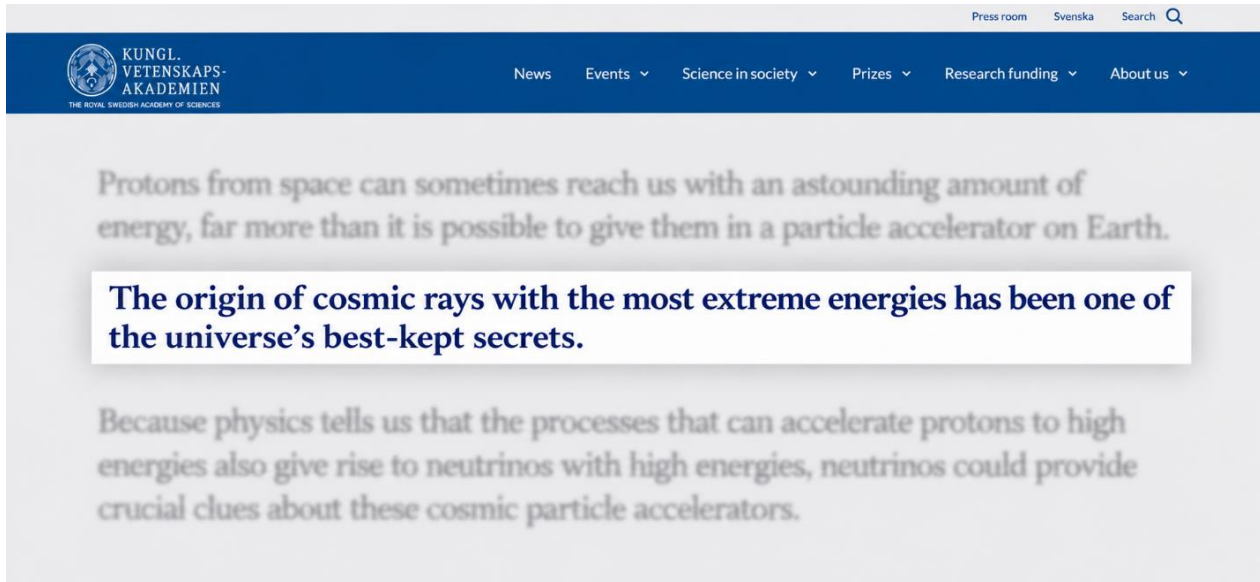


Answering Unresolved Questions in Neutrino Physics

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Description:

Three main sources may be identified for the neutrino:

a. Stars

Given that stars, upon reaching the end of their life cycle, undergo explosive collapse and are thereby capable of generating energy, impact, and related effects, they possess the capacity to split their own photons and release sub-photon particles. They may therefore constitute one of the sources of neutrino production.

b. White Holes

Given that black holes are among the largest and most powerful sources of energy in the universe — capable, as they are, of readily absorbing all surrounding matter — they may, in order to maintain their own equilibrium, also expel matter, elements, and particles (via the white-hole channel). Given their considerable scale and high energy content, white holes are expected to constitute one of the persistent sources of neutrino particles.

c. The Big Bang

One of the main sources of neutrino production — potentially accounting for around 50% of these particles — is the Big Bang phenomenon. At that moment, the energy present was of such magnitude that it could have given rise to the constituent atoms of every photon present in the primordial Big



Bang. Since the Big Bang is itself the origin of all particles, photons, and related entities, it may accordingly be regarded as a major source emitting neutrino particle throughout the universe. Indeed, just as our own Sun emits its particles and photons in all directions and to all points, the Big Bang may be understood to have done likewise.

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What do researchers hope to learn from the universe's neutrinos?

Compared to protons, neutrinos have the advantage that they are not electrically charged. The path of the charged protons in space is curved by the magnetic fields they travel through, making it impossible to deduct their origin by tracking the direction they took.

However, the processes that accelerate the protons will also produce neutrinos, which are not affected by magnetic fields, so it should be possible to conclude

where the cosmic ray protons are accelerated by tracing back along the path of the highest energy neutrinos.

Another type of messenger from the universe's most violent processes is gamma radiation. This also diminishes when it interacts with light and matter on its journey through space, while the neutrinos are unaffected.

Description:

If the location of neutrino sources is to be stated, it must be said that it is everywhere in the sky. Stars are continually undergoing collapse, black holes (via white holes) continually emit particles, and the primordial particles from the Big Bang continue to wander throughout the universe. It may indeed be said that the entire universe, at every moment, constitutes a pathway for neutrino particles.

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More results are expected

One important aim is determining individual sources of celestial neutrinos. A few potential sources have been found by IceCube, of which one is the active galaxy NGC 1068 (also called M77). Of the neutrinos registered in IceCube, 79 appear to come from the direction of this galaxy. However, this evidence is not robust enough to definitively identify NGC 1068 as a neutrino source; the more neutrinos that are captured by the sensors, the greater the chance of being able to find their origin.

In recent years, the researchers behind IceCube have also been able to see high-

Description:

Where there is a likelihood, within the specific region of NGC 1068, of the explosion of a massive star or of the presence of a white hole, this region may be regarded as a neutrino source.





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Description:

Given that the volume and mass of collapsing stars, of white holes, and of the primordial Big Bang are exceedingly large, particles necessarily move in groups in a given direction. However, depending on the distance involved and the positioning of the detector relative to the neutrinos' trajectory, neutrinos may be observed at detectors either in groups, in smaller clusters, or even singly.

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