SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Elementary Particle Physics

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

Giuliano MAGGI

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Search for High-Energy Neutrinos from Obscured Flat Spectrum Radio AGN using the IceCube Neutrino Observatory

Promotor:
Prof. Nick van Eijndhoven

The defense will take place on

Tuesday June 27 2017 at 16:00 h

in Auditorium E.0.12 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)
Dr. Krijn de Vries (co-promotor)
Prof. Alberto Mariotti
Prof. Dominique Maes
Prof. Julia Tjus (Univ. Bochum, D.)
Prof. Kumiko Kotera
(Institut d'Astrophysique de Paris, F.)

Curriculum vitae

Giuliano Maggi obtained his master degree in physics at Universidad Santa María (USM) in Chile in 2010. Afterwards, he worked until 2013 in the MINERvA neutrino experiment located in Fermilab (U.S.), as part of the experimental staff at USM. Subsequently, Giuliano started his PhD at the VUB to work on a neutrino search from Active Galactic Nuclei (AGN). Based on multiple wave length observations, he worked on building a catalog of a specific class of AGN as possible neutrino sources. Giuliano is also part of the IceCube collaboration, where he investigated the obtained AGN catalog with data and resources of the IceCube neutrino observatory at the South Pole. During his PhD, he also provided a working service for IceCube, as a member of the IceCube software strike team.

Abstract of the PhD research

Recently the IceCube Collaboration has reported the observation of high-energy astrophysical neutrinos, but their sources are still unknown. This discovery has opened a new window on the Universe and initiated a new field of research, dubbed Neutrino Astronomy.
Neutrinos are unique astrophysical messengers, since they are electrically neutral and interact only via the weak force so that they point straight back to their source and can convey information about the inner engines of cosmic phenomena over cosmological distances. The presence of a high-energy muon-neutrino flux provides unambiguous evidence for hadronic acceleration. As such, cosmic neutrinos are essential to gain insight in the underlying physics processes concerning astrophysical phenomena. Several cataclysmic cosmic events like Gamma Ray Bursts (GRBs) and Active Galactic Nuclei (AGN) have been investigated by the IceCube Collaboration in order to find the origin of the observed high-energy neutrinos. Nevertheless, so far no evidence has been obtained for neutrino production associated with these objects, and consequently the sources of the observed high-energy cosmic neutrinos still remain a mystery.

The AGN that have been investigated by IceCube are characterized by being bright objects, with strong emission at the highest frequencies of the electromagnetic spectrum. However, in the current PhD thesis we investigate a special class of AGN, so-called Obscured Flat Spectrum Radio AGN, which has not yet been explored via high-energy neutrinos. The main feature of these astrophysical objects is that they have strong emission at radio frequencies with the characteristics of a beamed relativistic matter outflow, called a jet, pointing towards Earth. Furthermore, high-energy emission in the electromagnetic band is attenuated by a column of matter in the vicinity of the source and in our line of sight. This column of matter is expected to play the role of a hadronic beam dump, in case hadronic acceleration takes place at the AGN. The hadron beam dump is expected to produce a large neutrino flux, which could be observed by a neutrino observatory as IceCube.

In this PhD thesis we first outline the procedure, based on multi-wavelength observations, via which we have identified a sample of Obscured Flat Spectrum Radio AGN. Subsequently, this sample has been investigated with the data and resources of the IceCube neutrino observatory at the South Pole and the results are presented and discussed.