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Investigating the potential of current and future neutrino detectors to identify the sources of the astrophysical neutrinos seen by IceCube

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Abstract:

High energy neutrino astronomy aims to view the universe with a new messenger, the neutrino. This messenger provides another window onto the universe, complementing what we can learn from photons, cosmic rays, and gravitational waves. The neutrino constitutes together with these other messengers the so-called multi-messenger approach to studying the universe.
Recently, an all-sky diffuse flux of astrophysical neutrinos has been observed by the IceCube neutrino detector. However, the origins of these astrophysical neutrinos have not yet been clearly identified. Since neutrinos traverse large distances unimpeded, neutrinos from distant and individually faint sources are likely to dominate the extragalactic neutrino flux. This complicates the prospects of identifying the sources of astrophysical neutrinos.
This thesis explores the requirements that different source classes put on a generic neutrino detector, in order for such a detector to be able to resolve individual sources of neutrinos, and investigates which kinds of source classes might be detectable with current and future detectors. While starburst galaxies may be difficult to resolve if they are the main source of the astrophysical neutrino flux, blazars and active galactic nuclei are promising sources that could be resolved with IceCube or next generation neutrino detectors such as IceCube Gen2.

Akademisk avhandling för avläggande av licentiatexamen vid Stockholms universitet, Fysikum

Licentiatseminariet äger rum 2 maj 2018 i sal A4:1003, Fysikum, Albanova universitetscentrum, Roslagstullsbacken 21, Stockholm.