

Giant cosmic ray halos around M31 and the Milky Way

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Recently, a diffuse emission of 1-100 GeV γ -rays has been detected from the direction of Andromeda. The emission is centered on the galaxy, and extends for $\sim 100 - 200$ kpc away from its center. Explaining the extended γ -ray emission within the framework of standard scenarios for the escape of cosmic rays injected in the galactic disk or in the galactic center is problematic. Here, we argue that a cosmic ray origin (either leptonic or hadronic) of the γ -ray emission is possible in the framework of non standard cosmic ray propagation scenarios or in the case of particle acceleration taking place in the galaxy's halo. It would imply the existence of a giant cosmic ray halo surrounding M31, possibly powered by the galaxy nuclear activity, or by accretion of intergalactic gas. Remarkably, if cosmic ray halos, as the one observed around M31, are a common feature of galaxies, including our own, the interactions between cosmic ray protons and the Milky Way circumgalactic gas could also explain the isotropic diffuse flux of neutrinos observed by Icecube.

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