ESRF	**Experiment title:** Search for magnetic moments in a typical correlated 2D system on a frustrated triangular lattice: Sn/Si(111)-√3x√3	**Experiment number**: **HC-3664**
Beamline: ID18	**Date of experiment**: from: 26 feb 2018 to: 7 mar 2018	**Date of report**: 22-02-2019
Shifts: 18	**Local contact(s)**: Aleksandr Chumakov	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Silvio Modesti*, Dipartimento di Fisica, Università di Trieste, Trieste IT

Alessandro Barla*, CNR – Istituto di Struttura della Materia, Trieste IT

Giorgio Rossi*, Dipartimento di Fisica, Università di Milano, Milano IT

Caterina Petrillo*, Dipartimento di Fisica e Geologia, Università di Perugia, Perugia IT

Francesco Sacchetti*, Dipartimento di Fisca e Geologia, Università di Perugia, Perugia IT

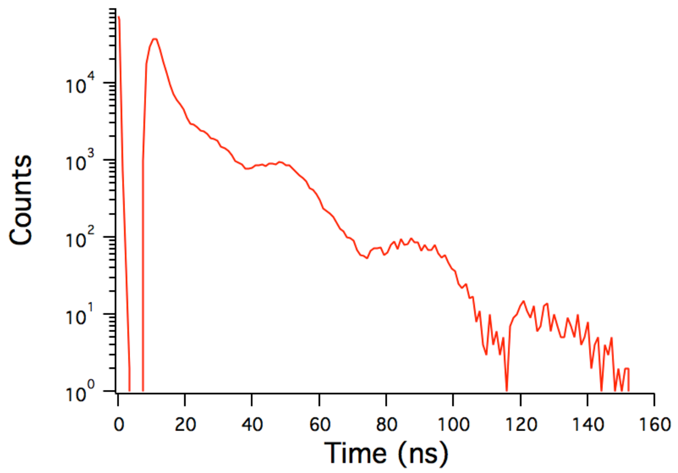
Report:

An UHV system with a manipulator cooled by liquid He, LEED, Sn evaporator and other facilities was built in Trieste for this experiment, brought to ESRF, assembled and mounted on the ID18 with the help of the beamline scientists and technicians. The system reached UHV conditions and the sample holder reached 24 K, well below the temperature of the metal-insulator transition of the Sn/Si(111)-√3x√3 surface (60 K). Two Si(111) substrates were mounted on the sample holder on the manipulator.

The Sn/Si(111)-√3x√3 surfaces at a coverage of 0.33 monolayers (ML) of Sn were obtained by flash-annealing of the Si substrate at ~1500 K, annealing at 1100 K , cooling down to RT, depositing enriched ^{119}Sn from a calibrated evaporator, and annealing at 900 K. The quality of the surface was checked by LEED. The samples have been then cooled to ~25 K.

Time resolved nuclear resonant scattering (NRS) at 23.9 keV under UHV conditions using grazing incidence and forward scattering conditions was used to measure the possible Zeeman splitting of the ^{119}Sn levels caused by the magnetic moment on the Sn $5p_z$ orbitals. The acquisition time of a time resolved spectrum with good statistics was of the order of a few hours, with total counts of the order of 10^5 – 10^6 in a 15-150 ns range. During the acquisition time the contamination of the surface at 25 K was acceptable. The sample temperature was then raised above the metal-insulator transition temperature (60 K) to measure the NRS spectrum in the metallic phase. During the warming above 80-100 K the surface contamination of the sample was not negligible. Because of this problem some spectra were measured cooling the samples from RT to about 150 K directly. Spectra of the “mosaic phase” of Sn/Si(111)-√3x√3 at 0.15 ML of Sn , of the 2√3 x 2√3 phase at about 1 ML, and of the clean Si(111) surface where acquired to make a comparison with those of the correlated √3x√3 phase at 0.3 ML. The re-alignment process of the beamline and the experimental chamber and the recovery of the resonance condition after every new sample preparation, temperature change and monochromator instabilitiy required 1-1.5 hours by the beamline scientists and could not be done reliably by the users themselves, new to the beamline.

The analysis of the NRS spectra is in progress. Both the MOTIF software provided by the beamline scientists and a program written by one of the participants are used. The appearance of the spectra measured at different temperatures does not support the presence of a strong temperature dependent magnetic signal. On the other hand, a simple quadrupole doublet, as expected for the paramagnetic state of Sn/Si(111)-√3x√3 surfaces at a coverage of 0.33 monolayers (ML) of Sn, cannot reproduce the measured data. Thus, more complicated models will have to be explored for the final analysis.



Time resolved NRS spectrum of 0.3 ML of Sn on Si(111) at about in grazing incidence and forward scattering conditions