Nuclear resonance scattering at high pressure: status and future

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Information from Nuclear Resonance Scattering:

Electronic and magnetic properties:
- Oxidation state, temperature
- Symmetry of environment, coordination to oxygen
- Value and direction of magnetic field

Atomic dynamics:
- Composition
- Sound velocity
- Force constants, structure

INTRODUCTION
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Nuclear Resonance high pressure studies with EBS:

Nanoscope:

Improving beam size:

10 × 10 μm² → 0.2 × 0.2 μm²

Keeping the same intensity

Spectrograph:

Improving energy resolution:

0.5 meV → 50 μeV

Keeping the same intensity
Magnetism in cold subducting slabs at mantle transition zone depths


synchrotron Mössbauer source

portable laser heating system

Image courtesy Timofei Fedotenko

magnetic Earth's mantle!

Grenoble, 17-21 June 2019

BEAM SIZE

19.4 GPa

295 K

295 K

1031 K

1165 K

40 GPa

52 GPa

75 GPa

948 K

0.2 × 0.2 μm²

same studies in TPa range
**BEAM SIZE**

**Superconductivity**

**Observation of superconductivity in hydrogen sulfide from nuclear resonant scattering**

Ivan Troyan, Alexander Gavriliuk, Rudolf Rüffer, Alexander Chumakov, Anna Mironovich, Igor Lynubtin, Dmitry Perekalin, Alexander P. Drozdov, Mikhail I. Eremets

**Magnetic landscape**

0.2 × 0.2 μm²

**Hands on! High-pressure techniques at the ESRF-EBS, Grenoble, 17-21 June 2019**
ENERGY RESOLUTION

**diffraction:**
bulk velocity

**nuclear resonance:**
Debye velocity

High Poisson’s ratio, similar to Earth inner core

50 µeV
same studies for much softer (all) systems
EBS will allow you to see
electronic and magnetic properties with 0.2 micron beam

lattice dynamics with 50 μeV resolution

Plan your experiments!
Thank you for your attention!
accessible isotopes:

Fe
Sn  Sm  Eu  Dy  Sb  I  Ni  Te  Xe  Ge  Os  Ru

if required  –  K  Kr  Ba  Tm