Annual Report

Funding Programme:	Helmholtz Young Investigators Groups
Project ID No.:	VH-NG-1202
Project Title:	Identifying the Sources of High-Energy Neutrinos with Multi-Messenger Observations
Group Leader:	Dr. Anna Franckowiak
Helmholtz Centre:	DESY, Zeuthen
Participating University:	Humboldt University Berlin
Report Period (=Calendar Year):	01/2017-12/2017

1) Group Structure

Please report briefly on the structure and personnel development of your group.

Robert Stein started as a PhD student in July 2017.
Dr. Ludwig Rauch started as a postdoc in August 2017.
Simone Garrappa started as a PhD student in February 2018.

2) Network

Please describe how you / your research group are integrated within the Helmholtz Centre and the partner university (e.g. as member of committees).

All group members participate actively in the weekly group meeting of the IceCube group and we have a weekly meeting with the supernova cosmology group at Humboldt University, with whom we have a fruitful collaboration on developing software for the optical survey ZTF.

3) Satisfaction

How satisfied are you with the general working conditions provided by the Helmholtz Centre / partner university? Is there anything that meets your criticism?

I am very satisfied with the general working conditions provided by DESY and Humboldt University.

4) Scientific Progress / Milestones

How has your work plan progressed? Which important milestones could be achieved during the report period? Is the progress of your work in accordance with original planning or has the work plan been changed?

The work plan is progressing very well. More details are listed below following the structure of the work plan.

WP1 Real-time neutrino analysis
WP1.1 Online event reconstruction and trigger algorithm
Robert Stein and Simone Garrappa get trained as IceCube real-time shifters to be able to react to future alerts quickly.
WP1.2 Extension of the follow-up observatory network
The group leader joined the ASAS-SN collaboration, which gives all group members access to their optical survey data. ASAS-SN telescopes started to follow-up on IceCube high-energy neutrinos in real-time. One alert was observed 37 seconds after it was received, including scheduling the observation and slewing the telescope. Robert Stein works on transferring the ASAS-SN data to DESY.

WP2: Discovery and identification of optical transients with ZTF

The optical survey telescope Zwicky Transient Facility (ZTF) started data taking in engineering mode. A first neutrino alert could be followed up through manual scheduling and data processing during the engineering run. Software development to follow-up future neutrino alerts automatically and cross-correlate optical transients with a real-time stream of IceCube neutrinos is ongoing and lead by Ludwig Rauch. Ludwig Rauch attended the Global Relay of Watching Transients Happen (GROWTH) conference in Oct. 2017 in Milwaukee, where he presented the plans for the neutrino follow-up with ZTF and established a network with optical astronomers.
A new server machine was purchased to handle the incoming data flow from ZTF to DESY.

WP3 Stacking analysis using archival multi-wavelength data sets
Robert Stein develops a tool for time-dependent neutrino stacking analysis. He compares a preliminary version of the code with the SkyLab tool used in the IceCube collaboration for time-integrated analyses.
WP3.1 Search for neutrinos from SNe
Robert Stein works on compiling a list of superluminous supernovae from the literature as an input to a time-dependent stacking. Simone Garrappa investigated gamma-ray emission from the supernova iPTF14hls and prepares a search for neutrinos from this search.
WP3.2 Search for neutrinos from AGN flares
For the first time a flaring gamma-ray blazar could be identified as a potential neutrino counterpart at 3 sigma confidence. The group worked on the optical and gamma-ray follow-up of this event as well as on the statistical analysis estimating the chance coincidence of the two events. The results were submitted to Science.
Simone Garrappa started working on a follow-up analysis of that source.
WP3.3 Search for neutrinos from TDEs
Robert Stein attended a TDE conference in Aspen in January 2018, where he received useful input for the compilation of a TDE catalog as input for a search for high-energy neutrinos from TDEs.

5) Financial Plan / Time Schedule
Can you comply with the financial plan and time schedule or do you see a need for adjustment?

Compared to the time schedule the first PhD student and postdoc started 7/8 months late, because the hiring process took some time and both had to finish their previous appointment or graduate first. This will slightly move the time schedule.

6) Status
Do you hold a joint Junior Professorship or a W2/W3 Professorship? Do you aim for such a position? What is the status of your negotiations in this respect?

I do currently not hold a professorship position. I am interested in a Junior Professorship at HU and I am discussing this option with my host scientist at HU.

7) Teaching Activities of the Group Leader

The group leader taught the following courses at HU Berlin:
In the summer semester: “Bahnbrechende Experimente der Teilchen- und Astroteilchenphysik” and “Research Seminar”
in the winter semester: “Übungen zur Kern- und Teilchenphysik”

8) Publications of the Group

“Search for gamma-ray emission from Galactic Novae”, A. Franckowiak et al., A&A, 609, A120, 2018
“Multiwavelength follow-up of a rare IceCube neutrino multiplet”, M.G. Aartsen et al. (IceCube Collaboration), A&A 607, A115 (2017)

9) External Funding

No external funding was received

10) Patent Applications *No. of pending/granted patents*
Not applicable
11) Awards received by Group Members / Professorship Appointments offered to Group Leader
The group leader was offered the Analysis Coordinator position in the Fermi-LAT collaboration, but declined the offer because it would have required a 1year stay at NASA's Goddard Space Flight Center, which was not compatible with leading a group at DESY.