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Study of solar activity with AERA at the Pierre Auger Observatory

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Solar activity events release vast amounts of energy, including radio waves, X-rays, ultraviolet radiation, and energetic particles, which interact with the Earth's ionosphere and can disrupt radio wave propagation, affecting radio communications. They can either enhance reflections, enhancing long-distance terrestrial communications, or cause signal degradation and absorption, respectively depending on whether the increased ionization affects the upper or lower layers of the ionosphere. In the first case, the solar cycle modulates the Maximum Usable Frequency (MUF), the highest frequency usable for radio communication between two Earth-based points. The Auger Engineering Radio Array (AERA) of the Pierre Auger Observatory was developed to measure the radio emission from extensive air showers in the 30-80 MHz band. We examine the impact of solar activity on AERA data collected over approximately 11 years. We report the detection of different types of solar radio bursts and we investigate how increased solar radiation - particularly in the X-ray and extreme ultraviolet bands - also affects measurements in the AERA energy band. Our results show a remarkable correlation between the MUF and the broadband noise observed in the 30-40 MHz frequency range. Radio blackouts are also observed in AERA spectrograms in coincidence with those reported by the National Oceanic and Atmospheric Administration (NOAA). These findings highlight the complex interplay between solar activity and radio wave propagation, which is also relevant for cosmic-ray detection.

Collaboration(s)

Pierre Auger Collaboration

Author: MENEZES, Rogerio

Presenter: MENEZES, Rogerio

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