

Short report on the measurements performed at DUBBLE

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Proposal Title “Characterization of iron-bearing compounds in interstellar dust”

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In order to explore the possibility of current and future astronomical X-ray space observatories, carrying high resolution X-ray spectrographs, to resolve the structure of interstellar dust particles, we aim at obtaining NEXAFS and EXAFS absorption structures of interstellar dust representatives.

With previous measurements we successfully tested the suitability of the DUBBLE beamline for obtaining these X-ray absorption structures around the Fe-K edge. With the current experiment we further enriched our current set of measurements with six more compounds: $\text{Mg}_{0.9}\text{Fe}_{0.1}\text{SiO}_3$ and $\text{Mg}_{0.74}\text{Fe}_{0.26}\text{SiO}_3$ (both in crystalline and amorphous form) and finally FeS (synthetic pyrrhotite, and a meteoritic troilite).

Figures 1 and 2 show some first (raw) results. Both plots show the Fe-K absorption edge for different chemicals that were currently missing in any dust model for astronomical data. As shown in our previous report, the differences among similar chemicals, but with different structure will be easily resolved using future X-ray instruments (like e.g. the ASTRO-H calorimeter).

These measurements show that the exploration of different interstellar dust representatives with the DUBBLE beamline is of crucial importance. The final goal is to have a number of measurements which are representative of dust in the interstellar space and implement them into models for astronomical data.

Resolving the spatial structure of interstellar dust particles may resolve key questions about the generation, growth and decay of these nuclei of stars and planet formation.

The results at this stage are in line with what expected in the project proposal. Within the framework of exploration of possible instrumental setups suitable for determining X-ray absorption characteristics of interstellar dust representative samples, we are currently performing other measurements of our samples at different energies, in order to explore absorption by the Fe-bearing constituents (O, Fe, Mg, Si) in the whole X-ray band (~ 0.3 -10 keV). In particular we just started a large set of measurements using the electron microscope in Utrecht for the O-K and Fe-L edges.

We are also implementing the DUBBLE measurements in our, publicly available, fitting package for X-ray data (www.sron.nl/spex).

The experiments carried out at DUBBLE are currently under analysis and will be the subject of future publications. More samples will be available in the near future as candidates for DUBBLE measurements.

Fig 1: Raw data and preliminary analysis of the FeS meteoritic troilite sample.

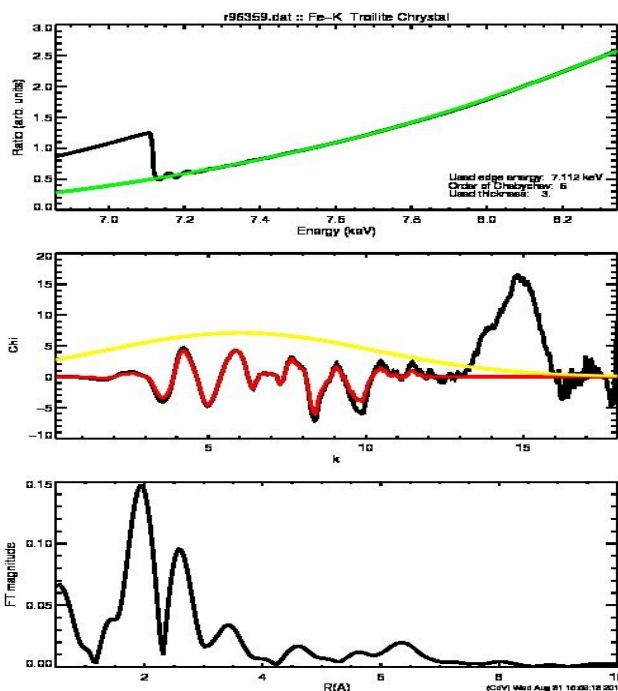


Fig 2: Raw data and preliminary analysis of the Mg_{0.74}Fe_{0.26}SiO₃ sample.

