Peering at the 81P/Wild 2 comet from Earth

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This work is part of the Preliminary Examination Team (PET) on Bulk Chemistry investigation of Wild 2 cometary grains brought back to Earth by the NASA Stardust mission [1]. X-rays are among the least destructive yet sensitive micro-probes, capable of analyzing minute samples embedded in low density collectors, so methods based on Synchrotron Radiation had access to Stardust samples in priority. The main goal of the PET was to produce a preliminary characterization of the abundance and nature of the elements present in the returned samples [2]. In this phase it was paramount to analyze the grains in-situ, in the aerogel foam of the collectors to record the total mass fragments and avoid extraction risks.

We have performed measurements on beamlines ID22/ID21 of the ESRF synchrotron in Grenoble, France, devoted to high/low energy microspectroscopy and recorded results on a collection of 6 keystones out of a total of 23 used in the study by several international teams [3]. Terminal particles as well as fragmentation tracks in the aerogel were mapped out with micron resolution, recording total mass composition for elements of $Z \geq 15$ by means of X-ray fluorescence [4], as well as structural information by X-ray diffraction. This allowed the direct identification of the mineralogy of some of the grains. Finally, we recorded the evolution of the charge states of S and Fe as a function of the position in the track by means of micro-Xanes measurements. All these analyses were combined to produce a description of the Wild 2 cometary grains [3, 5, 6], as well as a history of their formation and of the thermal interactions during their slowing down in the aerogel collectors.

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