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Particle propagation in clumpy media

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The presence of dense clumps in the environment where a supernova remnant (SNR) expands might have a strong impact in shaping the observed hadronic gamma-ray spectrum. I will here present a detailed numerical study about the penetration of relativistic protons into clumps which are engulfed by a SNR shock, taking into account the magneto-hydrodynamical properties of the background plasma. In such a scenario, the spectrum of protons inside clumps results much harder than that in the diffuse inter-clump medium: this effect has strong implications for the formation of the spectrum of hadronic gamma rays, which does not reflect anymore the acceleration spectrum of protons, resulting substantially modified by propagation effects. For the Galactic SNR RX J1713-3946.7, I will show that a hadronic scenario including dense clumps inside the remnant shell is able to reproduce the broadband gamma-ray spectrum from GeV to TeV energies. Moreover, small clumps crossed by the shock could provide a natural explanation to the X-ray variability observed in some hot spots of RX J1713-3946.7. The detection of neutrinos from this source would represent a smoking gun for the hadronic origin of the observed radiation: in this view, I will explore the potentials of the upcoming KM3NeT. Finally I will discuss the detectability of gamma-ray emission from clumps with CTA.

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