



30th International Cosmic Ray Conference

Contribution ID : 1037

On the instabilities and scattering of diffusive shock acceleration

The non-linear back reaction of accelerated cosmic rays at a non-relativistic shock front leads to the formation of a smooth precursor with a length scale corresponding to the diffusive scale of the energetic particles. The instabilities present in these modified shocks may play a crucial role as past theoretical work has shown. First, it was claimed that shocklets that could be created in the precursor region of a specific width might energize few thermal particles to sufficient acceleration and second, some precursor regions may act as confining large angle scatterers for very high energy cosmic rays. Our aim here is to investigate numerically these claims by constructing a Monte Carlo code simulating the above conditions which could throw further light to the exact mechanism of efficiency, particularly in the case of highly oblique shocks as these appear in nature much more often.

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Session classification : Posters 1 + Coffee

Track classification : OG.1.4

Type : Poster