



Time-resolved RIXS study of NiO photoexcited above the optical gap

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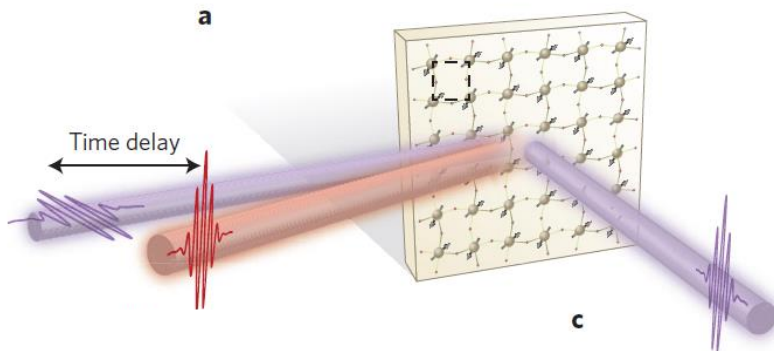
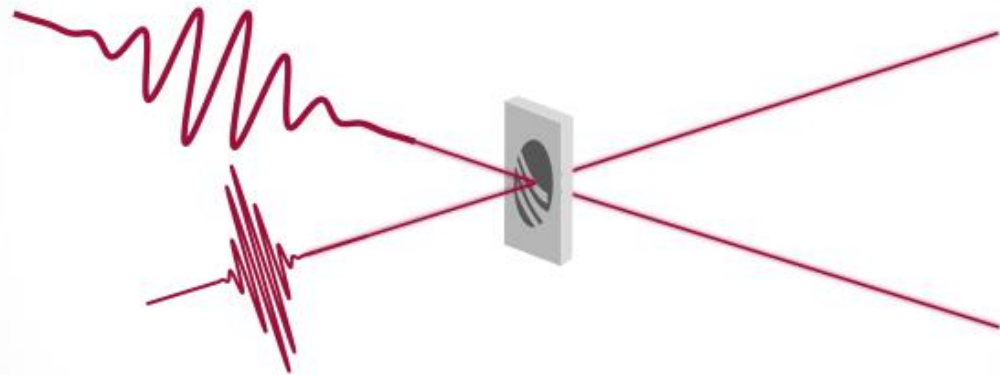


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XFEL User Meeting 2023

Pump-probe spectroscopies

- New perspectives on ground-state physics



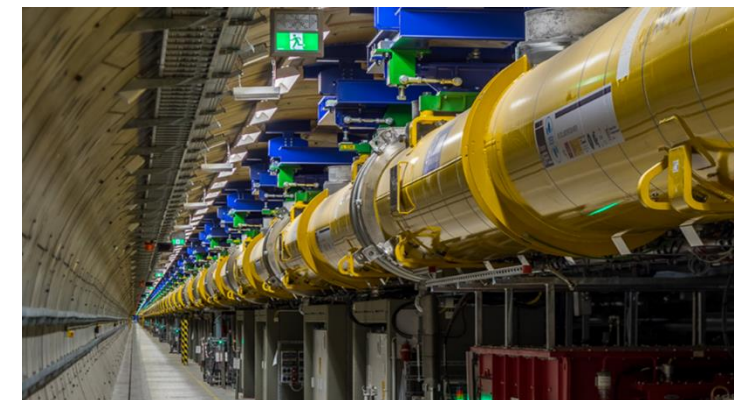
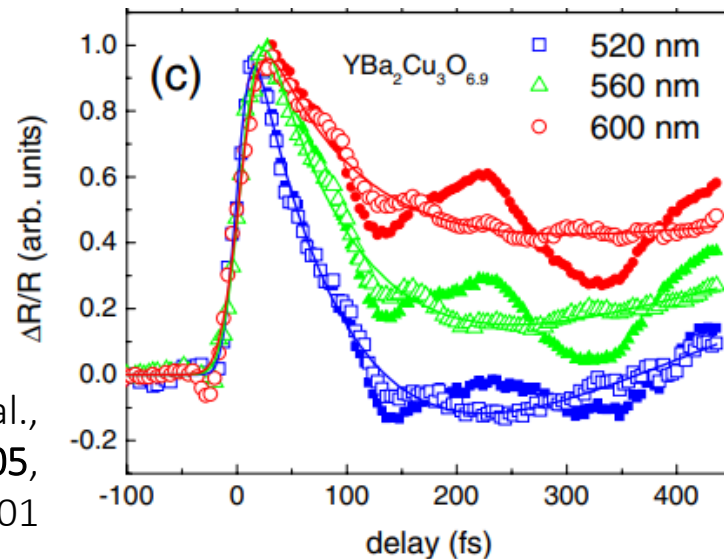
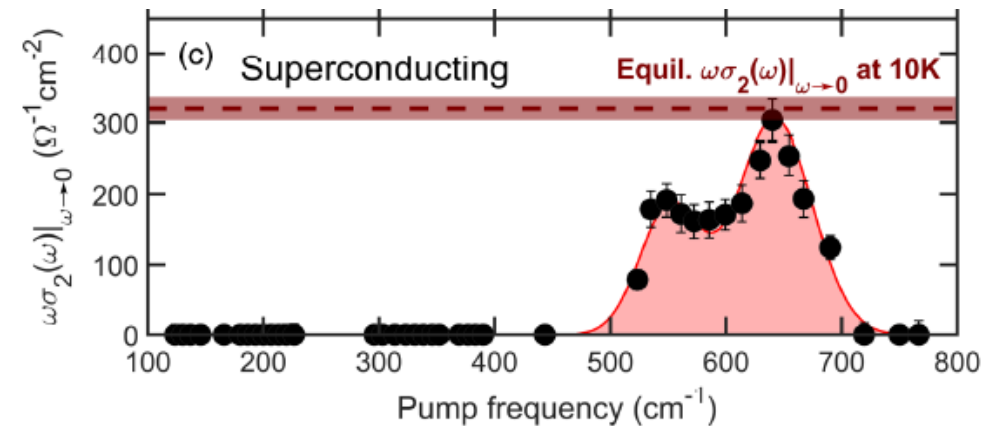
Dean, M., Cao, Y., Liu, X. *et al.* . *Nature Mater* **15**, 601–605

C. Gadermeier *et al.*, *Phys. Rev. Lett.* **105**, 257001

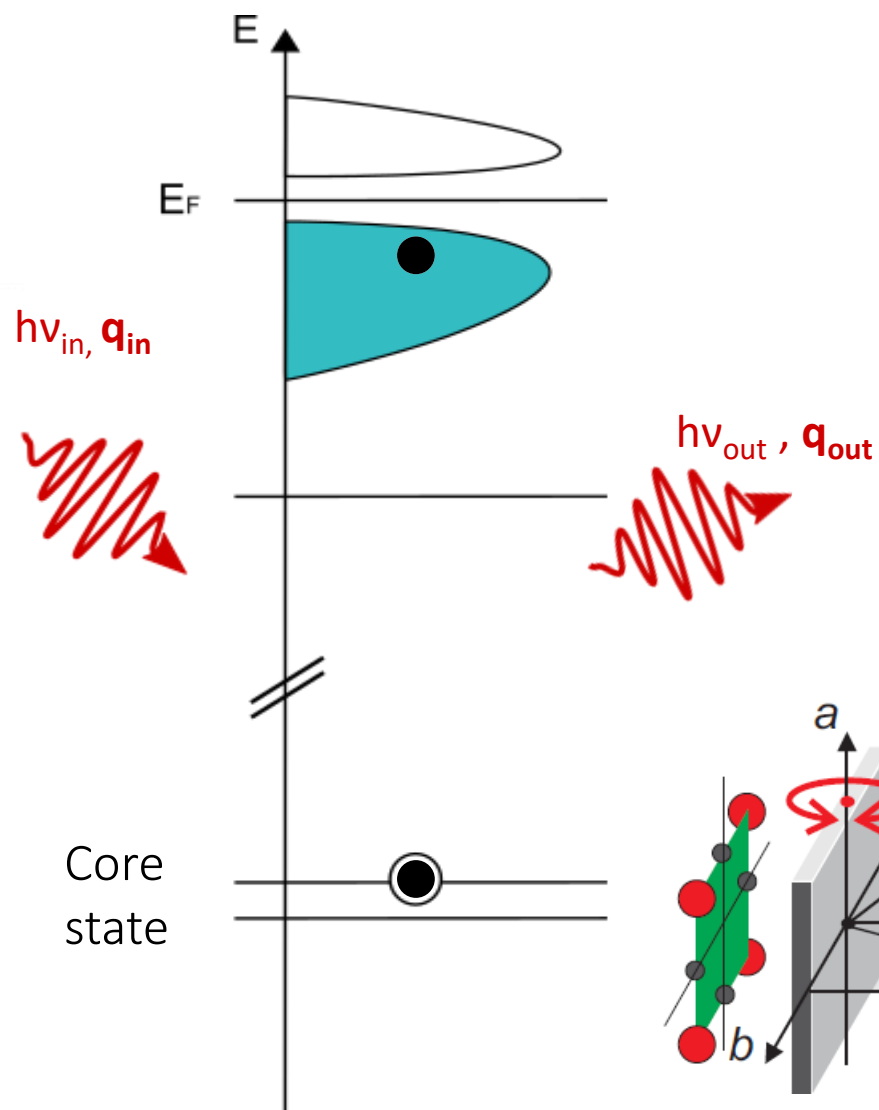
- Exploring meta-stable excited state

B Liu *et al.*, *Phys. Rev. X* **10**, 011053 (2020)

Mankowsky, R., Subedi, A., Först, M. *et al.* *Nature* **516**, 71–73 (2014).

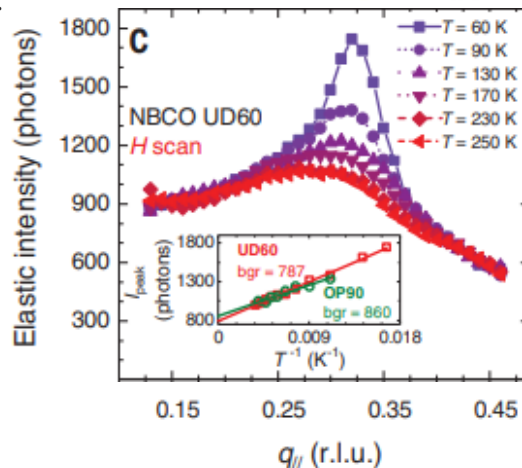
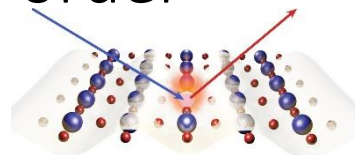


Resonant Inelastic X-ray Scattering

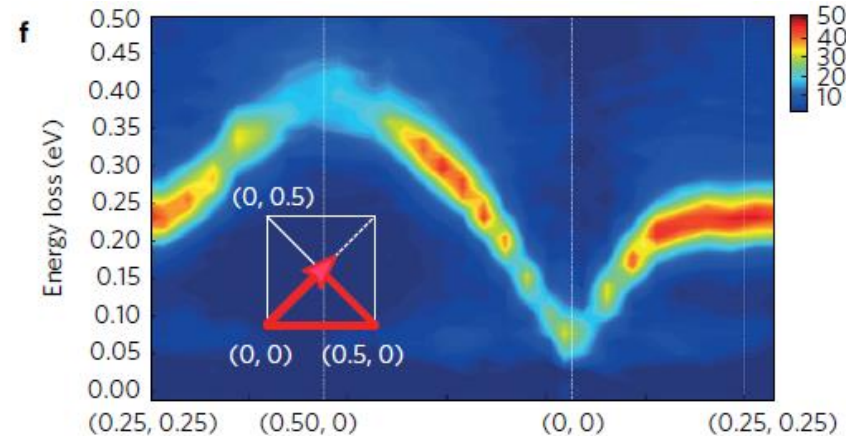


Charge-order

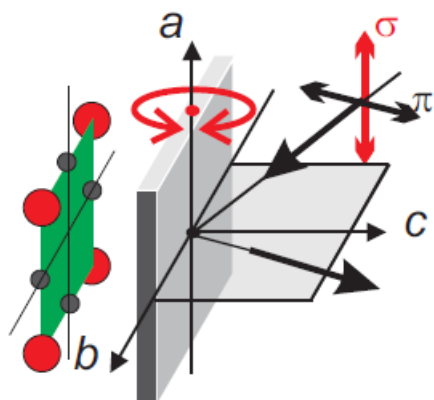
Arpaia, R., et al. *Science* 365 (2019): 906-910.



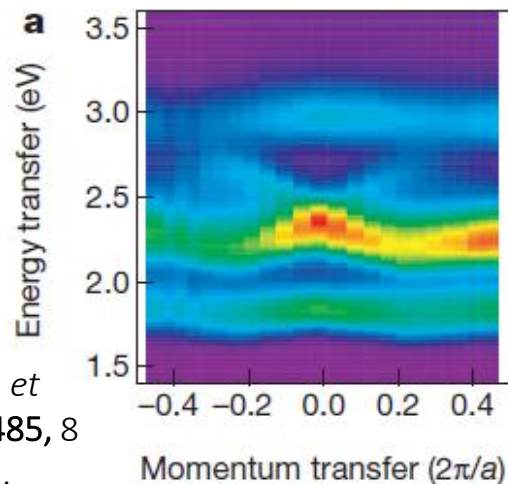
Magnetic excitations



Peng, Y. Y., et al. *Nature Physics* 13 (2017): 1201-1206.

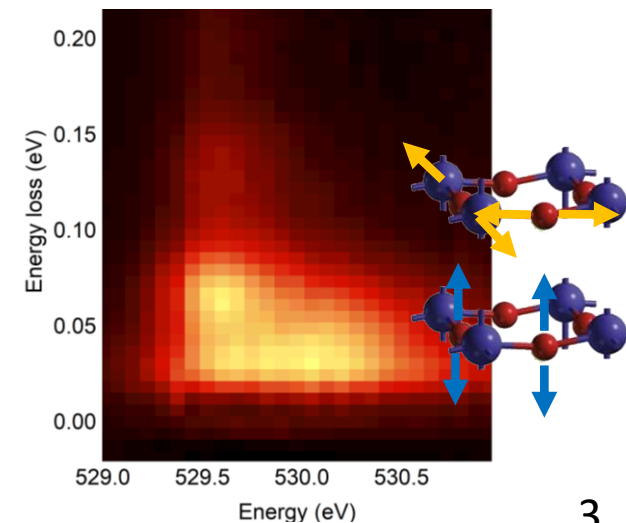


Orbital

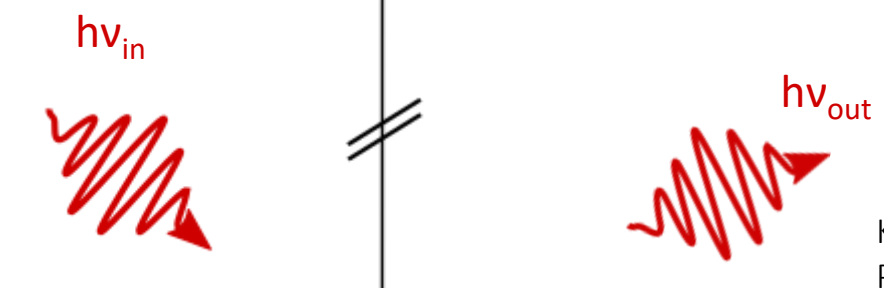
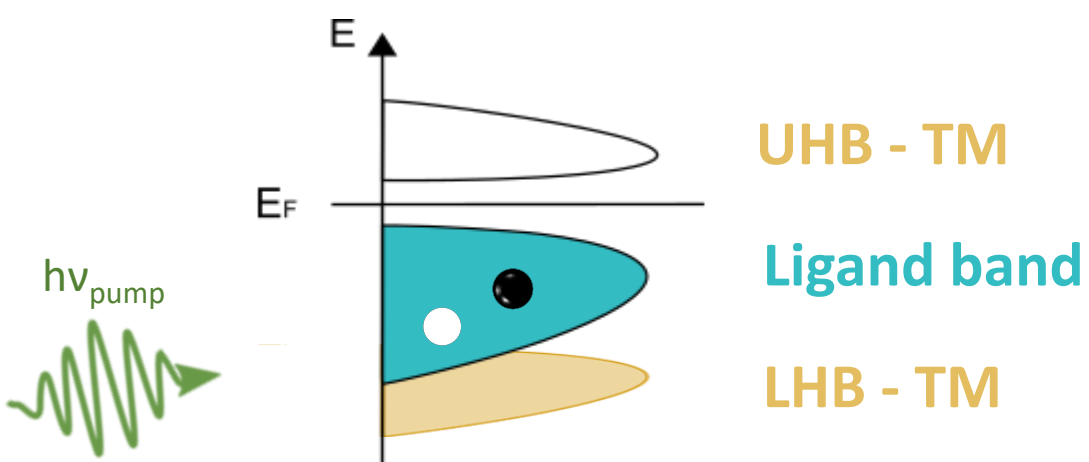


Schlappa, J., et al., *Nature* 485, 82-85 (2012).

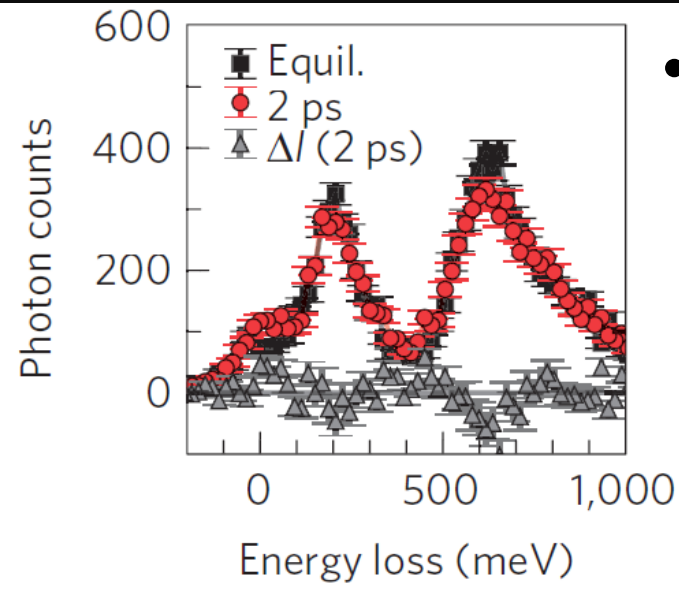
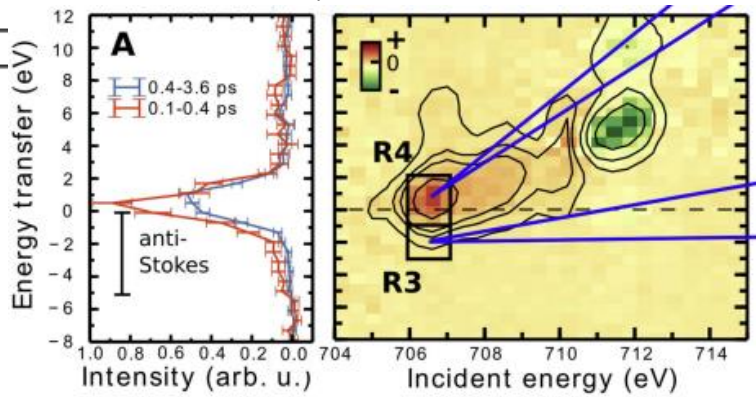
Phonons



ppRIXS



• Kristjan Kunnus et al 2016 New J. Phys. 18 103011

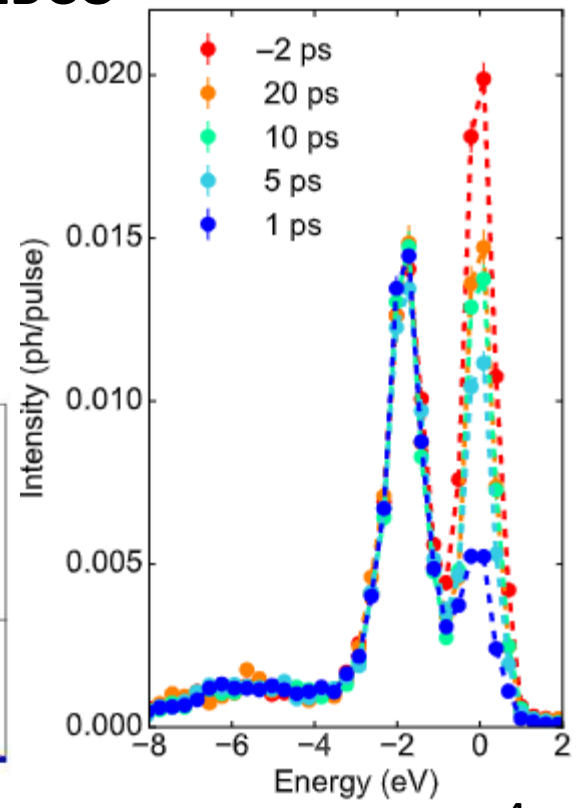


• Hard x-ray: Sr₂IrO₄

Dean, M., Cao, Y., Liu, X. *et al.* . *Nature Mater* 15, 601–605

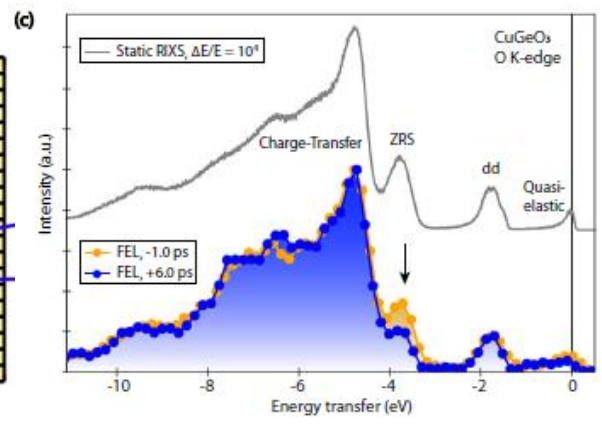
M. Mitrano, et al. *Science advances* 5.8 (2019): eaax3346.

LBCO



CuGeO₃

Paris, E., *et al.* *npj Quantum Mater.* 6, 51 (2021)

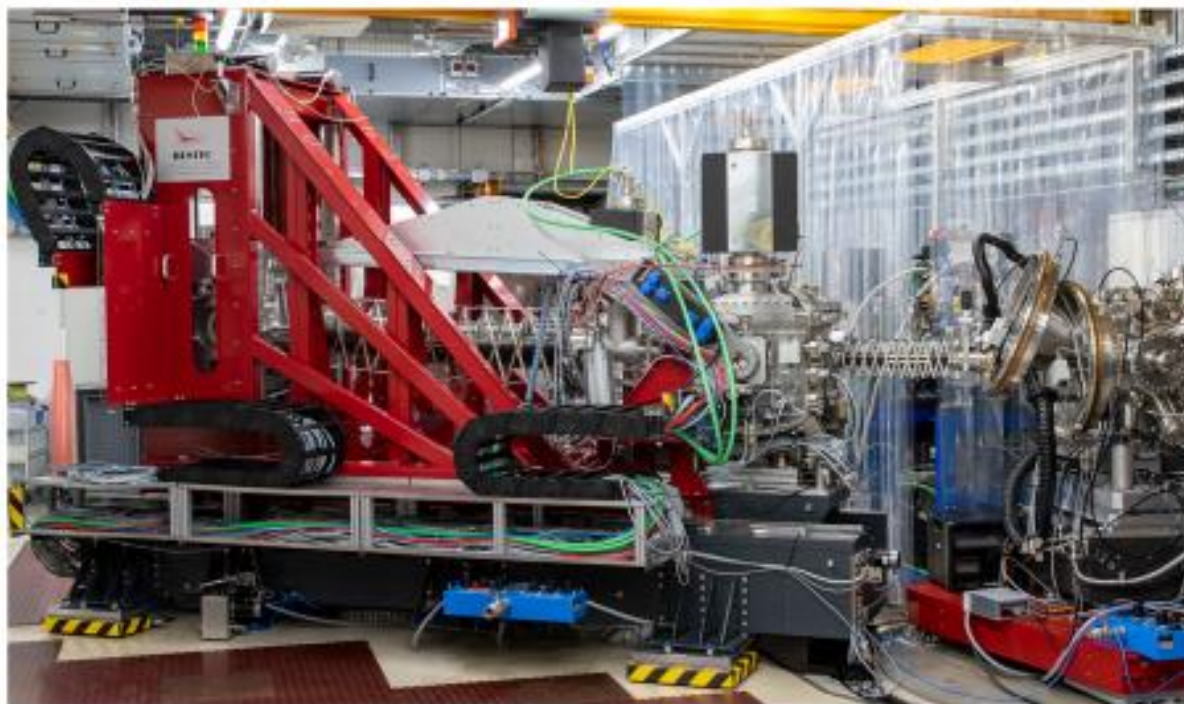


hRIXS @ SCS instrument: first **high-resolution**,
tr-RIXS spectrometer in **soft x-rays**,

Design and built by the hRIXS Consortium 

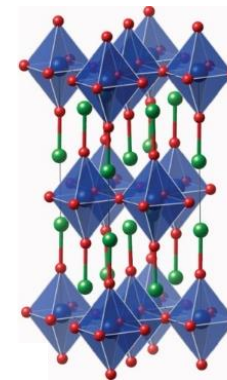
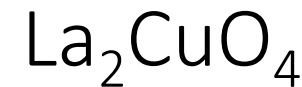


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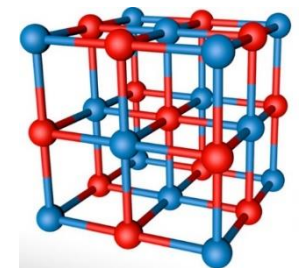


- Feb-March 2022: Commissioning and first pump-probe RIXS at the Cu and Ni L₃ edges, with 800, 400 and 266 nm laser pumps.

Poster 24
Giacomo
Merzoni



Cu L₃ (2p → 3d)
E ~ 930 eV

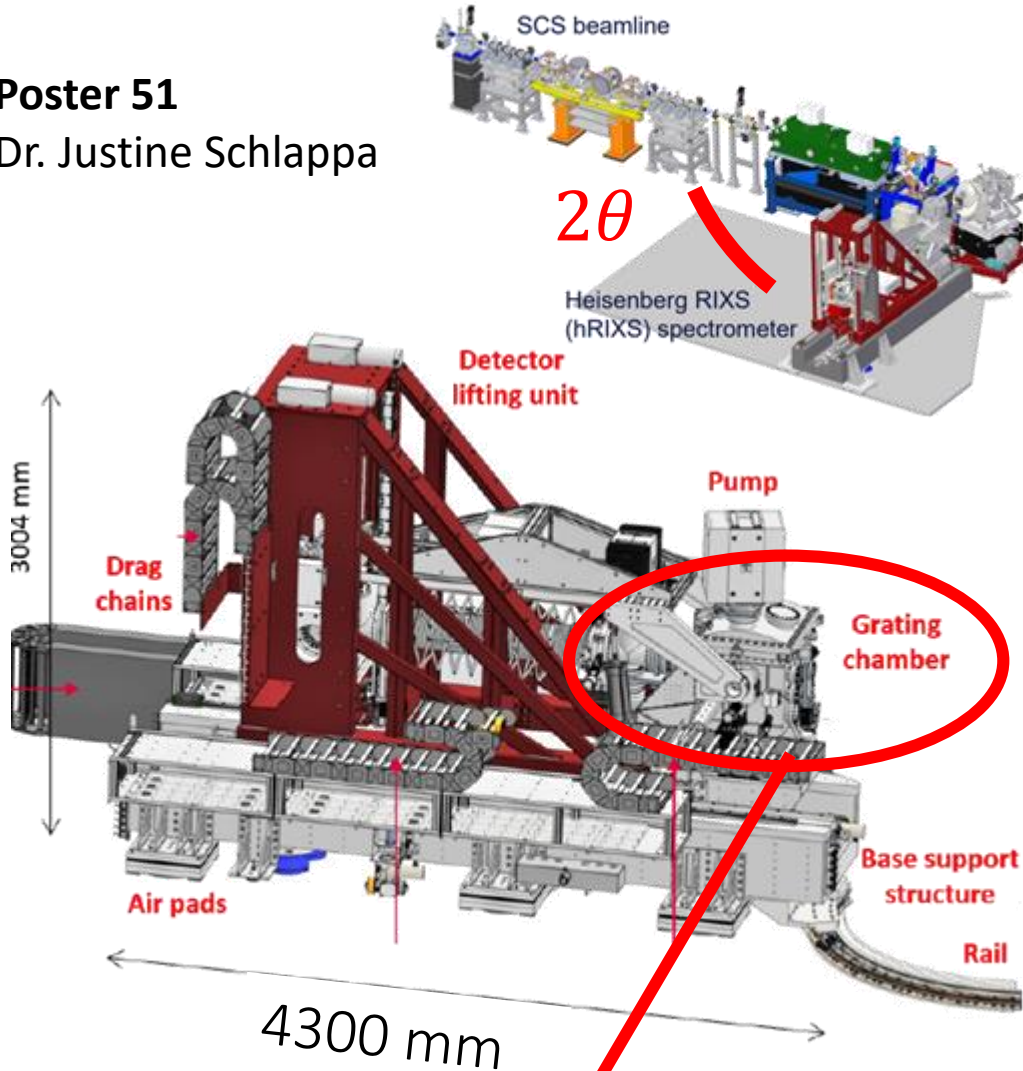


Ni L₃ (2p → 3d)
E ~ 850 eV

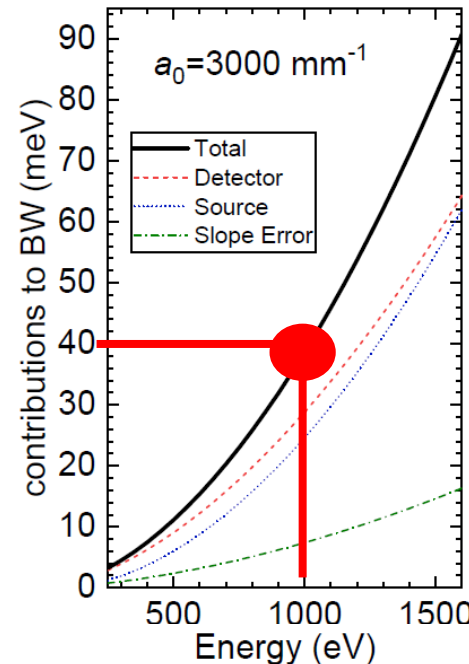
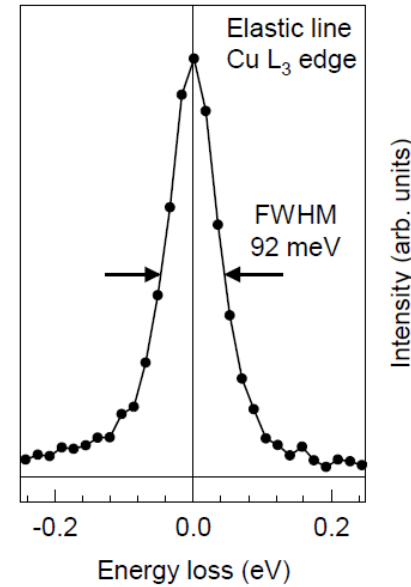
hRIXS: details and performance

Poster 51

Dr. Justine Schlappa



- Spherical VLS gratings (3000 lines/mm, 1000 lines/mm)



X-ray pulses:

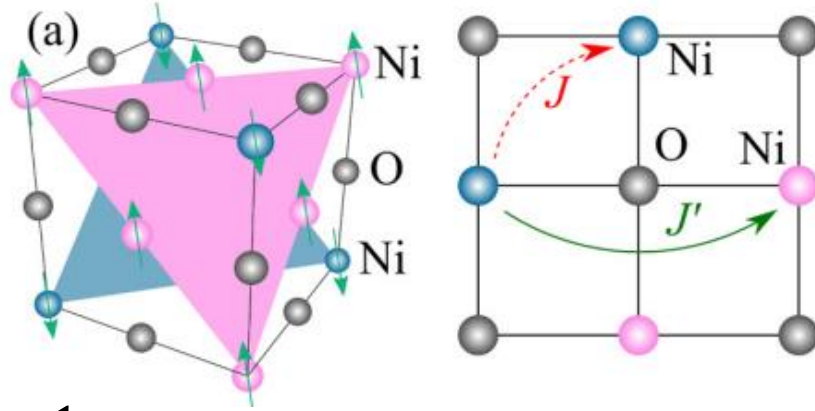
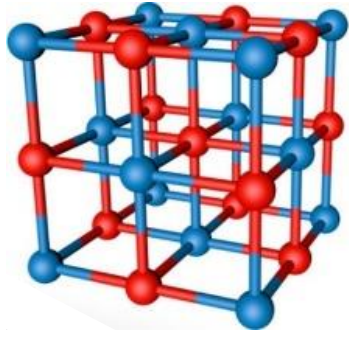
- 113 kHz (intra-train acquisition) (39 x 10 pulses/s),
 $1.3 \cdot 10^{12} ph/s$
- 90 meV resolution @ Ni L₃ egde (resolving power ~ 10.000)
- 100/150 fs temporal resolution

Laser pump:

- 266 nm THG (4.66 eV), fluences up to 35 mJ/cm² 50x300 μm² spot size

Tr-RIXS of NiO @ SCS

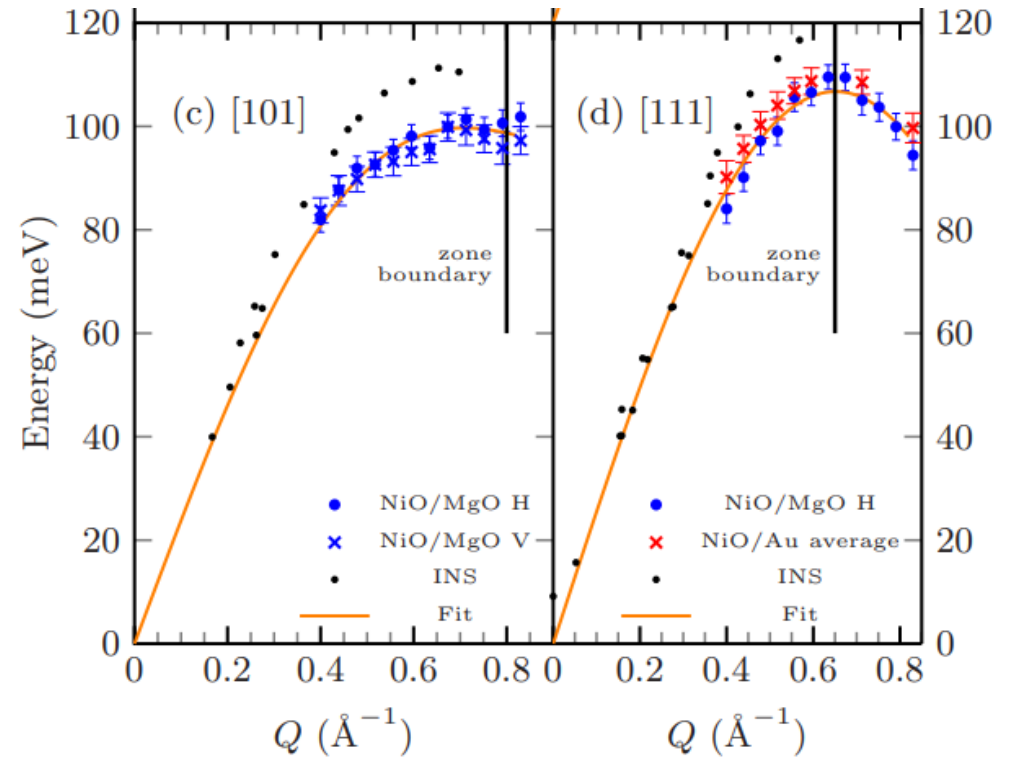
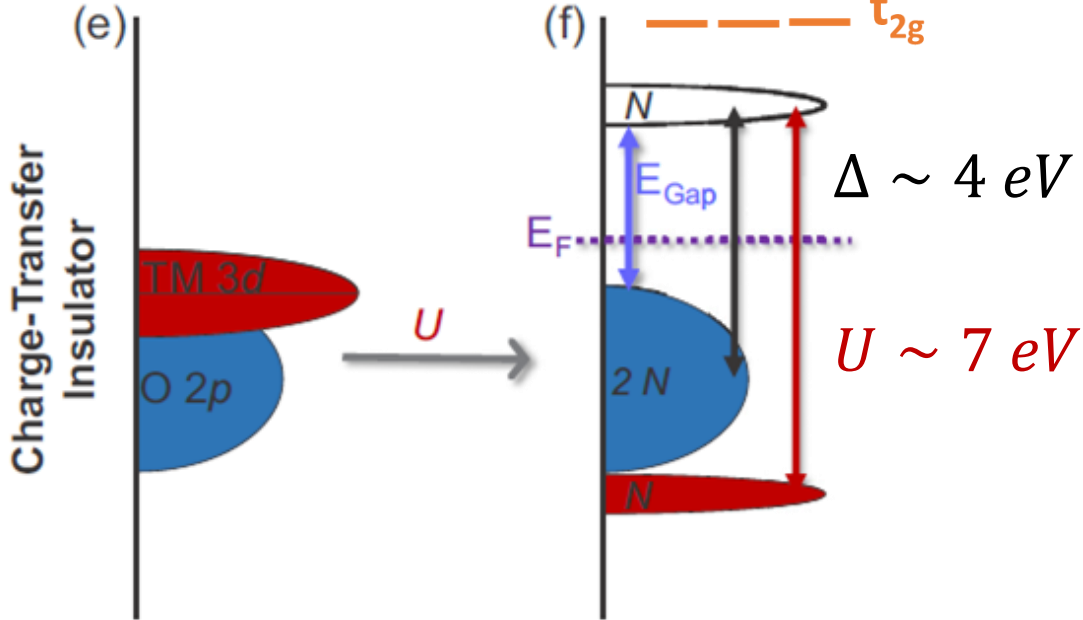
NiO



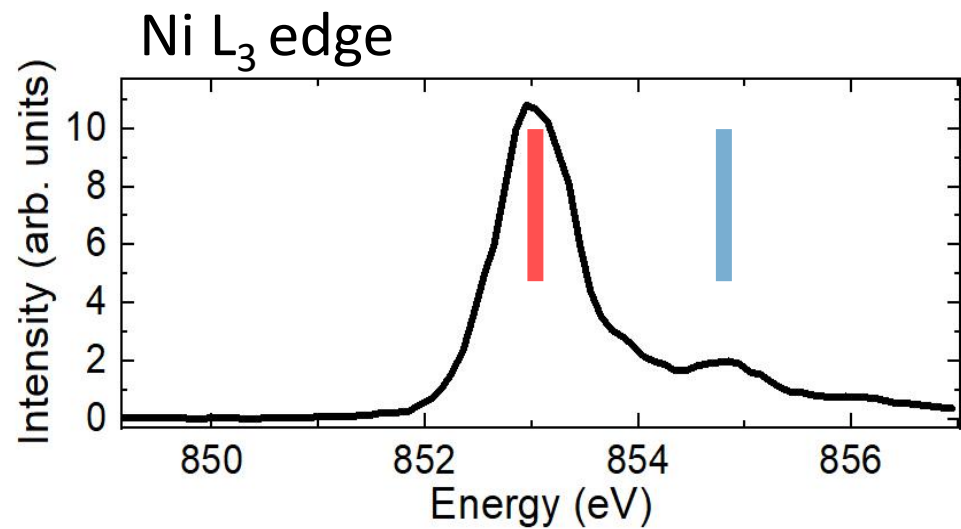
$$J \sim 20 \text{ meV}$$

$$E_{mag} \sim 120 \text{ meV}$$

Betto et al., Phys. Rev. B 96, 020409(R) (2017)



Static XAS and RIXS on NiO



G. Ghiringhelli et al., PRL 102, 027401 (2009)

G. Ghiringhelli et al 2005 J. Phys Condens. Matter 17 5397

