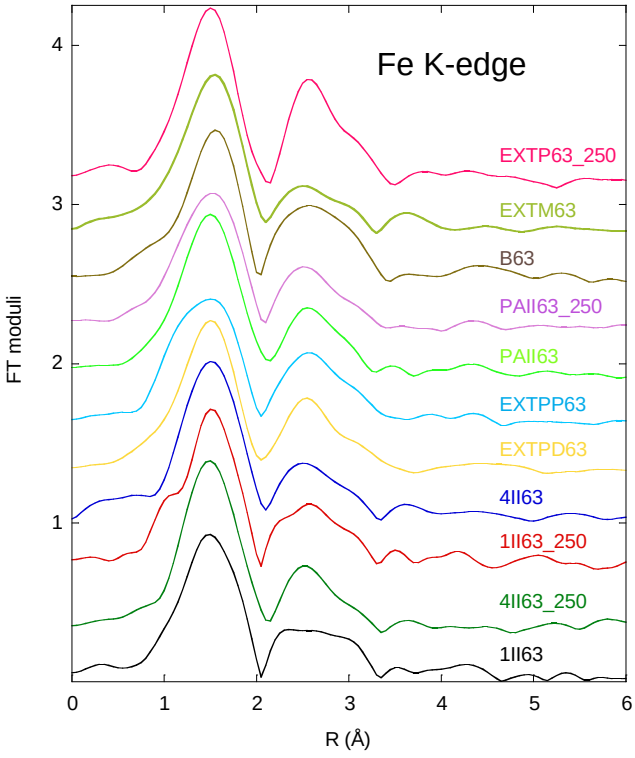
Report on the experiment EC-240 (9-13 July 2008)

EXAFS study of atmospheric pollutant particles: the case of Pt

Atmospheric particles, in particular those with diameter less than 10 μm (PM10), act as carriers of metal pollutants coming from road traffic, but their transport routes in the case of the Venice area is still to be addressed, due to the peculiar environment of the area. The knowledge of the chemical environment of the Pt and other metals in the particles is becoming therefore crucial for studying the atmospheric transport of the pollutant, allowing establishing models for its diffusion in the environment.

In this experiment, samples were prepared by collecting particles with different methodologies, namely, filters or impactors, in different locations in the Venice area. The particles, trapped in the air filters or removed from impactor walls, were isolated and pressed in pellets for the X-ray absorption spectroscopy (XAS) investigation. Eighteen samples, collected in difference locations (near heavy traffic roads, inside road tunnels, at different heights, in the urban surrounding of Venice) were analysed. XAS measurements were performed at Pt L_{III}-edge (11564 eV), Fe K-edge (7112 eV) and Mn K-edge (6539 eV) at the BM08 GILDA beamline, in fluorescence mode, using a 13 elements HP Ge detector. The samples were cooled at LNT to reduce the thermal contribution to the disorder and to avoid reduction under the X-ray beam.

Platinum was observed to be highly diluted in almost all samples, with concentration values below ppm. This made very difficult to isolate its contribution in the fluorescence spectra, due to the presence of the absorption of several other metal species (mainly Mn and Fe), the overlapping of which made critical both the collection and the data analyses. The results do not allow so far to quantitatively address if Pt atoms are bond with organic compounds (PHAs), benzene, CO, or if they are carried as metal or oxide particles. At this stage, we were however able to point out that the Pt exhibits the co-presence of several different behaviours, whose complexity certainly requires further specific investigations. Because of the very low Pt concentration, we investigated the local environment of Mn and Fe, too, in order to retrieve as much information as possible (Mn and Fe also comes from road traffic exhaust).



The figure shows the Fourier moduli at the Fe K-edge for the samples. For several of them, structural values at the Fe edge exhibit similar behaviour (Mn K-edge data analysis is in progress), but small differences indicate a more complex situation, requiring a refinement of the data analysis. The first results for Fe are:

path	number	distance (Angstroem)
Fe-O	4	2.0
Fe-Fe	4	3.0
Fe-N	0.5-1.0	3.4

The comparison with the examined iron standards (Fe oxides, sulphate, nitrate and chloride), measured in this same experiment, and a detailed analysis of the edge region of the spectra (still in progress) should reveal more details (oxidation state and speciation). These experimental findings confirm that Fe actually exhibits different behaviours, which can be in principle related to several environmental parameters, as well as to the status of the engines from which the particulate is origined. In particular, differences were observed depending on the particles size, and this indicates that all the examined metal species can be used as indicators for the improvement of the particulate transport models.

The results should allow adding information in the establishing of a model that must take into account the actual origin of the road dust. The collected data, in particular, will be used to "mark" the particles and to relate the chemical state of the elements at issue to their origin and possible environmental diffusion.