Talk at Splinter Meeting

Splinter A

Astronomy with Ultra-High Energy Cosmic Rays

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Measurements of the Pierre Auger Observatory and more recently also of the Telescope Array have dramatically advanced our understanding of ultra-high energy cosmic rays. The suppression of the flux around $5 \cdot 10^{19}$ eV is now confirmed without any doubt. Strong limits have been placed on the photon and neutrino components of the flux indicating that top-down source processes, such as the decay of superheavy particles, cannot account for a significant part of the observed particle flux. A large-scale dipole anisotropy of 4% amplitude has been found for energies above $8 \cdot 10^{18}$ eV by Auger and a flux excess over an angular scale of 20 degrees (hot-spot) has been seen in TA data above $5 \cdot 10^{19}$ eV. Particularly exciting is the observed behavior of the depth of shower maximum with energy in the Auger data which implies a gradual shift to a heavier cosmic ray composition above the ankle. Such an evolution as well as the high level of isotropy is rather well described by astrophysical models that describe the observed flux suppression at the highest energies in terms of cosmic ray source exhaustion, rather than by energy losses in the CMB (GZK-effect). Answering this fundamental question by measurements of the composition event-by-event into the flux suppression region is the primary goal of the upgrade of the Auger Observatory, while increasing the statistics of events is the goal of the Telescope Array upgrade. This talk will review recent results and give an outlook into the plans and challenges for the next decade.