ESRF	**Experiment title:** Search for hidden order in the unconventional noncentrosymmetric superconductor $CePt_3Si$	**Experiment number:** HE-3477
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Shifts: 18	**Local contact(s):** Luigi Paolasini	*Received at ESRF:*

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The aim of the experiment was to investigate the antiferromagnetically ordered phase of the non-centrosymmetric heavy-fermion $CePt_3Si$ [1–4]. Unconventional superconductivity evolves out of this phase and there is some experimental evidence that the magnetically ordered state could either consist of two different phases or possess higher order multipolar components, which would provide new routes for the pairing mechanism of unconventional superconductivity.

The new displex being unavailable, measurements were performed in an orange cryostat at a nominal temperature of 1.55 K, i.e. well below T_N of 2.2 K. Polarization analysis was performed using a LiF(220) analyzer. The $CePt_3Si$ crystals were mounted with $(h0l)$ as horizontal scattering plane with $(00l)$ in specular geometry, since the magnetic propagation vector is $\mathbf{k} = (0, 0, 1/2)$.

The first crystal showed weak non-resonant, energy-independent, and temperature-independent charge peaks in the π–π channel at magnetic positions of type $(h, k, 1/2)$, and even other "half-positions" such as $(h+1/2, k, l)$ and $(h+1/2, k+1/2, l+1/2)$. No resonant magnetic signal was detected at the L_3 edge of Ce at 5.724 keV, where electric dipole transitions probe $2p_{3/2} \rightarrow 5d$ transitions, even with strong beam attenuation (to lower the sample temperature). It is possible that these half-position reflections are related to stacking faults of the non-centrosymmetric structure. Since the only known ways to grow large single crystals of $CePt_3Si$ are Bridgman or image furnace (the latter being used by us), such faults as well as wide mosaic spreads could indeed be expected. In view of the observation of half-position reflections, important rod-scattering, and rather poor mosaic of 0.17°, it was decided to change to another crystal.

The second crystal was considerably better, with a mosaic of only 0.06°, no rod-like scattering, and no charge peaks at half-positions. The existence of two distinct grains separated by 0.35° caused no major problems, as one of the grains could be avoided by careful alignment and closing of the beam-defining slits. Scans in θ and along l of magnetic specular positions (0,0,2.5), (0,0,3.5) and off-specular (1,0,3.5) in both the π–π and π–σ channels for both resonant and slightly off-resonant energies of the L_3 edge and for various beam attenuations (to limit the effect of beam heating) were performed. No magnetic signal was observed.

We also tried the L_2 edge at 6.165 keV, where electric dipolar transitions probe $2p_{1/2} \rightarrow 5d$, in the same configuration as before and with similar types of scans. The (0,0,2.5) position was affected by high background, but finally, very early on Monday morning we found the first resonant magnetic Bragg peak in a specular reflection in the π–σ channel at T=1.51 K. This reflection was then optimized, and the optimal beam attenuation of 31.5 (a compromise between flux and temperature) was found. A typical longitudinal Q-scan is shown in Figure 1(left) and an energy scan showing the resonance is shown in Figure 1(right). In the absence of the displex, azimutal scans could not be performed, so we measured instead a series of magnetic Bragg reflections along the specular (00l) direction, from which information on the dipolar moment direction can be obtained. A preliminary analysis shows that the moment is essentially along the c axis, with $m_a/m_c < 0.05$, in contradiction with published neutron scattering results [2–3].

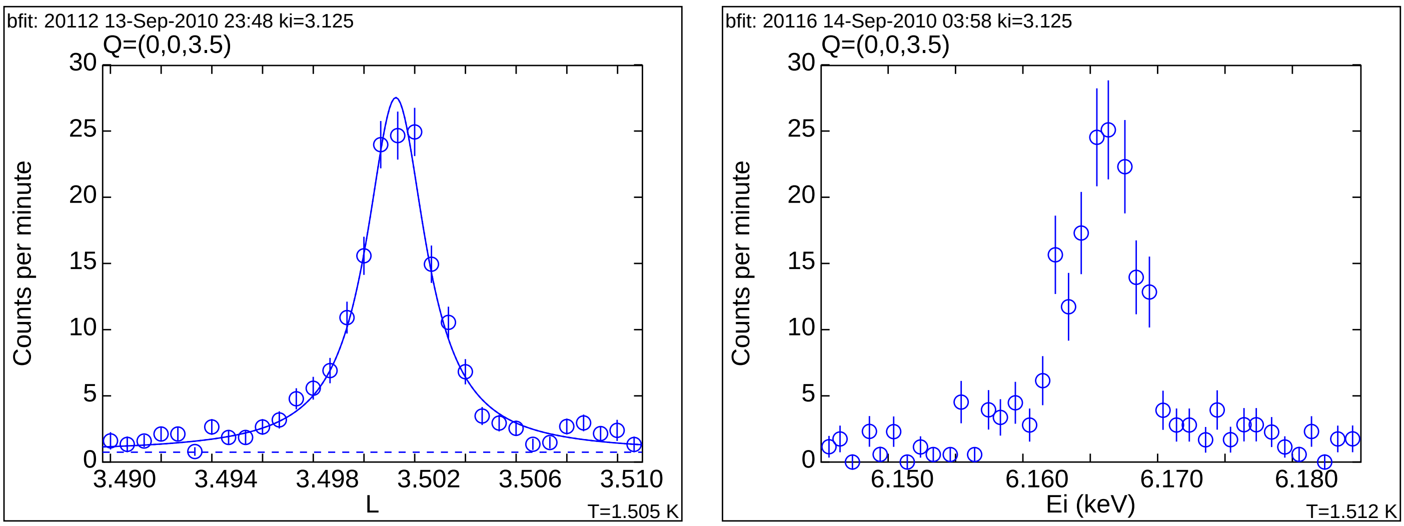

Figure 1. Scan along l (left) and in energy (right) of the (0,0,3.5) magnetic Bragg peak.

References

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