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Effects of non-continuous losses during inverse Compton cooling in blazars

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Blazar flares are ideally suited to study the extreme physics of relativistic outflows, with the primary method for this objective being physical modeling of the varying broad-band emission from blazar jets. Many of the numerical codes developed for this task, are based on the kinetic approach tracking the particle spectrum evolution due to various physical processes (acceleration, cooling, etc). In the existing leptonic codes, the inverse Compton (IC) cooling of electrons is described with a continuous-loss term in the kinetic equation, which is however only valid when the relative losses are much smaller than unity. In the Klein-Nishina (KN) regime, this is no longer the case, and one has to treat properly the large relative jumps of electrons in energy. The full transport equation then becomes an integro-differential one, and is quite challenging to solve. To avoid this issue, continuous-loss approximations attempting to include KN effects were derived by different authors. Here, we explore the limits of applicability of such approximations for typical conditions during blazar flares. To solve the kinetic equation with the full cooling term, we extend our blazar flare modeling code EMBLEM, and using it, investigate the importance of the non-continuous cooling effect on the electron spectrum and spectral energy distribution (SED). Finally, we explore the parameter space and identify the range of physical conditions in which these effects manifest the most.

Track

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