PARTICLE ACCELERATION AND KINEMATICS IN SOLAR FLARES

A Synthesis of Recent Observations and Theoretical Concepts (Invited Review)

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Abstract. We review the physical processes of particle acceleration, injection, propagation, trapping, and energy loss in solar flare conditions. An understanding of these basic physical processes is inexorable to interpret the detailed timing and spectral evolution of the radiative signatures caused by nonthermal particles in hard X-rays, gamma-rays, and radio wavelengths. In contrast to other more theoretically oriented reviews on particle acceleration processes, we aim here to capitalize on the numerous observations from recent spacecraft missions, such as from the *Compton Gamma Ray Observatory (CGRO)*, the *Yohkoh Hard X-Ray Telescope (HXT)* and *Soft X-Ray Telescope (SXT)*, and the *Transition Region and Coronal Explorer (TRACE)*. High-precision energy-dependent time delay measurements from *CGRO* and spatial imaging with *Yohkoh* and *TRACE* provide invaluable observational constraints on the topology of the acceleration region, the reconstruction of magnetic reconnection processes, the resulting electromagnetic fields, and the kinematics of energized (nonthermal) particles.

Keywords: solar flares, particle acceleration, particle kinematics, nonthermal particles, hard X-ray emission, soft X-ray emission, radio emission

Abbreviations: BATSE – Burst And Transient Source Experiment (instrument aboard *CGRO*);
CGRO – Compton Gamma Ray Observatory;
ETH – Eidgenössische Technische Hochschule (Zurich, Switzerland), radio observatory;
EUV – Extreme ultra-violet;
HXT – Hard X-Ray Telescope (instrument aboard *Yohkoh*);
HXRBS – Hard X-Ray Burst Spectrometer (instrument aboard *SMM*);
SMM – Solar Maximum Mission;
SXT – Soft X-Ray Telescope (instrument aboard *Yohkoh*);
TRACE – Transition Region and Coronal Explorer;
VLA – Very Large Array (Socorro, New Mexico).

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