Adding Context to the Interior Structures of Jupiter and Saturn with the Bulk Compositions of Cool, Giant Exoplanets

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Years of in situ observations at Jupiter and Saturn have painted a complex picture of their interior structures. Giant exoplanets present the opportunity to place these Solar System findings in a greater statistical context, but the comparison is not straightforward. Most well characterized giant exoplanets, those with measured mass and radius, are substantially hotter than Jupiter and Saturn owing to their short-period orbits. This observational bias of exoplanets inhibits our ability to make useful comparisons with Jupiter and Saturn. I will present results of a five-year observational effort focused on producing a novel sample of giant exoplanets on moderately long orbits (hundreds to a thousand days) with measured mass and radius. The temperatures of these giant exoplanets are far cooler than the typical hot Jupiter, well below 1000 K and under 300 K in some cases. Despite their long orbital periods, each of these exoplanets was initially discovered via the transit method by Kepler or TESS. Our long-term Doppler spectroscopy campaigns, conducted at Keck and Lick Observatories, have finally yielded planet masses, which allow us to infer the bulk compositions of these cool giant exoplanets. I will discuss emerging empirical trends in the correlation between bulk metallicity and planet mass which suggest that heavy element accretion is affected by the orbital period of planet. I will also present a few of the exoplanets individually as unique case studies and as opportunities for atmospheric characterization via JWST. This sample of giant exoplanets act as a stepping stone that connects most hotter exoplanets to the cold gas giants of the Solar System.