ESRF	**Experiment title:** Pressure dependence of the crystal field, i.e. d-d, excitation spectra in $La_{5/3}Sr_{1/3}NiO_4$ system by resonant inelastic x-ray scattering.	**Experiment number:** **HE- 3466**
Beamline: ID16	**Date of experiment:** from: 03 Nov. 2010 to: 09 Nov. 2010	**Date of report:** 21-March-2011
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Names and affiliations of applicants (* indicates experimentalists):

*SIMONELLI Laura and *HUOTARI Simo

ID 16 Inelastic X-ray Scattering Line

European Synchrotron Radiation Facility (www.esrf.eu),

6 Rue Jules Horowitz, BP220, Grenoble Cedex, 38043 France

Report:

The aim of this experiment is to investigate the pressure dependence of the crystal field, i.e. d-d, excitation spectra in $La_{5/3}Sr_{1/3}NiO_4$ system by resonant inelastic x-ray scattering (RIXS) and X-ray Emission Spectroscopy (XES).

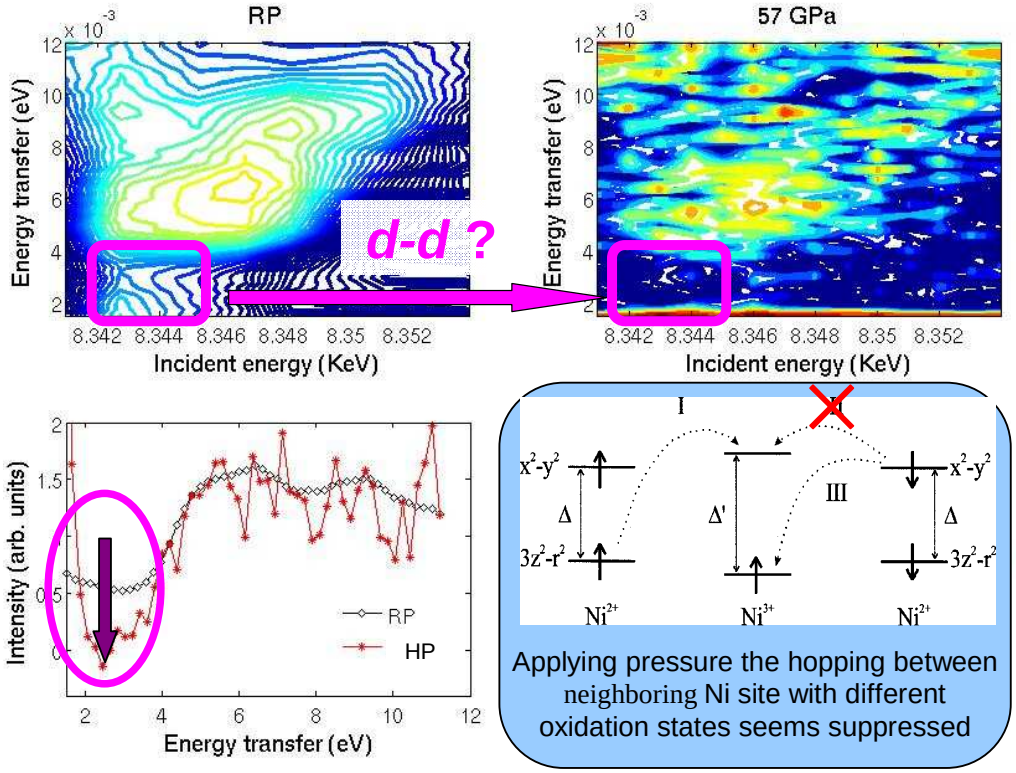

Fig 1. *On the top: RIXS map at room pressure (left) and high pressure (right). On the bottom: summing the RIXS maps toward the incoming energy direction we obtained the classical spectra intensity vs energy*

transfer (left), where the low energy spectral weight seems suppressed applying the pressure. On the right, model used for the interpretetion of the room pressure data [2].

Due to the difficulties of a high pressure study on striped compounds, not many experiments have been performed so far. Nevertheless, high-pressure effects open up possibilities for finding new features [1] and for understanding the properties of stripe states [2].

We measure the pressure effect on the d-d excitations in the $La_{5/3}Sr_{1/3}NiO_4$ system showing the suppression of the inelastic intensity around 2 eV at high pressure. Following the model represented in Fig. 1 the hopping between neighboring Ni site with different oxidation states results suppressed applying pressure. Looking at the Kβ emission line we experimentally detect the high spin (HS) to low spin (LS) transition that has been theoretically predicted by applying an external pressure [1].

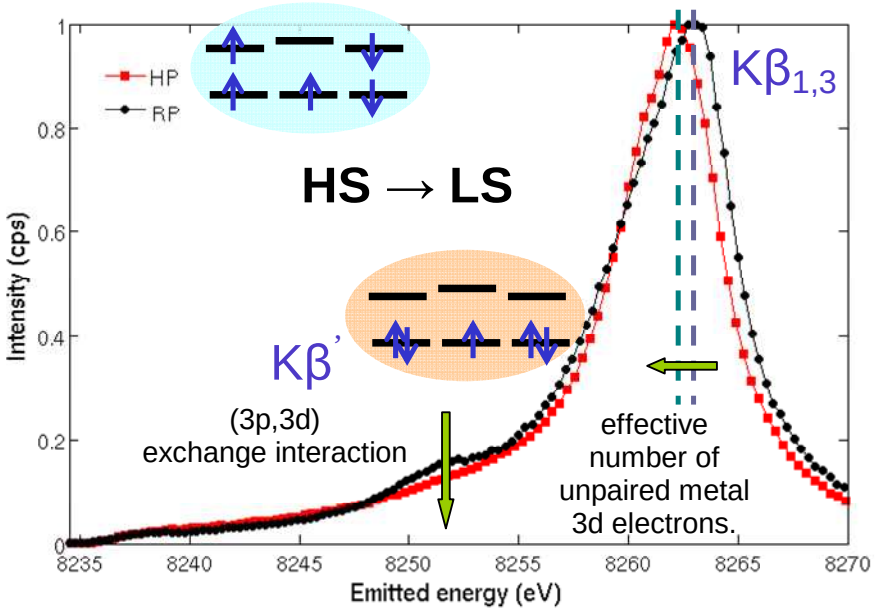

Fig. 2 *Kβ emission line at room (RP) and high pressure (HP, 57 GPa). A clear high spin (HS) to low spin (LS) transition is detected by applying pressure*

This result is nicely in agreement with the previous one. In fact in the low spin configuration the hopping between neighboring Ni site with different oxidation states results suppressed.

The results helped to clarify the role of electronic properties in strongly correlated materials, especially in the stripe ordering regime.

References

[1] Eiji Kaneshita and Alan R. Bishop, "*Pressure-Induced Phase Transition to a Novel Spin State in Striped Nickelates*", Journal of the
physical Society of Japan **77**, 123709 (2008)

[2] Simonelli et al., "d-d excitations and charge ordering in La5/3Sr1/3NiO4", Phys. Rev. B **81**, 195124 (2010)