

Katherine de Kleer – Colloquium Seminar – April 24, 2025
Caltech

TITLE: Jupiter's volcanic moon Io: Tidal heating, mass loss, and chemical evolution

ABSTRACT: Jupiter's moon Io is heated internally by tides arising from its Laplace orbital resonance with neighboring moons Europa and Ganymede. The resultant volcanic activity provides remotely-observable signatures by which we can study the influence of tides on the interior of a planetary-scale body. This talk will present telescopic observations of Io's volcanic gasses and lava flows, which we use to derive constraints on Io's interior and on the interactions between its outgassed atmosphere and the jovian magnetosphere. Such observations provide important clues into the processes governing Io's current state. However, Io's activity rapidly erases any indicators of its history prior to the most recent ~million years. As a consequence, the history of Io's volcanism, and of the resonance between the galilean moons, has remained largely unknown. We are currently using isotopic measurements of the volatile-forming elements at Io to constrain the processes acting on its volatile reservoirs over long timescales. This talk will present results from millimeter-wavelength telescopic measurements of Io's sulfur and chlorine isotopes and plans for future measurements. The isotopic ratios hold a record of Io's volcanic activity, volatile recycling, and mass loss over the age of the Solar System, shedding light on past tidal heating at Io and hence the age of the Laplace resonance between the moons.

BIO: Katherine de Kleer is an Assistant Professor of Planetary Science and Astronomy at Caltech. Her research in Solar System astronomy aims to understand the heat sources of planetary bodies over their histories, and how this heating has influenced their atmospheres,

geological activity, and evolution. Her work utilizes innovative telescope techniques at optical through radio wavelengths, and has covered a broad range of topics with a current emphasis on the four galilean satellites of Jupiter and main-belt asteroids. Katherine received her Bachelors degrees in mathematics and physics from MIT in 2009 and her PhD in Astrophysics from UC Berkeley in 2017. She moved to Caltech in 2017 as a 51 Pegasi b postdoctoral fellow before joining the faculty there in 2019.