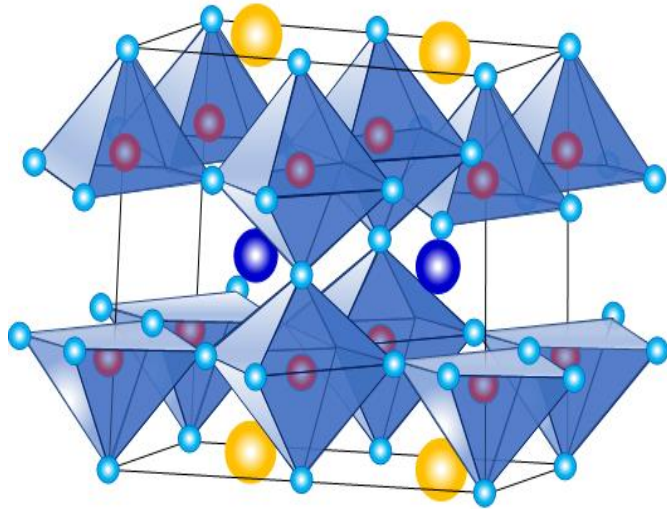
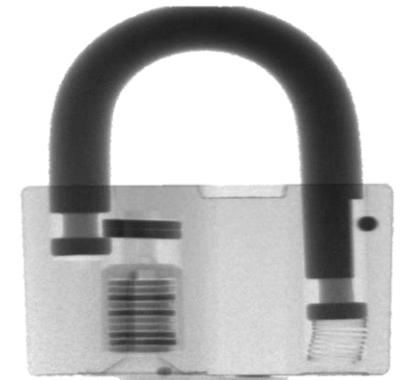
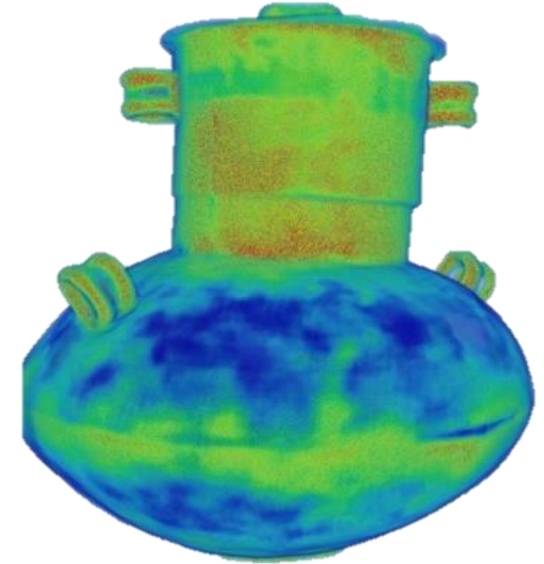
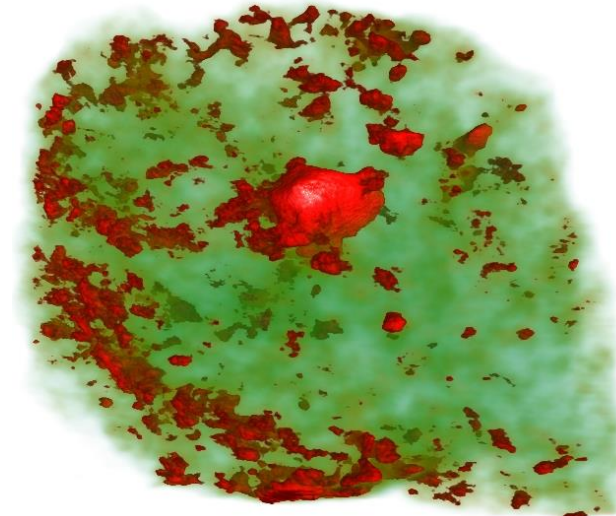
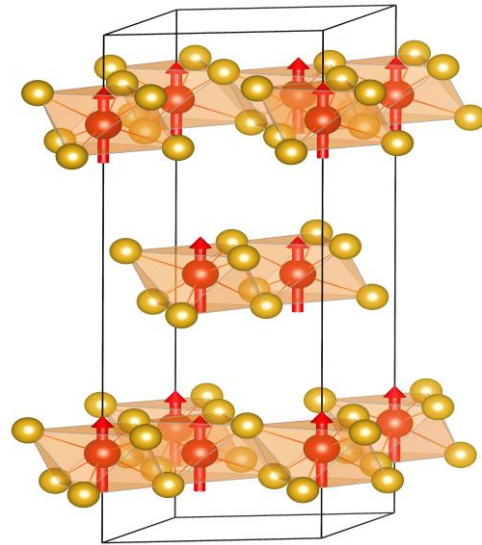


High Pressure Diffraction and Imaging at the IBR-2 and Science



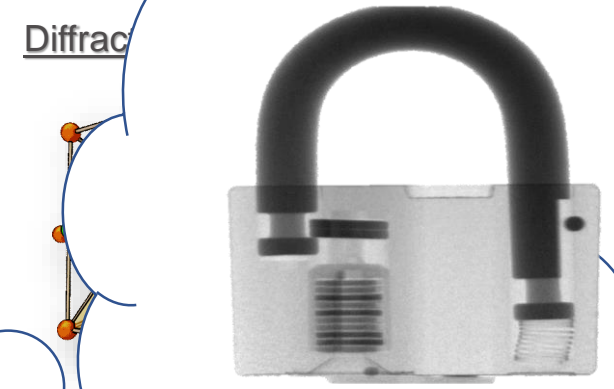
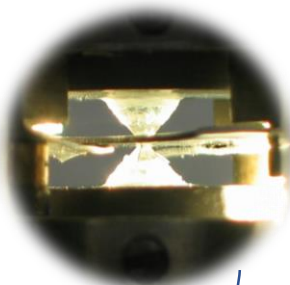
Kichanov Sergey



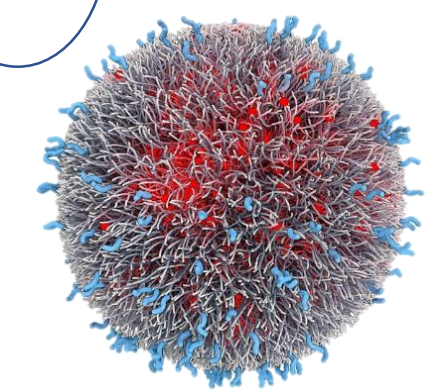
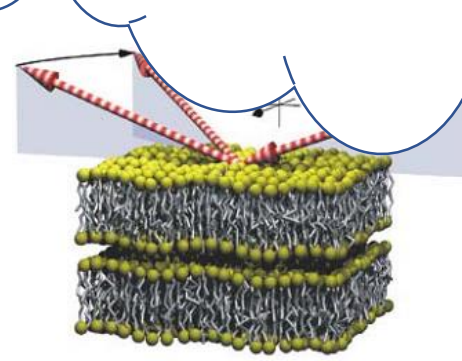
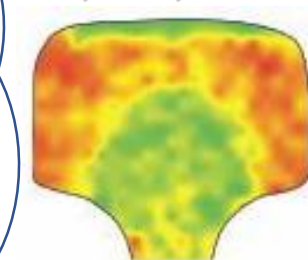
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SNS

FLn.P

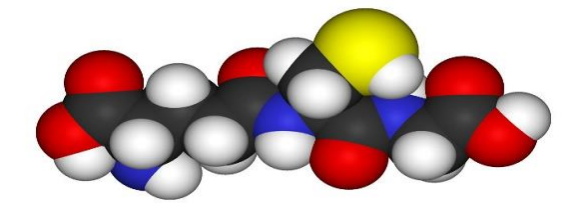
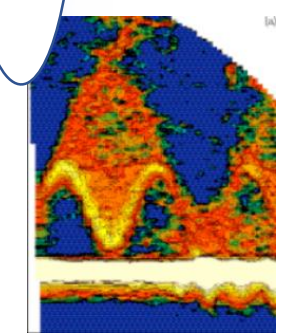


FRON, FSD, DN-12



Reflectometers: REMUR, REFLEX, GRAIN

Inelastic scattering: DIN-2PI, NERA





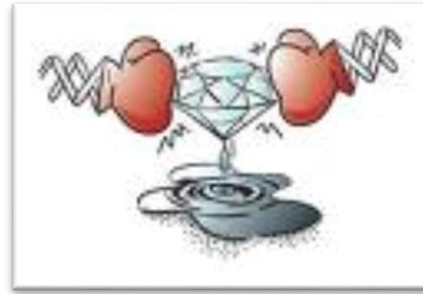
Synchrotron radiation source

Flux on sample

$\sim 10^{16}-10^{18}$

$V \sim \mu\text{m}^3$

Exposition time ~ 1 sec



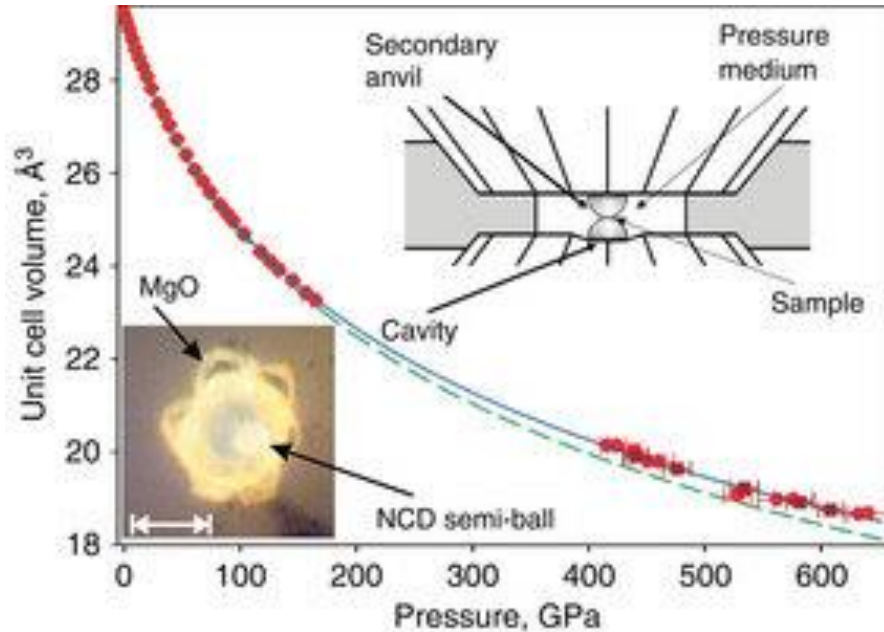
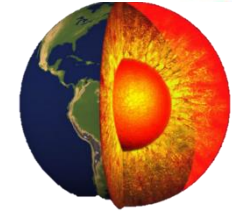
Neutron source

Flux on sample

$\sim 10^6-10^9$

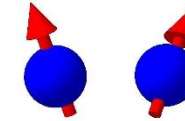
$V \sim 10-100 \text{ mm}^3$

Exposition time $\sim 2-10$ h



Dubrovinsky, L. et al. Implementation of micro-ball nanodiamond anvils for high-pressure studies above 6 Mbar. Nat. Commun. 3:1163 doi: 10.1038/ncomms2160 (2012).

• Magnetic structure



Magnetic phase transitions or spin-reorientation transitions

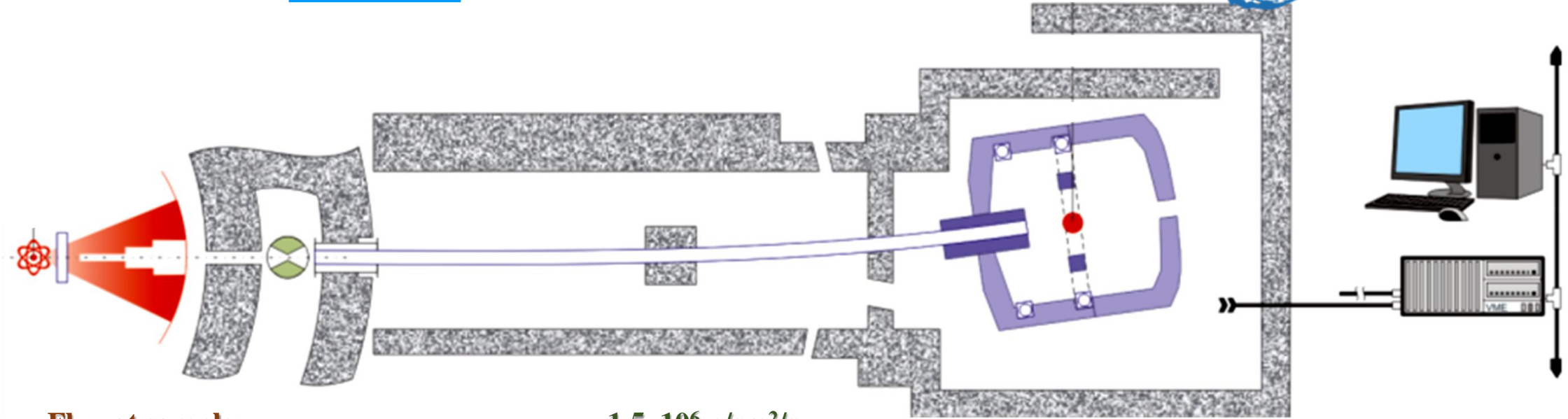
• Compound s contained light elements: H, D, Li, O ...

Heavy atom



Structural phase transition in molecular crystals, in hydrides, hydrate, pressure induced ice forms and others....

• High penetrating effect: pressure cells, ovens, magnets, refrigerators...

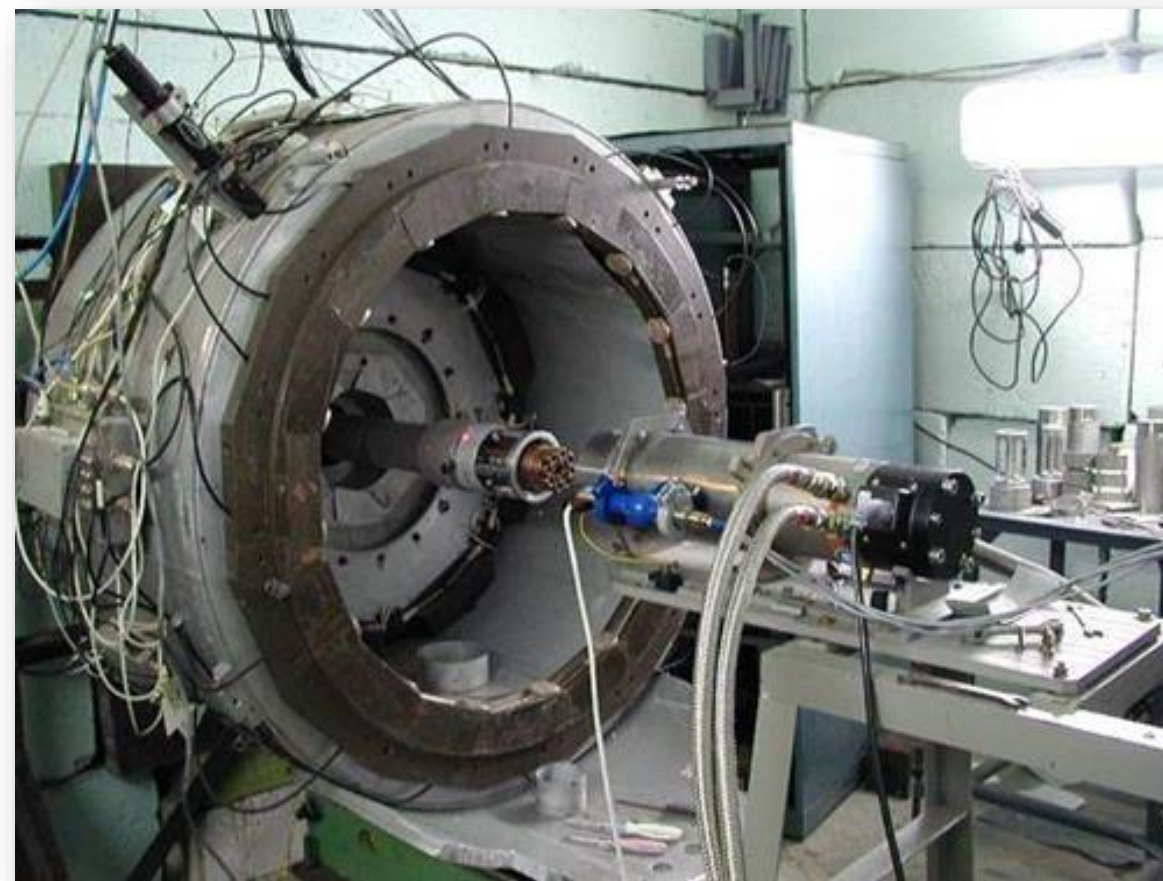


Flux at sample:	1.5×10^6 n/sm²/s
TOF distance:	26.0 m
Ranges:	
wavelengths	0.8 - 10 Å
scattering angles	45° - 135°
d-spacing	0.6 - 13 Å
Resolution :	
at $2\theta=90^\circ$	0.022
at $2\theta=135^\circ$	0.012
Sample volume:	0.5-3 mm³
Pressure range:	0-8 GPa
Temperature range	10 - 300 K





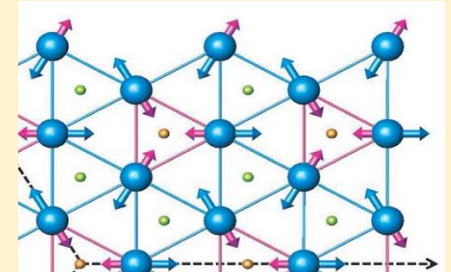
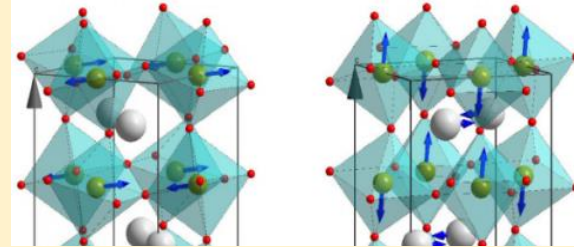
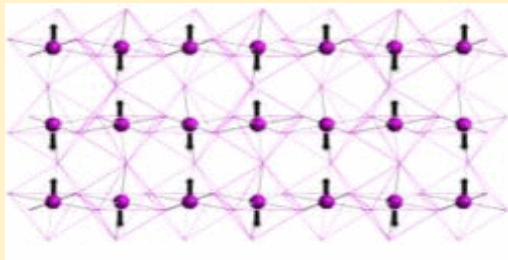
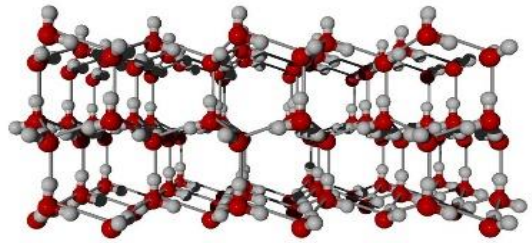
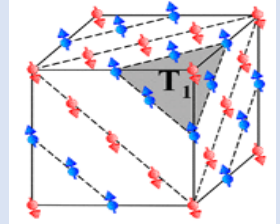
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Investigations of crystal and magnetic structures of materials at high pressure using neutron powder diffraction



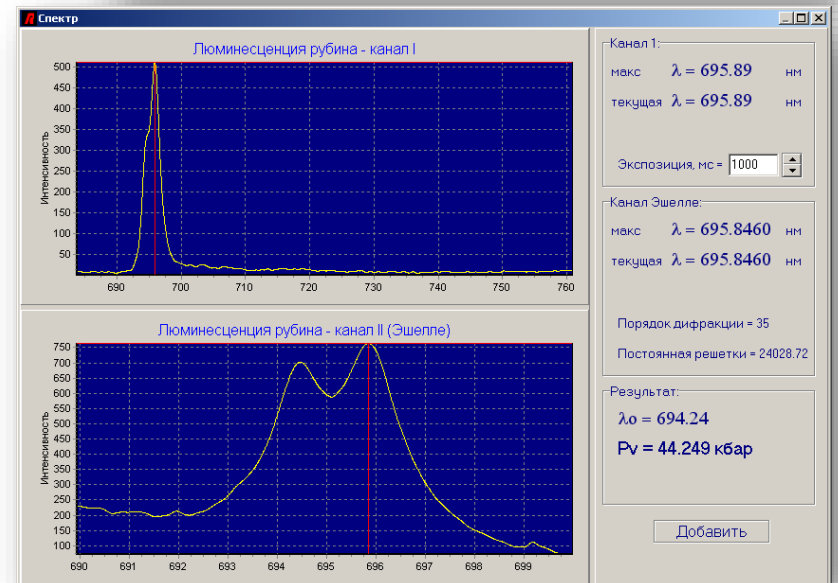
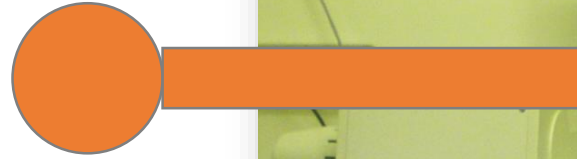
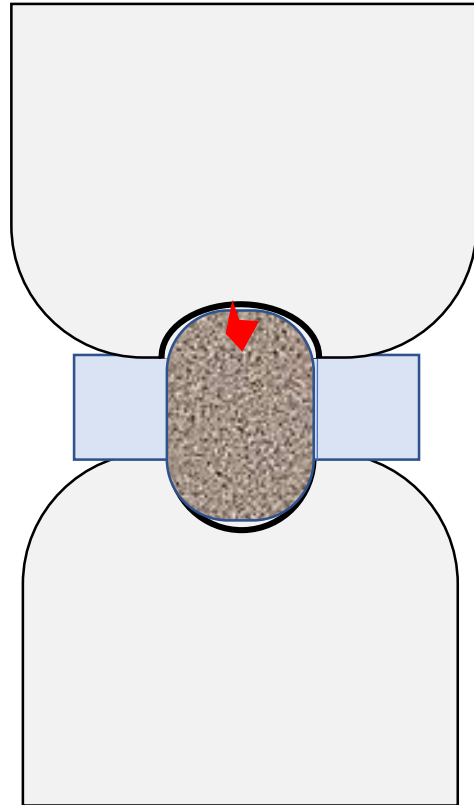
- Structural and magnetic phase transitions at high pressure
- P-T phase diagrams of materials
- Changes in magnetic structures of materials at high pressure



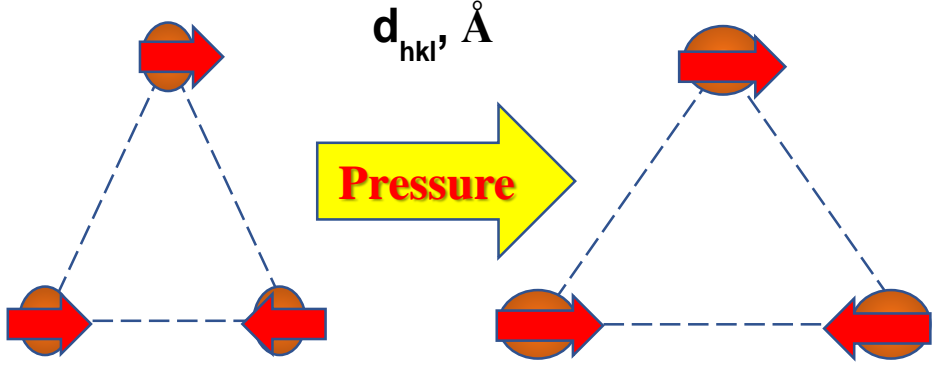
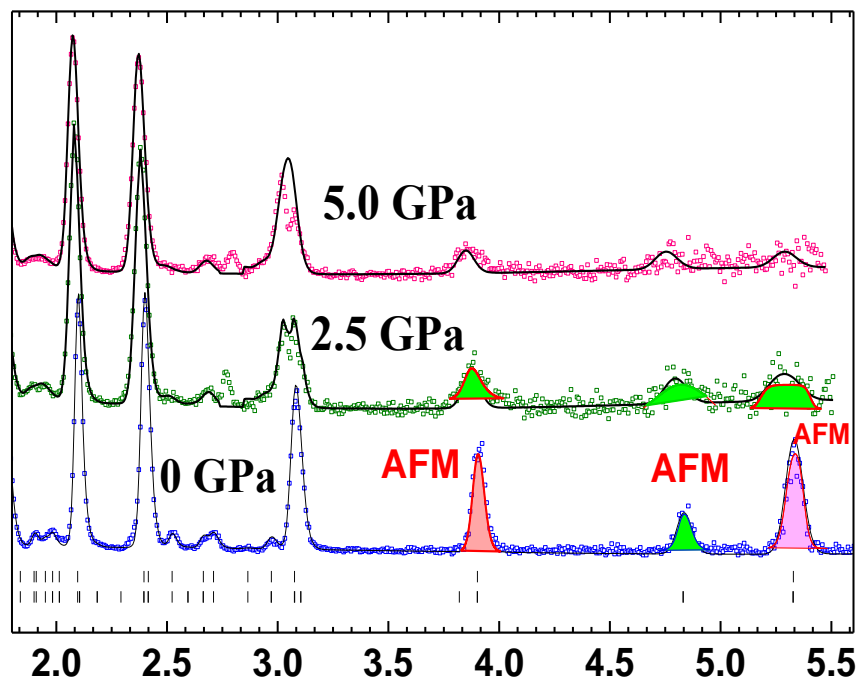
Investigations of crystal and magnetic structure of microsamples ($V \leq 20 \text{ mm}^3$) using neutron powder diffraction method

- hard synthesised materials
 - HP-HT synthesis

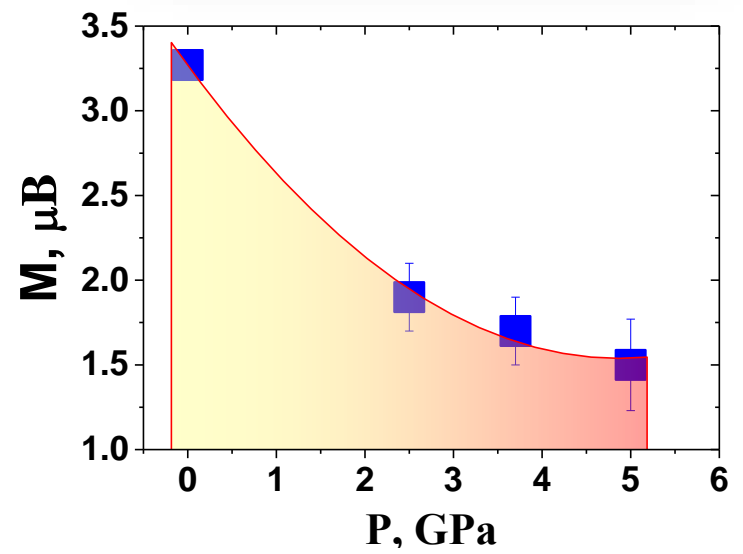
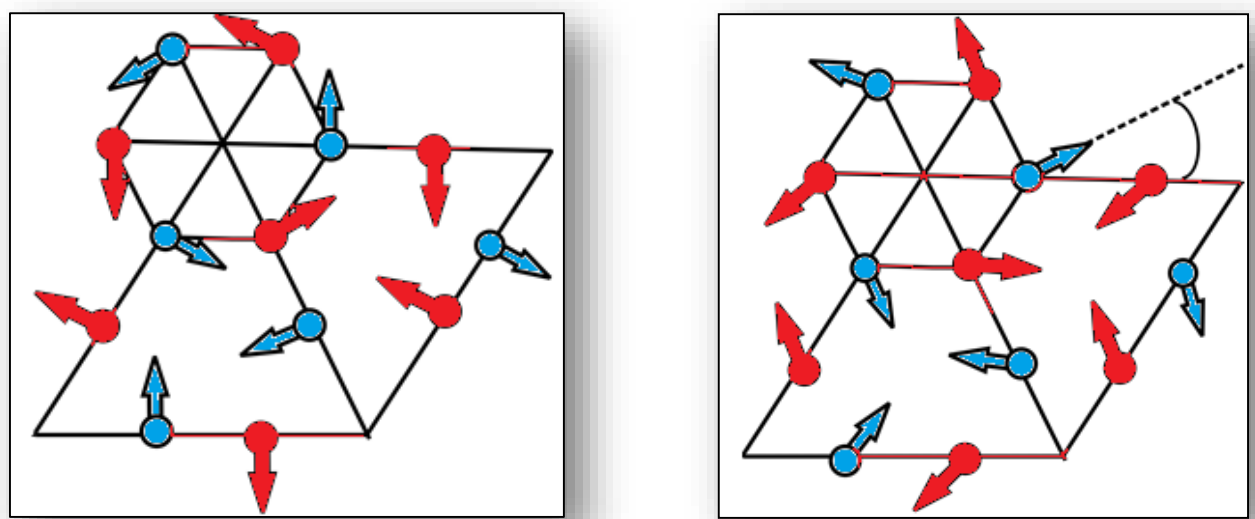




Pressure effect on magnetic structure of
hexagonal magnetite YMnO_3 and LuMnO_3



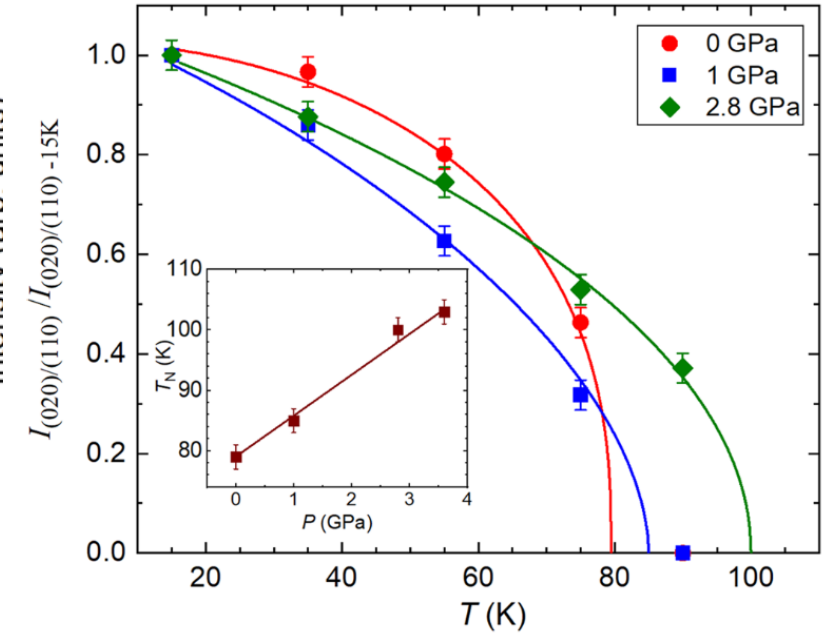
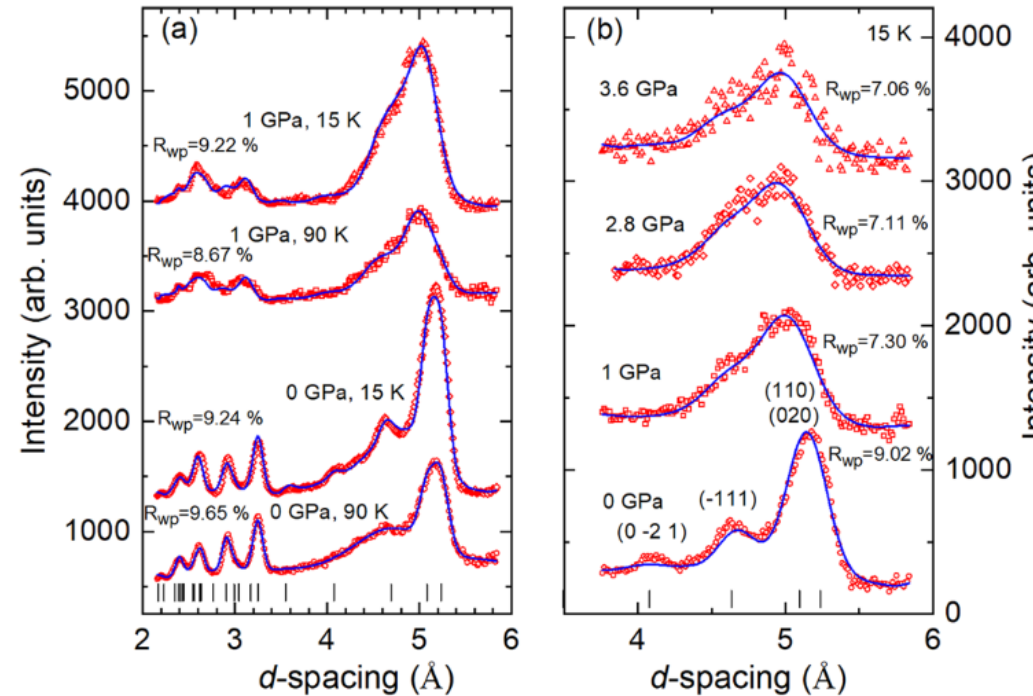
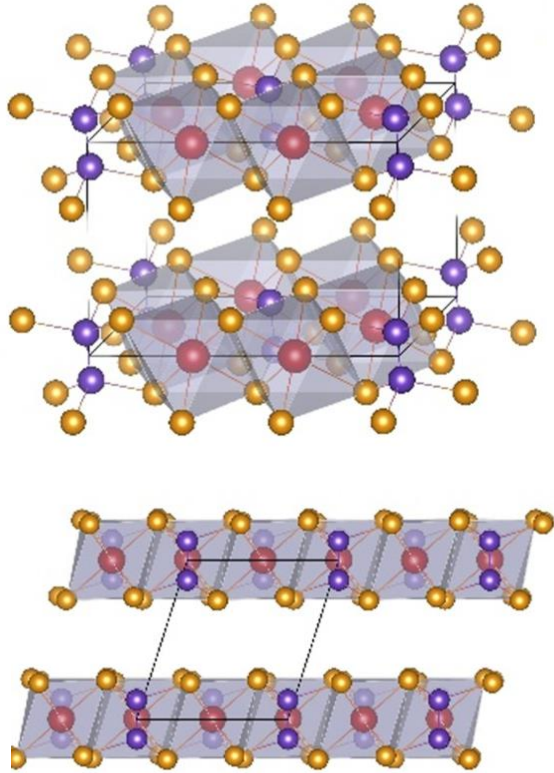
Spin-reorientation transition



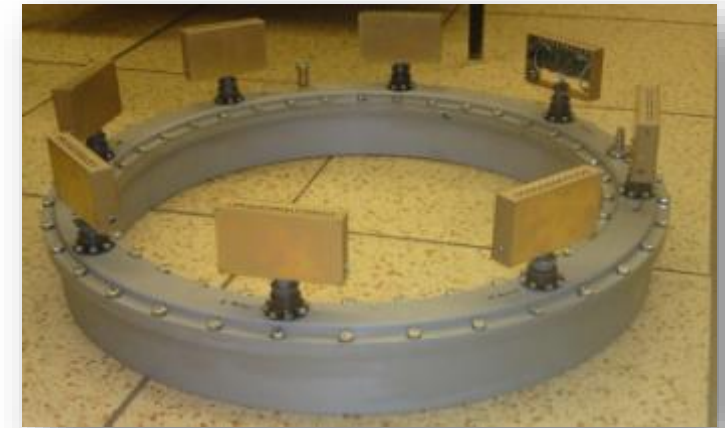
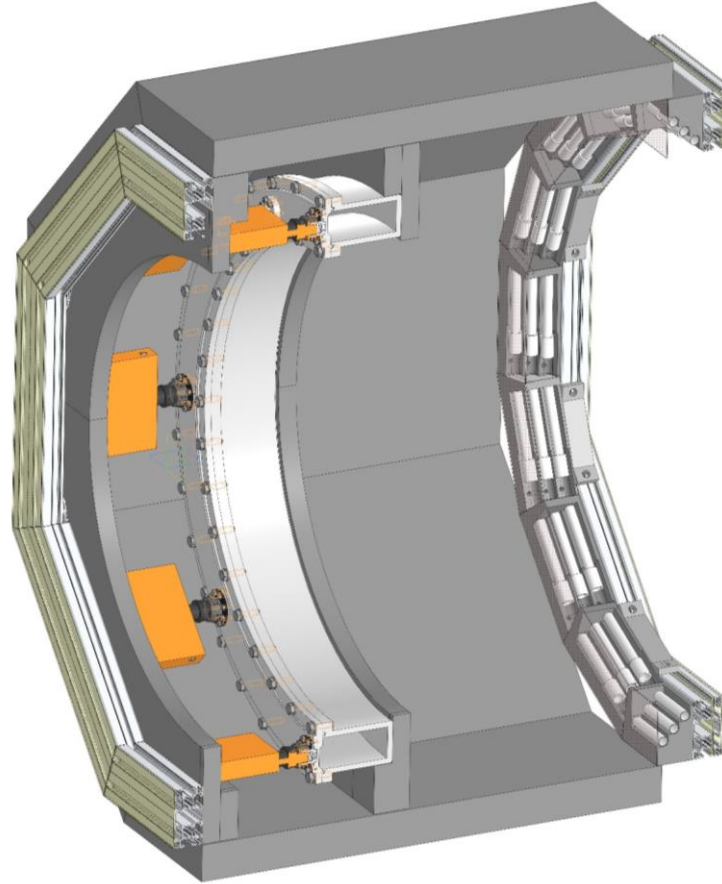
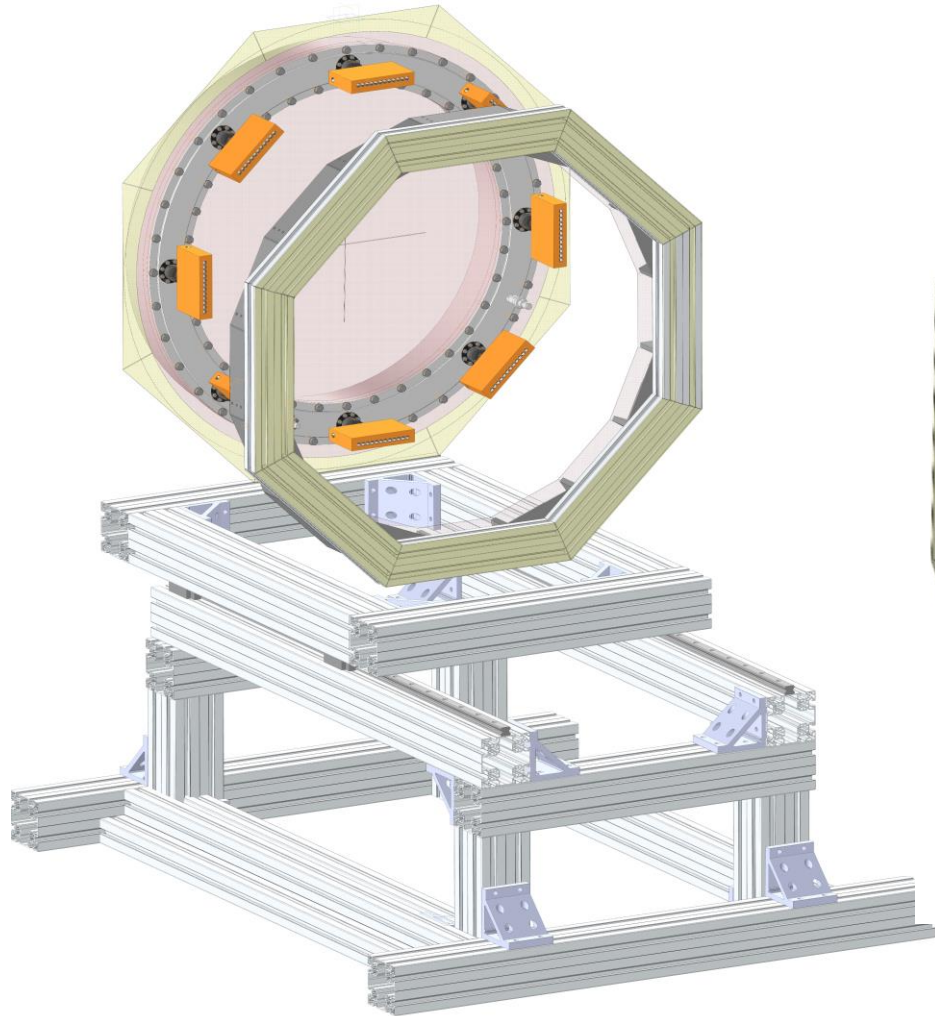
*Kozlenko, D.P., Kichanov, S.E., Lee, S. et al. High-pressure effect on the crystal and magnetic structures of the frustrated antiferromagnet YMnO_3 . *Jetp Lett.* 82, 193–197 (2005).*

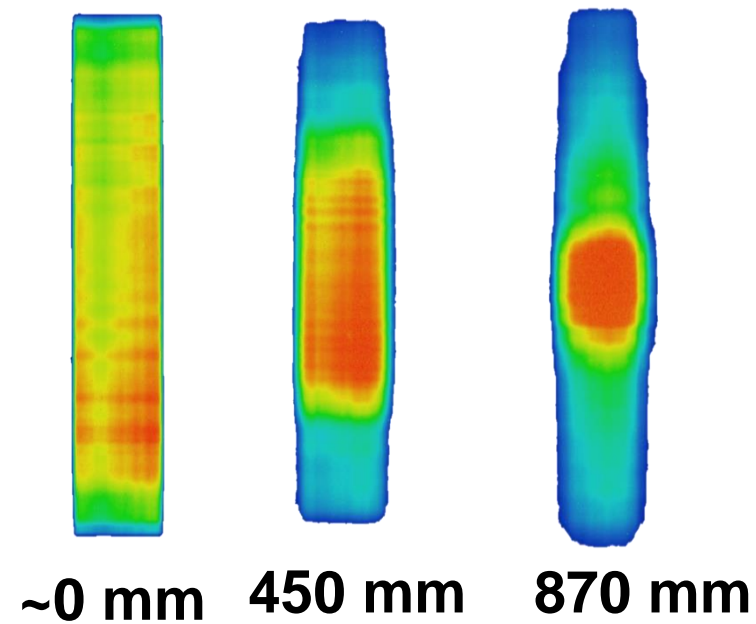
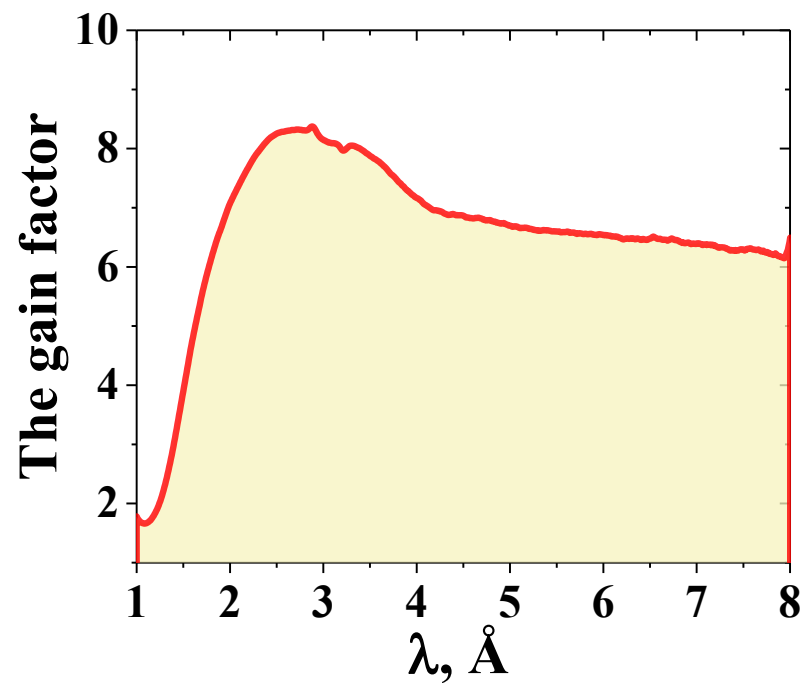
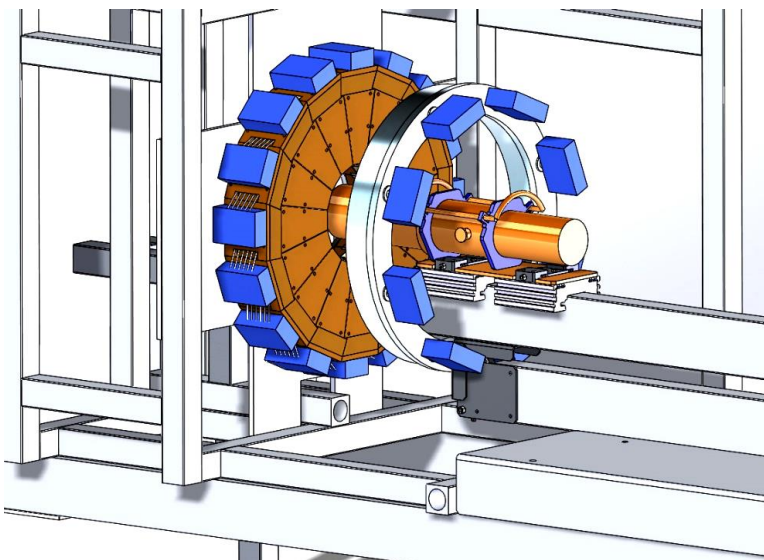
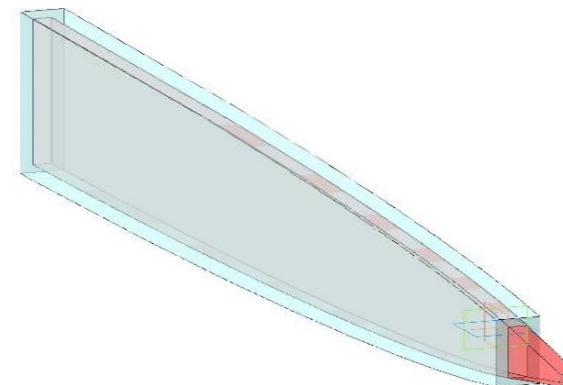
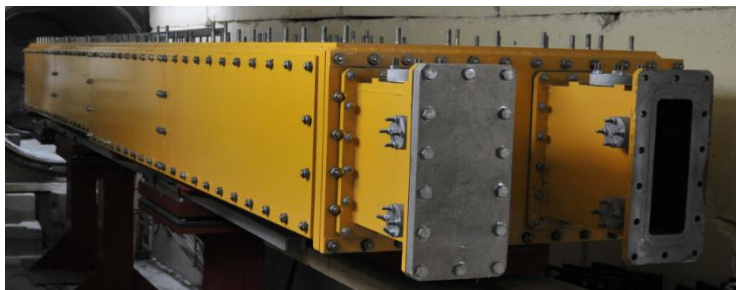
*D P Kozlenko et al 2007 *J. Phys.: Condens. Matter* 19 156228*

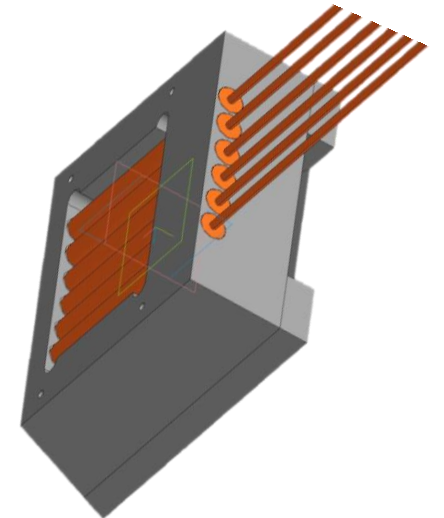
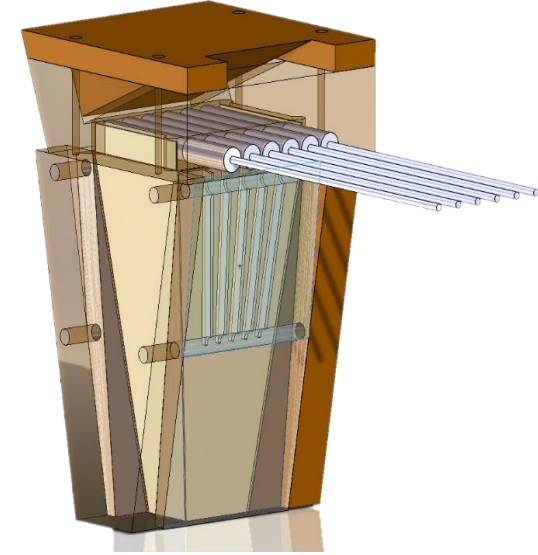
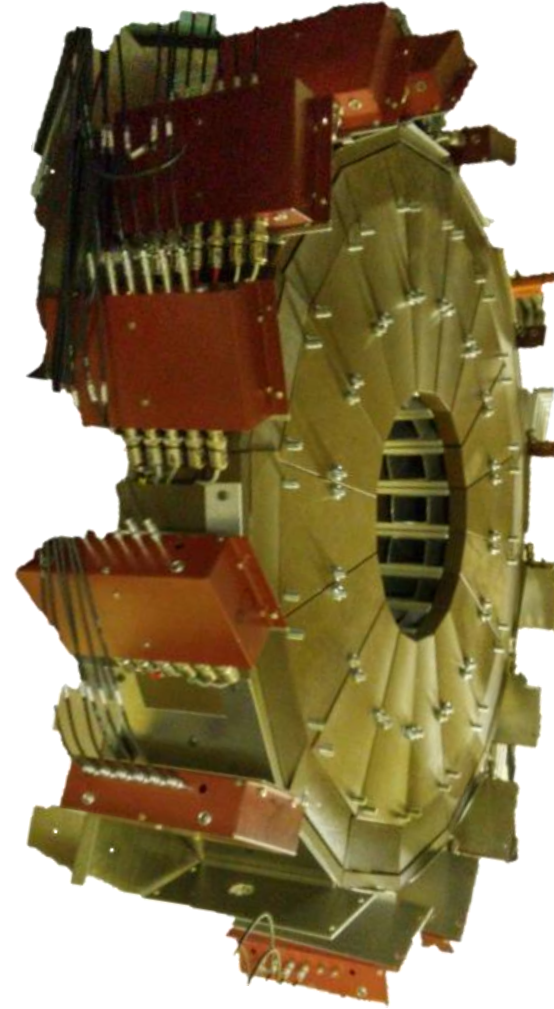
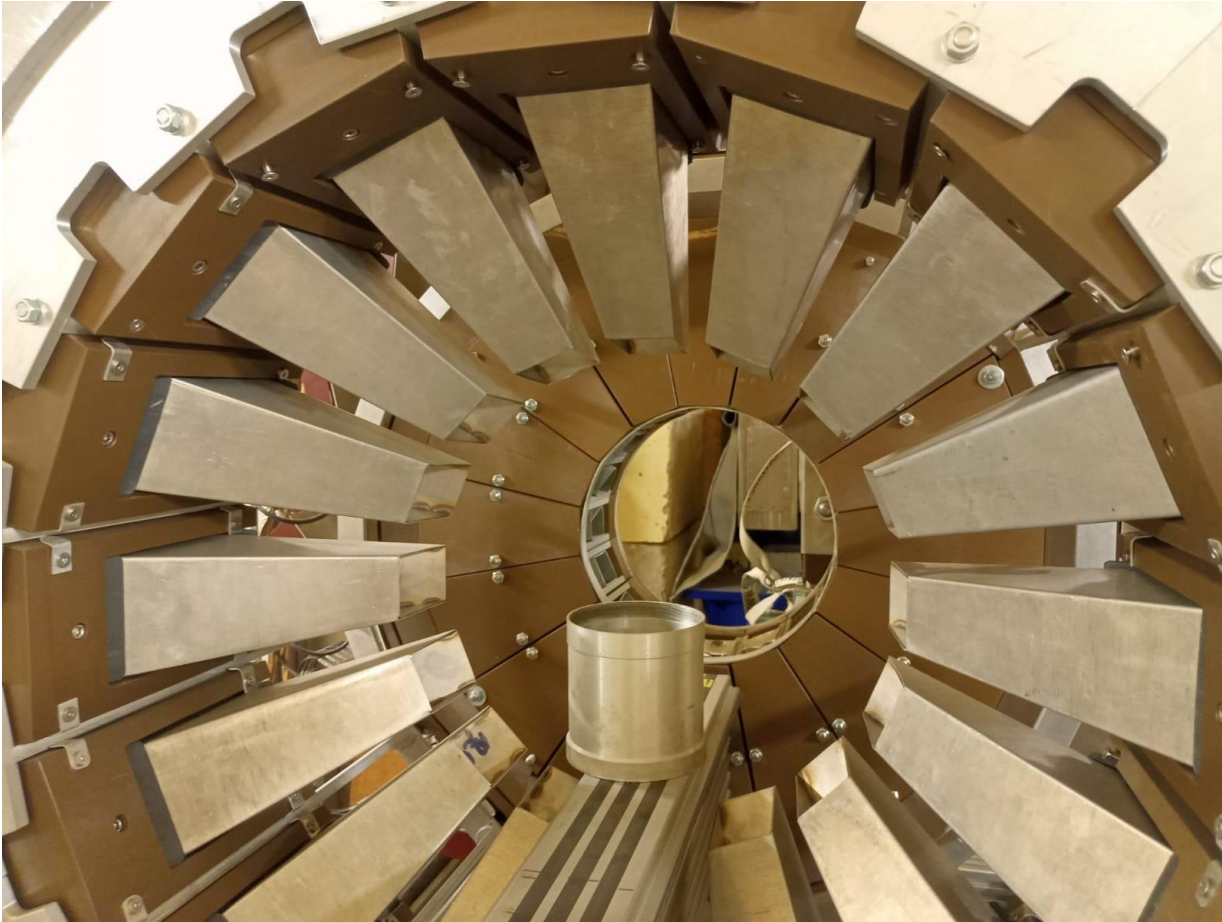
Pressure effect on the magnetic structure of van der Waals antiferromagnet MnPS_3



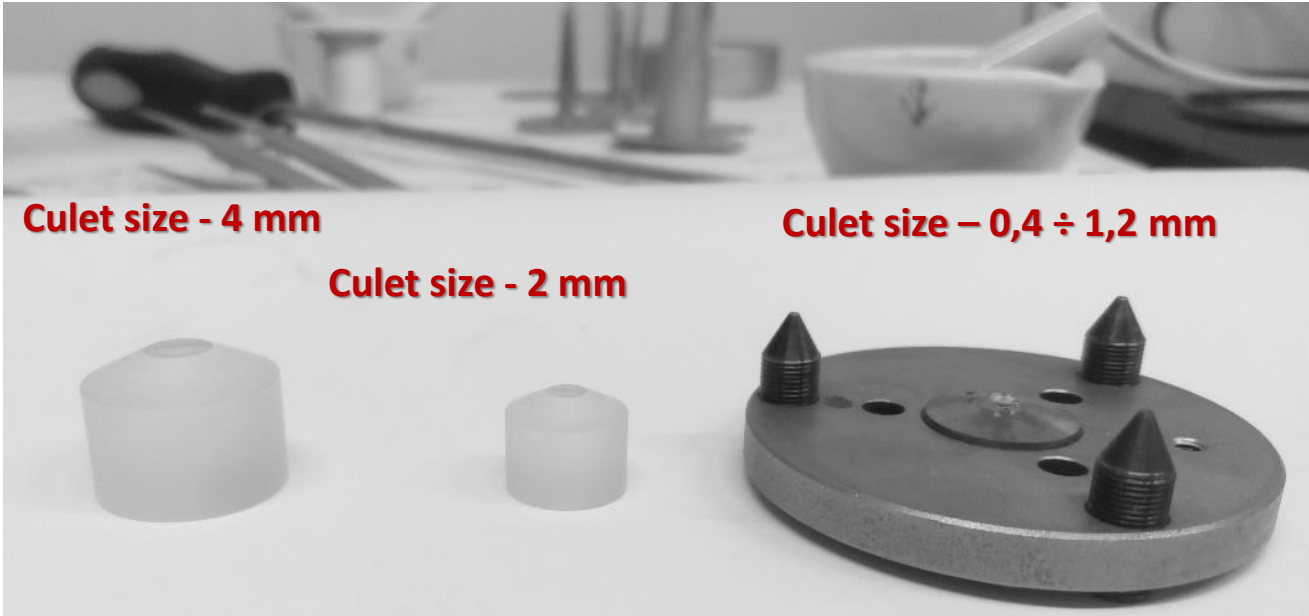
Future update of DN-12 diffractometer

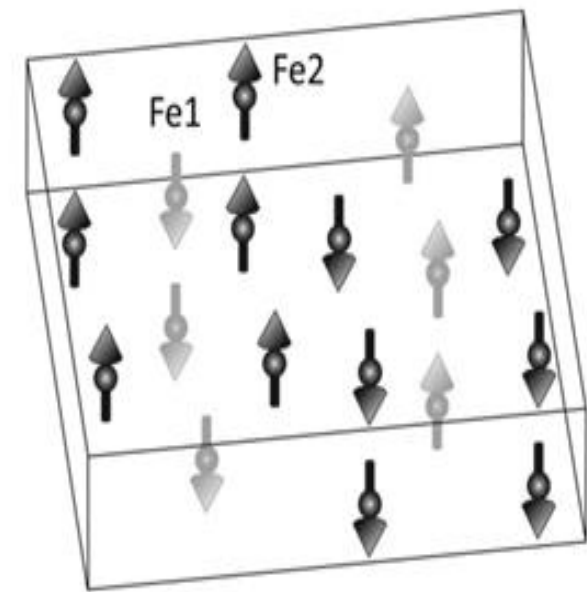
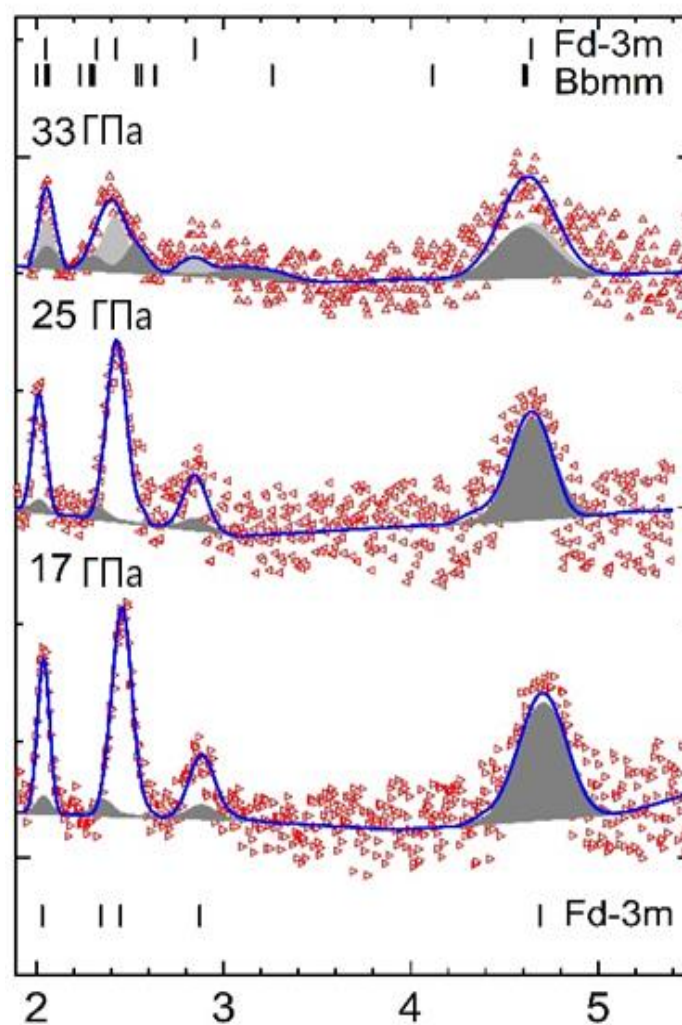
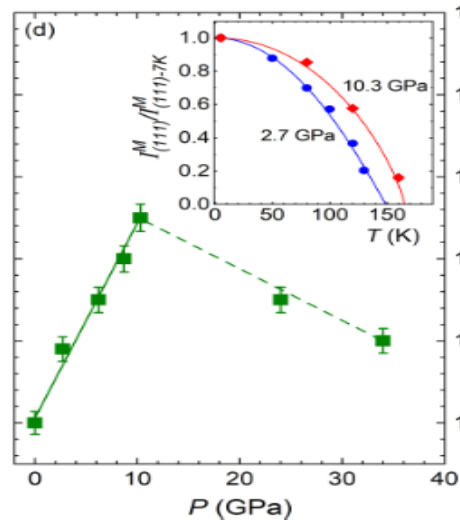
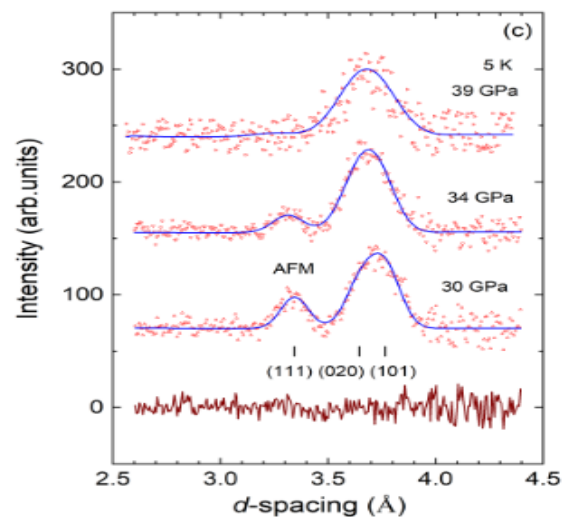
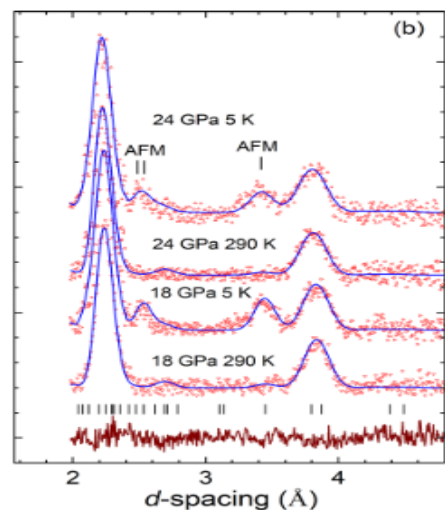
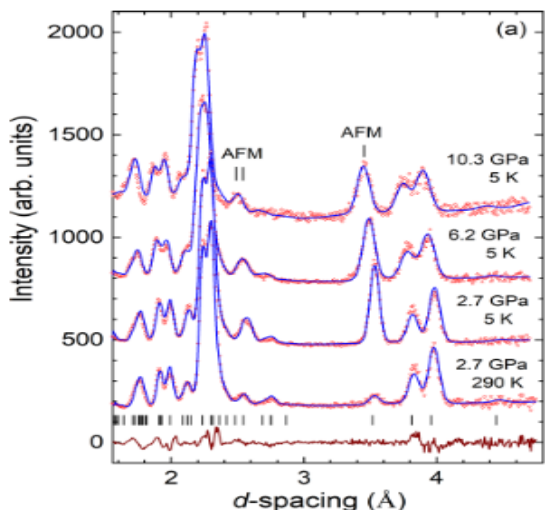






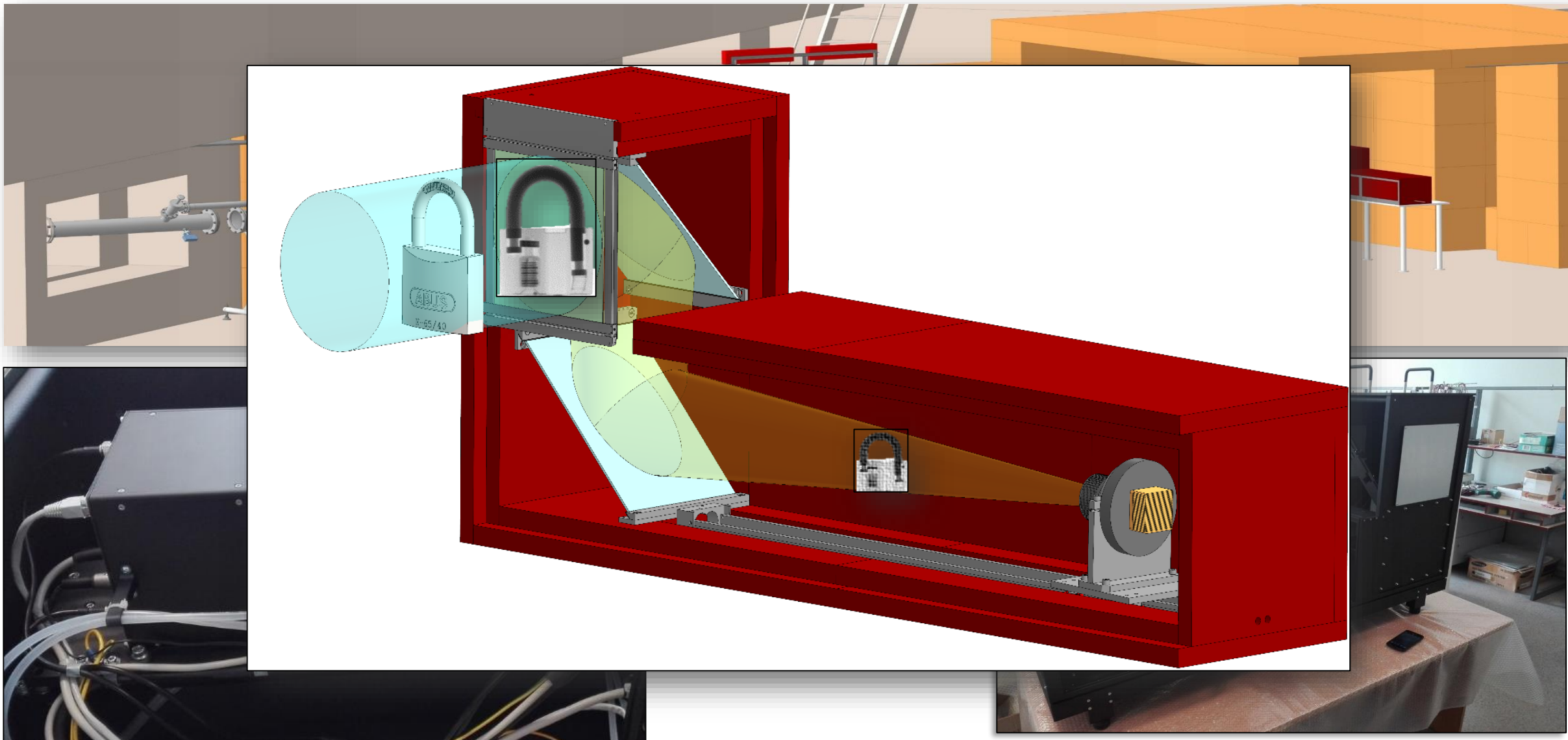
Total gain factor in comparison with DN-12 is **~100**

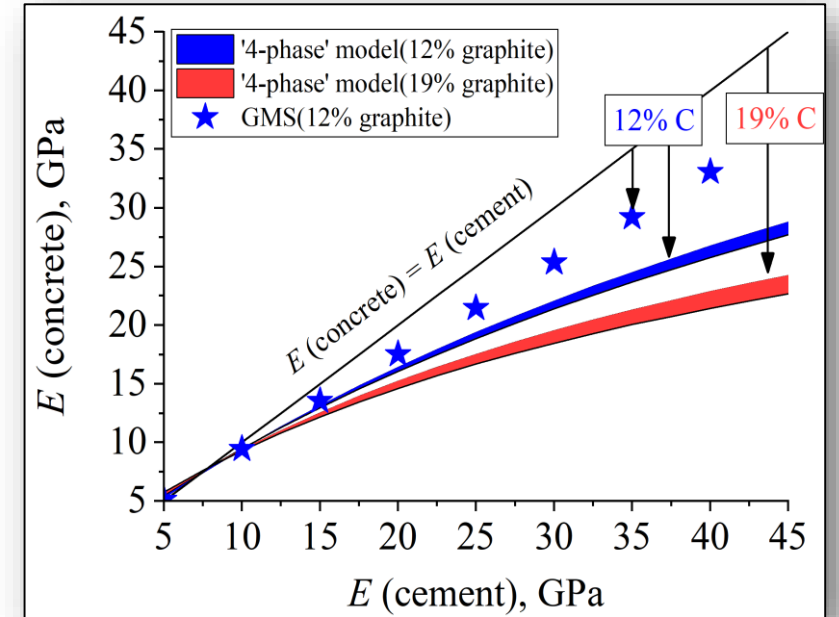
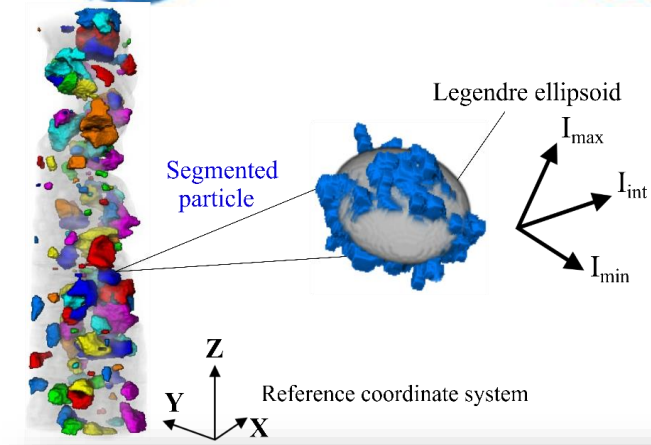
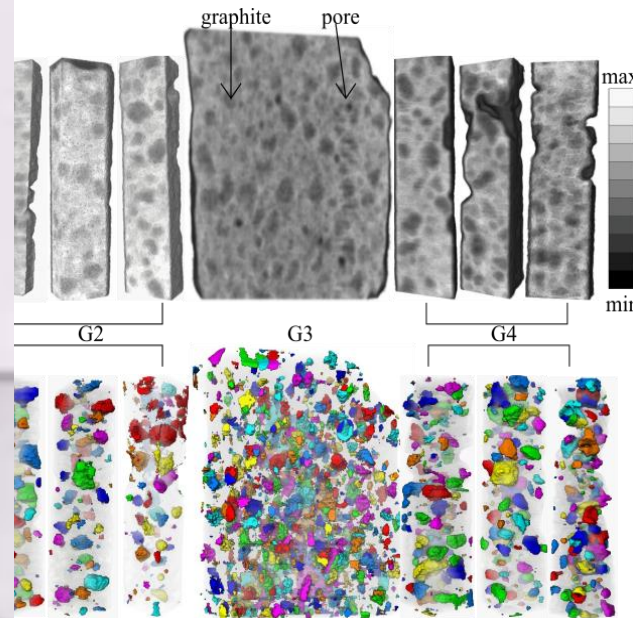
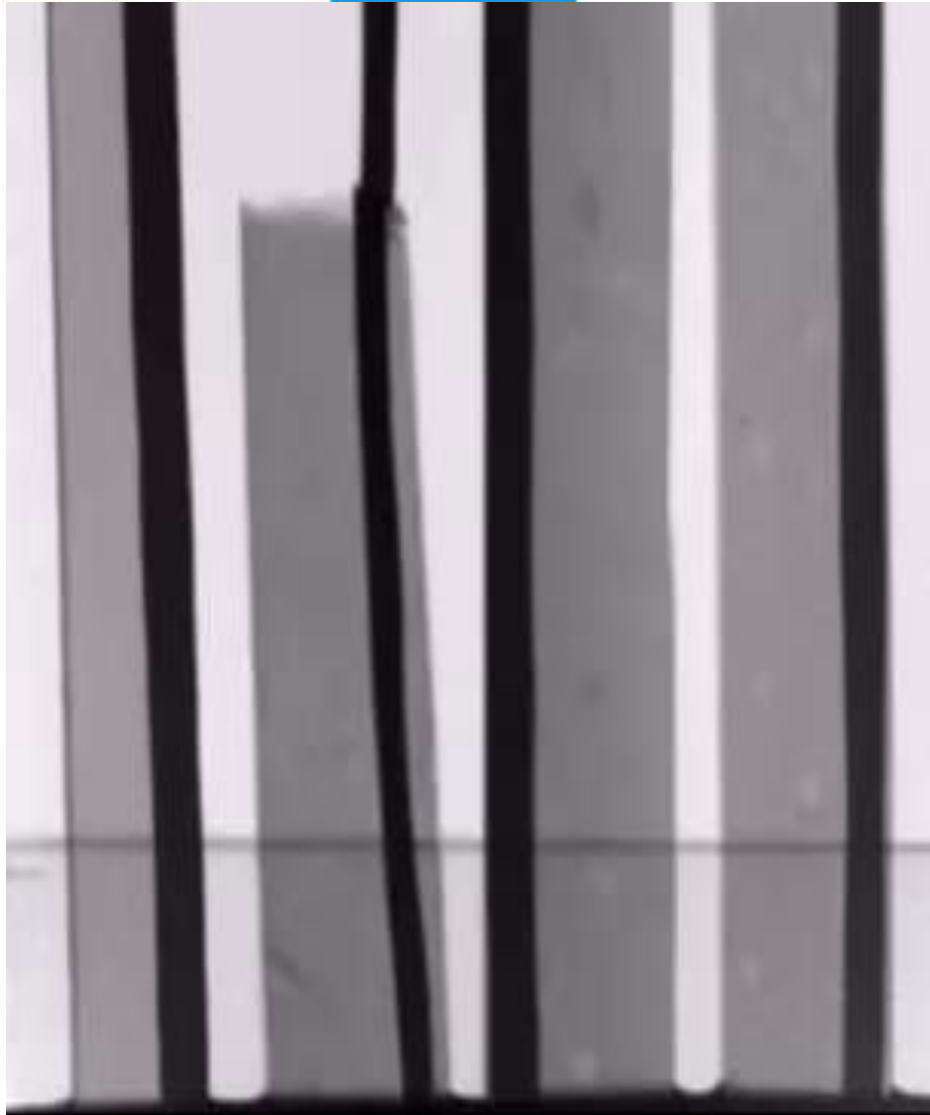


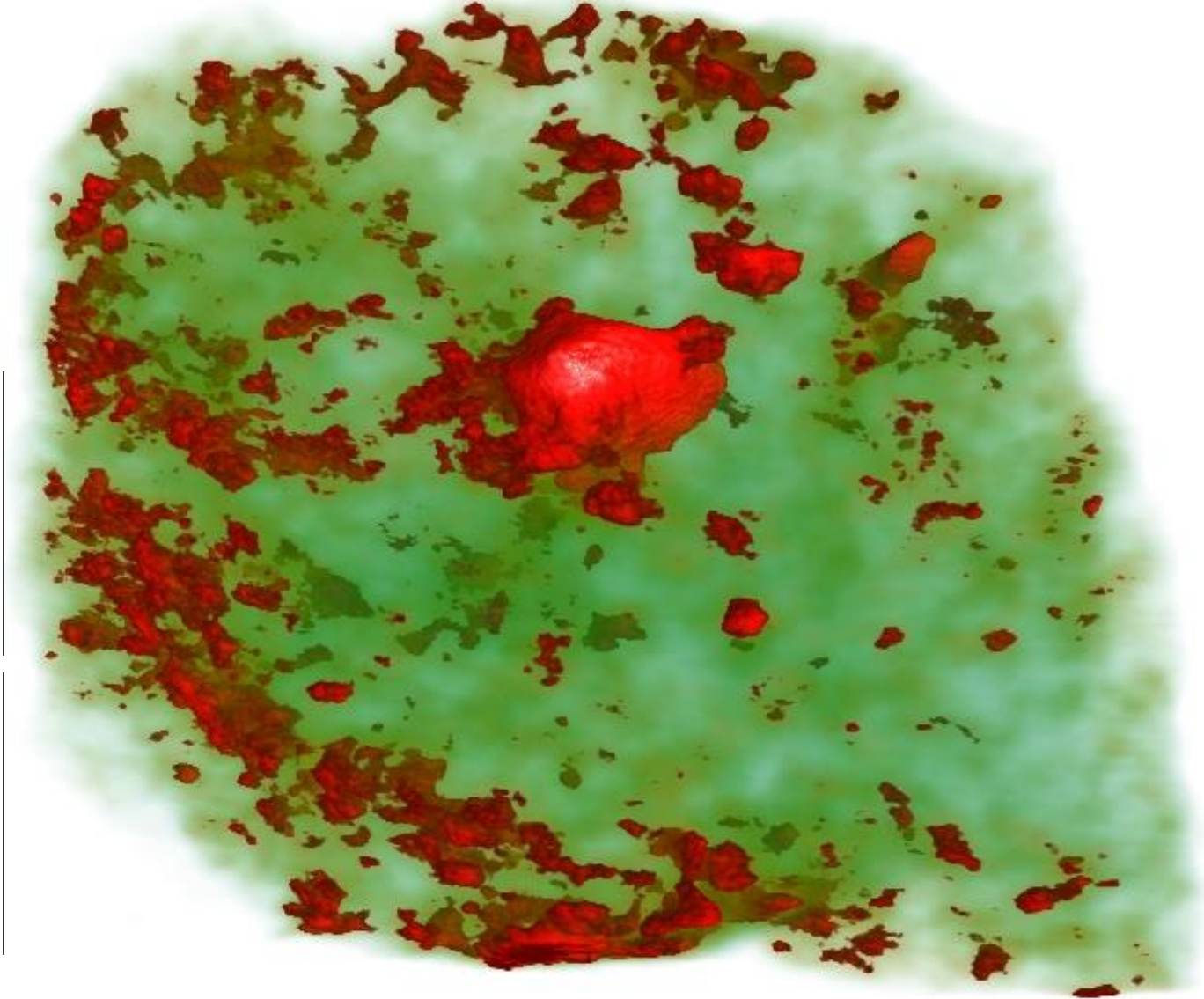
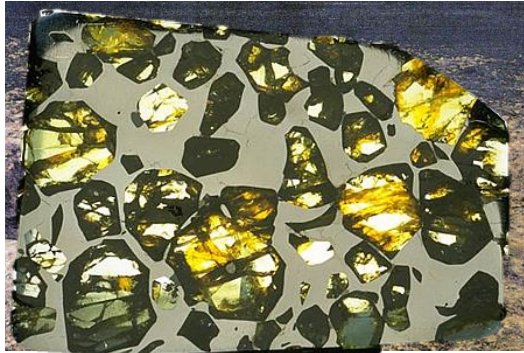


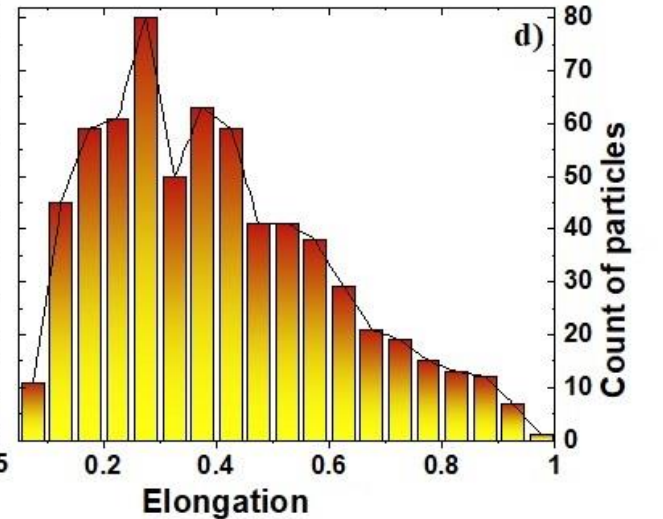
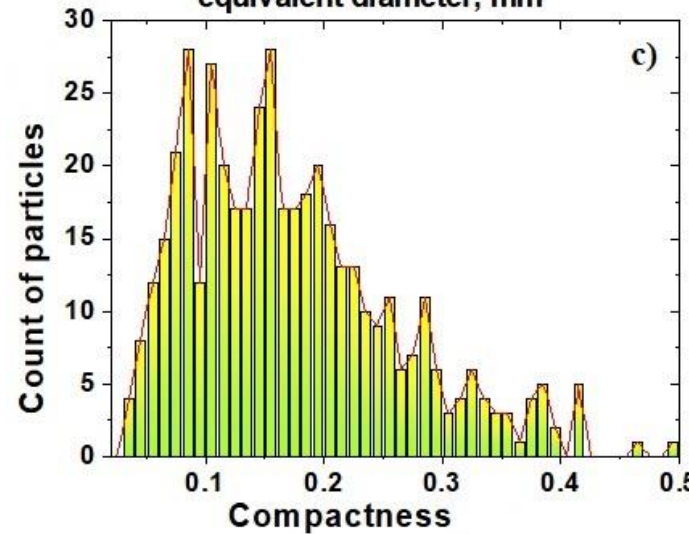
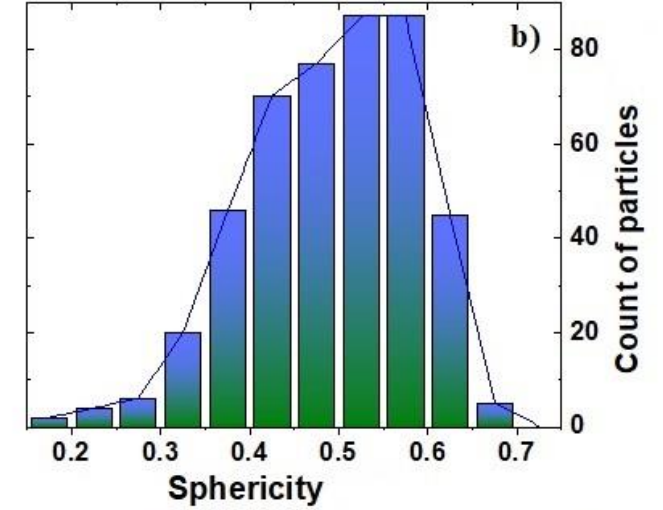
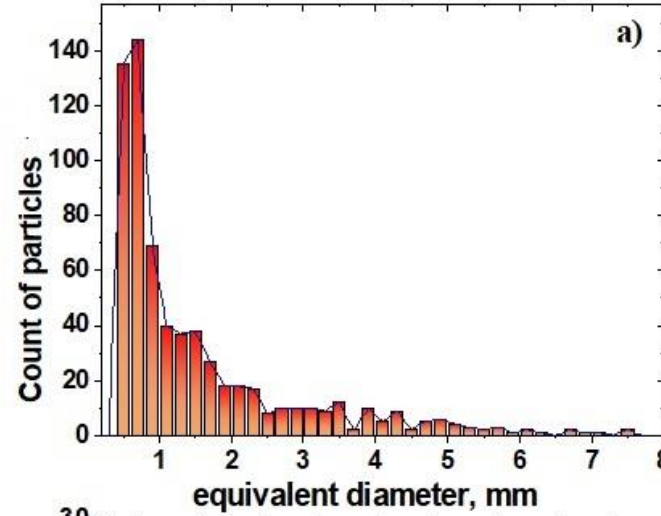
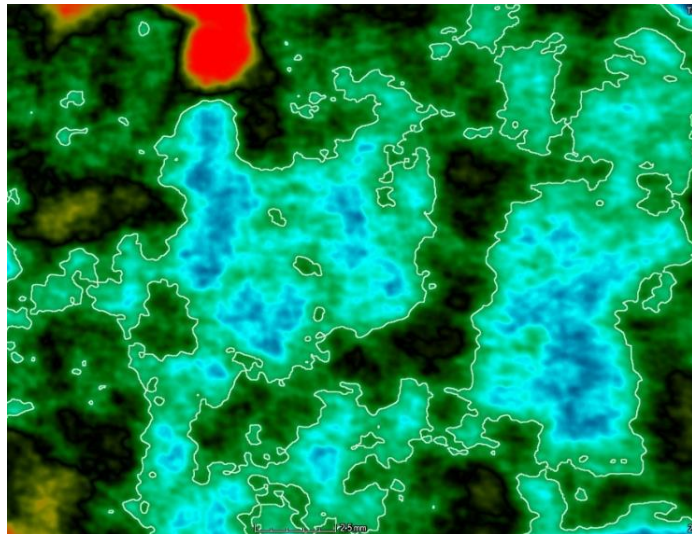
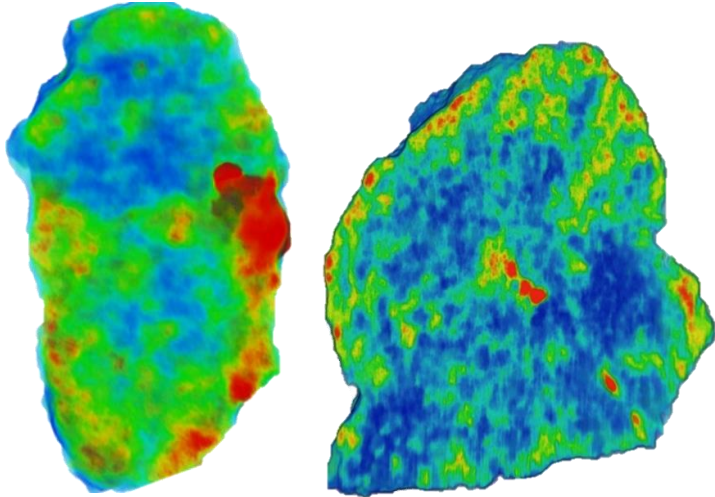
*D. P. Kozlenko, E. V. Lukin, S. E. Kichanov, Z. Jirák, N. O. Golosova, and B. N. Savenko "High-pressure evolution of the magnetic order in LaMnO₃", Phys. Rev. B **107**, 144426 (2024)*

*Kozlenko, D.P., Dubrovinsky, L.S., Kichanov, S.E. et al. Magnetic and electronic properties of magnetite across the high pressure anomaly. Sci Rep **9**, 4464 (2019).*











Bolgar



Saray-Batu



SS-3



SS-5



SS-6



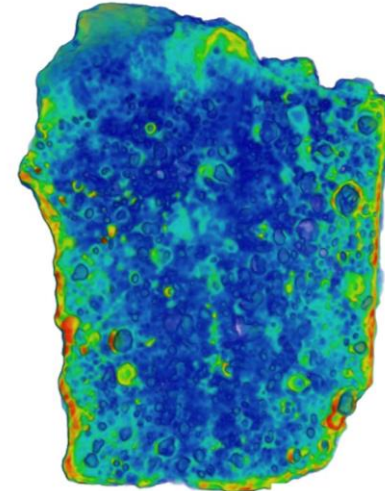
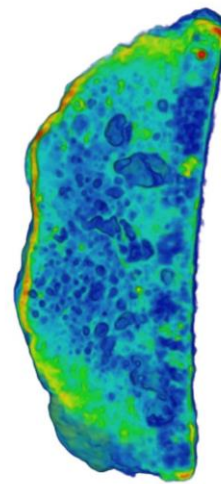
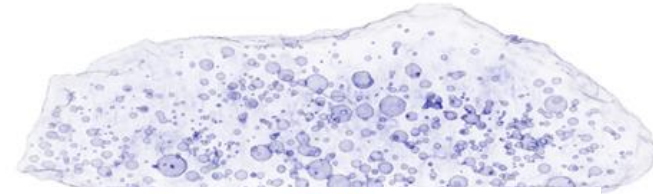
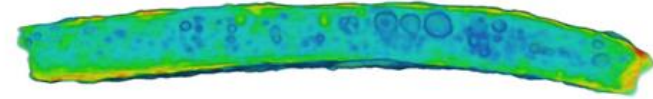
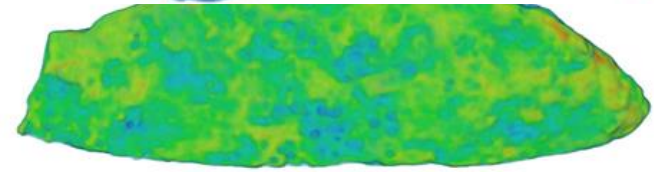
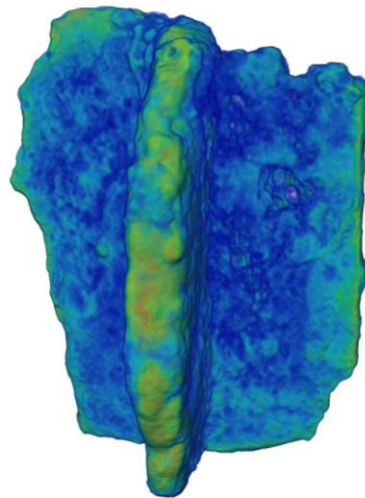
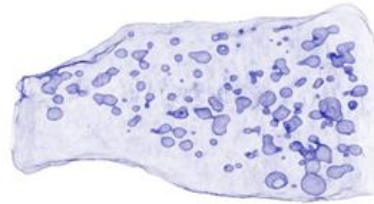
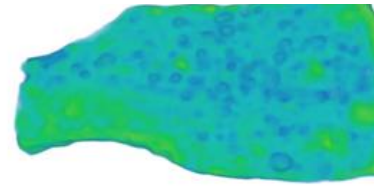
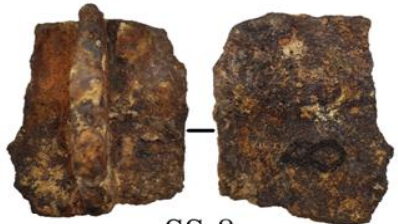
5 cm

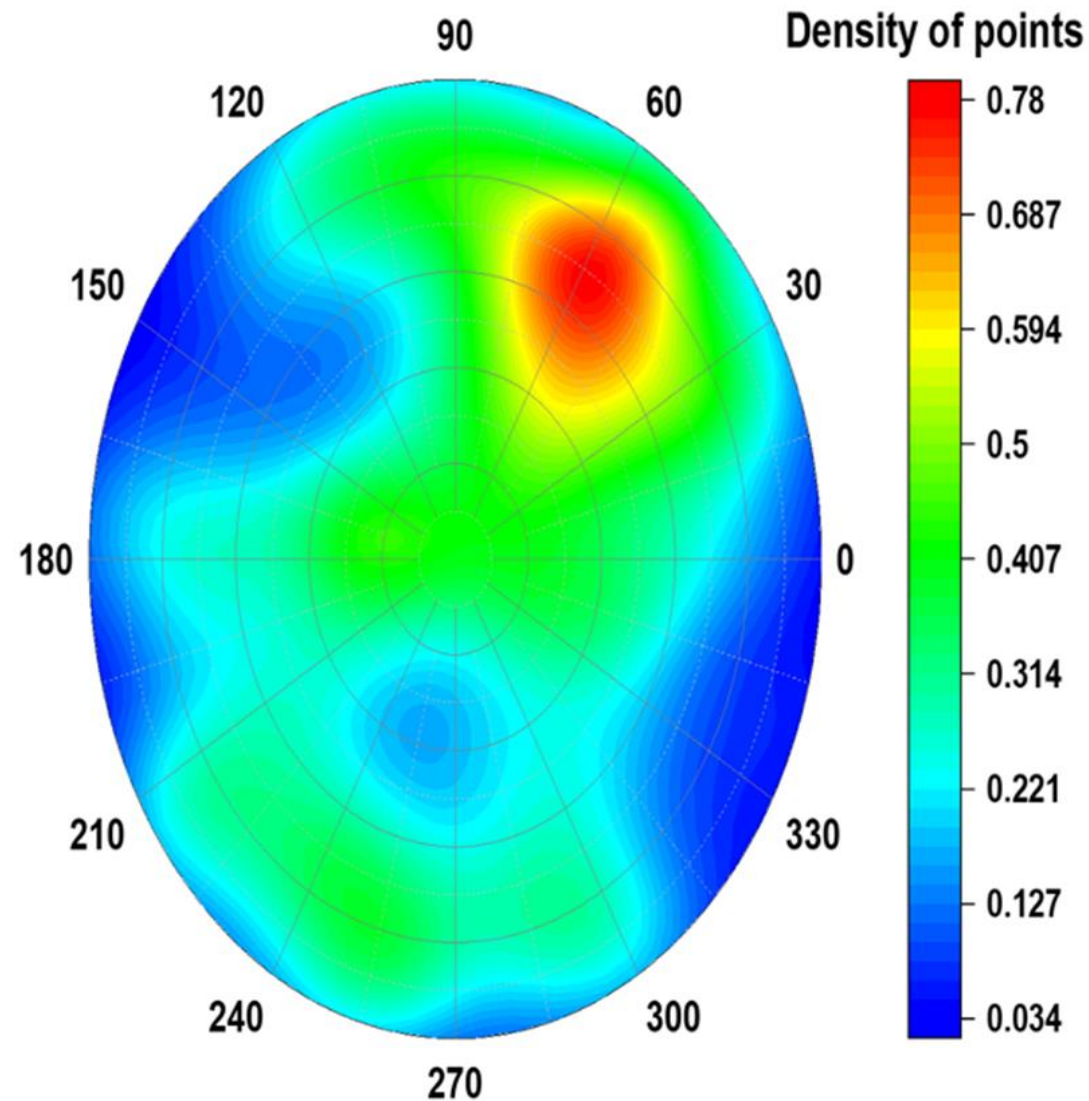
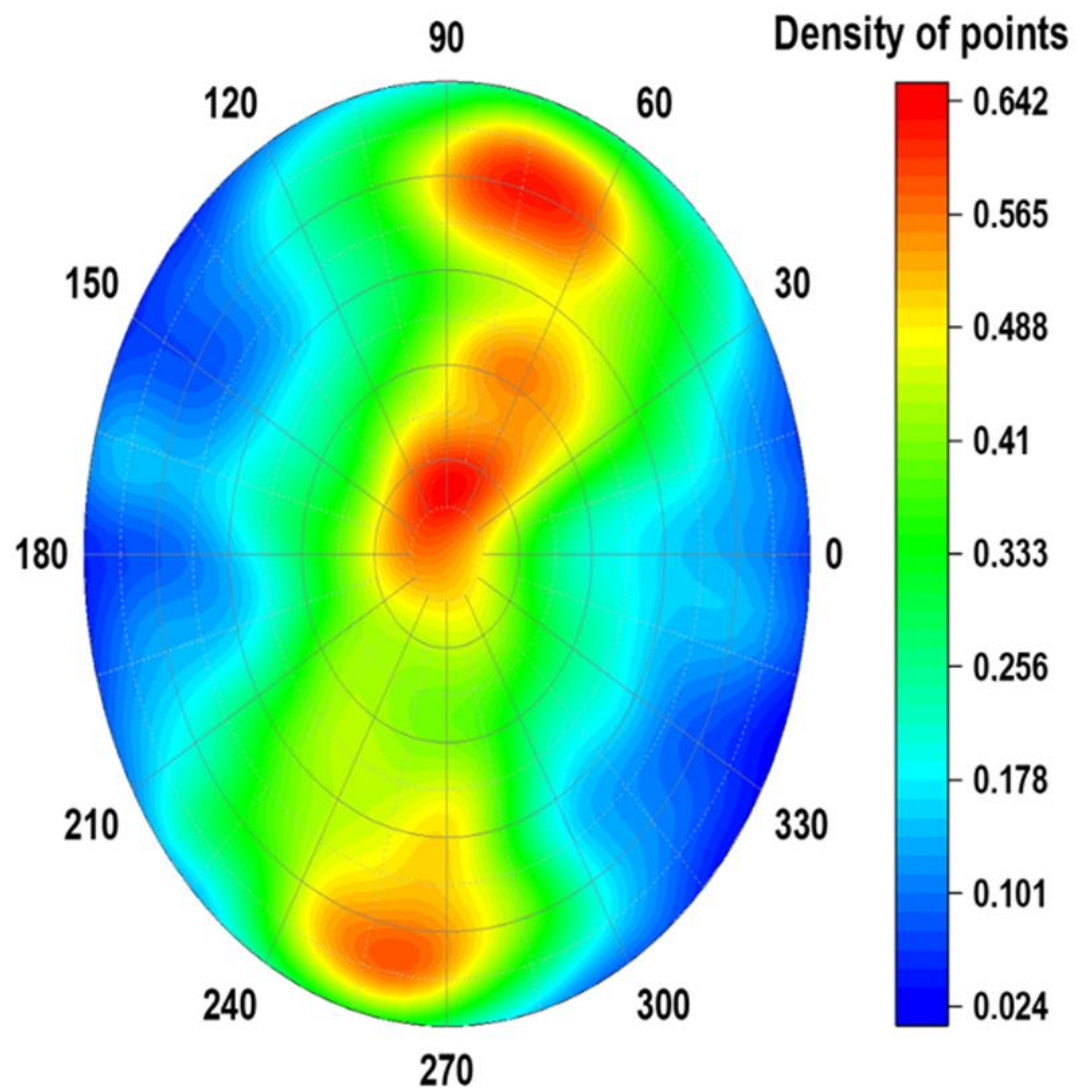


SS-7



SS-8







Joint Institute for Nuclear Research
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Denis Kozlenko

Evgenii Lukin

Boris Savenko

Natalia Golosova

Nadezhda Belozerova

Ivan Zel

Maria Balasoiu

Bekhzodjon Abdurakhimov

Bulat Bakirov

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Kuanysh Nazarov

Ayazhan Zhomartova

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Murat Kenessarin

Anton Rutkauskas

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Olga Lis

Gumar Aydanov



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Thank you for your attention