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Energetic particle emission in two solar flares with open magnetic field

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Energetic particle populations in the solar corona and in the heliosphere appear to have different characteristics even when produced in the same solar flare. It is not clear what causes this difference: properties of the acceleration region, the large-scale magnetic field configuration in the flare, or particle transport effects, such as scattering. We use a combination of non-linear force-free magnetohydrostatic simulations, magnetohydrodynamic and test-particle modelling to investigate magnetic reconnection, particle acceleration and transport in two solar flares events: an M-class flare on June 19th, 2013, and an X-class flare on September 6th, 2011. We show that, although in both events particles are energised at the same locations, the magnetic field structure around the acceleration region results in different characteristics between particle populations precipitating towards the photosphere and those ejected towards the upper corona and the heliosphere. We expect this effect to be ubiquitous when particles are accelerated close to the boundary between open and colsed magnetic fields and, therefore, may be key to solar flares with substantial particle emission into the heliosphere. Furthermore, this analysis elucidates the mechanisms by which escaping particle populations can be created in flares.