Sungrazing comets: Probing the inner extremes of the Solar System

M. Knight[1]

[1]Lowell Observatory

Comet ISON (C/2012 S1) gained much notoriety as the first known dynamically new sungrazing comet, and was observed extensively leading up to its perihelion passage in November 2013. While ISON's destruction near perihelion was disappointing, its intense study will yield unprecedented insight into the behavior of sungrazing comets. In light of this heightened interest in sungrazing comets, I will present a brief overview of the populations of sungrazing comets and review what their study has revealed about the solar system.

Our knowledge of the near-Sun environment has been revolutionized over the last few decades by the discovery of thousands of faint comets on sungrazing orbits. The vast majority of these objects are seen only by the telescopes onboard SOlar and Heliospheric Observatory (SOHO) and/or Solar-TErrestrial RElations Observatory (STEREO), with observations typically spanning hours to a few days. About 85 % are dynamically related to each other as members of the Kreutz group, whose members were likely produced by cascading fragmentation from a single parent in the last few thousand years. The Kreutz group was the only group of sungrazing comets known prior to the modern space-based coronagraphic era, and includes such spectacular naked eye objects as Ikeya-Seki (1965f = C/1965 S1) and Lovejoy (C/2011 W3). Kreutz comets are seen in SOHO and STEREO images on average every few days and all but the largest historical comets are destroyed during the tiny perihelion passage (1–2 solar radii). At least three additional groups of near-Sun comets, sometimes termed "sunskirting" due to their moderately larger perihelion distances (8–12 solar radii) have been discovered in SOHO and STEREO images. As a result of the decreased insolation and tidal forces sustained during their perihelion passages, many sunskirters survive perihelion. Two sunskirting groups, the Marsden and Kracht groups have short (4–6 yr) orbital periods and are dynamically related to comet 96P/Machholz 1. The third group, Meyer, has not been linked to any known solar system object and has an unknown orbital period. The remaining known sungrazing comets have a variety of orbits and, with the notable exception of ISON, are generally not observed extensively.

Due to their extreme orbits, sungrazing comets offer unique opportunities for understanding evolutionary processes in our solar system. During their perihelion passages they experience equilibrium temperatures exceeding 1500 K, resulting in sublimation of their dust and potentially allowing the least volatile components of our solar system to be cataloged. In fact, while all of the near-Sun objects discovered by SOHO and STEREO are designated "comets", many of those not associated with other known cometary objects may be asteroids or defunct comets whose apparent activity at these distances is due to sublimation of their bare surfaces. Sungrazing comets also experience strong tidal forces, resulting in frequent fragmentation. Such breakups expose the unprocessed interiors, potentially allowing intercomparison of the compositions of discrete fragments and revealing the size distribution of the planetessimals out of which the parent comet formed. Finally, it has recently become possible to use comets as "solar probes", treating them as test particles that can reveal properties of the solar environment such as the coronal temperature and density, magnetic field strength, and solar wind speed and direction.