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Cosmic Rays: The Hidden Architects of the Circumgalactic Medium

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Cosmic rays (CRs) remain a key uncertainty in galaxy evolution due to their poorly constrained transport and acceleration in diverse plasma environments. They may play a crucial role in shaping the multiphase structure of the Circumgalactic Medium (CGM), with their impact varying across different phases depending on their transport properties and coupling with the thermal plasma. A central question is how CRs might affect different CGM phases and whether CR pressure support may be dynamically significant. In this talk, I will discuss the influence of CRs on both the cold and hot phases of the CGM. I will present results from a suite of idealized simulations of a Milky Way-type host galaxy with varying satellite distributions, incorporating CRs from supernovae into both the host and satellite galaxies. I find that CR pressure enhances the surface area of ram pressure-stripped cool satellite clouds, boosting cooling in turbulent mixing layers and thereby prolonging cloud survival and increasing the cold-phase covering fraction. Conversely, I find that the CRs cannot efficiently heat gas to super-virial temperatures. I will also present results from new simulations exploring the dynamics of CR-driven shells and super-bubbles on a variety of scales in and around star-forming galaxies. Overall, these findings highlight the potential importance of CRs on galaxy ecosystems and how uncertainties in CR transport properties map to uncertainties in their importance.

Collaboration(s)

Todd Thompson, Stephanie Tonnesen, Kung-Yi Su

Author: ROY, Manami (The Ohio State University)

Presenter: ROY, Manami (The Ohio State University)

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