PAUL SCHERRER INSTITUT

PSI

Wir schaffen Wissen – heute für morgen

Paul Scherrer Institut

Sándor Tóth

Life as a PSI Fellow ☺

Short intro

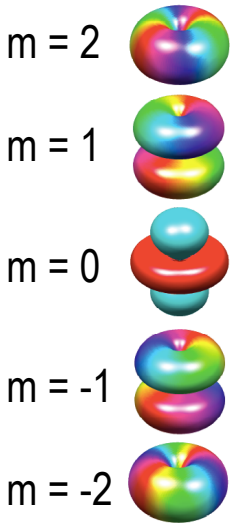
Name:
Sándor Tóth

Scientific background:
-Development of holgraphic microscope at Hungarian Academy of Science, Budapest, HU
-Diploma on EPR studies of carbon nanotubes at BUTE, Budapest, HU
-PhD on neutron scattering on quantum magnets at HZB, Berlin, DE
-PSI-Fellow: research on quantum magnets

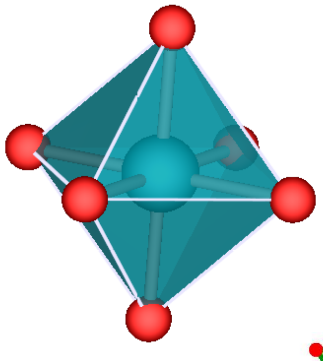
Motivation:
-good opportunities at PSI (expertise on neutron and X-ray scattering, world class large scale facilities, active in-house research beside user operation)
-independence of instrumentation/user support → more freedom in research

Quantum magnetism LEGO

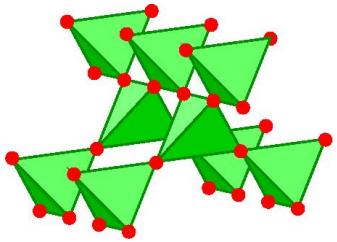
Bricks

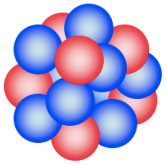


d-electrons

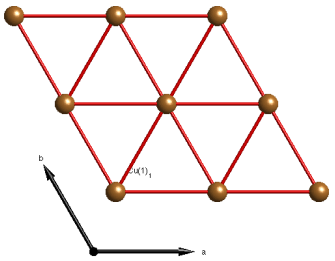


crystal field



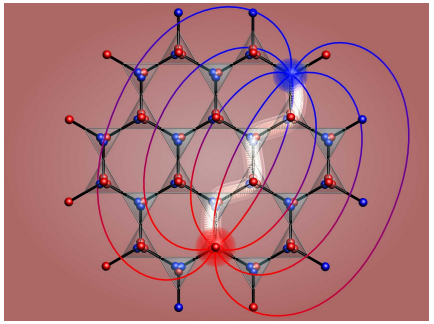


nucleus



lattice

Strongly correlated physics



magnon - phonon

magnetic monopoles

e^- → spinon – holon - orbiton

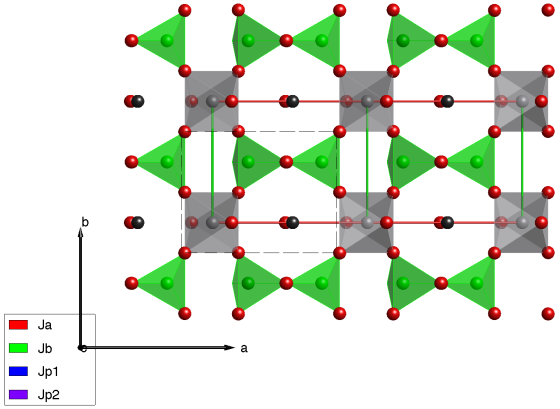
valence bond crystal/liquid

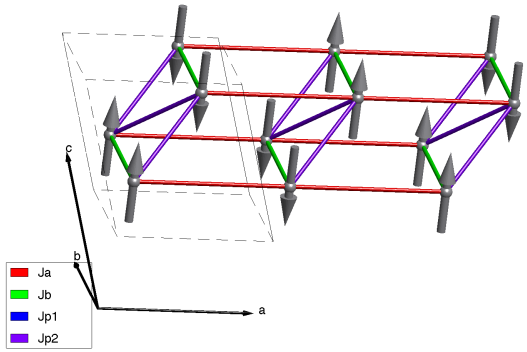
spin liquid

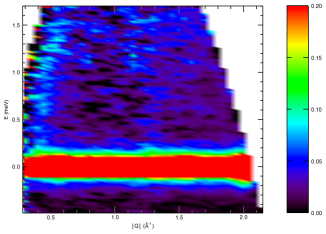
multiferroicity

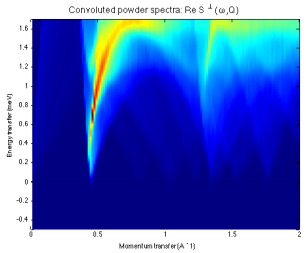
Projects – 2013 first results

Spin chains in BaV_3O_8

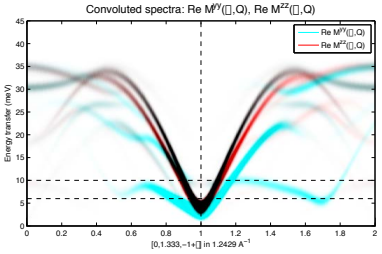


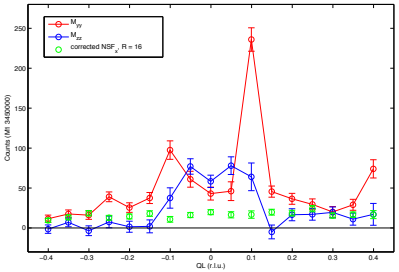




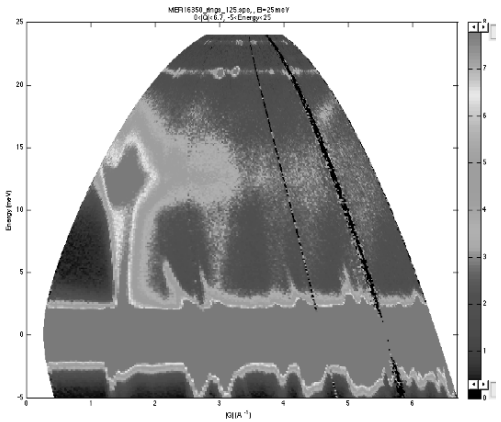


Polarised neutron scattering α-$CaCr_2O_4$

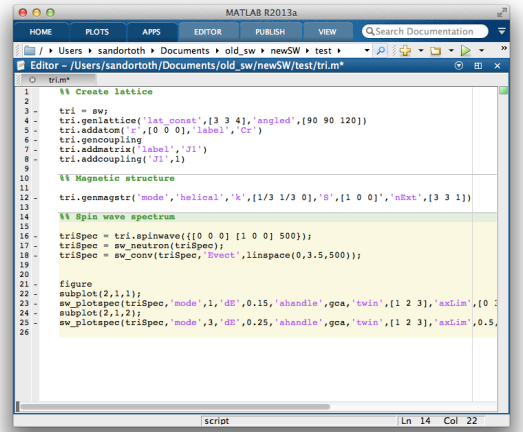


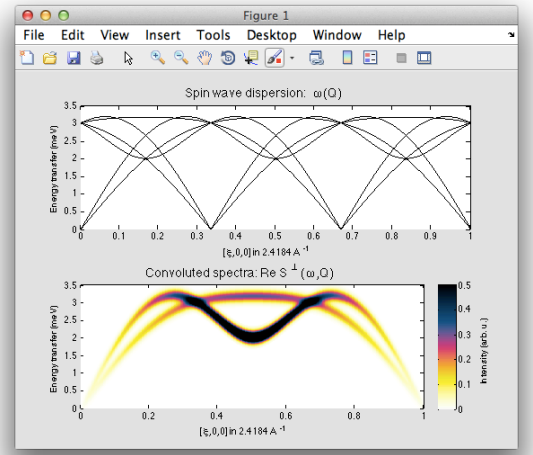


Magnetic excitations of $LiCrO_3$



Development of SpinW code





Publication record

Publications:
A. Ayoub, Sz. Tõkés, L. Orzó, P. Divós, **ST**, report, SZTAKI, Hungaran Academy of Science
ST, D. Quintavalle, B. Náfrádi, L. Forró, L. Korecz, A. Rockenbauer, T. Kálai, et al., Phys. Stat. Sol. **245**, 2034 (2008)
ST, D. Quintavalle, B. Náfrádi, L. Korecz, L. Forró, and F. Simon, Phys. Rev. B **77**, (2008)
ST, B. Lake, S. A. J. Kimber, O. Pieper, M. Reehuis, A. T. M. N. Islam, O. Zaharko, et al., Phys. Rev. B **84**, 054452 (2011)
D. Wulferding, K.-Y. Choi, P. Lemmens, A. N. Ponomaryov, J. van Tol, A. T. M. Nazmul Islam, **ST**, et al., JPCM, **24**, 435604 (2012)
ST, B. Lake, K. Hradil, T. Guidi, K. Rule, M. Stone, and A. Islam, Phys. Rev. Lett. **109**, 127203 (2012)
M. Schmidt, Z. Wang, C. Kant, F. Mayr, **ST**, A. T. M. N. Islam, B. Lake, et al., Phys. Rev. B **87**, 224424 (2013).

Invited talks (2013):
ILL TAS meeting
Helmholtz Zentrum Berlin

Talks (2013):
International Conference on Neutron Scattering (Edinburgh, UK)
Mott Physics beyond the Heisenberg Model (Monte Verità, CH)
Neutron 2.0 Workshop (Berlin, D)

Poster presentation (2013):
PSI Summer School (Zuoz, CH)

Next steps

Cs_2CuBr_4

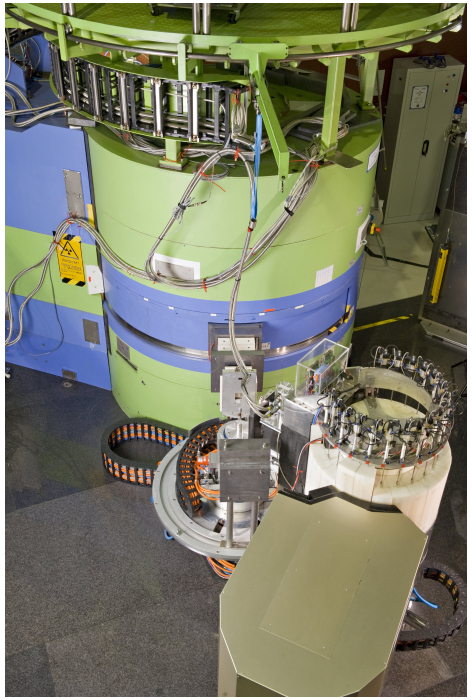
- 1D-2D crossover between AF chain and triangular lattice
- neutron scattering under high pressure (kBar) & low temperature (mK) on Panda

$LiCrO_2$ and α-$CaCr_2O_4$

- colossal exchange striction
- understand & find evidence of magnon-phonon coupling

SpinW

- further developments (symbolic calculation, higher order terms)
- promotion (standalone version, manual)



PANDA instrument at FRM2 Munich

Critical path & contingency plan

PSI-Fellow successful if:

-magnon-phonon coupling problem is solved

-succesfull neutron experiment on Cs_2CuBr_4

-publications

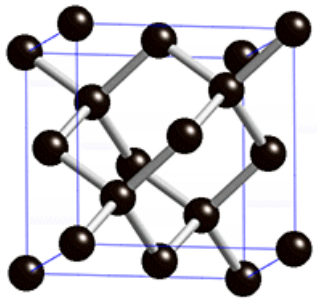
Contingency plan: **escape forward**

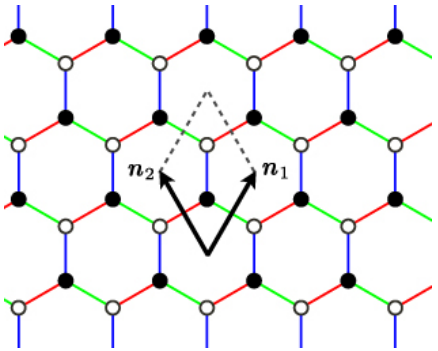
additional projects in collaboration

-$NaIrO_3$ Heisenberg-Kitaev physics?

-$RbTiCl_3$ Haldane chain compound?

-$CoAl_2O_4$ order by disorder effect on frustrated diamond lattice?





Resources available / needed

Used resources at PSI:

- SINQ instruments: HRPT, DMC, TASP, FOCUS
- SLS instruments: material science beamline
- chemistry lab: well equiped
- bulk property measurements: heat capacity, magnetic properties

Resources outside of PSI:

- neutron scattering (ILL, ORNL, ISIS, FRM2) due to higher neutron flux, specialised instruments

Collaboration with Henrik M. Rønnow:

- bulk property measurements under pressure
- computation resources

Many collaborators:

Christian Rüegg (PSI)
Kathrina Rolfs (PSI)
Oksana Zaharko (PSI)
Tom Fennell (PSI)
Denis Sheptyakov (PSI)
Lukas Keller (PSI)
Jonathan White (PSI)
Avinash V. Mahajan (IIT, IN)
Bella Lake (HZB, D)
Elisa Wheeler (ILL, FR)

Outlook for future career

Research at national facilities:

- better funded
- better availability of large instruments
- being close to experts

Research at university:

- being closer to theorists
- teaching (+/-)
- better oportunities to establish own research group and labs

?

PSI-Fellow program: expectations, pros and cons

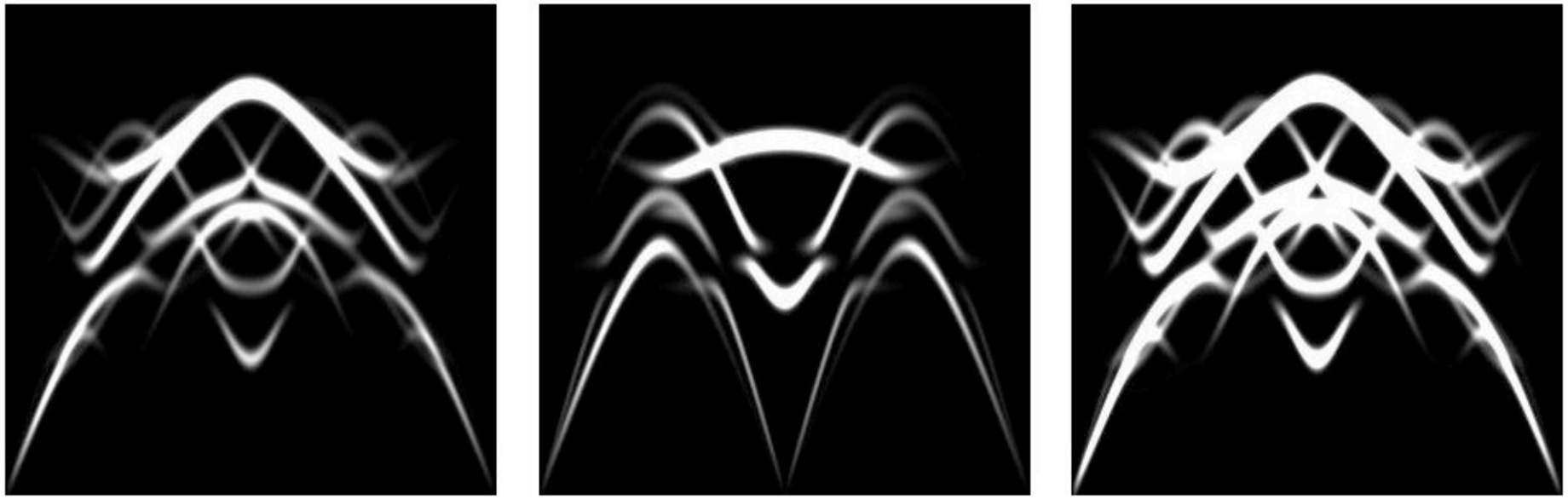
Pro:

- PSI national facility
- independence

Cons:

- none

Thank you!



spin waves, 2012