# Test particle simulations of SEPs originating from an expanding shock-like source

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We consider a 3D test particle code previously used to study solar energetic particle transport under the assumption of instantaneous injection, uniform in longitude and the sine of latitude (i.e. uniform on a spherical surface) close to the Sun (e.g. Dalla et. al. 2020; Battarbee et. al. 2018; Marsh et. al. 2013).

In this work we have developed a radially extended injection that is non-uniform in longitude and latitude that approximates particle injection from a CME-driven shock source. We present preliminary results where we consider the effects of the extended injections in time of 100 MeV protons on their 0.3 and 1 AU intensity profiles and anisotropies. We also analysed the influence on the observables of different efficiencies of injection across the shock front. By considering the observable parameters close to the Sun (0.3 au) we aim to support observations from new spacecraft such as Solar Orbiter and Parker Solar Probe.

Compared to the case of an instantaneous injection, an extended particle injection causes slower decay phases in intensity profiles and slightly lower peak anisotropies.

When considering injection efficiencies of different standard deviations ($\sigma$) across the shock, we found that a more shock-nose skewed injection results in larger intensities and slower decays measured at the initial magnetically well-connected regions at 1 au. However, faster decays are observed eastwards of the initial magnetically well-connected position as fewer protons are injected into the flux tube due to the radial motion of the particle-injecting shock.

The intensity profiles obtained at 0.3 au behave similarly for all extended injections, implying little dependence on how the particle acceleration efficiency changes in longitude and latitude across the shock front.