ESRF	**Experiment title:** **Spin-Polarized-Circular-Polarized** Resonant **Photoemission**	**Experiment number:** **HC-275**
Beamline: **BL26**	**Date of experiment:** **from:** 18-Oct-9595 to: 29-oct-95	**Date of report:** **25/3/96**
Shifts: 30	**Local contact(s):** **N.** B. Brookes	*Received at ESRF:* 15 APR 1996

Names and affiliations of applicants (* indicates experimentalists):

Prof. Dr. G. A. Sawatzky, Univ. of Groningen, The Netherlands

Dr. Ir. L. H. Tjeng*, Univ. of Groningen, The Netherlands

Dr. E. Pellegrin *, Univ. of Groningen, The Netherlands

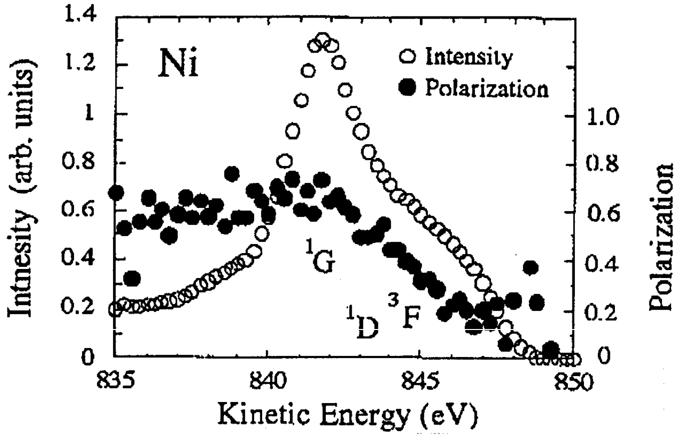
R. Hesper *, Univ. of Groningen, The Netherlands

Dr. B. Sinkovic*, New York University, USA

Dr. N. B. Brookes*, ESRF, France

Dr. J. B. Goedkoop*, ESRF, France

Report: In the Oct.'95 experimental run at BL26 we have successfully performed the first spin-resolved circularly-polarized resonant (L3) photoemission (SRCPRPES) experiment. Such "complete" photoemission measurements have the unique ability to measure the spin character of the single-particle excitation spectrum which will provide fresh insight into the nature and the behavior of quasi-particles in strongly correlated systems. Since such measurements are not confined to the system with net macroscopic magnetization (as ordinary spin-resolved photoemission measurements are), this new technique can be applied to any system, including antiferromagnets and paramagnets, thus being able to study a variety of highly correlated systems including for example HTc superconductors and ferromagnets above their Curie temperature. In our first measurements we have concentrated on the study of Ni above and below the Curie temperature and we have also obtained some preliminary data on CUO. The measurements were performed using NYU's spin-resolving electron spectrometer (including UHV-chamber) that was shipped from the US and reassembled at ESRF. The Ni sample was prepared in the form of a thick film grown epitaxially on CU(001) substrate in a UHV environment. The nickel films exhibited out-of-plane magnetization (perpendicular to surface) as reported by others, and its magnetization state was measured by absorption MCD. In order to prove that the proposed experiment is capable of measuring spin character of single-particle excitation spectrum of any material, including those exhibiting no net macroscopic magnetization, we have first performed SRCPRPES measurements on Ni below the Curie temperature (at room temperature: $T=0.48T_C$) on an unmagnetized Ni film. This was achieved bv demagnetizing the Ni film with the coils and monitoring the MCD effect until it became less then 2.5% of its initial (fully magnetized) value. The resonant Ni L3 photoemission spectra were recorded along surface normal with circularly polarized light from BL26 coming at 45° wrt the surface normal. The sum of the four spectra (I+(up), I+(down), I-(up),I-(down),) obtained with two felicities of the light (+ and -) and two channels of the spin detector (up and down) is shown in the Fig. below (0). The local spin-polarization was calculated using the four spectra taking into account the geometry of the experiment and the spin detector's Sherman function, see Fig. below (S):



The intensity profile (0) corresponds to the well known spectral distribution associated with d^8 final state, composed of mostly 1 G, ID, and 3F multiples. We measure a large local spin-polarization of +60% at the peak maxima assigned to the 1 G multiplet in agreement with theoretical predictions and previous spin-resolved M_{23} -resonant measurements of Clauberg et al. However our measurements at the giant L3-resonance also permit the investigation of the polarization of the other multiples (1D and 3F) which are not overshadowed by the direct photoemission, as they are at M_{23}-resonance. Our results indicate a strong decrease in the polarization for the lD, 3F part of the spectrum. However the polarization doesn't become negative as may be expected for the pure 3F state, which we interpret as being due to the decrease of triplet matrix elements due to correlation effects. In order to test for any possible sources of instrumental spin asymmetries that may contribute to the spin polarization spectrum we have performed a "null''experiment by keeping all the experimental parameters the same and replacing the Au-target in the spin detector with a carbon one. The C-target has no measurable spin sensitivity (S=0.00) and all observed "spin polarization" would be attributed to instrumental asymmetries. Our measurement of zero "spin-polarization" using C-target was therefore an experimental proof that the polarization curve shown above is the true local spin-polarization of the single particle excitation spectrum of Ni. It was thus of particular interest to measure the same SRCPRPES spectra above the Ni Curie temperature. The measurements at $1.04T_c$ have been performed and they also show large local spin polarization indicating that the magnitude of the local Ni magnetic moment (d-contribution) is preserved above the Curie temperature which is incontrast to the Stoner picture of the itinerant magnetism at finite temperature.

*The manuscript based on Ni SRCPRPES measurements is in preparation.