PROCEEDINGS OF SCIENCE

A New Component from the Quiet Sun: Synchrotron Radiation from Galactic Cosmic Rays from Radio to Gamma

Elena Orlando,[a,b,*] **Vahe' Petrosian**[b] **and Andrew Strong**[c]

[a] *University of Trieste/INFN, Italy*
[b] *Stanford University, USA*
[c] *MPE, Germany*

E-mail: orlandele@gmail.com

The quiet Sun, i.e. in its non-flaring state or non-flaring regions, produces non-thermal radiation observed in gamma rays due to interactions of Galactic Cosmic Rays (GCR) with the solar gas and photons.Here, we report our very recent study (Orlando et al. 2023, ApJ 943, 173) on a new component: the synchrotron emission by GCR electrons in the solar magnetic field. To the best of our knowledge this is the first time this emission has been theoretically claimed and modeled. We find that the measured GCR electrons with energies from tens of GeV to a few TeV produce synchrotron emission in X-rays, which is a few orders of magnitude lower than current upper limits of the quiet Sun set by RHESSI and FOXSI. For a radially decreasing solar magnetic field we find the expected synchrotron intensity to be almost constant in the solar disk, to peak in the close proximity of the Sun, and to quickly drop away from the Sun. We estimate the synchrotron emission from radio to gamma rays and we compare it with current observations, especially with LOFAR. While it is negligible from radio to UV compared to the solar thermal radiation, this emission can potentially be observed at high energies with X-ray instruments and more promising future FOXSI observations. This could potentially allow for constraining CR densities and magnetic-field intensities at the Sun. This study provides a more complete description and a possible new way for understanding the quiet Sun and its environment.

38th International Cosmic Ray Conference (ICRC2023)
26 July - 3 August, 2023
Nagoya, Japan

ICRC2023
38th International Cosmic Ray Conference
The Astroparticle Physics Conference

*Speaker

PoS(ICRC2023)1333