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High energy astrophysical neutrinos

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This lecture will cover the status and perspectives of neutrino astronomy that opened a new unique observational window on the high energy Universe where the most violent phenomena take place. Neutrino astronomy was born in 2013 with the observation of a cosmic neutrino flux made by IceCube at South Pole. The realization of deep underwater/ice Cherenkov neutrino telescopes is a very challenging enterprise where new technologies were developed and validated leading also to the construction of telescope prototypes (AMANDA, ANTARES, BAIKAL) paving the way the construction of km3-scale detectors. The full coverage of the neutrino sky requires telescopes located in different regions, at least one in the Southern hemisphere and one in the Northern hemisphere.
Several observations provided hints on high energy neutrino sources. In particular, the observation of a very energetic neutrino from the blazar TX560+056 which inaugurated the era of multi-messenger neutrino astronomy and the evidence for neutrino emission from the active galaxy NGC1068 by IceCube were the first indications of high energy neutrino sources. More recently, KM3NeT, still under construction in the Mediterranean Sea, detected an ultra-high-energy neutrino of 220 PeV KM3-20230213, in a totally unexplored region of extreme interest for astroparticle physics. Several questions are however still open, in particular, classes of astrophysical sources that explain the data as a whole has not be identified so far.
In order to solve the open problems and increase its discovery potential, neutrino astronomy requires a strong synergy between running telescopes (IceCube, KM3NeT and GVD) and new projects (HUNT, TRIDENT, P-ONE$\cdots$) and the strengthening of multi messenger astronomy.

Collaboration you are representing

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