The DESY II Testbeam Facility

5th Beam Telescopes and Test Beams Workshop 2017, Barcelona
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DESY Testbeam Facility

- Facility fed by DESY II synchrotron
- Three thin, internal carbon fiber targets generate bremsstrahlung photons
- Conversion at target to $e^+/e^-$ with energies up to 6 GeV
- Rates depend on beam line, energy, target, collimation
- Very high availability (~99% uptime)

- Three individual beam lines, controlled by the user
  - Shutter, area interlock
  - Select particle momentum/collimation
Infrastructure

• All the useful things:
  • 30 kg and 1 ton stages
  • 25 t crane
  • Patch panels: Ethernet, optical fiber, BNC, S-HV
  • IP cameras, dry nitrogen
  • Gas setup (incl. flammable gas)
  • Dipole magnet in TB 21
  • Superconducting solenoid (1 T)
    • Usable diameter ~ 75 cm
    • Wall: 0.2 $X_0$
    • Mounted on movable stage
Pixel Beam Telescopes

- Complete Package:
  - Hardware, trigger, software
- Using MAPS pixel planes
  - 6 Layers, 1 x 2 cm$^2$ size
  - 18 μm pixel pitch
- Dedicated stages to move/rotate Devices-under-test (DUT)
- Both Arms adjustable for different DUTs
- Trigger rates up to 3 kHz
- Few micron tracking resolution
- Dedicated support crew
- High demand: requested by ~ 70% of users in 2016
2016

• Run 2016
  • March 14th -December 23\textsuperscript{rd}
  • 105 weeks available, 67 allocated
  • 66 % booked, 30 % all beam lines used
  • 49 % from LHC groups
  • 292 Users from 21 countries
    • 67 % Germany,
      15 % other EU
      18 % outside the EU
  • 37 % new users, 47 % students

• Highlights
  • Belle II tracking system test with 66 Users
  • First Time: Physics teachers training
- Operation starts Feb. 13
- Belle II already in setup phase
- Shutdown in July/August for 4 weeks
- Beam until Dec. 22
- So far: 44 weeks requested by 24 groups
  - ~ 75 % LHC, ~ 80 % telescope
- AIDA2020
  - Common slow control for environmental conditions (temperature, humidity, ...)
  - Large area strip beam telescope inside PCMAG 1T solenoid

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4th Beam Line

- Current beam lines well used, but sufficient → additional of this type not needed

- Under study: 4th beam line using DESY beam directly (∼10^{10} e⁻/bunch, 12.5 Hz)

- Electrons with max DESY II energy and/or high intensity
  - Studies with 6.3 GeV beam, high intensities (100 kHz or more)
  - Fan out + collimation: 10^{10} to 100 electrons/cm²
  - User communities: HL-LHC, Pixel detectors

- Pion/muon beam (beryllium target): up to 4 GeV / O(10) pions per bunch
  - Extended test possibilities: hadronic calorimetry and particle identification
  - User communities: calorimeter & PID detectors

- Electromagnetic irradiation (∼ 10 X₀ tungsten target)
  - Intensive electromagnetic shower of electrons and photons with E < 1 GeV
  - User communities: beam instrumentation, space flight
4th Beam Line

- No influence on DESY II operations
- Uses only dumped beam
- Extraction and beam line already installed (former transport line to DORIS)
- Needed
  - Small building incl. shielding/interlock
  - Magnets, collimator, targets, instrumentation, ...
- Studies to establish the full feasibility
- Workshop planned for summer 2017
  - Demand and requirements of user communities
  - More details of planning
- Subscribe to testbeam-info mailing list
Information, Contact, Scientific Accounting

- More information available on: http://testbeam.desy.de
- Annual calls for testbeam time and other information (free slots etc.): Subscribe to testbeam-info mailing list
- AIDA2020 transnational access possible
- Contact over web page link or via: testbeam-coor@desy.de
- Acknowledging the use of the facility: The measurements leading to these results have been performed at the Test Beam Facility at DESY Hamburg (Germany), a member of the Helmholtz Association (HGF)
- Scientific Accounting
  - We need to keep track of talks, proceedings, papers that have used the DESY testbeam
  - Please provide the necessary information
Summary

- DESY II testbeam facility
  - 3 beam lines with 1 to 6 GeV electrons/positrons, controlled by the users
  - Very high availability, open to the entire community
  - Infrastructure: Test beam telescopes, 1T solenoid and dipole magnet

- Schedule
  - 2016/17 winter shutdown ongoing till Feb. 13
  - This year 4 week summer shutdown (July)
  - Operation till Christmas 2017

- Studies for 4th beam line offering new possibilities
  - Dedicated workshop planned for summer 2017

Acknowledgements: The DESY testbeam setup is / has been supported by: European Commission / Union (6th Framework Programme “Structuring the European Research Area”, contract number RII3-026126, FP7 Research Infrastructures project AIDA, grant agreement no. 262025, H2020 project AIDA-2020, GA no. 654168), JSPS KAKENHI Grant Number 23000002
Additional information
DESY II

- Radius: 46.601 m (circumference is 292.8 m)
- Bunch of about $10^{10}$ (electrons or positrons) injected from LINAC at 450 MeV
- Acceleration by eight 7-cell PETRA-type cavities
- Revolution frequency is 1 MHz, bunch length around 30 ps
- Acceleration/deceleration in sinusoidal mode; frequency of 12.5 Hz (cycle: 80 ms)
- Today: DESY II runs as pre-accelerator for PETRA
- Usual running conditions: acceleration to 6.3 GeV (maximum 7 GeV)
- Extraction for PETRA every minute at 6.0 GeV
The DESY II Testbeam Facility, 5th BTTB, 25.01.2017

DESY Synchrotron

- 1964-1979:
  - DESY I runs with electrons at up to 7 GeV

- 1974-1986:
  - DESY delivers electrons/positrons for DORIS (3 GeV)

- 1976-1986:
  - Pre-accelerator for PETRA

- 1985: first run tests of DESY II
  (electrons beam up to 10 GeV)

- 1986: DESY I switched off and converted into proton synchrotron DESY III

- 1987: DESY II takes over and delivers beam to DORIS (→2013), PETRA and the testbeam area

- Runs with an availability of 99% in automatic operation

- “DESY II is assigned to deliver beam quietly without fanfare. This challenge has been completely and continuously fulfilled.” from: “25 years DESY II beam operation”
Testbeam Rates

- Rates depend on beam line, energy, target material, collimator setting and DESY II beam energy / filling
Beam Generation

- Three thin, internal carbon fiber targets generate bremsstrahlung photons
- Conversion at target to $e^+/e^-$ with energies up to 6 GeV
- Beam momentum steered by magnet current