. Banas [86], M. Bandieramonte [131], A. Bandyopadhyay [25], S. Bansal [25], L. Barak [155], M. Barakat [47], E.L. Barberio [105], D. Barberis [18b], M. Barbero [102], M.Z. Barel [116], T. Barillari [110], M-S. Barisits [37], T. Barklow [147], P. Baron [135], D.A. Baron Moreno [101], A. Baroncelli [61], A.J. Barr [128], J.D. Barr [96], F. Barreiro [99], J. Barreiro Guimarães da Costa [14], M.G. Barros Teixeira [132a], F. Bartels [62a], R. Bartoldus [147], A.E. Barton [91], P. Bartos [29a], M. Baselga [48], S. Bashiri[86], A. Bassalat [65,b], M.J. Basso [160a], S. Bataju [44], R. Bate [167], R.L. Bates [58], S. Batlamous[99], M. Battaglia [138], D. Battulga [19], M. Bauce [74a,74b], L. Bauckhage [47], P. Bauer [25], L.T. Bayer [47], L.T. Bazzano Hurrell [31], T. Beau [129], J.Y. Beaucamp [90], S. Beauceron [129], P.H. Beauchemin [162], P. Bechtle [25], H.P. Beck [20,o], K. Becker [170], A.J. Beddall [80], V.A. Bednyakov [38], C.P. Bee [149], L.J. Beemster [16], M. Begalli [81d], M. Begel [30], J.K. Behr [47], J.F. Beirer [37], F. Beisiegel [25], M. Belfkir [118b], G. Bella [155], L. Bellagamba [24b], A. Bellerive [35], C.D. Bellgraph [67], P. Bellos [21], I. Benaoumeur [21], D. Benchekroun [36a], F. Bendebba [36a], Y. Benhammou [155], K.C. Benkendorfer [168], L. Beresford [47], M. Beretta [52], E. Bergeaas Kuutmann [164], N. Berger [4], B. Bergmann [134], J. Beringer [18a], M. Berkat [137], G. Bernardi [5], C. Bernius [147], F.U. Bernlochner [25], A. Berrocal Guardia [13], T. Berry [95], P. Berta [135], A. Berti[132a],

R. Bertrand[102], S. Bethke[110], A. Betti[74a,74b], T.F. Beumker[174], A.J. Bevan[94], L. Bezio[55], N.K. Bhalla[53], S. Bharthuar[110], S. Bhatta[149], P. Bhattarai[147], Z.M. Bhatti[119], K.D. Bhide[53], V.S. Bhopatkar[123], R.M. Bianchi[131], G. Bianco[24b,24a], O. Biebel[109], M. Biglietti[76a], P. Bijl[53], C.S. Billingsley[44], Y. Bimgdi[36f], M. Bindi[54], A. Bingham[174], A. Bingul[22b], C. Bini[74a,74b], G.A. Bird[33], M. Biros[135], S. Biryukov[150], T. Bisanz[48], E. Bisceglie[24b,24a], J.P. Biswal[136], D. Biswas[145], M. Biyabi[14], I. Bloch[47], A. Blue[58], U. Blumenschein[94], V.S. Bobrovnikov[38], L. Boccardo[56b,56a], M. Boehler[53], B. Boehm[169], D. Bogavac[13], L.S. Boggia[129], V. Boisvert[95], P. Bokan[164], T. Bold[85a], M. Bomben[5], M. Bona[94], M. Boonekamp[137], A.G. Borbély[58], G. Borissov[91], A. Borkar[169], D. Bortoletto[128], M. Borysova[172], D. Boscherini[24b], M. Bosman[13], K. Bouaouda[36a], L. Boudet[137], J. Boudreau[131], E.V. Bouhova-Thacker[91], D. Boumediene[40], R. Bouquet[56b,56a], A. Boveia[121], D. Boye[30], I.R. Boyko[38], L. Bozianu[55], J. Bracinik[21], N. Brahimi[4], G. Brandt[174], O. Brandt[33], B. Brau[103], R. Brener[172], L. Brenner[116], R. Brenner[164], S. Bressler[172], M. Brettell[96], G. Brianti[116], D. Britton[58], D. Britzger[110], I. Brock[25], R. Brock[107], H. Bronson[130], G. Brooijmans[41], A.J. Brooks[67], E.M. Brooks[160b], E. Brost[30], L.M. Brown[168,160a], L.E. Bruce[60], T.L. Bruckler[128], P.A. Bruckman de Renstrom[86], B. Brüers[47], A. Bruni[24b], G. Bruni[24b], D. Brunner[46a,46b], M. Bruschi[24b], N. Bruscino[74a,74b], T. Buanes[17], Q. Buat[141], D. Buchin[110], A.G. Buckley[58], J. Bucko[135], M. Buhring[49], O. Bulekov[80], B.A. Bullard[147], T.O. Buratovich[90], S. Burdin[92], C.D. Burgard[48], A.M. Burger[89], B. Burghgrave[8], O. Burlayenko[53], J. Burleson[165], J.C. Burzynski[122], V. Büscher[100], P.J. Bussey[58], O. But[25], J.M. Butler[26], C.M. Buttar[58], J.M. Butterworth[96], P. Butti[37], W. Buttinger[136], C.J. Buxo Vazquez[107], A.R. Buzykaev[38], S. Cabrera Urbán[166], L. Cadamuro[65], H. Cai[37], Y. Cai[24b,112c,24a], Y. Cai[112a], M.A. Cairo[130], V.M.M. Cairo[37], O. Cakir[3a], N. Calace[37], P. Calafiura[18a], G. Calderini[129], P. Calfayan[35], L. Calic[98], G. Callea[58], L.P. Caloba[81b], D. Calvet[40], S. Calvet[40], R. Camacho Toro[129], S. Camarda[37], D. Camarero Munoz[27], P. Camarri[75a,75b], C. Camincher[37], M. Campanelli[96], A. Camplani[42], V. Canale[71a,71b], A.C. Canbay[3a], E. Canonero[95], J. Cantero[166], F. Capocasa[27], P. Cappelli[27], M. Capua[43b,43a], A. Carbone[70a,70b], R. Cardarelli[75a], J.C.J. Cardenas[8], M.P. Cardiff[27], G. Carducci[43b,43a], T. Carli[37], G. Carlino[71a], J.I. Carlotto[13], B.T. Carlson[131,q], E.M. Carlson[168], L. Carminati[70a,70b], A. Carnelli[4], M. Carnesale[37], S. Caron[115], E. Carquin[139g], I.B. Carr[105], S. Carrá[72a,72b], G. Carratta[24b,24a], C. Carrion Martinez[166], A.M. Carroll[125], N. Cartalade[40], M.P. Casado[13,h], P. Casolaro[71a,71b], M. Caspar[47], F. Cassinese[90], W.R. Castiglioni[39], F.L. Castillo[4], V. Castillo Gimenez[166], N.F. Castro[132a,132e], A. Catinaccio[37], J.R. Catmore[127], T. Cavaliere[4], V. Cavaliere[30], E. Celebi[80], S. Cella[30], V. Cepaitis[55], K. Cerny[124], A.S. Cerqueira[81a], A. Cerri[73a,ap], L. Cerrito[75a,75b], F. Cerutti[18a], B. Cervato[70a,70b], A. Cervelli[24b], G. Cesarini[52], S.A. Cetin[80], V.C. Chabalala[34j], P.M. Chabrillat[129], R. Chakkappai[65], S. Chakraborty[170], A. Chambers[60], J. Chan[18a], J.D. Chapman[33], E. Chapon[137], D.G. Charlton[21], C. Chauhan[133], Y. Che[112a], S. Chekanov[6], G.A. Chelkov[38,a], H. Chen[30], J. Chen[142a], J. Chen[146], M. Chen[59], S. Chen[87], S.J. Chen[112a], X. Chen[142a], X. Chen[15,ai], Z. Chen[61], C.L. Cheng[173], H.C. Cheng[63a], S. Cheong[147], A. Cheplakov[38], E. Cherepanova[116], E. Cheu[7], K. Cheung[64], L. Chevalier[137], G. Chiarelli[73a], G. Chiodini[69a], A.S. Chisholm[21], J.L. Chisholm[167], A. Chitan[28b], M. Chitishvili[166], M.V. Chizhov[38,r], K. Choi[11], Y. Chou[141], E.Y.S. Chow[115], G. Christou[51], K.L. Chu[172], M.C. Chu[63a], Z. Chubinidze[52], J. Chudoba[133], J.J. Chwastowski[86], D. Cieri[110], K.M. Ciesla[85a], V. Cindro[93], A. Ciocio[18a], F. Cirotto[71a,71b], Z.H. Citron[172], M. Citterio[70a], D.A. Ciubotaru[28b], A. Clark[55], P.J. Clark[51], N. Clarke Hall[96], C. Clarry[159], S.E. Clawson[47], C. Clement[46a,46b], L. Clissa[24b,24a], Y. Coadou[102], M. Cobal[68a,68c],

A. Coccaro [56b], M.G. Cochran Branson [141], R.F. Coelho Barrue [132a], R. Coelho Lopes De Sa [103], S. Coelli [70a], M.M. Cohen [130], L.S. Colangeli [159], B. Cole [41], P. Collado Soto [99], J. Collot [59], M.R. Coluccia [69a], I. Combes[65], P. Conde Muiño [132a,132g], L.H.J. Condren [163], M.P. Connell [34c], S.H. Connell [34c], E.I. Conroy [128], M. Contreras Cossio [11], F. Conventi [71a,ak], A.M. Cooper-Sarkar [128], L. Corazzina [74a,74b], F.A. Corchia [24b,24a], A. Cordeiro Oudot Choi [141], L.D. Corpe [40], M. Corradi [74a,74b], F. Corriveau [104,ab], A. Cortes-Gonzalez [157], M.J. Costa [166], F. Costanza [4], D. Costanzo [143], J. Couthures [4], G. Cowan [95], K. Cranmer [173], L. Cremer [48], D. Cremonini [24b,24a], S. Crépé-Renaudin [59], F. Crescioli [129], T. Cresta [72a,72b], M. Cristinziani [145], M. Cristoforetti [77a,77b], T.M. Critchley [55], E. Critelli [96], A. Cueto [99], H. Cui [96], Z. Cui [7], B.M. Cunnett [150], W.R. Cunningham [58], E. Cuppini[110], F. Curcio [166], J.R. Curran [51], M.J. Da Cunha Sargedas De Sousa [56b,56a], J.V. Da Fonseca Pinto [81b], C. Da Via [101], W. Dabrowski [85a], T. Dado [37], S. Dahbi [152], T. Dai [106], D. Dal Santo [20], C. Dallapiccola [103], M. Dam [42], G. D'amen [30], V. D'Amico [109], J.R. Dandoy [35], M. D'Andrea [56b,56a], D. Dannheim [37], G. D'anniballe [73a,73b], M. Danninger [146], V. Dao [149], G. Darbo [56b], F. Dattola [47], S. D'Auria [70a,70b], A. D'Avanzo [71a,71b], T. Davidek [135], J. Davidson [170], I. Dawson [94], K. De [8], C. De Almeida Rossi [159], N. De Biase [47], S. De Castro [24b,24a], N. De Groot [115], P. de Jong [116], H. De la Torre [117], A. De Maria [112a], S. De Miranda Rimes [81d], A. De Salvo [74a], U. De Sanctis [75a,75b], F. De Santis [69a,69b], A. De Santo [150], J.B. De Vivie De Regie [59], K.G. De Vries [116], J. Debevc [93], D.V. Dedovich[38], J. Degens [92], A.M. Deiana [44], J. Del Peso [99], L. Delagrange [27], F. Deliot [137], C.M. Delitzsch [48], M. Della Pietra [71a,71b], D. Della Volpe [55], A. Dell'Acqua [37], L. Dell'Asta [70a,70b], M. Delmastro [4], C.C. Delogu [56b,56a], P.A. Delsart [59], S. Demers [175], M. Demichev [38], H. Denizli [22a,l], M.G. Depala [92], L. D'Eramo [40], D. Derendarz [86], L. Derin [56b,56a], F. Derue [129], P. Dervan [92,*], A.M. Desai [1], K. Desch [25], F.A. Di Bello [73a,73b], A. Di Ciaccio [75a,75b], L. Di Ciaccio [4], D. Di Croce [37], C. Di Donato [71a,71b], A. Di Girolamo [37], G. Di Gregorio [65], A. Di Luca [77a,77b], B. Di Micco [76a,76b], R. Di Nardo [76a,76b], K.F. Di Petrillo [39], M. Diamantopoulou [35], F.A. Dias [116], M.A. Diaz [139a,139b], A.R. Didenko [38], M. Didenko [166], S.D. Diefenbacher [18a], E.B. Diehl [106], S. Díez Cornell [47], C. Diez Pardos [145], C. Dimitriadi [148], A. Dimitrievska [21], A. Dimri [149], Y. Ding[61], J. Dingfelder [25], T. Dingley [128], I-M. Dinu [28b], S.J. Dittmeier [62b], F. Dittus [37], M. Divisek [135], B. Dixit [92], F. Djama [102], T. Djobava [153b], C. Doglioni [101,98], A. Dohnalova [29a], Z. Dolezal [135], K. Domijan [85a], K.M. Dona [39], M. Donadelli [81d], B. Dong [107], J. Donini [40], A. D'Onofrio [71a,71b], M. D'Onofrio [92], J. Dopke [136], A. Doria [71a], N. Dos Santos Fernandes [132a], I.A. Dos Santos Luz [81e], P. Dougan [44], M.T. Dova [90], A.T. Doyle [58], M.P. Drescher [54], E. Dreyer [172], I. Drivas-koulouris [10], M. Drnevich [119], D. Du [61], T. Du[39], T.A. du Pree [116], Z. Duan[112a], M. Dubau [4], F. Dubinin [38], M. Dubovsky [29a], E. Duchovni [172], G. Duckeck [109], P.K. Duckett[96], O.A. Ducu [28b], D. Duda [51], A. Dudarev [37], M.M. Dudek [86], E.R. Duden [27], M. D'uffizi [101], L. Duflot [65], M. Dührssen [37], I. Duminica [28g], A.E. Dumitriu [28b], M. Dunford [62a], T. Duong[4], A. Duperrin [102], A.F. Duque Bran [40], H. Duran Yildiz [3a], A. Durglishvili [153b], G.I. Dyckes [18a], M. Dyndal [85a], B.S. Dziedzic [37], G.H. Eberwein [128], B. Eckerova [29a], J.C. Egan [96], S. Eggebrecht [54], E. Egidio Purcino De Souza [81e], G. Eigen [17], K. Einsweiler [18a], T. Ekelof [164], P.A. Ekman [98], S. El Farkh [36b], Y. El Ghazali [61], H. El Jarrari [104], A. El Moussaouy [36a], I. Elbaz [155], D. Elitez [37], M. Ellert [164], F. Ellinghaus [174], T.A. Elliot [95], J. Elmsheuser [30], M. Elsawy [118a], M. Elsing [37], D. Emeliyanov [136], Y. Enari [82], S. Epari [108], D. Ernani Martins Neto [86], F. Ernst[37], M. Escalier [65], C. Escobar [166], R. Estevam De Paula [81c], E. Etzion [155], G. Evans [132a,132b], H. Evans [67], L.S. Evans [47], S. Ezzarqtouni [36a], F. Fabbri [24b,24a], L. Fabbri [24b,24a], G. Facini [96], V. Fadeyev [138], D. Fakoudis [100], S. Falciano [74a], L.F. Falda Ulhoa Coelho [27], F. Fallavollita [110],

G. Falsetti [43b,43a], J. Faltova [135], C. Fan [165], K.Y. Fan [63b], Y. Fan [14], Y. Fang [14,112c], M. Fanti [70a,70b], M. Faraj [68a,68c], Z. Farazpay [97], A. Farbin [8], A. Farilla [76a], K. Farman [152], J.N. Farr [175], M.S. Farrington [60], S.M. Farrington [136,51], F. Fassi [36e], D. Fassouliotis [9], L. Fayard [65], G. Fazzino [62b], P. Federic [135], P. Federicova [133], M. Feickert [173], L. Feligioni [102], D.E. Fellers [18a], C. Feng [113b], Y. Feng[14], Z. Feng [65], B. Fernandez Barbadillo [91], P. Fernandez Martinez [66], C. Fernandez Ruiz [33], J. Ferrando [91], A. Ferrari [164], P. Ferrari [116,115], R. Ferrari [72a], D. Ferrere [55], C. Ferretti [106], M.P. Fewell [1], D. Fiacco [74a,74b], F. Fiedler [100], P. Fiedler [134], S. Filimonov [38], M.S. Filip [28b,s], A. Filipčič [93], E.K. Filmer [160a], F. Filthaut [115], M.C.N. Fiolhais [132a,132c,c], L. Fiorini [166], W.C. Fisher [107], T. Fitschen [101], I. Fleck [145], P. Fleischmann [106], T. Flick [174], M. Flores [34d,ag], L.R. Flores Castillo [63a], M. Foll [127], F.M. Follega [77a,77b], N. Fomin [33], J.H. Foo [159], A. Formica [137], M. Fornasiero [150], A.C. Forti [101], N. Forti [24b,24a], E. Fortin [102], A.W. Fortman [18a], L. Foster [18a], L. Fountas [9], H. Fox [91], P. Francavilla [73a,73b], S. Francescato [60], S. Franchellucci [20], M. Franchini [24b,24a], S. Franchino [62a], D. Francis[37], L. Franco [47], L. Franconi [47], M. Franklin [60], G. Frattari [37], Y.Y. Frid [155], N. Fritzsche [37], A. Froch [55], D. Froidevaux [37], J.A. Frost [136], Y. Fu [107], S. Fuenzalida Garrido [139g], Y.C. Fujikake [138], M. Fujimoto [149], K.Y. Fung [63a], E. Furtado De Simas Filho [81e], M. Furukawa [157], M. Fuste Costa [47], P. Fuste Martin [13], J. Fuster [166], A. Gaa [54], A. Gabrielli [24b,24a], A. Gabrielli [159], G. Gagliardi [56b,56a], L.G. Gagnon [18a], S. Galantzan [155], J. Gallagher [1], E.J. Gallas [128], A.L. Gallen [164], B.J. Gallop [136], K.K. Gan [121], Y. Gao [51], Z. Gao [112a], A. Garabaglu [141], F.M. Garay Walls [139a,139b], C. García [166], A. Garcia Alonso [116], A.G. Garcia Caffaro [175], J.E. García Navarro [166], M.A. Garcia Ruiz [23b], M. Garcia-Sciveres [18a], G.L. Gardner [130], R.W. Gardner [39], N. Garelli [162], R.B. Garg [147], J.M. Gargan [33], C.A. Garner[159], C.M. Garvey [34a], V.K. Gassmann[162], G. Gaudio [72a], A.J. Gavin [94], J. Gavranovic [93], I.L. Gavrilenko [132a], C. Gay [167], G. Gaycken [125], A. Gekow[121], C. Gemme [56b], M.H. Genest [59], A.D. Gentry [114], S. George [95], T. Geralis [45], A.A. Gerwin [122], P. Gessinger-Befurt [37], M. Ghani [170], K. Ghorbanian [94], A. Ghosal [145], A. Ghosh [163], A. Ghosh [7], B. Giacobbe [24b], S. Giagu [74a,74b], A. Giannini [61], S.M. Gibson [95], D.T. Gil [85b], B.J. Gilbert [41], D. Gillberg [35], G. Gilles [116], D.M. Gingrich [2,aj], M.P. Giordani [68a,68c], P.F. Giraud [137], G. Giugliarelli [68a,68c], D. Giugni [70a], F. Giuli [75a,75b,al], I. Gkialas [9,i], B.C. Gladwyn [128], C. Glasman [99], M. Glazewska [20], R.M. Gleason [163], G. Glemža [47], I. Gnesi [24b,24a,am], Y. Go [30], M. Goblirsch-Kolb [37], B. Gocke [48], D. Godin[108], B. Gokturk [22a], S. Goldfarb [105], T. Golling [55], M.G.D. Gololo [34c], A. Golub [141], J.P. Gombas [107], A. Gomes [132a,132b], G. Gomes Da Silva [145], A.J. Gomez Delegido [37], R. Gonçalo [132a], A. Gongadze [153c], F. Gonnella [21], J.L. Gonski [147], R.Y. González Andana [51], S. González de la Hoz [166], L. Gonzalez Escudero[104], M.V. Gonzalez Rodrigues [47], R. Gonzalez Suarez [164], S. Gonzalez-Sevilla [55], L. Goossens [37], B. Gorini [37], E. Gorini [69a,69b], A. Gorišek [93], T.C. Gosart [130], A.T. Goshaw [50], M.I. Gostkin [38], S. Goswami [123], C.A. Gottardo [37], S.A. Gotz [109], M. Gouighri [36b], A.G. Goussiou [141], N. Govender [34c], R.P. Grabarczyk [128], I. Grabowska-Bold [85a], K. Graham [35], E. Gramstad [127], S. Grancagnolo [69a,69b], C.M. Grant[1], P.M. Gravila [28f], F.G. Gravili [69a,69b], H.M. Gray [18a], M. Greco [110], M.J. Green [1], C. Grefe [25], A.S. Grefsrud [17], I.M. Gregor [47], K.T. Greif [163], P. Grenier [147], S.G. Grewe[110], K. Grimm [32], S. Grinstein [13,x], E. Gross [172], J. Grosse-Knetter [54], L.H. Grossman [18b], L. Guan [106], G. Guerrieri [37], R. Guevara [127], R. Gugel [100], J.A.M. Guhit [106], A. Guida [19], E. Guilloton [170], S. Guindon [37], F. Guo [14,112c], J. Guo [142a], L. Guo [47], L. Guo [112b,u], Y. Guo [106], Y. Guo [41], A. Gupta [48], R. Gupta [131], S. Gupta [27], S. Gurbuz [25], S.S. Gurdasani [47], G. Gustavino [74a,74b], P. Gutierrez [122], L.F. Gutierrez Zagazeta [130], M. Gutsche [49], C. Gutschow [96], W. Guérin [89], C. Gwenlan [128], C.B. Gwilliam [92], E.S. Haaland [127], A. Haas [119], M. Habedank [58], C. Haber [18a], R.J. Haberle [172], H.K. Hadavand [8], A. Haddad [40], A. Hadef [49], A.I. Hagan [91], J.J. Hahn [145], M. Haleem [169], J. Haley [123], G.D. Hallewell [102], J.A. Hallford [47], K. Hamano [168], H. Hamdaoui [164], M. Hamer [25], S.E.D. Hammoud [65], E.J. Hampshire [95], L. Han [112a], L. Han [61], S. Han [14], K. Hanagaki [82], M. Hance [138], D.A. Hangal [41], H. Hanif [146], M.D. Hank [130], J.B. Hansen [42], P.H. Hansen [42], T. Harenberg [174], S. Harkusha [176], M.L. Harris [103], Y.T. Harris [25], J. Harrison [13], P.F. Harrison[170], M.L.E. Hart [96], N.M. Hartman [110], N.M. Hartmann [109], R.Z. Hasan [95,136], Y. Hasegawa [144], D. Hashimoto [111], F. Haslbeck [37], S. Hassan [127], R. Hauser [107], M. Haviernik [135], C.M. Hawkes [21], R.J. Hawkings [37], Y. Hayashi [157], D. Hayden [107], R.L. Hayes [116], C.P. Hays [128], J.M. Hays [94], H.S. Hayward [92], M. He [14,112c], Y. He [47], Y. He [96], N.B. Heatley [94], V. Hedberg [98], J. Heilman [35], S. Heim [47], T. Heim [18a], J.J. Heinrich [125], L. Heinrich [110], J. Hejbal [133], M. Helbig [49], A. Held [173], S. Hellesund [17], C.M. Helling [167], F.N.E. Henry [58], H. Herde [98], Y. Hernández Jiménez [149], G. Herten [53], R. Hertenberger [109], L. Hervas [37], M.E. Hesping [100], N.P. Hessey [160a], J. Hessler [110], R. Hicks [130], M. Hidaoui [36b], N. Hidic [135], E. Hill [159], T.S. Hillersoy [17], S.J. Hillier [21], J.R. Hinds [107], F. Hinterkeuser [25], M. Hirose [126], S. Hirose [161], D. Hirschbuehl [174], B. Hiti [93], J. Hobbs [149], R. Hobincu [28e], N. Hod [172], A.M. Hodges [165], M.C. Hodgkinson [143], B.H. Hodkinson [128], A. Hoecker [37], D.D. Hofer [106], J. Hofer [166], J. Hofner [100], M. Holzbock [37], L.B.A.H. Hommels [33], V. Homsak [128], J.J. Hong [67], T.M. Hong [131], B.H. Hooberman [165], W.H. Hopkins [6], M.C. Hoppesch [165], Y. Horii [111], M.E. Horstmann [110], M.M. Horzela [54], S. Hou [152], M.R. Housenga [165], J. Howarth [58], J. Hoya [6], M. Hrabovsky [124], T. Hryn'ova [4], P.J. Hsu [64], S.-C. Hsu [141], T. Hsu [65], M. Hu [18a], P. Hu [63b], Q. Hu [61], S. Huang [33], X. Huang [14,112c], Y. Huang [135], Y. Huang [112b], Y. Huang [14], Z. Huang [65], Z. Hubacek [134], F. Huegging [25], T.B. Huffman [128], M. Hufnagel Maranha De Faria [81a], C.A. Hugli [47], M. Huhtinen [37], S.K. Huiberts [17], R. Hulsken [104], C.E. Hultquist [18a], D.L. Humphreys [103], N. Huseynov [12], J. Huston [107], B. Huth [37], J. Huth [60], L. Huth [47], R. Hyneman [7], G. Iacobucci [55], G. Iakovidis [30], L. Iconomidou-Fayard [65], J.P. Iddon [37], P. Iengo [71a,71b], Y. Iiyama [157], T. Iizawa [157], Y. Ikegami [82], D. Iliadis [156], N. Ilic [159], H. Imam [36a], G. Inacio Goncalves [81d], S.A. Infante Cabanas [139c], T. Ingebretsen Carlson [46a,46b], J.M. Inglis [94], G. Introzzi [72a,72b], M. Iodice [76a], V. Ippolito [74a,74b], R.K. Irwin [92], M. Ishino [157], W. Islam [173], C. Issever [19], S. Istin [22a,ar], K. Itabashi [126], H. Ito [171], R. Iuppa [77a,77b], A. Ivina [172], F. Ivone [37], S. Izumiyama [111], V. Izzo [71a], P. Jacka [134], P. Jackson [1], P.R. Jacobson [50], P. Jain [47], K. Jakobs [53], J. Jamieson [58], W. Jang [157], S. Jankovych [116], B.K. Jashal [136], M. Javurkova [103], P. Jawahar [101], L. Jeanty [125], J. Jejelava [153a,ae], P. Jenni [53,f], L. Jerala [93], C.E. Jessiman [35], H. Jia [167], J. Jia [149], X. Jia [110,112c], C. Jiang [51], Q. Jiang [63b], S. Jiggins [47], M. Jimenez Ortega [166], J. Jimenez Pena [13], S. Jin [112a], A. Jinaru [28b], O. Jinnouchi [140], P. Johansson [143], K.A. Johns [7], J.W. Johnson [138], F.A. Jolly [47], D.M. Jones [150], E. Jones [47], K.S. Jones[8], P. Jones [33], R.W.L. Jones [91], T.J. Jones [92], H.L. Joos [37], R. Joshi [121], J. Jovicevic [16], X. Ju [18a], J.J. Junggeburth [37], T. Junkermann [62a], A. Juste Rozas [13,x], M.K. Juzek [86], S. Kabana [139f], A. Kaczmarska [86], S.A. Kadir[147], M. Kado [110], H. Kagan [121], M. Kagan [147], A. Kahn [130], C. Kahra [100], T. Kaji [157], E. Kajomovitz [154], N. Kakati [172], N. Kakoty [13], S. Kandel [8], E. Kanellaki[45], N. Kanellos [10], D. Kar [34j,*], E. Karentzos [25], K. Karki [8], O. Karkout [116], S.N. Karpov [38], Z.M. Karpova [38], V. Kartvelishvili [91,153b], E. Kasimi [156], J. Katzy [47], S. Kaur [35], R. Kavak [165], K. Kawade [144], M.P. Kawale [122], C. Kawamoto [87], E.F. Kay [37], S. Kazakos [107], K. Kazakova [102], J.M. Keaveney [34a], R. Keeler [168], G.V. Kehris [60], J.S. Keller [35], J.M. Kelly [168], J.J. Kempster [150], O. Kepka [133],

J. Kerr [160b], B.P. Kerridge [136], B.P. Kerševan [93], L. Keszeghova [29a], R.A. Khan [131], A. Khanov [123], M. Kholodenko [132a], T.J. Khoo [19], G. Khoriauli [169], Y. Khoulaki [36a], Y.A.R. Khwaira [129], D. Kim [6], D.W. Kim [18b], Y.K. Kim [39], N. Kimura [96], M.K. Kingston [54], F. Kirfel [25], J. Kirk [136], A.E. Kiryunin [110], S. Kita [161], O. Kivernyk [25], M. Klassen [162], C. Klein [35], L. Klein [169], M.H. Klein [44], S.B. Klein [55], U. Klein [92], A. Klimentov [30], P. Kluit [116], S. Kluth [110], E. Kneringer [78], T.M. Knight [159], A. Knue [48], M. Kobel [49], D. Kobylianskii [172], S.F. Koch [37], M. Kocian [147], P. Kodyš [135], D.M. Koeck [125], T. Koffas [35], K. Kojima [82], O. Kolay [49], I. Koletsou [4], T. Komarek [86], S. Kondo [157], K. Köneke [54], A.X.Y. Kong [1], T. Kono [120], N. Konstantinidis [96], P. Kontaxakis [55], B. Konya [98], R. Kopeliansky [41], S. Koperny [85a], R. Koppenhofer [53], K. Korcyl [86], K. Kordas [156,d], A. Korn [96], S. Korn [54], I. Korolkov [13], B. Kortman [116], O. Kortner [110], S. Kortner [110], W.H. Kostecka [117], M. Kostov [29a], V.V. Kostyukhin [145], A. Kotsokechagia [37], A. Kotwal [50], A. Koulouris [37], A. Kourkoumeli-Charalampidi [72a,72b], O. Kovanda [125], R. Kowalewski [168], W. Kozanecki [125], G. Kramberger [93], P. Kramer [25], A. Krasznahorkay [103], A.C. Kraus [117], J.W. Kraus [174], J.A. Kremer [47], N.B. Krengel [145], T. Kresse [159], L. Kretschmann [174], J. Kretzschmar [92], P. Krieger [159], K. Krizka [21], K. Kroeninger [48], H. Kroha [110], J. Kroll [133], J. Kroll [130], K.S. Krowpman [107], U. Kruchonak [38], H. Krüger [25], N. Krumnack[79], J. Krupa [147], M.C. Kruse [50], O. Kuchinskaia [38], S. Kuday [3a], S. Kuehn [37], R. Kuesters [53], T. Kuhl [47], V. Kukhtin [38], Y. Kulchitsky [38], S. Kuleshov [139d,139b], J. Kull [1], E.V. Kumar [109], M. Kumar [34j], N. Kumari [47], P. Kumari [160b], A. Kupco [133], O. Kuprash [53], H. Kurashige [84], L.L. Kurchaninov [160a], O. Kurdysh [4], M. Kuze [140], A.K. Kvam [103], J. Kvita [124], N.G. Kyriacou [141], M. Laassiri [30], C. Lacasta [166], H. Lacker [19], D. Lacour [129], E. Ladygin [38], A. Lafarge [40], B. Laforge [129], T. Lagouri [175], F.Z. Lahbabi [36a], S. Lai [54], W.S. Lai [96], I.K. Lakomiec [54], J.E. Lambert [168], S. Lammers [67], W. Lampl [7], C. Lampoudis [156], G. Lamprinoudis [169], A.N. Lancaster [117], U. Landgraf [53], M.P.J. Landon [94], V.S. Lang [53], A.J. Lankford [163], F. Lanni [37], C.S. Lantz[165], K. Lantzsch [25], A. Lanza [72a], M. Lanzac Berrocal [166], T. Lari [70a], D. Larsen [17], L. Larson [11], F. Lasagni Manghi [24b], M. Lassnig [37], H.C. Lau[168], S.D. Lawlor [143], R. Lazaridou[163], M. Lazzaroni [70a,70b], E.T.T. Le [163], H.D.M. Le [107], E.M. Le Boulicaut [175], D.O. Le Guennec[137], L.T. Le Pottier [18a], B. Leban [24b,24a], F. Ledroit-Guillon [59], T.F. Lee [160b], L.L. Leeuw [34h], M. Lefebvre [168], C. Leggett [18a], L.M. Lehmann [116], G. Lehmann Miotto [37], M. Leigh [55], W.A. Leight [103], W. Leinonen [115], A. Leisos [156,t], M.A.L. Leite [81c], C.E. Leitgeb [19], R. Leitner [135], K.J.C. Leney [44], T. Lenz [25], S. Leone [73a], C. Leonidopoulos [51], A. Leopold [148], J. LePage-Bourbonnais [35], R. Les [107], C.G. Lester [33], J. Levêque [4], L.J. Levinson [172], G. Levrini [24b,24a], M.P. Lewicki [86], C. Lewis [141], D.J. Lewis [4], L. Lewitt [143], A. Li [30], B. Li [113b], C. Li[106], C-Q. Li [110], H. Li [113b], H. Li [101], H. Li [15], H. Li[61], H. Li [113b], J. Li [142a], L. Li [142a], R. Li [175], S. Li [142b,142a], T. Li [5], Y. Li[14], Z. Li [14,112c], Z. Li [61], S. Liang [14,112c], Z. Liang [14], M. Liberatore [137], B. Liberti [75a], G.B. Libotte [81d], K. Lie [63c], J. Lieber Marin [81e], H. Lien [67], H. Lin [106], S.F. Lin [149], L. Linden [109], R.E. Lindley [7], J.H. Lindon [37], J. Ling [60], E. Lipeles [130], A. Lipniacka [17], A. Lister [167], J.D. Little [67], B. Liu [113a], B.X. Liu [112b], D. Liu [154], D. Liu [138], E.H.L. Liu [21], H. Liu[112b], J.K.K. Liu [119], K. Liu [142b], K. Liu [142b], M. Liu [61], M.Y. Liu [61], P. Liu [113b], Q. Liu [147], S. Liu [149], X. Liu [113b], Y. Liu [112b,112c], Y. Liu [165], Y.L. Liu [113b], Y.W. Liu [61], Z. Liu [65,j], S.L. Lloyd [94], E.M. Lobodzinska [47], P. Loch [7], E. Lodhi [159], K. Lohwasser [143], E. Loiacono [123], J.D. Lomas [21], I. Longarini [163], R. Longo [24b,24a,am], A. Lopez Solis [13], N.A. Lopez-canelas [7], N. Lorenzo Martinez [4], A.M. Lory [109], M. Losada [118a], G. Löschcke Centeno [4], X. Lou [14,112c], P.A. Love [91], M. Lu [65], S. Lu [130], Y.J. Lu [152], H.J. Lubatti [141], C. Luci [74a,74b], F.L. Lucio Alves [112a], F. Luehring [67], B.S. Lunday [130],

O. Lundberg [148], J. Lunde [37], N.A. Luongo [6], M.S. Lutz [159], A.B. Lux [26], D. Lynn [30], R. Lysak [133], V. Lysenko [134], E. Lytken [98], V. Lyubushkin [38], T. Lyubushkina [38], M.M. Lyukova [149], H. Ma [30], K. Ma [61], L.L. Ma [113b], W. Ma [61], Y. Ma [113b], J.C. MacDonald [100], P.C. Machado De Abreu Farias [81e], D. Macina [37], R. Madar [40], T. Madula [96], J. Maeda [84], T. Maeno [30], P.T. Mafa [34f], H. Maguire [143], M. Maheshwari [33], V. Maiboroda [65], G. Maineri [70a,70b], A. Maio [132a,132b,132d], K. Maj [85a], O. Majersky [47], S. Majewski [125], A. Makita [157], N. Makovec [65], V. Maksimovic [16], B. Malaescu [129], J. Malamant[127], Pa. Malecki [86], F. Malek [59,n], M. Mali [93], D. Malito [95], A. Maloizel [5], A. Malvezzi Lopes [81d], S. Malyukov[38], J. Mamuzic [93], G. Mancini [52], M.N. Mancini [27], G. Manco [72a,72b], S.S. Mandarry [150], I. Mandić [93], L. Manhaes de Andrade Filho [81a], I.M. Maniatis [172], J. Manjarres Ramos [89], D.C. Mankad [172], A. Mann [109], T. Manoussos [37], M.N. Mantinan [39], S. Manzoni [37], L. Mao [142a], X. Mapekula [34c], A. Marantis [156], R.R. Marcelo Gregorio [1], G. Marchiori [5], C. Marcon [70a], E. Maricic [16], M. Marinescu [47], S. Marium [47], M. Marjanovic [122], A. Markhoos [53], M. Markovitch [65], M.K. Maroun [103], M.C. Marr [146], T.L. Marsault[137], G.T. Marsden[101], Z. Marshall [18a], S. Marti-Garcia [166], J. Martin [96], T.A. Martin [136], V.J. Martin [51], B. Martin dit Latour [17], L. Martinelli [74a,74b], V.I. Martinez Outschoorn [103], P. Martinez Suarez [37], S. Martin-Haugh [136], G. Martinovicova [135], V.S. Martoiu [28b], A. Martone [89], A.C. Martyniuk [96], A. Marzin [37], D. Mascione [77a,77b], L. Masetti [100], J. Masik [101], A.L. Maslennikov [38], S.L. Mason [41], P. Massarotti [71a,71b], P. Mastrandrea [73a,73b], A. Mastroberardino [43b,43a], R. Mastrofrancesco [72a,72b], T. Masubuchi [126], T.T. Mathew [125], J. Matousek [135], D.M. Mattern [48], K. Mauer [47], J. Maurer [28b], T. Maurin [58], A.J. Maury [65], B. Maček [93], C. Mavungu Tsava [102], A.E. May [101], E. Mayer [40], R. Mazini [34j], S.M. Mazza [138], E. Mazzeo [37], J.P. Mc Gowan [168], S.P. Mc Kee [106], C.C. McCracken [167], E.F. McDonald [105], L.F. Mcelhinney [91], J.A. Mcfayden [150], R.P. McGovern [130], R.P. Mckenzie [34j], D.J. Mclaughlin [96], S.J. McMahon [136], C.M. Mcpartland [92], R.A. McPherson [168,ab], S. Mehlhase [109], A. Mehta [92], D. Melini [166], B.R. Mellado Garcia [14,ah], A.H. Melo [54], F. Meloni [47], A.M. Mendes Jacques Da Costa [101], L. Meng [91], S. Menke [110], M. Mentink [37], E. Meoni [43b,43a], G. Mercado [117], S. Merianos [156], C. Merlassino [68a,68c], C. Meroni [70a,70b], J. Metcalfe [6], A.S. Mete [6], E. Meuser [100], C. Meyer [67], J-P. Meyer [137], Y. Miao[112a], R.P. Middleton [136], M. Mihovilovic [65], L. Mijović [51], G. Mikenberg [172], M. Mikestikova [133], M. Mikuž [93], H. Mildner [100], A. Milic [37], D.W. Miller [39], E.H. Miller [147], A. Milov [172], D.A. Milstead[46a,46b], T. Min[112a], I.A. Minashvili [153b], A.I. Mincer [119], B. Mindur [85a], M. Mineev [38], Y. Mino [87], L.M. Mir [13], M. Miralles Lopez [58], M. Mironova [18a], M. Missio [40], A. Mitra [170], V.A. Mitsou [166], Y. Mitsumori [111], P.S. Miyagawa [94], R. Mizuhiki[84], T. Mkrtchyan [37], M. Mlinarevic [96], T. Mlinarevic [96], M. Mlynarikova [135], L. Mlynarska [85a], C. Mo [142a], H. Mobius [47], S. Mobius [20], M.H. Mohamed Farook [114], S. Mohapatra [41], M.F. Mohd Soberi [51], S. Mohiuddin [123], G. Mokgatitswane [34j], R. Mole [21], L. Moleri [172], U. Molinatti [128], L.G. Mollier [20], L. Monaco [37,58], B. Mondal [133], S. Mondal [135], K. Mönig [47], E. Monnier [102], L. Monsonis Romero[166], A. Montella [46a,46b], M. Montella [121], F. Montereali [76a,76b], F. Monticelli [90], S. Monzani [68a,68c], M.E.E. Moors [25], A. Morancho Tarda [42], N. Morange [65], M. Moreno Llácer [166], C. Moreno Martinez [55], J.M. Moreno Perez[23b], P. Morettini [56b], S. Morgenstern [62a], M. Morii [60], M. Morinaga [157], F. Morodei [74a,74b], P. Moschovakos [37], B. Moser [53], M. Mosidze [153b], T. Moskalets [44], P. Moskvitina [115], C.J. Mosomane[34b], J. Moss [32], T. Motta Quirino [81d], A. Moussa [36d], Y. Moyal [172,k], H. Moyano Gomez [13], E.J.W. Moyse [103], T.G. Mroz [86], S. Muanza [102], M. Mucha [25], J. Mueller [131], D. Muller [145], G.A. Mullier [164], A.J. Mullin[33], J.J. Mullin[50], A.C. Mullins[44], A.E. Mulski [60], D.P. Mungo [159], D. Munoz Perez [123], F.J. Munoz Sanchez [101], W.J. Murray [170,136], E. Musajan [61], M. Muškinja [93], C. Mwewa [47], A.J. Myers [8], G. Myers [106], M. Myska [134], B.P. Nachman [147], K. Nagai [128], K. Nagano [82], R. Nagasaka[157], J.L. Nagle [30,ao], E. Nagy [102], A.M. Nairz [37], T. Nakagawa [87], Y. Nakahama [82], K. Nakamura [82], K. Nakkalil [5], A. Nandi [62b], H. Nanjo [126], E.A. Narayanan [44], Y. Narukawa [157], L. Nasella [70a,70b], S. Nasri [118b], C. Nass [25], G. Navarro [23a], A. Nayaz [19], S. Nechaeva [24b,24a], F. Nechansky [133], L. Nedic [128], A. Negri [72a,72b], M. Negrini [24b], C. Nellist [116], C. Nelson [104], K. Nelson [106], S. Nemecek [133], M. Nessi [37,g], M.S. Neubauer [165], J. Newell [92], P.R. Newman [21], Y.W.Y. Ng [165], B. Ngair [118a], H.D.N. Nguyen [108], J.D. Nichols [122], R. Nicolaidou [137], J. Nielsen [138], M. Niemeyer [54], J. Niermann [37], N. Nikiforou [37], I. Nikolic-Audit [129], P. Nilsson [30], G. Ninio [155], A. Nisati [74a], R. Nisius [110], N. Nitika [172], E.K. Nkadimeng [34b], T. Nobe [157], D. Noll [147], T. Nommensen [151], M.B. Norfolk [143], B.J. Norman [35], L.C. Nosler[18a], M. Noury [36a], J. Novak [93], T. Novak [93], P. Novotny [172], R. Novotny [134], L. Nozka [124], K. Ntekas [37], D. Ntounis [147], N.M.J. Nunes De Moura Junior [81b], J. Ocariz [129], I. Ochoa [132a], A. Odella Rodriguez [13], S. Oerdek [47], J.T. Offermann [39], A. Ogrodnik [86], A. Oh [101], C.C. Ohm [148], H. Oide [82], M.L. Ojeda [37], Y. Okumura [157], L.F. Oleiro Seabra [132a], I. Oleksiyuk [55], G. Oliveira Correa [13], D. Oliveira Damazio [30], J.L. Oliver [1], R. Omar [67], A.P. O'Neill [20], Y. Onoda[140], A. Onofre [132a,132e,e], P.U.E. Onyisi [11], M.J. Oreglia [39], D. Orestano [76a,76b], R. Orlandini [76a,76b], R.S. Orr [159], L.M. Osojnak [41], Y. Osumi [111], G. Otero y Garzón [31], H. Otono [88], M. Ouchrif [36d], F. Ould-Saada [127], T. Ovsiannikova [141], M. Owen [58], R.E. Owen [136], S.A. Oyeniran [114], V.E. Ozcan [22a], F. Ozturk [86], N. Ozturk [8], S. Ozturk [80], H.A. Pacey [128], K. Pachal [160a], A. Pacheco Pages [13], C. Padilla Aranda [13], G. Padovano [74a,74b], S. Pagan Griso [18a], L. Pagani [75a,75b], J. Pampel [25], D.K. Panchal [11], C.E. Pandini [59], J.G. Panduro Vazquez [136], H.D. Pandya [1], H. Pang [137], P. Pani [47], G. Panizzo [68a,68c], L. Panwar [129,w], L. Paolozzi [21], S. Parajuli [165], A. Paramonov [6], C. Paraskevopoulos [52], D. Paredes Hernandez [63b], S.R. Paredes Saenz [51], A. Pareti [72a,72b], K.R. Park [41], T.H. Park [110], F. Parodi [56b,56a], J.A. Parsons [41], U. Parzefall [53], B.A. Paschen [18a], B. Pascual Dias [40], L. Pascual Dominguez [99], E. Pasqualucci [74a], S. Passaggio [56b], F. Pastore [95], P. Patel [86], U.M. Patel [50], J.R. Pater [101], T. Pauly [37], A. Paunovic [16], F. Pauwels [135], C.I. Pazos [162], M. Pedersen [127], R. Pedro [132a], O. Penc [133], C.C. Penelaud [129], S. Peng [15], G.D. Penn [175], B.S. Peralva [81d], A.P. Pereira Peixoto [141], L. Pereira Sanchez [147], D.V. Perepelitsa [30,ao], G. Perera [103], E. Perez Codina [37], M. Perganti [10], H. Pernegger [37], S. Perrella [74a,74b], K. Peters [47], R.F.Y. Peters [101], B.A. Petersen [37], T.C. Petersen [42], E. Petit [102], V. Petousis [134], A.R. Petri [70a,70b], T. Petru [135], M. Pettee [18a], A. Petukhov [80], K. Petukhova [37], R. Pezoa [139g], L. Pezzotti [24b,24a], G. Pezzullo [175], L. Pfaffenbichler [37], A.J. Pfleger [78], T.M. Pham [173], T. Pham [105], P.W. Phillips [136], G. Piacquadio [149], E. Pianori [18a], F. Piazza [125], R. Piegaia [31], D. Pietreanu [28b], A.D. Pilkington [101], T. Pilusa [34j], M. Pinamonti [68a,68c], J.L. Pinfold [2], G. Pinheiro Matos [41], B.C. Pinheiro Pereira [132a], J. Pinol Bel [13], A.E. Pinto Pinoargote [129], L. Pintucci [68a,68c], K.M. Piper [150], A. Pirttikoski [55], D.A. Pizzi [35], L. Pizzimento [63b], A. Plebani [33], M.-A. Pleier [30], V. Pleskot [135], E. Plotnikova[38], G. Poddar [94], R. Poettgen [98], L. Poggioli [129], S. Polacek [135], G. Polesello [72a], A. Poley [146], A. Polini [24b], C.S. Pollard [170], Z.B. Pollock [121], E. Pompa Pacchi [122], N.I. Pond [96], D. Ponomarenko [67], L. Pontecorvo [37], S. Popa [28a], G.A. Popeneciu [28d], A. Poreba [37], D.M. Portillo Quintero [160a], S. Pospisil [134], M.A. Postill [143], P. Postolache [28c], K. Potamianos [170], P.A. Potepa [85a], I.N. Potrap [38], C.J. Potter [33], H. Potti [151], J. Poveda [166], M.E. Pozo Astigarraga [37], R. Pozzi [37], A. Prades Ibanez [75a,75b], S.R. Pradhan [143], J. Pretel [168], D. Price [101], M. Primavera [69a], L. Primomo [68a,68c], M.A. Principe Martin [99], R. Privara [124], T. Procter [85b], M.L. Proffitt [141], N. Proklova [130], K. Prokofiev [63c], G. Proto [110], J. Proudfoot [6], M. Przybycien [85a],

W.W. Przygoda [85b], A. Psallidas [45], D. Pudzha [52], P. Puhl [57], H.I. Purnell [1],
D. Pyatiizbyantseva [115], J. Qian [106], R. Qian [107], D. Qichen [128], Y. Qin [13], T. Qiu [51],
A. Quadt [54], M. Queitsch-Maitland [101], G. Quetant [55], R.P. Quinn [167], D. Rafanoharana [110],
J.L. Rainbolt [39], S. Rajagopalan [30], E. Ramakoti [38], L. Rambelli [56b,56a], I.A. Ramirez-Berend [35],
K. Ran [106,112c], S.D. Randles [92], D.S. Rankin [130], N.P. Rapheeha [34j], H. Rasheed [28b],
A. Rastogi [18a], S. Rave [100], S. Ravera [56b,56a], B. Ravina [37], I. Ravinovich [172], M. Raymond [37],
A.L. Read [127], N.P. Readioff [143], D.M. Rebuzzi [72a,72b], A.S. Reed [58], K. Reeves [27],
D. Reikher [37], A. Rej [48], C. Rembser [37], H. Ren [61], M. Renda [28b], F. Renner [47],
A.G. Rennie [58], M. Repik [55], A.L. Rescia [56b,56a], S. Resconi [70a], M. Ressegotti [56b],
S. Rettie [116], W.F. Rettie [35], M.M. Revering [33], O.L. Rezanova [38], P. Reznicek [135], H. Riani [36d],
N. Ribaric [50], B. Ricci [68a,68c], E. Ricci [77a,77b], R. Richter [110], E. Richter-Was [85b], M. Ridel [129],
S. Ridouani [36d], P. Riedler [37], E.M. Riefel [46a,46b], J.O. Rieger [116], M. Rimoldi [34c],
L. Rinaldi [24b,24a], P. Rincke [164,54], G. Ripellino [164], I. Riu [13], J.C. Rivera Vergara [168],
F. Rizatdinova [123], E. Rizvi [94], B.R. Roberts [39], S.S. Roberts [138], D. Robinson [33], A. Robson [58],
A. Rocchi [75a,75b], C. Roda [73a,73b], F.A. Rodriguez [117], S. Rodriguez Bosca [37],
Y. Rodriguez Garcia [23a], A.M. Rodríguez Vera [117], S. Roe[37], J.T. Roemer [37], O. Røhne [127],
R.A. Rojas [37], Z. Rokavec[93], C.P.A. Roland [129], A. Romaniouk [78], E. Romano [72a,72b],
M. Romano [24b], N. Rompotis [92], L. Roos [129], S. Rosati [74a], L. Roscher [47], B.J. Rosser [39],
E. Rossi [128], E. Rossi [71a,71b], L.P. Rossi [60], L. Rossini [53], R. Rosten [121], M. Rotaru [28b],
R. Roth [37], D. Rousseau [65], D. Rousso [47], S. Roy-Garand [55], A. Rozanov [102],
Z.M.A. Rozario [58], Y. Rozen [154], A. Rubio Jimenez [166], V.H. Ruelas Rivera [19], T.A. Ruggeri [1],
A. Ruggiero [128], A. Ruiz-Martinez [166], A. Rummler [37], G.B. Rupnik Boero [37],
N.A. Rusakovich [38], S. Ruscelli [48], H.L. Russell [168], G. Russo [138], J.P. Rutherfoord [7],
S. Rutherford Colmenares [119], M. Rybar [135], P. Rybczynski [85a], A. Ryzhov [44],
F. Safai Tehrani [74a], S. Saha [1], B. Sahoo [172], B.T. Saifuddin [122], M. Saimpert [137],
I. Sainz Saenz Diez [62a], G.T. Saito [81c], M. Saito [157], T. Saito [157], A. Sala [70a,70b], O.T. Salin [65],
A. Salnikov [147], J. Salt [166], A. Salvador Salas [155], F. Salvatore [150], A. Salzburger [37],
D. Sammel [53], E. Sampson [91], D. Sampsonidis [156,d], D. Sampsonidou [125], M.A.A. Samy [58],
J. Sánchez [166], V. Sanchez Sebastian [166], H. Sandaker [127], C.O. Sander [47], J.A. Sandesara [173],
M. Sandhoff [174], C. Sandoval [23b], L. Sanfilippo [62a], D.P.C. Sankey [136], T. Sano [87], A. Sansar [22c],
A. Sansoni [52], M. Santana Queiroz [18b], L. Santi [37], C. Santoni [40], H. Santos [132a,132b],
L. Santos Pereira Trigo [47], E. Sanzani [24b,24a], K.A. Saoucha [83b], J.G. Saraiva [132a,132d],
J. Sardain [7], S. Sarkar [50], O. Sasaki [82], K. Sato [161], C. Sauer[37], E. Sauvan [4], P. Savard [159,aj],
R. Sawada [157], C. Sawyer [136], L. Sawyer [97], A.M. Sayed [27], C. Sbarra [24b], A. Sbrizzi [24b,24a],
R. Scaglioni [72a,72b], T. Scanlon [96], J. Schaarschmidt [141], U. Schäfer [100], A.C. Schaffer [65,44],
D. Schaile [109], R.D. Schamberger [149], C. Scharf [19], M.M. Schefer [20], D. Scheirich [135],
M. Schernau [139f], C. Scheulen [55], C. Schiavi [56b,56a], M. Schioppa [43b,43a], S. Schlenker [37],
T. Schlomer [54], J. Schmeing [174], C.R. Schmidt [49], E. Schmidt [110], M.A. Schmidt [174],
K. Schmieden [25], C. Schmitt [100], N. Schmitt [100], S. Schmitt [47], N.A. Schneider [109],
L. Schoeffel [137], A. Schoening [62b], P.G. Scholer [35], E. Schopf [145], M. Schott [25], S. Schramm [55],
T. Schroer [55], H-C. Schultz-Coulon [62a], M. Schumacher [53], B.A. Schumm [138], Ph. Schune [137],
H.R. Schwartz [7], A. Schwartzman [147], T.A. Schwarz [106], Ph. Schwemling [137],
R. Schwienhorst [107], F.G. Sciacca [20], A. Sciandra [30], G. Sciolla [27], S.A. Scoville [131],
F. Scuri [73a], C.D. Sebastiani [37], K. Sedlaczek [117], A. Sehrawat [139b], S.C. Seidel [114],
B.D. Seidlitz [41], C. Seitz [47], J.M. Seixas [81b], G. Sekhniaidze [71a], L. Selem [129],
N. Semprini-Cesari [24b,24a], A. Semushin [176], V. Senthilkumar [116], L. Serin [65], M. Sessa [71a,71b],
H. Severini [122], F. Sforza [56b,56a], A. Sfyrla [55], Q. Sha [14], H. Shaddix [117], A.H. Shah [33],

R. Shaheen[148], J.D. Shahinian[130], M. Shamim[37], L.Y. Shan[14], M. Shapiro[18a], A. Sharma[37], A.S. Sharma[167], P. Sharma[30], K. Shaw[150], S.M. Shaw[101], D. Shemyakin[172], Q. Shen[14], D.J. Sheppard[146], P. Sherwood[96], L. Shi[112b], X. Shi[14], S. Shimizu[82], S. Shirabe[88], M. Shiyakova[38,z], M.J. Shochet[39], D.R. Shope[127], B. Shrestha[122], S. Shrestha[121,aq], I. Shreyber[38], M.J. Shroff[104], P. Sicho[133], A.M. Sickles[165], E. Sideras Haddad[34j], A.C. Sidley[116], A. Sidoti[24b], F. Siegert[49], Dj. Sijacki[16], F. Sili[61], J.M. Silva[51], I. Silva Ferreira[81b], M.V. Silva Oliveira[30], S.B. Silverstein[46a], S. Simion[65], R. Simoniello[37], E.L. Simpson[101], H. Simpson[150], L.R. Simpson[6], S. Simsek[80], S. Sindhu[54], S.N. Singh[27], S. Singh[30], S. Sinha[47], S. Sinha[101], M. Sioli[24b,24a], K. Sioulas[9], I. Siral[37], E. Sitnikova[47], J. Sjölin[46a,46b], A. Skaf[54], E. Skorda[21], P. Skubic[122], M. Slawinska[86], I. Slazyk[17], I. Sliusar[127], V. Smakhtin[172], B.H. Smart[136], S.Yu. Smirnov[139b], Y. Smirnov[34c], O. Smirnova[98], J.L. Smith[101], M.B. Smith[35], R. Smith[147], H. Smitmanns[100], M. Smizanska[91], K. Smolek[134], P. Smolyanskiy[134], A.A. Snesarev[38], H.L. Snoek[116], R.M. Snyder[50], S. Snyder[30], R. Sobie[168,ab], A. Soffer[155], C.A. Solans Sanchez[37], E.Yu. Soldatov[38], U. Soldevila[166], A.A. Solodkov[34j], S. Solomon[27], A. Soloshenko[38], O.V. Solovyanov[40], P. Sommer[49], A. Sopczak[134], A.L. Sopio[51], F. Sopkova[29b], J.D. Sorenson[114], I.R. Sotarriva Alvarez[140], V. Sothilingam[62a], O.J. Soto Sandoval[139c,139b], S. Sottocornola[67], R. Soualah[83a], D. South[47], N. Soybelman[172], S. Spagnolo[69a,69b], A.S. Spellman[125], D. Sperlich[53], B. Spisso[71a,71b], L. Splendori[102], M. Spousta[135], E.J. Staats[35], R. Stamen[62a], E. Stanecka[86], W. Stanek-Maslouska[47], M.V. Stange[49], B. Stanislaus[18a], M.M. Stanitzki[47], G.H. Stark[138], J. Stark[89], P. Staroba[133], P. Starovoitov[83b], R. Staszewski[86], C. Stauch[109], G. Stavropoulos[45], A. Stefl[37], A. Stein[100], P. Steinberg[30], B. Stelzer[146,160a], H.J. Stelzer[131], O. Stelzer[160a], H. Stenzel[57], T.J. Stevenson[150], G.A. Stewart[47], G. Stoicea[28b], M. Stolarski[132a], S. Stonjek[110], A. Straessner[49], J. Strandberg[148], S. Strandberg[46a,46b], M. Stratmann[174], M. Strauss[122], T. Strebler[102], P. Strizenec[29b], R. Ströhmer[169], D.M. Strom[125], R. Stroynowski[44], A. Strubig[46a,46b], S.A. Stucci[30], B. Stugu[17], J. Stupak[122], N.A. Styles[47], D. Su[147], S. Su[61], X. Su[61], D. Suchy[29a], A.D. Sudhakar Ponnu[54], L. Sudit[172], Y. Sue[82], K. Sugizaki[130], D.M.S. Sultan[128], L. Sultanaliyeva[25], S. Sultansoy[3b], S. Sun[173], W. Sun[14], S. Sundar Raman[167], N. Sur[98], J.P. Surdutovich[121], N. Suri Jr[175], M.R. Sutton[150], M. Svatos[133], P.N. Swallow[33], S.N. Swatman[37], M. Swiatlowski[160a], A. Swoboda[37], I. Sykora[29a], M. Sykora[135], T. Sykora[135], D. Ta[100], K. Tackmann[47,y], A. Taffard[163], R. Tafirout[160a], Y. Takubo[82], M. Talby[102], N.M. Tamir[155], A. Tanaka[157], J. Tanaka[157], R. Tanaka[65], M. Tanasini[149], Z. Tao[167], S. Tapia Araya[139g], S. Tapprogge[100], A. Tarek Abouelfadl Mohamed[37], S. Tarem[154], K. Tariq[14], G. Tarna[37], G.F. Tartarelli[70a], M.J. Tartarin[142b], P. Tas[135], M. Tasevsky[133], E. Tassi[43b,43a], A.C. Tate[165], Y. Tayalati[36e,aa], G.N. Taylor[105], W. Taylor[160b], R.J. Taylor Vara[166], A.S. Tegetmeier[89], P. Teixeira-Dias[95], J.J. Teoh[159], K. Terashi[157], J. Terron[99], S. Terzo[13], M. Testa[52], R.J. Teuscher[159,ab], A. Thaler[78], T. Theveneaux-Pelzer[102], J.P. Thomas[21], E.A. Thompson[18a], P.D. Thompson[21], E. Thomson[130], R.E. Thornberry[30], T.M. Thory-Rao[21], C.N. Thotamuna Wijewardhana[149], C. Tian[61], Y. Tian[55], V. Tikhomirov[80], Yu.A. Tikhonov[38], D. Timoshyn[135], E.X.L. Ting[1], P. Tipton[175], A. Tishelman-Charny[30], K. Todome[140], S. Todorova-Nova[135], L. Toffolin[68a,68c], M. Togawa[82], J. Tojo[88], S. Tokár[29a], O. Toldaiev[67], G. Tolkachev[102], M. Tomoto[82], L. Tompkins[147], E. Torrence[125], H. Torres[89], D.I. Torres Arza[139g], E. Torres Reoyo[166], E. Torró Pastor[166], M. Toscani[31], C. Tosciri[39], M. Tost[11], D.R. Tovey[143], T. Trefzger[169], P.M. Tricarico[13], A. Tricoli[30], I.M. Trigger[160a], S. Trincaz-Duvoid[129], D.A. Trischuk[168], A. Tropina[38], D. Truncali[75a,75b], L. Truong[34c], M. Trzebinski[86], A. Trzupek[86], F. Tsai[149], A. Tsiamis[156], P.V. Tsiareshka[38], S. Tsigaridas[160a], A. Tsirigotis[156,t], V. Tsiskaridze[153a], E.G. Tskhadadze [153a], H.F. Tsoi [130], Y. Tsujikawa [87], V. Tsulaia [18a], K. Tsuri [120], D. Tsybychev [149], Y. Tu [63b], A. Tudorache [28b], V. Tudorache [28b], S.B. Tuncay [128], S. Turchikhin [56b,56a], I. Turk Cakir [3a], R. Turra [70a], T. Turtuvshin [38,ac], P.M. Tuts [41], Y. Uematsu [82], F. Ukegawa [161], P.A. Ulloa Poblete [139c,139b], G. Unal [37], A. Undrus [30], J. Urban [29b], P. Urrejola [139e], G. Usai [8], R. Ushioda [158], M. Usman [108], F. Ustuner [51], Z. Uysal [80], V. Vacek [134], B. Vachon [104], T. Vafeiadis [37], A. Vaitkus [96], C. Valderanis [109], E. Valdes Santurio [46a,46b], M. Valente [37], S. Valentinetti [24b,24a], A. Valero [166], E. Valiente Moreno [166], A. Vallier [89], J.A. Valls Ferrer [166], D.R. Van Arneman [116], R. Van Den Broucke [129], A. Van Der Graaf [48], H.Z. Van Der Schyf [34j], P. Van Gemmeren [6], M. Van Rijnbach [37], S. Van Stroud [96], I. Van Vulpen [116], P. Vana [135], M. Vanadia [75a,75b], U.M. Vande Voorde [148], W. Vandelli [37], E.R. Vandewall [147], D. Vannicola [155], R. Vari [74a], M. Varma [175], E.W. Varnes [7], C. Varni [85a], D. Varouchas [65], L. Varriale [166], K.E. Varvell [151], M.E. Vasile [28b], A. Vasileiadou[9], L. Vaslin[82], M.D. Vassilev [147], A. Vasyukov [38], L.M. Vaughan [123], R. Vavricka[135], T. Vazquez Schroeder [13], J. Veatch [32], V. Vecchio [101], M.J. Veen [103], I. Veliscek [30], I. Velkovska [93], L.M. Veloce [159], F. Veloso [132a,132c], A.G. Veltman [51], S.H. Venetianer [162], S. Veneziano [74a], A. Ventura [69a,69b], A. Verbytskyi [110], M. Verducci [73a,73b], C. Vergis [94], M. Verissimo De Araujo [81b], W. Verkerke [116], J.C. Vermeulen [116], C. Vernieri [147], M. Vessella [163], M.C. Vetterli [146,aj], A. Vgenopoulos [100], N. Viaux Maira [139g,af], L. Vicenik [134], T. Vickey [143], O.E. Vickey Boeriu [143], G.H.A. Viehhauser [128], L. Vigani [62b], M. Vigl [110], M. Villa [24b,24a], M. Villaplana Perez [166], E.M. Villhauer[39], E. Vilucchi [52], M. Vincent [166], M.G. Vincter [35], A. Visibile [116], A. Visive [116], C. Vittori [162], I. Vivarelli [24b,24a], M.I. Vivas Albornoz [47], E. Voevodina [110], F. Vogel [109], J.C. Voigt [49], P. Vokac [134], Yu. Volkotrub [85b], L. Vomberg [25], E. Von Toerne [25], B. Vormwald [37], K. Vorobev [50], M. Vos [166], K. Voss [145], M. Vozak [37], L. Vozdecky [122], N. Vranjes [16], M. Vranjes Milosavljevic [16], M. Vreeswijk [116], N.K. Vu [112a], R. Vuillermet [37], O. Vujinovic [100], I. Vukotic [39], I.K. Vyas [35], J.F. Wack [33], A. Wada [111], S. Wada [161], C. Wagner[147], J.M. Wagner [18a], W. Wagner [174], S. Wahdan [174], H. Wahlberg [90], C.H. Waits [122], J. Walder [136], R. Walker [109], K. Walkingshaw Pass [58], W. Walkowiak [145], A. Wall [130], E.J. Wallin [98], T. Wamorkar [147], K. Wandall-Christensen [166], A. Wang [61], A.Z. Wang [138], C. Wang [47], C. Wang [11], H. Wang [18a], J. Wang [63c], P. Wang [101], P. Wang [96], R. Wang [60], R. Wang [106], R. Wang [6], S.M. Wang [152], S. Wang [14], T. Wang [115], T. Wang [61], W.T. Wang [128], W. Wang[113c], X. Wang [165], X. Wang [142a], X. Wang [47], Y. Wang [149], Y. Wang [114], Z. Wang [106], Z. Wang [14], Z. Wang[63b], C. Wanotayaroj [82], A. Warburton [104], A.L. Warnerbring [145], S. Waterhouse [96], A.T. Watson [21], H. Watson [51], M.F. Watson [21], E. Watton [37], G. Watts [141], B.M. Waugh [96], J.M. Webb [53], C. Weber [30], M.S. Weber [20], C. Wei [61], Y. Wei [53], A.R. Weidberg [128], E.J. Weik [119], J. Weingarten [48], C. Weiser [53], C.J. Wells [47], T. Wenaus [30], T. Wengler [37], N.S. Wenke[110], N. Wermes [25], D. Werner [47], M. Wessels [62a], A.M. Wharton [91], A.S. White [37], A. White [8], M.J. White [1], D. Whiteson [163], L. Wickremasinghe [126], W. Wiedenmann [173], M. Wielers [136], R. Wierda [148], C. Wiglesworth [42], H.G. Wilkens [37], J.J.H. Wilkinson [33], S. Williams [33], S. Willocq [103], D.J. Wilson [101], P.J. Windischhofer [39], F.I. Winkel [31], F. Winklmeier [125], B.T. Winter [53], M. Wittgen[147], M. Wobisch [97], T. Wojtkowski[59], Z. Wolffs [116], J. Wollrath[37], M.W. Wolter [86], H. Wolters [132a,132c], M.C. Wong[138], E.L. Woodward [41], S.D. Worm [47], B.K. Wosiek [86], K.A. Wozniak [55], K.W. Woźniak [86], S. Wozniewski [54], K. Wraight [58], C. Wu [159], C. Wu [21], J. Wu [157], M. Wu [112b], M. Wu [115], S.L. Wu [173], S. Wu [14,an], X. Wu [61], Y.Q. Wu [159], Y. Wu [61], Z. Wu [102], Z. Wu [112a], J. Wuerzinger [110], T.R. Wyatt [101], B.M. Wynne [51], S. Xella [42], L. Xia [112a], M. Xie [61], A. Xiong [125], I. Xiotidis [37], D. Xu [14], H. Xu [61], L. Xu [61], R. Xu [130], T. Xu [106], W. Xu[112a],

Y. Xu [141], Z. Xu [51], R. Xue [131], B. Yabsley [151], S. Yacoob [11], Y. Yamaguchi [82], E. Yamashita [157], H. Yamauchi [161], T. Yamazaki [18a], Y. Yamazaki [84], S. Yan [58], Z. Yan [103], C. Yang [18a], H.J. Yang [142a], H.T. Yang [61], S. Yang [61], X. Yang [37], X. Yang [14], Y. Yang [157], Y. Yang[61], W-M. Yao [18a], C.L. Yardley [150], J. Ye [14], S. Ye [30], X. Ye [61], I. Yeletskikh [38], B. Yeo [18b], M.R. Yexley [96], T.P. Yildirim [128], K. Yorita [171], C.J.S. Young [37], C. Young [147], I.N.L. Young [58], N.D. Young[125], Y. Yu [61], J. Yuan [14,112c,an], M. Yuan [106], R. Yuan [142b], L. Yue [96], M. Zaazoua [61], B. Zabinski [86], I. Zahir [36a], Q.U.A. Zahoor [51], A. Zaio[56b,56a], Z.K. Zak [86], T. Zakareishvili [166], S. Zambito [55], J. Zang [157], R. Zanzottera [70a,70b], O. Zaplatilek [134], E. Zaya [148], C. Zeitnitz [174], H. Zeng [14], D.T. Zenger Jr [27], T. Ženiš [29a], S. Zenz [94], D. Zerwas [65], W. Zhan [61], B. Zhang [170], D.F. Zhang [143], G. Zhang [14,an], J. Zhang [113b], J. Zhang [6], L. Zhang [61], L. Zhang [112a], P. Zhang [14,112c], R. Zhang [112a], S. Zhang [36e], Y. Zhang [141], Y. Zhang [96], Y. Zhang [61], Y. Zhang [112a], Z. Zhang [18a], Z. Zhang [113b], Z. Zhang [65], H. Zhao [141], T. Zhao [113b], Y. Zhao [35], Z. Zhao [61], Z. Zhao [61], A. Zhemchugov [38], J. Zheng [112a], K. Zheng [165], L. Zheng [113b], X. Zheng [61], Z. Zheng [147], D. Zhong [165], B. Zhou [106], B. Zhou [142b,142a], N. Zhou [142a], Y. Zhou [15], Y. Zhou [112a], Y. Zhou[7], Z. Zhou [61], J. Zhu [106], X. Zhu[142b], Y. Zhu [142a], X. Zhuang [14], K. Zhukov [67], P. Ziakas [4], N.I. Zimine [38], J. Zinsser [62b], M. Ziolkowski [145], L. Živković [16], A. Zoccoli [24b,24a], K. Zoch [37], A. Zografos [37], T.G. Zorbas [143], L. Zwalinski [37].

[1]Department of Physics, University of Adelaide, Adelaide; Australia.
[2]Department of Physics, University of Alberta, Edmonton AB; Canada.
[3(a)]Department of Physics, Ankara University, Ankara;[(b)]Division of Physics, TOBB University of Economics and Technology, Ankara; Türkiye.
[4]LAPP, Université Savoie Mont Blanc, CNRS/IN2P3, Annecy; France.
[5]APC, Université Paris Cité, CNRS/IN2P3, Paris; France.
[6]High Energy Physics Division, Argonne National Laboratory, Argonne IL; United States of America.
[7]Department of Physics, University of Arizona, Tucson AZ; United States of America.
[8]Department of Physics, University of Texas at Arlington, Arlington TX; United States of America.
[9]Physics Department, National and Kapodistrian University of Athens, Athens; Greece.
[10]Physics Department, National Technical University of Athens, Zografou; Greece.
[11]Department of Physics, University of Texas at Austin, Austin TX; United States of America.
[12]Institute of Physics, Azerbaijan Academy of Sciences, Baku; Azerbaijan.
[13]Institut de Física d'Altes Energies (IFAE), Barcelona Institute of Science and Technology, Barcelona; Spain.
[14]Institute of High Energy Physics, Chinese Academy of Sciences, Beijing; China.
[15]Physics Department, Tsinghua University, Beijing; China.
[16]Institute of Physics, University of Belgrade, Belgrade; Serbia.
[17]Department for Physics and Technology, University of Bergen, Bergen; Norway.
[18(a)]Physics Division, Lawrence Berkeley National Laboratory, Berkeley CA;[(b)]University of California, Berkeley CA; United States of America.
[19]Institut für Physik, Humboldt Universität zu Berlin, Berlin; Germany.
[20]Albert Einstein Center for Fundamental Physics and Laboratory for High Energy Physics, University of Bern, Bern; Switzerland.
[21]School of Physics and Astronomy, University of Birmingham, Birmingham; United Kingdom.
[22(a)]Department of Physics, Bogazici University, Istanbul;[(b)]Department of Physics Engineering, Gaziantep University, Gaziantep;[(c)]Department of Physics, Istanbul University, Istanbul; Türkiye.
[23(a)]Facultad de Ciencias y Centro de Investigaciónes, Universidad Antonio Nariño,

Bogotá;[(b)]Departamento de Física, Universidad Nacional de Colombia, Bogotá; Colombia.
[24(a)]Dipartimento di Fisica e Astronomia A. Righi, Università di Bologna, Bologna;[(b)]INFN Sezione di Bologna; Italy.
[25]Physikalisches Institut, Universität Bonn, Bonn; Germany.
[26]Department of Physics, Boston University, Boston MA; United States of America.
[27]Department of Physics, Brandeis University, Waltham MA; United States of America.
[28(a)]Transilvania University of Brasov, Brasov;[(b)]Horia Hulubei National Institute of Physics and Nuclear Engineering, Bucharest;[(c)]Department of Physics, Alexandru Ioan Cuza University of Iasi, Iasi;[(d)]National Institute for Research and Development of Isotopic and Molecular Technologies, Physics Department, Cluj-Napoca;[(e)]National University of Science and Technology Politechnica, Bucharest;[(f)]West University in Timisoara, Timisoara;[(g)]Faculty of Physics, University of Bucharest, Bucharest; Romania.
[29(a)]Faculty of Mathematics, Physics and Informatics, Comenius University, Bratislava;[(b)]Department of Subnuclear Physics, Institute of Experimental Physics of the Slovak Academy of Sciences, Kosice; Slovak Republic.
[30]Physics Department, Brookhaven National Laboratory, Upton NY; United States of America.
[31]Universidad de Buenos Aires, Facultad de Ciencias Exactas y Naturales, Departamento de Física, y CONICET, Instituto de Física de Buenos Aires (IFIBA), Buenos Aires; Argentina.
[32]California State University, CA; United States of America.
[33]Cavendish Laboratory, University of Cambridge, Cambridge; United Kingdom.
[34(a)]Department of Physics, University of Cape Town, Cape Town;[(b)]iThemba Labs, Western Cape;[(c)]Department of Mechanical Engineering Science, University of Johannesburg, Johannesburg;[(d)]National Institute of Physics, University of the Philippines Diliman (Philippines);[(e)]Department of Physics, Stellenbosch University, Matieland;[(f)]University of KwaZulu-Natal, School of Agriculture and Science, Mathematics, Westville;[(g)]University of South Africa, Department of Physics, Pretoria;[(h)]University of Pretoria, Department of Mechanical and Aeronautical Engineering, Pretoria;[(i)]University of Zululand, KwaDlangezwa;[(j)]School of Physics, University of the Witwatersrand, Johannesburg; South Africa.
[35]Department of Physics, Carleton University, Ottawa ON; Canada.
[36(a)]Faculté des Sciences Ain Chock, Université Hassan II de Casablanca;[(b)]Faculté des Sciences, Université Ibn-Tofail, Kénitra;[(c)]Faculté des Sciences Semlalia, Université Cadi Ayyad, LPHEA-Marrakech;[(d)]LPMR, Faculté des Sciences, Université Mohamed Premier, Oujda;[(e)]Faculté des sciences, Université Mohammed V, Rabat;[(f)]Institute of Applied Physics, Mohammed VI Polytechnic University, Ben Guerir; Morocco.
[37]CERN, Geneva; Switzerland.
[38]Affiliated with an international laboratory covered by a cooperation agreement with CERN.
[39]Enrico Fermi Institute, University of Chicago, Chicago IL; United States of America.
[40]LPC, Université Clermont Auvergne, CNRS/IN2P3, Clermont-Ferrand; France.
[41]Nevis Laboratory, Columbia University, Irvington NY; United States of America.
[42]Niels Bohr Institute, University of Copenhagen, Copenhagen; Denmark.
[43(a)]Dipartimento di Fisica, Università della Calabria, Rende;[(b)]INFN Gruppo Collegato di Cosenza, Laboratori Nazionali di Frascati; Italy.
[44]Physics Department, Southern Methodist University, Dallas TX; United States of America.
[45]National Centre for Scientific Research "Demokritos", Agia Paraskevi; Greece.
[46(a)]Department of Physics, Stockholm University;[(b)]Oskar Klein Centre, Stockholm; Sweden.
[47]Deutsches Elektronen-Synchrotron DESY, Hamburg and Zeuthen; Germany.
[48]Fakultät Physik, Technische Universität Dortmund, Dortmund; Germany.
[49]Institut für Kern- und Teilchenphysik, Technische Universität Dresden, Dresden; Germany.

[50]Department of Physics, Duke University, Durham NC; United States of America.
[51]SUPA - School of Physics and Astronomy, University of Edinburgh, Edinburgh; United Kingdom.
[52]INFN e Laboratori Nazionali di Frascati, Frascati; Italy.
[53]Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, Freiburg; Germany.
[54]II. Physikalisches Institut, Georg-August-Universität Göttingen, Göttingen; Germany.
[55]Département de Physique Nucléaire et Corpusculaire, Université de Genève, Genève; Switzerland.
[56(a)]Dipartimento di Fisica, Università di Genova, Genova;[(b)]INFN Sezione di Genova; Italy.
[57]II. Physikalisches Institut, Justus-Liebig-Universität Giessen, Giessen; Germany.
[58]SUPA - School of Physics and Astronomy, University of Glasgow, Glasgow; United Kingdom.
[59]LPSC, Université Grenoble Alpes, CNRS/IN2P3, Grenoble INP, Grenoble; France.
[60]Laboratory for Particle Physics and Cosmology, Harvard University, Cambridge MA; United States of America.
[61]Department of Modern Physics and State Key Laboratory of Particle Detection and Electronics, University of Science and Technology of China, Hefei; China.
[62(a)]Kirchhoff-Institut für Physik, Ruprecht-Karls-Universität Heidelberg, Heidelberg;[(b)]Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg; Germany.
[63(a)]Department of Physics, Chinese University of Hong Kong, Shatin, N.T., Hong Kong;[(b)]Department of Physics, University of Hong Kong, Hong Kong;[(c)]Department of Physics and Institute for Advanced Study, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong; China.
[64]Department of Physics, National Tsing Hua University, Hsinchu; Taiwan.
[65]IJCLab, Université Paris-Saclay, CNRS/IN2P3, 91405, Orsay; France.
[66]Centro Nacional de Microelectrónica (IMB-CNM-CSIC), Barcelona; Spain.
[67]Department of Physics, Indiana University, Bloomington IN; United States of America.
[68(a)]INFN Gruppo Collegato di Udine, Sezione di Trieste, Udine;[(b)]ICTP, Trieste;[(c)]Dipartimento Politecnico di Ingegneria e Architettura, Università di Udine, Udine; Italy.
[69(a)]INFN Sezione di Lecce;[(b)]Dipartimento di Matematica e Fisica, Università del Salento, Lecce; Italy.
[70(a)]INFN Sezione di Milano;[(b)]Dipartimento di Fisica, Università di Milano, Milano; Italy.
[71(a)]INFN Sezione di Napoli;[(b)]Dipartimento di Fisica, Università di Napoli, Napoli; Italy.
[72(a)]INFN Sezione di Pavia;[(b)]Dipartimento di Fisica, Università di Pavia, Pavia; Italy.
[73(a)]INFN Sezione di Pisa;[(b)]Dipartimento di Fisica E. Fermi, Università di Pisa, Pisa; Italy.
[74(a)]INFN Sezione di Roma;[(b)]Dipartimento di Fisica, Sapienza Università di Roma, Roma; Italy.
[75(a)]INFN Sezione di Roma Tor Vergata;[(b)]Dipartimento di Fisica, Università di Roma Tor Vergata, Roma; Italy.
[76(a)]INFN Sezione di Roma Tre;[(b)]Dipartimento di Matematica e Fisica, Università Roma Tre, Roma; Italy.
[77(a)]INFN-TIFPA;[(b)]Università degli Studi di Trento, Trento; Italy.
[78]Universität Innsbruck, Department of Astro and Particle Physics, Innsbruck; Austria.
[79]Department of Physics and Astronomy, Iowa State University, Ames IA; United States of America.
[80]Istinye University, Sariyer, Istanbul; Türkiye.
[81(a)]Departamento de Engenharia Elétrica, Universidade Federal de Juiz de Fora (UFJF), Juiz de Fora;[(b)]Universidade Federal do Rio De Janeiro COPPE/EE/IF, Rio de Janeiro;[(c)]Instituto de Física, Universidade de São Paulo, São Paulo;[(d)]Rio de Janeiro State University, Rio de Janeiro;[(e)]Federal University of Bahia, Bahia; Brazil.
[82]KEK, High Energy Accelerator Research Organization, Tsukuba; Japan.
[83(a)]Khalifa University of Science and Technology, Abu Dhabi;[(b)]University of Sharjah, Sharjah; United Arab Emirates.
[84]Graduate School of Science, Kobe University, Kobe; Japan.

[85] [(a)] AGH University of Krakow, Faculty of Physics and Applied Computer Science, Krakow; [(b)] Marian Smoluchowski Institute of Physics, Jagiellonian University, Krakow; Poland.
[86] Institute of Nuclear Physics Polish Academy of Sciences, Krakow; Poland.
[87] Faculty of Science, Kyoto University, Kyoto; Japan.
[88] Research Center for Advanced Particle Physics and Department of Physics, Kyushu University, Fukuoka ; Japan.
[89] L2IT, Université de Toulouse, CNRS/IN2P3, UPS, Toulouse; France.
[90] Instituto de Física La Plata, Universidad Nacional de La Plata and CONICET, La Plata; Argentina.
[91] Physics Department, Lancaster University, Lancaster; United Kingdom.
[92] Oliver Lodge Laboratory, University of Liverpool, Liverpool; United Kingdom.
[93] Department of Experimental Particle Physics, Jožef Stefan Institute and Department of Physics, University of Ljubljana, Ljubljana; Slovenia.
[94] Department of Physics and Astronomy, Queen Mary University of London, London; United Kingdom.
[95] Department of Physics, Royal Holloway University of London, Egham; United Kingdom.
[96] Department of Physics and Astronomy, University College London, London; United Kingdom.
[97] Louisiana Tech University, Ruston LA; United States of America.
[98] Fysiska institutionen, Lunds universitet, Lund; Sweden.
[99] Departamento de Física Teorica C-15 and CIAFF, Universidad Autónoma de Madrid, Madrid; Spain.
[100] Institut für Physik, Universität Mainz, Mainz; Germany.
[101] School of Physics and Astronomy, University of Manchester, Manchester; United Kingdom.
[102] CPPM, Aix-Marseille Université, CNRS/IN2P3, Marseille; France.
[103] Department of Physics, University of Massachusetts, Amherst MA; United States of America.
[104] Department of Physics, McGill University, Montreal QC; Canada.
[105] School of Physics, University of Melbourne, Victoria; Australia.
[106] Department of Physics, University of Michigan, Ann Arbor MI; United States of America.
[107] Department of Physics and Astronomy, Michigan State University, East Lansing MI; United States of America.
[108] Group of Particle Physics, University of Montreal, Montreal QC; Canada.
[109] Fakultät für Physik, Ludwig-Maximilians-Universität München, München; Germany.
[110] Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München; Germany.
[111] Graduate School of Science and Kobayashi-Maskawa Institute, Nagoya University, Nagoya; Japan.
[112] [(a)] Department of Physics, Nanjing University, Nanjing; [(b)] School of Science, Shenzhen Campus of Sun Yat-sen University; [(c)] University of Chinese Academy of Science (UCAS), Beijing; China.
[113] [(a)] School of Physics, Nankai University, Tianjin; [(b)] Institute of Frontier and Interdisciplinary Science and Key Laboratory of Particle Physics and Particle Irradiation (MOE), Shandong University, Qingdao; [(c)] School of Physics, Zhengzhou University; China.
[114] Department of Physics and Astronomy, University of New Mexico, Albuquerque NM; United States of America.
[115] Institute for Mathematics, Astrophysics and Particle Physics, Radboud University/Nikhef, Nijmegen; Netherlands.
[116] Nikhef National Institute for Subatomic Physics and University of Amsterdam, Amsterdam; Netherlands.
[117] Department of Physics, Northern Illinois University, DeKalb IL; United States of America.
[118] [(a)] New York University Abu Dhabi, Abu Dhabi; [(b)] United Arab Emirates University, Al Ain; United Arab Emirates.
[119] Department of Physics, New York University, New York NY; United States of America.
[120] Ochanomizu University, Otsuka, Bunkyo-ku, Tokyo; Japan.

[121]Ohio State University, Columbus OH; United States of America.
[122]Homer L. Dodge Department of Physics and Astronomy, University of Oklahoma, Norman OK; United States of America.
[123]Department of Physics, Oklahoma State University, Stillwater OK; United States of America.
[124]Palacký University, Joint Laboratory of Optics, Olomouc; Czech Republic.
[125]Institute for Fundamental Science, University of Oregon, Eugene, OR; United States of America.
[126]Graduate School of Science, University of Osaka, Osaka; Japan.
[127]Department of Physics, University of Oslo, Oslo; Norway.
[128]Department of Physics, Oxford University, Oxford; United Kingdom.
[129]LPNHE, Sorbonne Université, Université Paris Cité, CNRS/IN2P3, Paris; France.
[130]Department of Physics, University of Pennsylvania, Philadelphia PA; United States of America.
[131]Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh PA; United States of America.
[132][(a)]Laboratório de Instrumentação e Física Experimental de Partículas - LIP, Lisboa;[(b)]Departamento de Física, Faculdade de Ciências, Universidade de Lisboa, Lisboa;[(c)]Departamento de Física, Universidade de Coimbra, Coimbra;[(d)]Centro de Física Nuclear da Universidade de Lisboa, Lisboa;[(e)]Departamento de Física, Escola de Ciências, Universidade do Minho, Braga;[(f)]Departamento de Física Teórica y del Cosmos, Universidad de Granada, Granada (Spain);[(g)]Departamento de Física, Instituto Superior Técnico, Universidade de Lisboa, Lisboa; Portugal.
[133]Institute of Physics of the Czech Academy of Sciences, Prague; Czech Republic.
[134]Czech Technical University in Prague, Prague; Czech Republic.
[135]Charles University, Faculty of Mathematics and Physics, Prague; Czech Republic.
[136]Particle Physics Department, Rutherford Appleton Laboratory, Didcot; United Kingdom.
[137]IRFU, CEA, Université Paris-Saclay, Gif-sur-Yvette; France.
[138]Santa Cruz Institute for Particle Physics, University of California Santa Cruz, Santa Cruz CA; United States of America.
[139][(a)]Departamento de Física, Pontificia Universidad Católica de Chile, Santiago;[(b)]Millennium Institute for Subatomic physics at high energy frontier (SAPHIR), Santiago;[(c)]Instituto de Investigación Multidisciplinario en Ciencia y Tecnología, y Departamento de Física, Universidad de La Serena;[(d)]Universidad Andres Bello, Department of Physics, Santiago;[(e)]Universidad San Sebastian, Recoleta;[(f)]Instituto de Alta Investigación, Universidad de Tarapacá, Arica;[(g)]Departamento de Física, Universidad Técnica Federico Santa María, Valparaíso; Chile.
[140]Department of Physics, Institute of Science, Tokyo; Japan.
[141]Department of Physics, University of Washington, Seattle WA; United States of America.
[142][(a)]State Key Laboratory of Dark Matter Physics, School of Physics and Astronomy, Shanghai Jiao Tong University, Key Laboratory for Particle Astrophysics and Cosmology (MOE), SKLPPC, Shanghai;[(b)]State Key Laboratory of Dark Matter Physics, Tsung-Dao Lee Institute, Shanghai Jiao Tong University, Shanghai; China.
[143]Department of Physics and Astronomy, University of Sheffield, Sheffield; United Kingdom.
[144]Department of Physics, Shinshu University, Nagano; Japan.
[145]Department Physik, Universität Siegen, Siegen; Germany.
[146]Department of Physics, Simon Fraser University, Burnaby BC; Canada.
[147]SLAC National Accelerator Laboratory, Stanford CA; United States of America.
[148]Department of Physics, Royal Institute of Technology, Stockholm; Sweden.
[149]Departments of Physics and Astronomy, Stony Brook University, Stony Brook NY; United States of America.
[150]Department of Physics and Astronomy, University of Sussex, Brighton; United Kingdom.

[151]School of Physics, University of Sydney, Sydney; Australia.
[152]Institute of Physics, Academia Sinica, Taipei; Taiwan.
[153(a)]E. Andronikashvili Institute of Physics, Iv. Javakhishvili Tbilisi State University, Tbilisi;[(b)]High Energy Physics Institute, Tbilisi State University, Tbilisi;[(c)]University of Georgia, Tbilisi; Georgia.
[154]Department of Physics, Technion, Israel Institute of Technology, Haifa; Israel.
[155]Raymond and Beverly Sackler School of Physics and Astronomy, Tel Aviv University, Tel Aviv; Israel.
[156]Department of Physics, Aristotle University of Thessaloniki, Thessaloniki; Greece.
[157]International Center for Elementary Particle Physics and Department of Physics, University of Tokyo, Tokyo; Japan.
[158]Graduate School of Science and Technology, Tokyo Metropolitan University, Tokyo; Japan.
[159]Department of Physics, University of Toronto, Toronto ON; Canada.
[160(a)]TRIUMF, Vancouver BC;[(b)]Department of Physics and Astronomy, York University, Toronto ON; Canada.
[161]Division of Physics and Tomonaga Center for the History of the Universe, Faculty of Pure and Applied Sciences, University of Tsukuba, Tsukuba; Japan.
[162]Department of Physics and Astronomy, Tufts University, Medford MA; United States of America.
[163]Department of Physics and Astronomy, University of California Irvine, Irvine CA; United States of America.
[164]Department of Physics and Astronomy, University of Uppsala, Uppsala; Sweden.
[165]Department of Physics, University of Illinois, Urbana IL; United States of America.
[166]Instituto de Física Corpuscular (IFIC), Centro Mixto Universidad de Valencia - CSIC, Valencia; Spain.
[167]Department of Physics, University of British Columbia, Vancouver BC; Canada.
[168]Department of Physics and Astronomy, University of Victoria, Victoria BC; Canada.
[169]Fakultät für Physik und Astronomie, Julius-Maximilians-Universität Würzburg, Würzburg; Germany.
[170]Department of Physics, University of Warwick, Coventry; United Kingdom.
[171]Waseda University, Tokyo; Japan.
[172]Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot; Israel.
[173]Department of Physics, University of Wisconsin, Madison WI; United States of America.
[174]Fakultät für Mathematik und Naturwissenschaften, Fachgruppe Physik, Bergische Universität Wuppertal, Wuppertal; Germany.
[175]Department of Physics, Yale University, New Haven CT; United States of America.
[176]Yerevan Physics Institute, Yerevan; Armenia.
[a] Also at Affiliated with an institute formerly covered by a cooperation agreement with CERN.
[b] Also at An-Najah National University, Nablus; Palestine.
[c] Also at Borough of Manhattan Community College, City University of New York, New York NY; United States of America.
[d] Also at Center for Interdisciplinary Research and Innovation (CIRI-AUTH), Thessaloniki; Greece.
[e] Also at Centre of Physics of the Universities of Minho and Porto (CF-UM-UP); Portugal.
[f] Also at CERN, Geneva; Switzerland.
[g] Also at Département de Physique Nucléaire et Corpusculaire, Université de Genève, Genève; Switzerland.
[h] Also at Departament de Fisica de la Universitat Autonoma de Barcelona, Barcelona; Spain.
[i] Also at Department of Financial and Management Engineering, University of the Aegean, Chios; Greece.
[j] Also at Department of Modern Physics and State Key Laboratory of Particle Detection and Electronics, University of Science and Technology of China, Hefei; China.
[k] Also at Department of Physics, Ben Gurion University of the Negev, Beer Sheva; Israel.
[l] Also at Department of Physics, Bolu Abant Izzet Baysal University, Bolu; Türkiye.

[m] Also at Department of Physics, King's College London, London; United Kingdom.
[n] Also at Department of Physics, Stellenbosch University; South Africa.
[o] Also at Department of Physics, University of Fribourg, Fribourg; Switzerland.
[p] Also at Department of Physics, University of Thessaly; Greece.
[q] Also at Department of Physics, Westmont College, Santa Barbara; United States of America.
[r] Also at Faculty of Physics, Sofia University, 'St. Kliment Ohridski', Sofia; Bulgaria.
[s] Also at Faculty of Physics, University of Bucharest; Romania.
[t] Also at Hellenic Open University, Patras; Greece.
[u] Also at Henan University; China.
[v] Also at Imam Mohammad Ibn Saud Islamic University; Saudi Arabia.
[w] Also at Indian Institute of Technology (IIT), Jodhpur; India.
[x] Also at Institucio Catalana de Recerca i Estudis Avancats, ICREA, Barcelona; Spain.
[y] Also at Institut für Experimentalphysik, Universität Hamburg, Hamburg; Germany.
[z] Also at Institute for Nuclear Research and Nuclear Energy (INRNE) of the Bulgarian Academy of Sciences, Sofia; Bulgaria.
[aa] Also at Institute of Applied Physics, Mohammed VI Polytechnic University, Ben Guerir; Morocco.
[ab] Also at Institute of Particle Physics (IPP); Canada.
[ac] Also at Institute of Physics and Technology, Mongolian Academy of Sciences, Ulaanbaatar; Mongolia.
[ad] Also at Institute of Physics, Azerbaijan Academy of Sciences, Baku; Azerbaijan.
[ae] Also at Institute of Theoretical Physics, Ilia State University, Tbilisi; Georgia.
[af] Also at Millennium Institute for Subatomic physics at high energy frontier (SAPHIR), Santiago; Chile.
[ag] Also at National Institute of Physics, University of the Philippines Diliman (Philippines); Philippines.
[ah] Also at School of Physics, University of the Witwatersrand, Johannesburg; South Africa.
[ai] Also at The Collaborative Innovation Center of Quantum Matter (CICQM), Beijing; China.
[aj] Also at TRIUMF, Vancouver BC; Canada.
[ak] Also at Università di Napoli Parthenope, Napoli; Italy.
[al] Also at Universita degli Studi Link; Italy.
[am] Also at University and INFN Torino, Torino; Italy.
[an] Also at University of Chinese Academy of Sciences (UCAS), Beijing; China.
[ao] Also at University of Colorado Boulder, Department of Physics, Colorado; United States of America.
[ap] Also at University of Siena; Italy.
[aq] Also at Washington College, Chestertown, MD; United States of America.
[ar] Also at Yeditepe University, Physics Department, Istanbul; Türkiye.
[*] Deceased