Investigating Activity Drivers of Comets in the Centaur-to-Jupiter Family Transition

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We present results from an ongoing observing campaign to characterize activity patterns, nucleus properties, and activity drivers of Jupiter Family comets (JFCs) with perihelion distances $q > 4.5$ au and of active Centaurs by acquiring longbaseline visible imaging and millimeter wavelength spectra. The active lifetimes of JFCs often start when they are still in the Centaur region [1, 2, 3], yet the transition from Centaur to JFC happens in a region where water sublimation cannot be the driver of the activity [4]. The presence of cometary activity beyond the historically established distance for strong water sublimation near 3 au has been well documented [3, 5], but the observational dataset for most distantly active comets has been sparse, limiting our ability to fully understand the transition region from the outer to inner Solar System. Dedicated observations of the comets' behavior can let us use thermal modeling to probe the compositional interior structure of the comet and investigate how (for example) CO/CO_2 sublimation or H_2O crystallization might drive the activity [6]. We have acquired nightly broadband imaging during 6 week-long observing runs over the course of two years for JFCs 158P, P/2011 U2, and P/2016 A3 and Centaurs C/2013 C2, P/2015 M2, and C/2016 Q4 using the KPNO WIYN 0.9-m and CTIO SMARTS 0.9-m telescopes. Objects 158P, C/2013 C2, P/2015 M2, and P/2016 A3 were active between heliocentric distances 4.81-4.88 au, 9.18-9.84 au, 5.96-6.56 au, and 4.79-5.17 au respectively and we report their absolute magnitudes and dust-production rates. For objects P/2011 U2 and C/2016 Q4 no activity was detected between heliocentric distances 5.53-5.63 au and 7.08-7.73 au respectively and we report nucleus size measurements. We additionally present preliminary thermophysical modeling results for the sample of objects to constrain plausible activity drivers for these distantly active objects.

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