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Relativistic particles from the Sun

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The particles ejected from the Sun during some particularly powerful eruptions (X-ray flare class X) reach the Earth in twenty minutes, immediately after the photons that carry the image and information of the event.
The speed of the most energetic protons of the solar wind is measurable from the images of C3 coronagraph of SOHO SOlar and Heliospheric Observatory and from the X-ray and proton tracks of the GOES 16 and 18 satellites. Their kinetic energy is E=$mc^2(\gamma - 1)$,
where γ is the Lorentz factor.
From the assumption of equipartition of the energy $1/2m \cdot v^2 = 3/2KT$ we also derive the equivalent thermodynamic temperature in the blasting zone, of the order of 10^{10} K.
Data from the M9.75 class flare on June 8, 2024 at 1:24 UT are taken into account to study these particles, which are protons. Their average velocity is $v \sim c/7$ and their kinetic energy is $E \sim 10$ MeV.
By cross-correlating the data of the GOES 16 and 18 satellites, maximum velocities between $v = 0.23$ c and $v = 0.38$ c are found, with kinetic energies of protons between 27 and 81 MeV. The presence of particles with E100 MeV and the possibility to detect particles with E500 MeV with the GOES satellite, implies α-particles ejected from the Sun, or Cosmic Rays.
The effects on the Earth's magnetosphere and atmosphere of such Solar Proton Events are discussed, as well as the biological threats, in order to extend these considerations to galactic Supernovae or galactic Gamma-Ray Bursts.

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