	Experiment title: EXAFS analysis of a Rhenium crystal: search for a link with the fine structure ^{187}Re low-energy β-decay spectrum	**Experiment number**: 08-01-239
Beamline: BM08	**Date of experiment**: from: 27 september 2000 to: 1 october 2000	**Date of report**: 18 march 2001
Shifts: 12	**Local contact(s)**: F. D'Acapito	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

F. Gatti, INFN, Physics Dept., University of Genoa, Italy

F. Gonella, Physical Chemistry Dept., University of Venice, Italy

F. D'Acapito*, GILDA CRG, ESRF, Grenoble, France

C. Maurizio*, Physics Dept., University of Padua, Italy

Report:

The purpose of the research is to point out the link between the EXAFS response of Rhenium and the fine structure of ^{187}Re low-energy β-decay spectrum, with the aim to study the so-called β environmental fine structure. The β-decay spectrum of ^{187}Re is particularly suitable for studying (in its terminal part) possible anomalies related to finite values of the neutrino mass, since this natural isotope has the lowest β-decay energy (Q=2.48 keV). The aim of the proposed experiment is to determine the structure of EXAFS oscillations at the K-edge of crystalline Rhenium. Since Re BEFS spectrum cover an electron energy range of about 3 keV, only EXAFS spectra recorded at K-edge (71.676 KeV) are reliable in such a large photoelectron energy range. In fact, L_I, L_{II} and L_{III}-edges are too close in energy and oscillations from different edges sum up, so preventing a quantitative analysis in the same range at L_{III}-edge, that is the absorption with the highest cross section (in respect to L_I and L_{II}). Moreover, since energy resolution of Re BEFS spectrum is worse than 10 eV, the poor energy resolution of EXAFS spectra in the range 71-74 keV due to core-hole width does not affect the analysis. We prepared three different samples: two slices (60-90 m thick) cut from ^{187} Re monocrystal (0001 and orthogonal plane) and one 50 m slice from a ^{187} Re polycrystal. This thickness range is set for a $\Delta^{-}1$ at Re K-edge. EXAFS spectra will be used as a standard for a quantitative analysis of Re BEFS spectrum. EXAFS measurements were performed in transmission mode using the third harmonic signal coming from a monochromator equipped with two Si(311) crystals; it was used in the so-called

limit Debye-Waller thermal damping. The EXAFS analysis was performed with theoretical phase and amplitudes calculated with FEFF8 code from hesagonal Re crystal: results, reported in Table I, are in agreement with crystallographic data. From the quantitative analysis experimental phases and amplitudes were calculated for the first shell (merging the two first coordinations shells in one) and used for fitting BEFS oscillations (in Fig. 1 the comparison between EXAFS and BEFS spectra is shown). The results, reported in Table I, are in agreement with crystallographic data so showing that BEFS oscillations, as EXAFS, give quantitative information on the local environment around β-emitting atoms. In the same experiment was also measured EXAFS spectrum at K-edge of Au (Eo = 80.725 keV).

	EXAFS	BEFS	CRYST. DATA
	theor. phase ampl.	exp. phase ampl.	
R_1 ( )	2.74–0.02	2.75–0.02	2.7395
R_2 ( )	2.77–0.02		2.7610
σ^2 (10^{-3} ^{2})	11–1	6.2–0.9	
N_1+N_2		11.5–0.5	6+6

Table I Results of EXAFS analysis of K-edge Re spectrum and of the analysis of BEFS oscillation using experimental phases and amplitudes calculated from Re EXAFS spectrum.

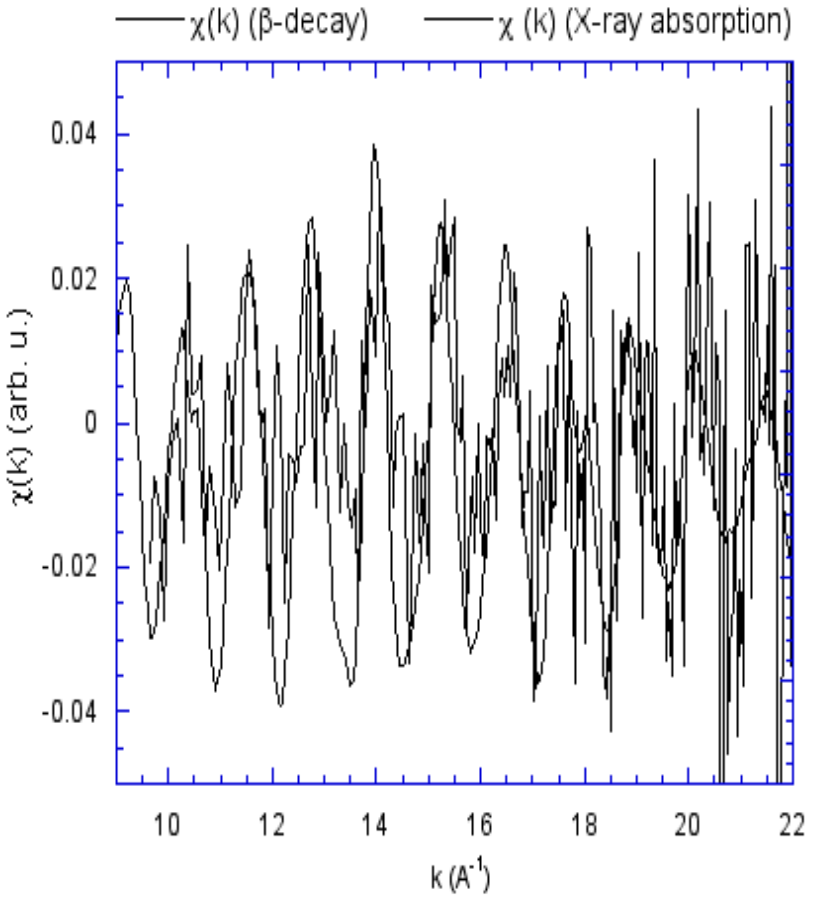

Fig. 1 Comparison between K-edge EXAFS spectrum and BEFS spectrum of a Rhenium crystal.

Publications

F. Gatti, F. D'Acapito, F. Gonella, C. Maurizio, S. Mobilio, S. Vitale, in preparation