MULTI-MESSENGER STUDIES OF COSMIC RAY ACCELERATION IN GALAXY CLUSTER ACCRETION SHOCKS

A. ĆIPRIJANOVIĆ[1] and T. PRODANOVIĆ[2]

[1]*Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, IL 60510, USA*
E-mail aleksand@fnal.gov

[2]*Department of Physics, University of Novi Sad, Trg Dositeja Obradovića 4, 21000 Novi Sad, Serbia*
E-mail prodanvc@df.uns.ac.rs

Abstract. Studying cosmic rays, their acceleration and interactions is of fundamental importance for understanding physics of the highest energies. Cosmic rays interact with magnetic fields, so their direct detection is not possible, but their presence can be measured by detecting different products of their interactions with the interstellar medium through which they propagate. Accretion of gas on the largest scales (around galaxy clusters) has been thought to give rise to shocks that can accelerate cosmic rays. Multi-messenger studies of particular galaxy clusters, as well as the possible contribution of distant unresolved galaxy clusters to the observed background radiation at different wavelengths, can be used to study particle acceleration in accretion shocks. Interactions of cosmic rays will, among other things, produce gamma rays, neutrinos and radio waves. Here we investigate how unresolved galaxy clusters and their accretion shocks contribute to extragalactic gamma-ray background observed by Fermi-LAT (Ackermann et al. 2015). We also study these objects using high-energy isotropic neutrino flux from the IceCube detector (Aartsen et al. 2014) and the cosmic radio background (Fixen et al. 2011). We show that the possible contribution of unresolved galaxy clusters to these backgrounds is not large. For example, even if all detected extragalactic IceCube neutrinos are entirely produced by cosmic rays accelerated in accretion shocks, they can make at best ∼20% of the extragalactic gamma-ray background (Dobardžić et al. 2015).

References

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