SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Elementary Particle Physics

has the honor to invite you to the public defense of the PhD thesis of

Gwenhaël DE WASSEIGE

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Solar Flare Neutrinos in the Multi-Messenger Era: Flux Calculations and a Search with the IceCube Neutrino observatory

Promotor:

Prof. Nick van Eijndhoven

The defence will take place on

Tuesday July 24 2018 at 16:00h

in Auditorium D.2.01 at the Campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, and will be followed by a reception.

Members of the jury:

Prof. Jorgen D'Hondt (chairman)
Prof. Stijn Buitink (secretary)
Prof. Kael Hanson
(co-promotor, Univ. of Wisconsin, Madison, USA)
Prof. Petra Van Mulders
Prof. Dominique Maes
Prof. Markus Ahlers (NBI, Copenhagen, Denmark)
Prof. Melissa Pesce-Rollins
(INFN, Sezione di Pisa, Italy)

Curriculum vitae

After obtaining her master degree at the Université Libre de Bruxelles, Gwenhaël de Wasseige started her PhD studies in the IceCube group of the VUB, working jointly with the University of Wisconsin, Madison, USA. In parallel to her PhD research, Gwenhaël had the opportunity to work on several other projects, including instrumentation at the South Pole, phenomenological projects coupling gravitational waves and neutrinos, as well as solar atmospheric neutrinos. She was also actively involved in dissemination and communication and was awarded one of the 2017 science communication prizes of the Royal Flemish Academy of Belgium for Science and the Arts as well as a young speaker award from the Belgian Physical Society.

Abstract of the PhD research

At the end of the eighties, the Homestake Collaboration has reported an increase in the total neutrino flux in coincidence with solar flares. Consequently, solar neutrino detectors have searched for solar flare signals but none of the searches were successful.

We demonstrated that solar flare neutrinos, coming from the decay of mesons produced in collisions of accelerated ions from the solar atmosphere, are expected with energies of O(MeV-GeV). In addition, we studied the influence of solar flare parameters on the subsequent neutrino flux and estimated the potential signal that large neutrino telescopes could detect from solar flares. The study of such neutrinos, combined with existing gamma-ray observations by the Fermi Large Area Telescope (LAT), would provide a novel window at the underlying physics of the acceleration process.

The IceCube Neutrino Observatory may be sensitive to solar flare neutrinos and therefore provides a possibility to measure the signal or establish more stringent upper limits on the solar flare neutrino flux. We therefore developed an innovative approach dedicated to low energy neutrinos coming from transient events. It combines a time profile analysis with an optimized selection of solar flare events based on Fermi-LAT observations.
This new approach allows to significantly lower the energy threshold of IceCube, which was initially designed to detect neutrinos with energies O(100 GeV) and above. We finally combined the results of the neutrino search in the IceCube Neutrino Observatory with the prediction of the neutrino flux we derived in view of obtaining constraints on proton acceleration in solar flares.