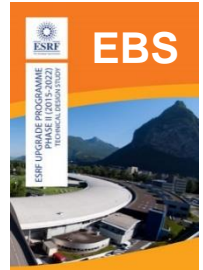


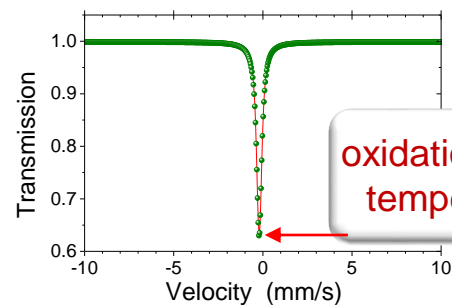
Nuclear resonance scattering at high pressure: status and future

Aleksandr Chumakov

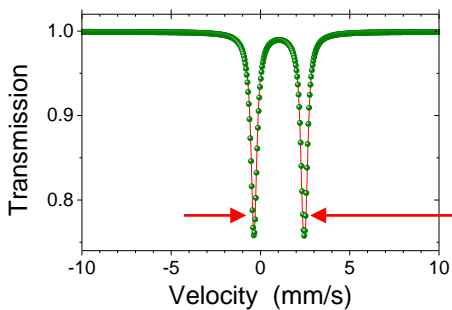


Information from Nuclear Resonance Scattering:

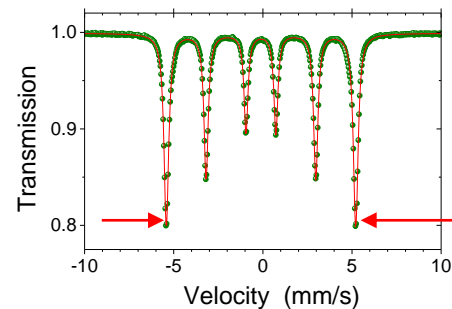
Electronic and magnetic properties:



oxidation state,
temperature

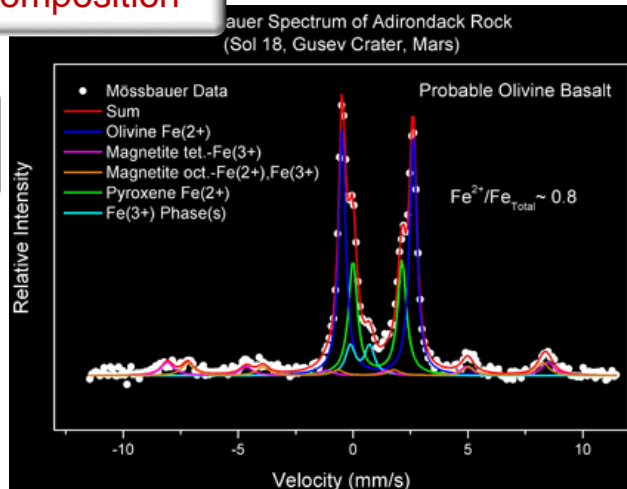


symmetry of environment,
coordination to oxygen

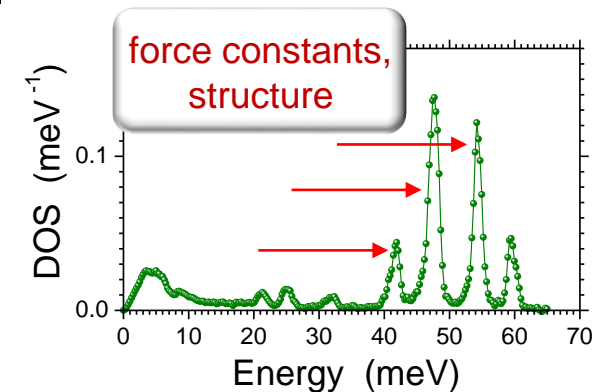
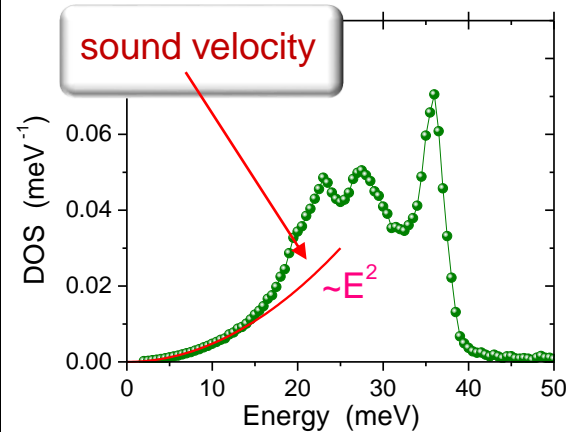


value and direction
of magnetic field

composition

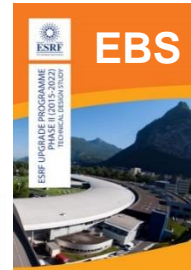
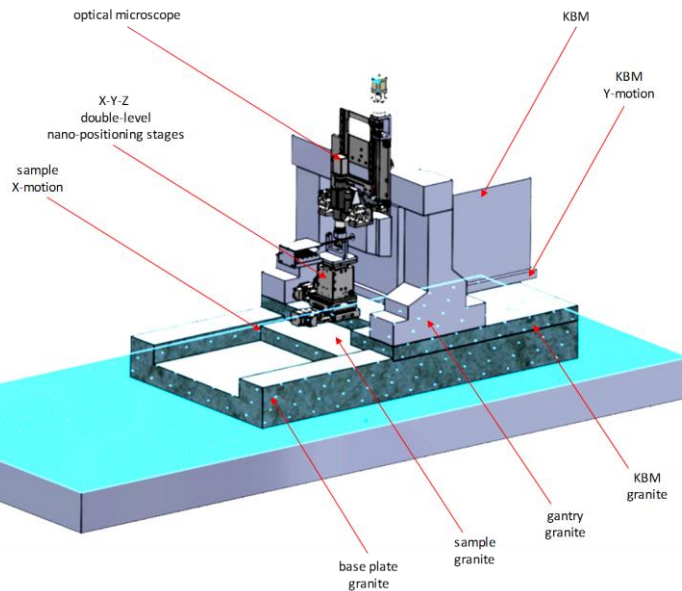


Atomic dynamics:

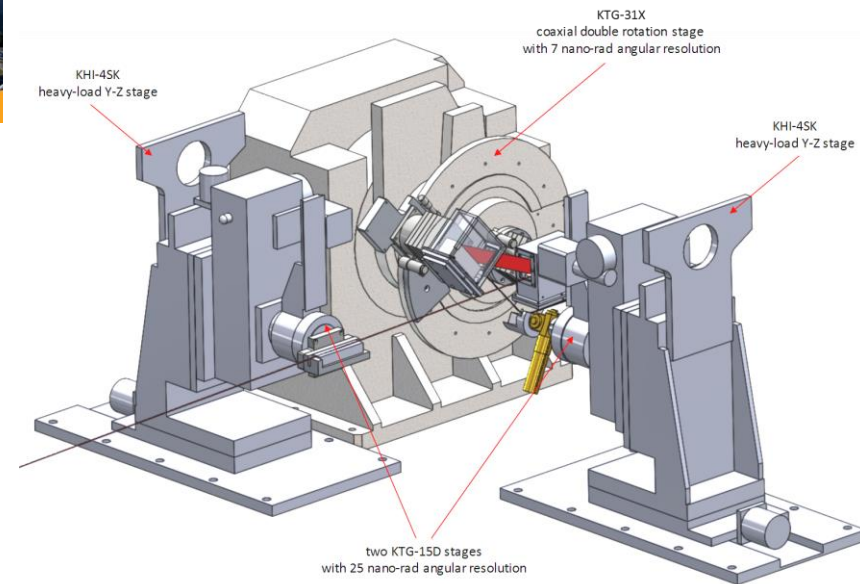


Nuclear Resonance high pressure studies with EBS:

Nanoscope:



Spectrograph:



improving beam size:

$10 \times 10 \mu\text{m}^2 \longrightarrow 0.2 \times 0.2 \mu\text{m}^2$

keeping the same intensity

improving energy resolution:

$0.5 \text{ meV} \longrightarrow 50 \mu\text{eV}$

keeping the same intensity

BEAM SIZE

nature
International journal of science

<https://doi.org/10.1038/s41586-019-1254-8>

Magnetism in cold subducting slabs at mantle transition zone depths

I. Kupenko^{1*}, G. Aprilis^{2,3}, D. M. Vasiukov^{2,3,4}, C. McCammon², S. Chariton², V. Cerantola^{2,5}, I. Kantor⁶, A. I. Chumakov⁵, R. Rüffer², L. Dubrovinsky² & C. Sanchez-Valle¹

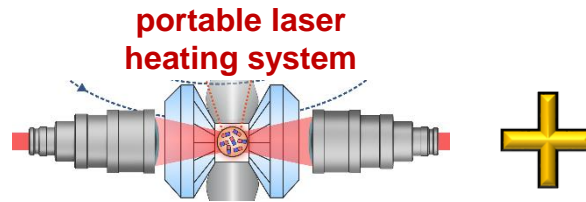
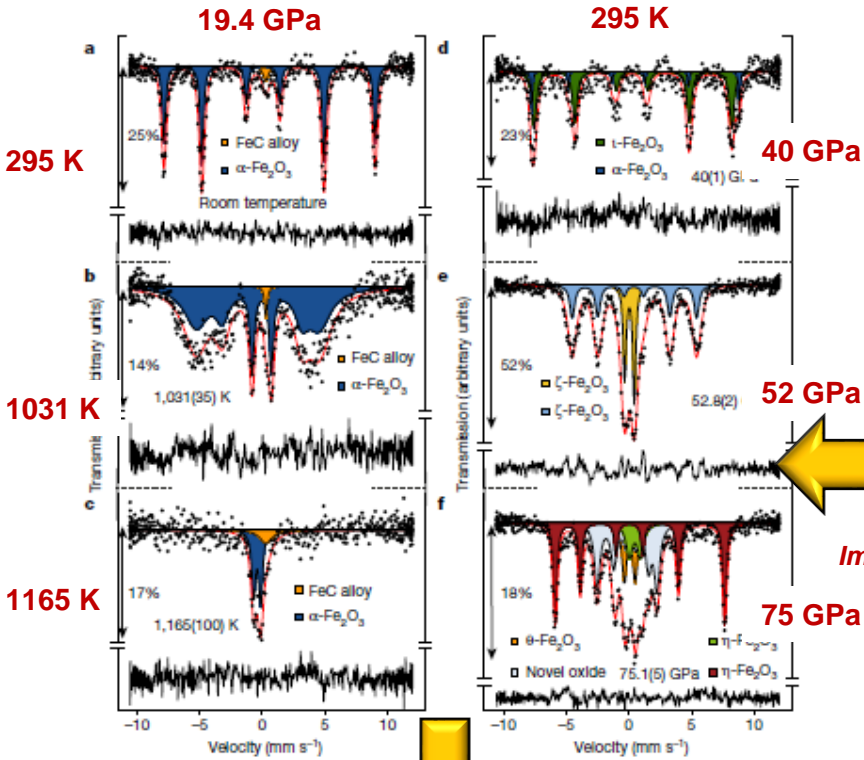
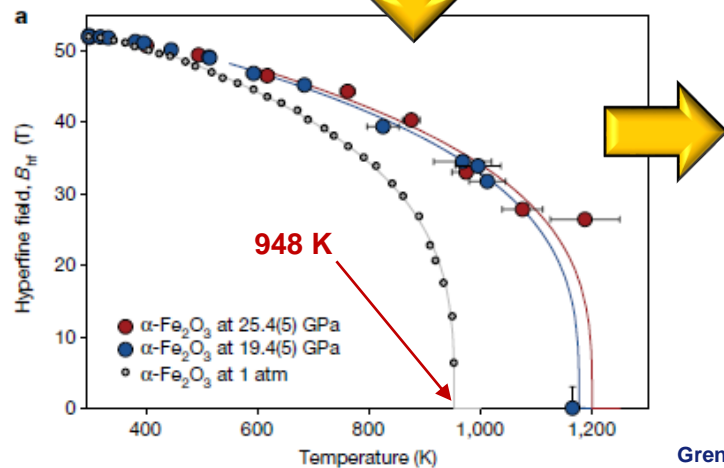
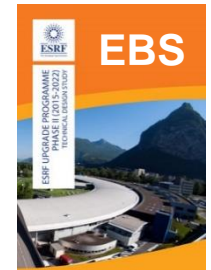
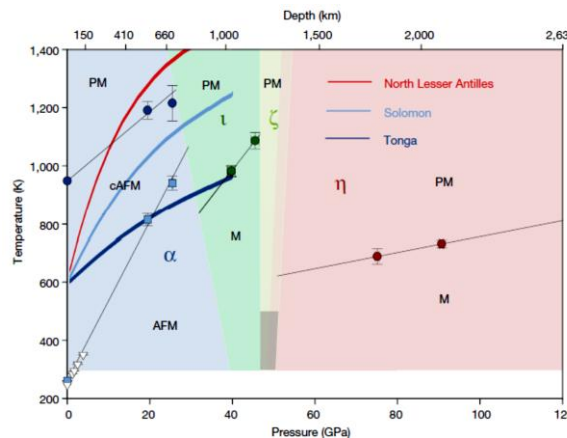


Image courtesy of Timofei Fedotenko

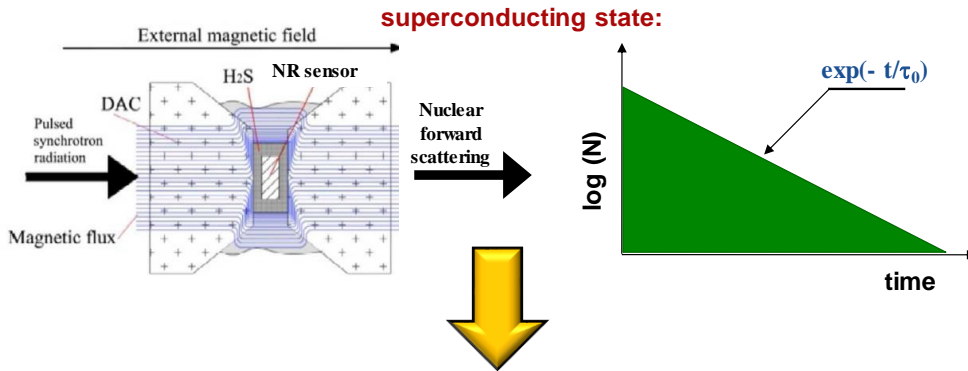
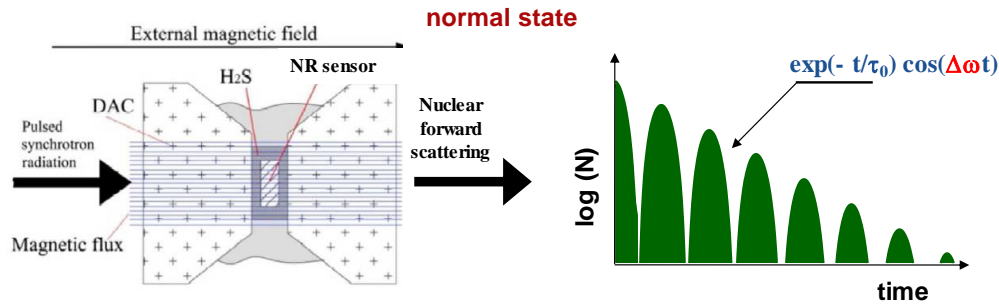


magnetic Earth's mantle!



$0.2 \times 0.2 \mu\text{m}^2$

same studies in TPa range

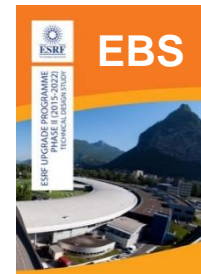


Science

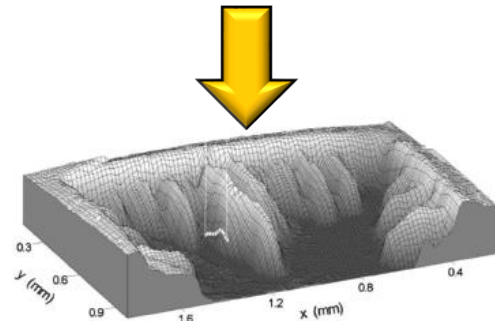
SUPERCONDUCTIVITY

Observation of superconductivity in hydrogen sulfide from nuclear resonant scattering

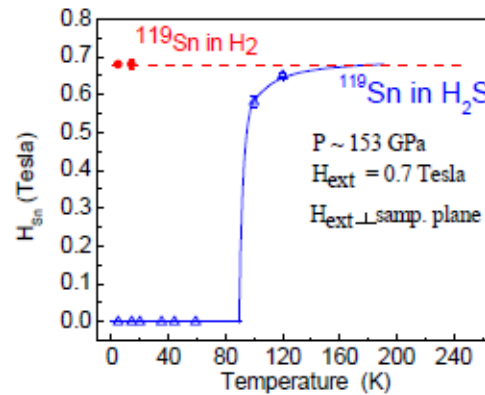
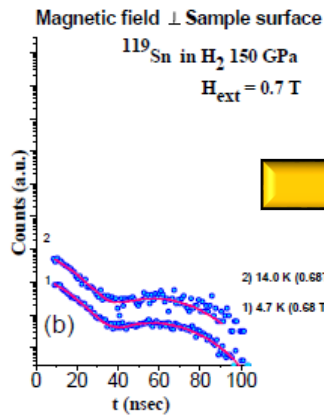
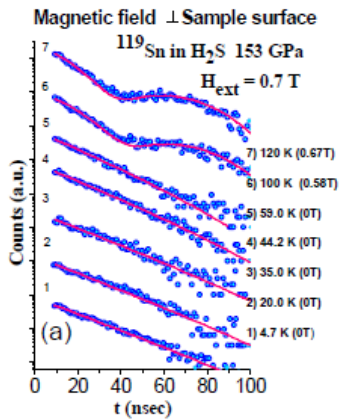
Ivan Troyan,^{1,2*} Alexander Gavriluk,^{2,3†} Rudolf Ruffer,⁴ Alexander Chumakov,^{4,5} Anna Mironovich,³ Igor Lyubutin,² Dmitry Perekalin,⁶ Alexander P. Drozdov,¹ Mikhail I. Erements¹



$0.2 \times 0.2 \mu\text{m}^2$

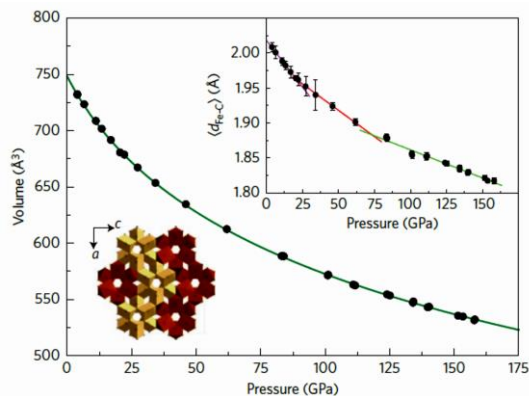


imaging magnetic landscape

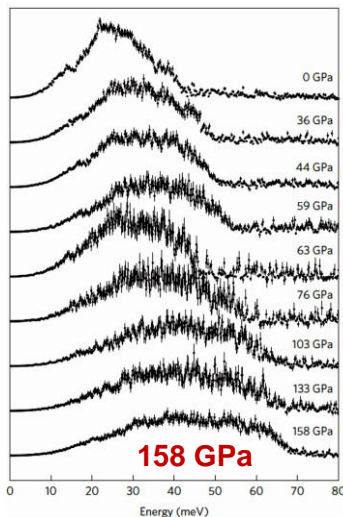


ENERGY RESOLUTION

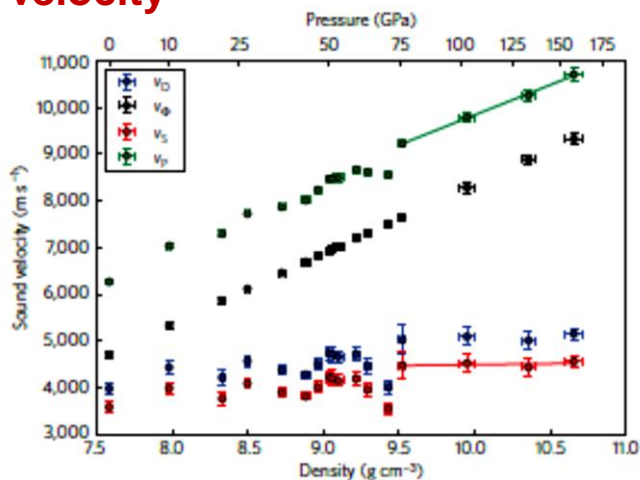
**diffraction:
bulk velocity**



**nuclear resonance:
Debye velocity**



**compressional velocity
shear velocity**



nature
geoscience

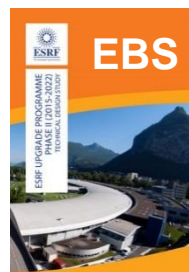
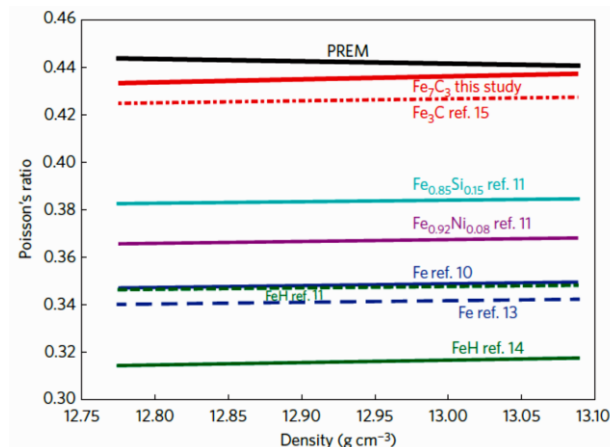
LETTERS

PUBLISHED ONLINE: 23 FEBRUARY 2015 | DOI: 10.1038/NGEO2370

High Poisson's ratio of Earth's inner core explained by carbon alloying

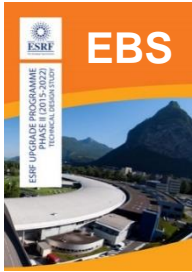
C. Prescher^{1,2*}, L. Dubrovinsky¹, E. Bykova^{1,3}, I. Kupenko^{1,4}, K. Glazyrin^{1,5}, A. Kantor^{1,4}, C. McCammon¹, M. Mookherjee^{1,6}, Y. Nakajima^{1,7}, N. Miyajima¹, R. Sinmyo¹, V. Cerantola¹, N. Dubrovinskaja³, V. Prakapenka², R. Rüffer⁴, A. Chumakov^{4,8} and M. Hanfland⁴

**High Poisson's ratio,
similar to Earth inner core**



50 μeV

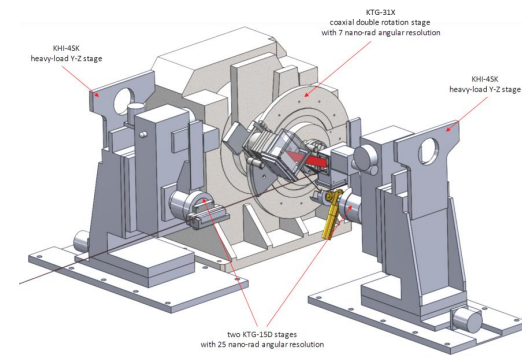
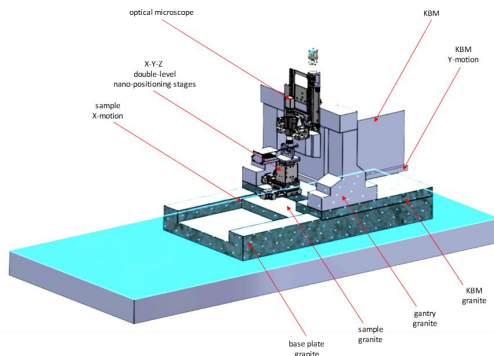
**same studies
for much softer
(all) systems**



EBS will allow you to see

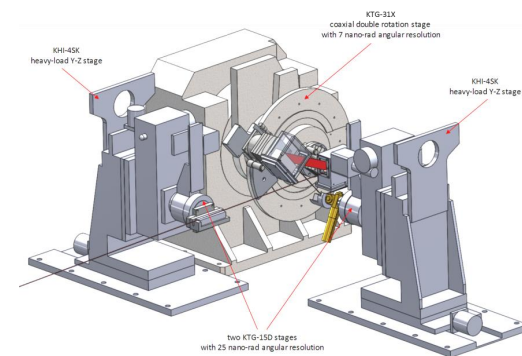
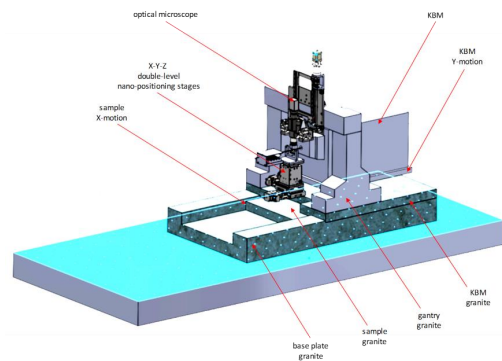
electronic and magnetic
properties
with **0.2 micron** beam

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