

Balzan Fellowship for a Postdoctoral Researcher

Francis Halzen

**2015 Balzan Prize for Astroparticle Physics
including neutrino and gamma-ray observation**

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Balzan Fellow: Daan Van Eijk

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Period: 2016-2019

Francis Halzen is Hildale and Gregory Breit Distinguished Professor at the University of Wisconsin-Madison and Director of its Institute for Elementary Particle Physics.

The Wisconsin IceCube Particle Astrophysics Center (WIPAC) at the University of Wisconsin-Madison has created the Balzan Fellowship for an outstanding postdoctoral candidate to work with the IceCube neutrino experiment, with special emphasis on future technologies and/or multi-wavelength campaigns to advance the future of neutrino astronomy.

The IceCube Neutrino Observatory is the first detector of its kind, designed to observe the cosmos from deep within the South Pole ice. It does so by recording the interactions of a nearly massless subatomic particle called the neutrino. IceCube is also the world's largest neutrino detector, encompassing a cubic kilometre of ice. The neutrinos come from the most violent astrophysical sources, like exploding stars, gamma-ray bursts, and cataclysmic phenomena involving black holes and neutron stars. Thus, the IceCube telescope is a powerful tool to search for dark matter, and could reveal the physical processes associated with the enigmatic origin of the highest energy particles in nature. Moreover, by exploring the background of neutrinos produced in the atmosphere, IceCube studies the neutrinos themselves; their energies far exceed those produced by accelerator beams.

After an extensive international search, Daan Van Eijk was selected as the Balzan Fellow. Van Eijk was previously employed as a scientist at NIKHEF, Amsterdam, as coordinator of the integration of KM3NeT digital optical modules. The DOM, which is shorthand for digital optical module, is the basic detection element of the KM3NeT neutrino detector. Van Eijk is a member of the KM3NeT Steering Committee. He contributes to the commissioning and data analysis of the first deployed DOMs, and his goal is to eventually work on the KM3NeT physics program to determine the neutrino mass hierarchy using atmospheric neutrino oscillations. His PhD research was performed at CERN, studying CP-violating decays using data from the LHC-B detector.

Van Eijk joined WIPAC in July 2017. Before taking up his position, his research program was planned and KM3NeT was under construction in the Mediterranean. Like IceCube, KM3NeT is a kilometer-scale neutrino detector, but the design of its photosensors is different. The same design is now being considered for the next-generation IceCube detector, and Van Eijk's expertise will be valuable for future decisions on sensors.

Telescopes evolve. AMANDA, an experiment preceding IceCube, provided proof of concept for a kilometer-scale detector by observing atmospheric neutrinos using natural ice as a particle detector. IceCube's discovery of a large flux of cosmic neutrinos has triggered the development of a next-generation instrument capable of observing thousands rather than hundreds of events in several years. It would turn discovery into astronomy. The experience gained with IceCube has augmented the capability to instrument a ten-times-larger volume of ice on a budget similar to the one for IceCube. Daan Van Eijk presently participates in completing the design of the instrument. He has already completed an extensive study of novel photomultipliers that are considered for the next-generation detector. A publication covering the research is in preparation. In the same context, novel technologies that do not necessarily involve the IceCube technique will also be researched, such as radio detectors and horizontal cosmic ray air shower arrays. With Van Eijk as a Balzan fellow at the lead institution of the IceCube project, there are hopes to further the excellent support and coordination that characterize the current collaboration between the IceCube and the European KM3NeT.