	Experiment title: Resonant X-ray scattering from CeSb at Sb L edges	Experiment number: HE-1287
Beamline: ID20	Date of experiment: from: 26/02/02 to: 12/03/02	Date of report: 21/03/02
Shifts: 21	Local contact(s): L. Paolasini	*Received at ESRF:*

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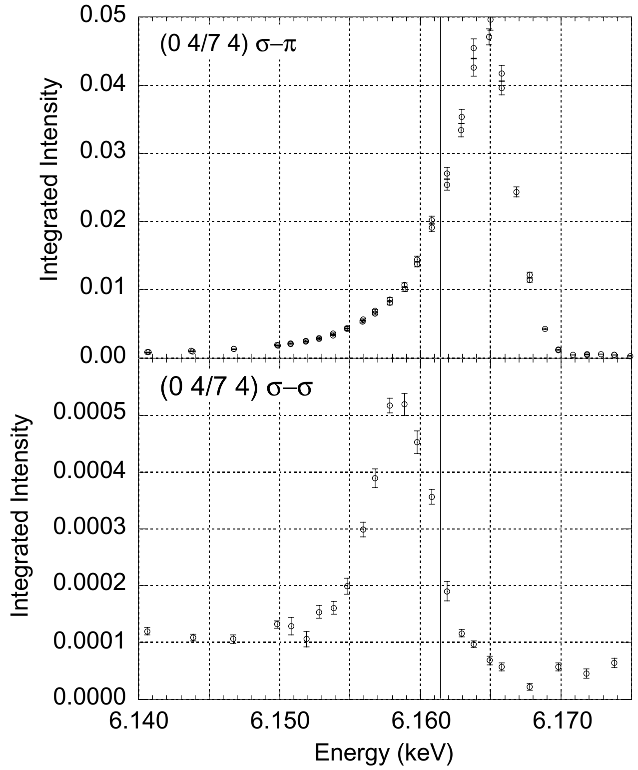
Report:

CeSb has a very complex magnetic phase diagram. Schematically, the magnetic structure propagates along the cubic axes, where “spin up” and “spin down” ferromagnetic planes alternate with paramagnetic plane, in different sequences giving different propagation vectors $\boldsymbol{\tau}_{mag}$ along the cube axes. The magnetic phases of CeSb are thought to be made of two types of Ce atoms, which leads to different interatomic distances, and therefore to lattice distortions, with a different propagation vector $\boldsymbol{\tau}_{lat}$.
The magnetic properties have been accounted for by the existence of a strong *p-f* mixing due to the electronic structure of the Ce. It has been proposed that the valence *p* electrons hybridise strongly with the Ce 4*f* electrons, leading to a reduction of the crystal field splitting, to an extremely large magnetic anisotropy and to the peculiar sequence of antiferromagnetic phases below T_N. Band calculations indicate that the valence *p* electrons come mainly from the pnictides (Sb and Bi).

The sample, a 4x4x4mm^3 cube, cleaved along the cube faces and polished, was mounted in a displex cryostat, on the 4-circle diffractometer of ID20, equipped with polarization analysis. We used a vertical scattering plane and different polarization analyzer crystals: Pyrolitic graphite (006) at 7.84 keV, LiF (220) at the Ce L edges, and Al (200) at the Sb L edges.
The magnetic phases of our sample were known from former neutron scattering experiments. However, the phase diagram can actually be different in the skin region, which we confirmed by first studying the temperature dependence of the lattice modulation at 7.84 keV, *i.e.* away from all absorption edges. While the bulk of the sample goes through 3 different magnetic phases on cooling from 16K to 10K (with $|\boldsymbol{\tau}|$ taking successively the values 4/7, 5/9, and 6/11), the skin region to which we had access with X-rays was frozen in the $|\boldsymbol{\tau}_{mag}| = 4/7$ phase (with lattice distortion propagation vector $|\boldsymbol{\tau}_{lat}|=2/7$). Below 12.5 K, this phase actually coexists with a weak $|\boldsymbol{\tau}_{mag}| = 5/9$ phase. The study of the resonances was then performed at 13.5 K, where we had a pure $|\boldsymbol{\tau}_{mag}| = 4/7$ phase.

Before going to the antimony L edges, we characterized the Ce L_2 and L_3 resonances. We could observe all three magnetic domains, but the domains propagating in the surface were at least 10 to 50 times more populated than the domain propagating perpendicular to the surface. At the L_2 edge, we observed a very strong dipole resonance in $\sigma-\pi$ (10000 cts/s) and a quadrupole resonance in $\sigma-\sigma$ (fig.1, left panel). The resonant intensities measured at the L_3 edge were actually at least one order of magnitude weaker than at the L_2 edge, which is mostly due to stronger absorption along the beam path.
Surprisingly we also observed a strong resonance at the lattice modulation satellites $|\boldsymbol{\tau}| = 2/7$, with an identical energy dependence (strong dipolar resonance observed in $\sigma-\pi$, fig.1, right panel).



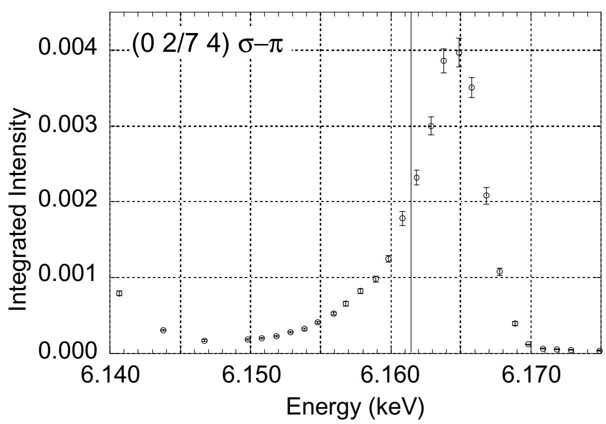


Fig1: Energy dependence of the Ce L_2 resonance at the magnetic (0 4/74) and lattice modulation (0 2/7 4) satellites. The vertical line marks the position of the inflexion point in the fluorescence.

At the Sb L_1 edge, we observed a dipole resonance, corresponding to 2s-4p transitions (fig.2). Like at the cerium $L_{2,3}$ edges, this resonance is also observed at the lattice distortion satellites. We checked that these resonant signals disappear above the phase transition, as expected for a p-f mixing mechanism. We also observed a weaker resonance at the Sb L_3 edge.

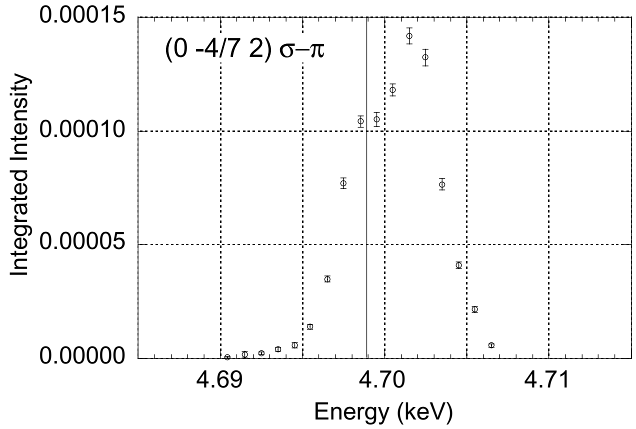


Fig2: Energy dependence of the (0 4/7 2) magnetic intensity around the Sb L_1 edge. The vertical line marks the position of the inflexion point in the fluorescence.