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How Cosmic Rays Reshape Their Accelerators

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Charged particles accelerated at the forward shocks of supernova remnants (SNRs) likely constitute the majority of the Galactic Cosmic Ray (CR) population. They also play a vital role in regulating the hydrodynamical evolution of their accelerators. For example, efficient CR acceleration at shocks leads to enhanced compression, which in turn alters the distribution of CRs released into the Galaxy. Galactic CRs can also extend the lives of SNRs, serving as a non-thermal pressure reservoir that supports expansion after the onset of the so-called "radiative phase,"when thermal gas pressure is lost to atomic transitions. In this talk, I will explore the dynamical role of CRs in regulating SNR evolution, and introduce observational evidence for CRs modifying the hydrodynamics of their accelerators. In particular, by coupling magnetohydrodynamic simulations of SNR evolution with a self-consistent model of CR acceleration at shocks, I will show how the presence of CRs and magnetic fields (which are themselves amplified by CRs) can drastically alter the both the radio and γ-ray appearance of a radiative SNR. As I will demonstrate, proper accounting for the dynamical effects of both CRs and magnetic fields is essential to producing simulated SNRs that are consistent with multi-wavelength observations.

Collaboration(s)

Author: DIESING, Rebecca (Institute for Advanced Study and Columbia University)

Co-authors: Dr KIM, Chang-Goo (Princeton University); Prof. CAPRIOLI, Damiano (University of Chicago); Prof. STONE, James (Institute for Advanced Study); GUO, Minghao (Princeton University); Dr GUPTA, Siddhartha (Princeton University)

Presenter: DIESING, Rebecca (Institute for Advanced Study and Columbia University)

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