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Sublimating grains in the coma of new comets originating from the Oort Cloud

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Abstract

Comets are pristine bodies of the Solar System and their studies can give precious hints on the formation of the Solar System itself. New comets, coming form the Oort Colud at their first passage close to the Sun, are particularly important because they are not differentiated by the Solar radiation and they are supposed to have a large quantity of organic matter close to the surface, that is injected in their coma as organic ices. We are interested in the detection and the study of such icy grains, in order to understand their evolution during the approach of the comet to the Sun.

1. Introduction

It is expected that billion of years of space weathering (see e.g. Kanuchova et al, 2012, Icarus, 221, 12) produces a crust of organic matter that will be released when a comet enter for the first time in the inner Solar System. When, approaching to the Sun, a comet is at heliocentric distances, R_h , greater than 3 AU the sublimation of CO and CO_2 is the main source of comet activity. At shorter distances, the sublimation of water become the most important mechanism of activity. The gases, escaping from the nucleus, drag in the coma grains that can be refractory dust (silicates, carbon), water ice and/or organic ices. Oort comets at their first passage in the inner Solar System, should produce an halo of organic or water icy particles.

2. Observations and theoretical simulations

Recently our group started to monitor new, inbound, bright Oort comets (C/2011 F1, C/2012 S1, C/2012 K1, C/2013 V5, C/2012 F3) to search for these grains. The method consists in detecting the cloud of sublimating grains in the inner coma by using the $\Sigma Af(\rho)$ function (Tozzi et al, A&A, 2007, 476, 979). However this over-population of grains, beside the sublimation, can be also due to short time activity (outburst) or too big grains expanding at very slow velocity, as it has been found in comet 67P/C-G (Tozzi et al, 2011, A&A, 531, 54). To disentangle between the phenomena it is necessary to monitor the comet both at short timescale, for the outbursts (by repeating the observations after few nights), and at long term (weeks-months). If the cloud does not expand with the decreasing of the heliocentric distance there is high probability that we are in presence of organic and/or water ice grains. We can disentangle between organic and water icy grains by measuring their color and spectra. In this talk we will present results obtained on observations of C/2011 F1 (LINEAR) and C/2012 S1 (ISON). The comparison between data and theoretical simulations, obtained with a simple model assuming sublimating grains, shows that this mechanism is the most probable phenomena occurred in those comeraty comae.