The History of Metal Production and Ejection in the Massive Spiral Galaxy M31

Grace Telford*[1]

[1]Rutgers, The State University of New Jersey [New Brunswick] – United States

Abstract

Metals encode the evolutionary histories of galaxies, tracing past accretion events and metal-enriched gaseous outflows. The fraction of metal mass produced by a galaxy's stars that is retained in the galaxy to the present day provides a unique constraint on the impact of outflows. In this work, we present an accounting of produced and present metals in the nearby massive spiral M31, where resolved-star photometry across _~1/3 of the disk was obtained by the Panchromatic Hubble Andromeda Treasury (PHAT) survey. Using spatially resolved star formation and enrichment histories inferred from the PHAT data, we calculate the present-day metal mass locked into stars. Combining the stellar metals with the gas-phase metallicity gradient and maps of dust and atomic hydrogen, we conduct a census of metals currently present in the PHAT footprint. The history of metal production in the same area is calculated by combining the star formation histories with a model of metal production by supernovae and AGB stars. We find that 62% of the metal mass has been lost via outflows, and that net metal loss is required under any model assumptions. The vast majority of M31's metal production occurred before redshift 1, implying metal loss early in its evolution. We further show that metals produced in the last 1.5 Gyr have been redistributed within M31's disk, suggestive of a galactic fountain mechanism.

*Speaker