# READi Workshop 2014

Research Exchange And Discovery Workshop.

Contribution ID: **34** Type: **not specified**

# Towards meV resolution above 40 keV using a sapphire X-ray monochromator

*Wednesday 9 April 2014 16:00 (20 minutes)*


## Summary

Recent developments of backscattering monochromators enabled an energy resolution of ΔE/E~1e-8 in the 21-40keV energy range by employing sapphire single crystals. Nuclear inelastic scattering, NIS, studies of the lattice dynamics on Eu, Sm, Sn, Te, Sb and Xe compounds are thus possible with meV to sub-meV resolution. In contrast to inelastic neutron scattering (INS), NIS probes phonon modes in an element specific way. Thus, the correct normalization of measured NIS spectra is provided and the pDOS can be probed element-specific. Another feature of NIS is that the scattered photons propagate in all directions, i.e. NIS probes the whole reciprocal space simultaneously, in contrast to IXS. Especially remarkable is the possibility to investigate lattice dynamics at high pressures in materials containing Mössbauer elements. Although theoretical calculations show the possibility to use sapphire for backscattering monochromators above 40keV with resolution ΔE/E~1e-8 or better, an experimental realization has not yet been achieved. meV-monochromatization above 40keV is required in order to perform nuclear resonant scattering experiments on 183-W at 46.5keV, 238-U at 44.9keV, 232-Th at 49.4keV, 157-Gd at 54.5keV, 239-Pu at 57.3keV, 127-I at 57.6keV, 159- Tb at 58.0keV, 237-Np at 59.5keV and to measure element specific density of phonon states in related compounds.


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**Session Classification:** Infection & Structural Biology