

Unraveling the mysteries of the most energetic particles in Nature and windows to new physics

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Cosmic Rays with energies beyond 10^{20} eV are regularly observed by the Pierre Auger Observatory covering an area of 3000 km^2 . They are known to be of extragalactic origin but despite enormous progress being made in recent years, Nature has not fully revealed their sources, yet. However, a simultaneous description of the observed energy spectrum, mass composition and arrival directions suggests powerful nearby Starburst Galaxies as a key contributor -- an observation that is independently supported by multi-messenger observations involving high energy photons and neutrinos. The enormous particle energies arriving at Earth can also be used to probe new particle and fundamental physics and a few examples will be presented.