I. T. – R. O. C. K. S. Comet Nuclei Sample Return Mission

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The main constituents of comets are ices, organics and minerals which record the chemical evolution of the outer regions of the early solar nebula. They are thought to have aggregated 4.6 Gyr ago. As comets maintain a nearly pristine nature of the cloud from which they formed their compositional, structural, thermodynamical and isotopic analyses can provide clues on the processes that occurred in the early phases of the solar system and possibly the Interstellar Medium (ISM) Cloud that predated the formation of the solar nebula [1].

The ability to analyze a sample from a comet in a laboratory will provide a unique perspective in understanding comets. The unprocessed materials which make up comets provide the best records of conditions in the outer solar system during its formation and evolution. They will aid us in understanding their role played in delivering water and organics to earth [2] as well as the other planets.

While the deep impact mission aimed at determining the internal structure of comet Temple1's nuclei [e.g. 3], the stardust mission sample return has dramatically deepened our understanding of comets. Its first implications indicated that some of the comet material originated in the inner solar system and was later transported outward beyond the freezing line [4]. A wide range of organics identified within different grains of the aerogel collectors has demonstrated the heterogeneity in their assemblages [5]. This suggests either many histories associated with these products or possibly analytical constraints imposed by capture heating of Wild2 material in silica aerogel. The current mission ROSETTA, will further expand our knowledge about comets considerably through rigorous in situ analysis of a Jupiter Family Comet (JFC). As the next generation of cometary research post ROSETTA, we present the cometary sample return mission IT - ROCKS (International Team - Return Of Cometary Key Samples) to return multipliable several minimally altered 100g samples from various locations of comet 88P/Howell, a typical JFC.

The mission scenario includes remote sensing of the comet's nucleus with onboard instruments similar to the ROSETTA instruments [6, 7, 8] (VIS, IR, Thermal IR, X-Ray, Radar) and gas/dust composition measurements including a plasma science package. Additionally two microprobes [9] will further investigate the physical properties of the comet's surface. Retrieving of the samples will be performed by touch and go maneuvers and a penetrator device [10]. Solar arrays are used as energy source and additional cooling is required to keep the samples at low temperatures (<135K) to prevent them from alteration during return [11]. The return of the samples will be performed by a re-entry capsule similar to that used in the stardust mission. A combined propulsion method of solar electric and chemical propulsion was chosen and an Ariane 5 ECB will be used as launching vehicle due to the payload of nearly 5.5 tons. The overall mission time is about 9 years and it will operate after 2025. The total costs will exceed 2000 million Euro.

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