Inelastic neutron scattering studies of phonon anomalies in relaxor ferroelectrics

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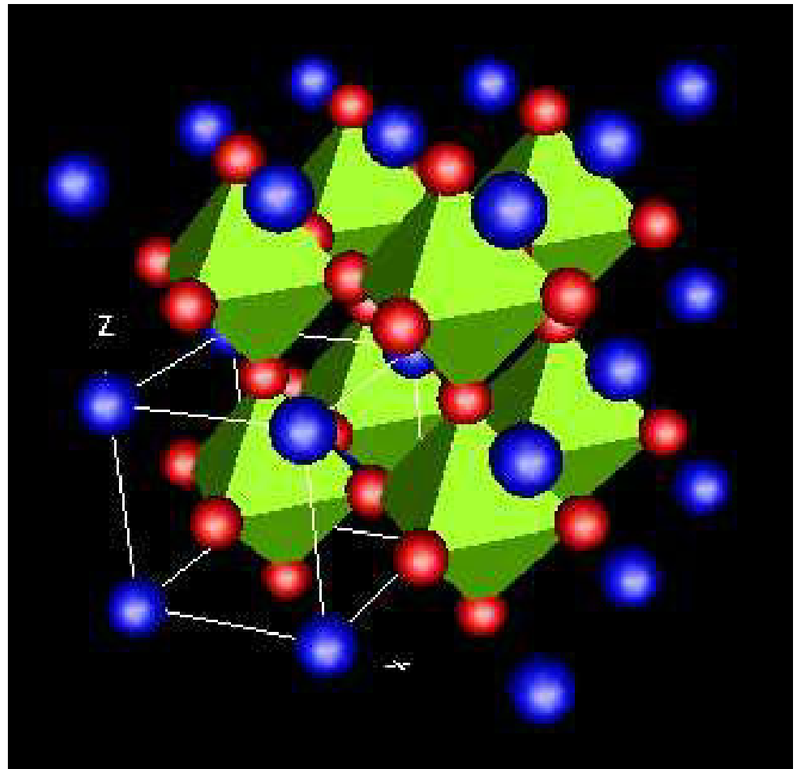
Why Relaxors?

- anomalously high dielectric, piezoelectric and other material constants
  → important applications
  (piezoelectric devices, capacitors, FE-RAMs etc.)
  → miniaturization

- ABO_3 perovskite structure

- Disorder on B-sites
  → formation of ***polar nanoregions (PNR)***

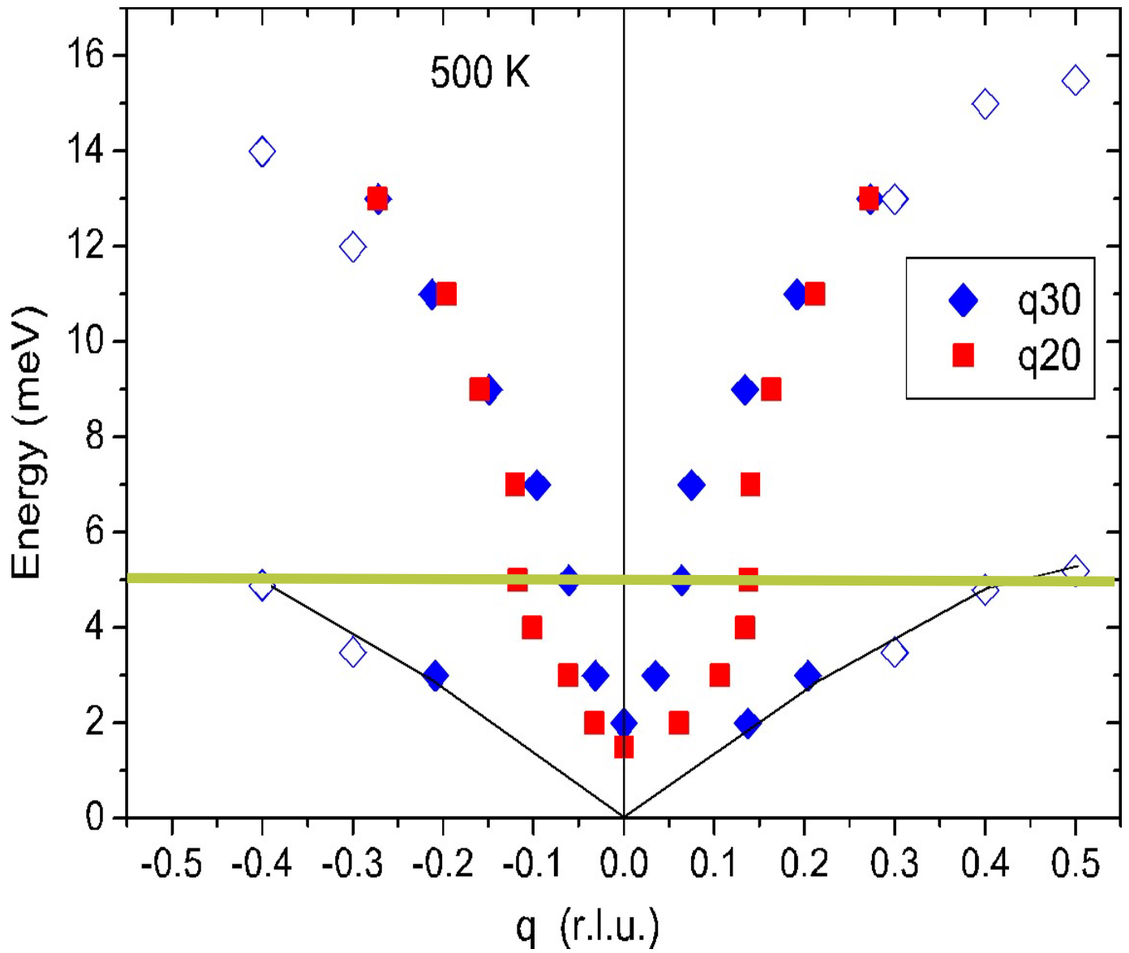
- ***Examples:***
  $Pb(Zn_{1/3}Nb_{2/3})O_3$ – 8% $PbTiO_3$ (**PZN- PT**)
  $Pb(Mg_{1/3}Nb_{2/3})O_3$ (**PMN**)

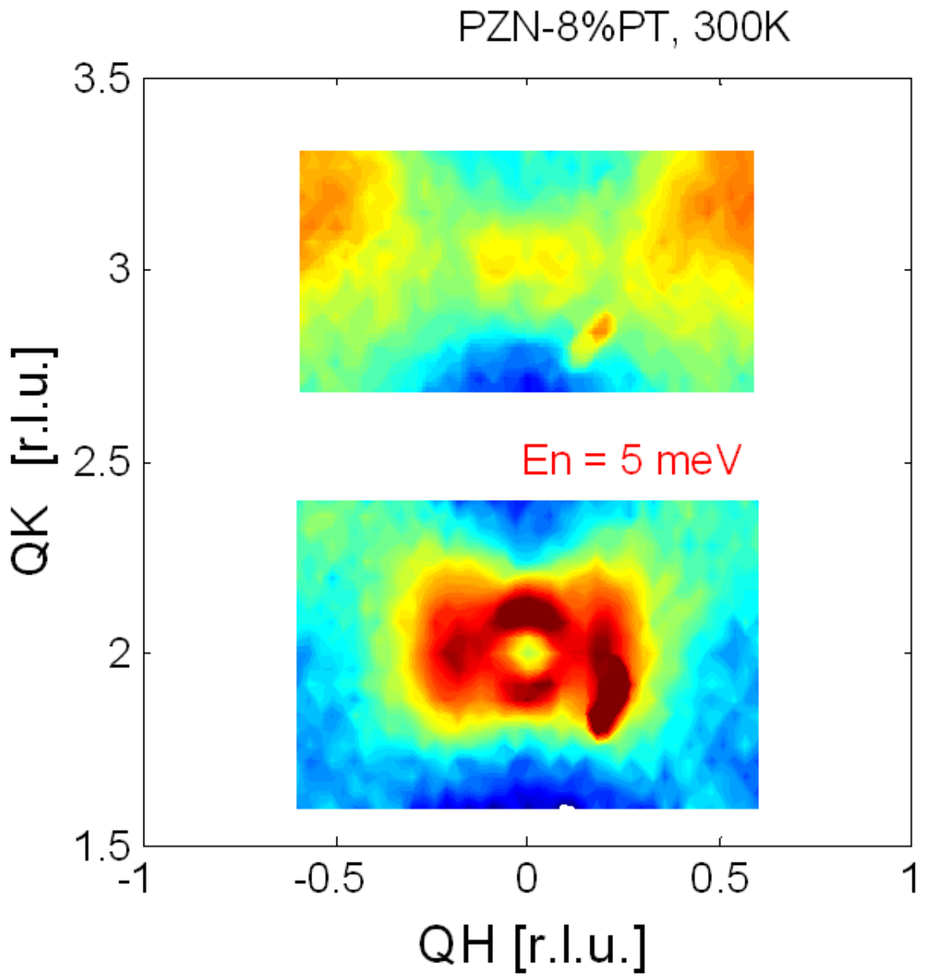


Pb O Nb/Zn

The Waterfall effect

-vertical dispersion of the coupled phonon branches (optic and acoustic)

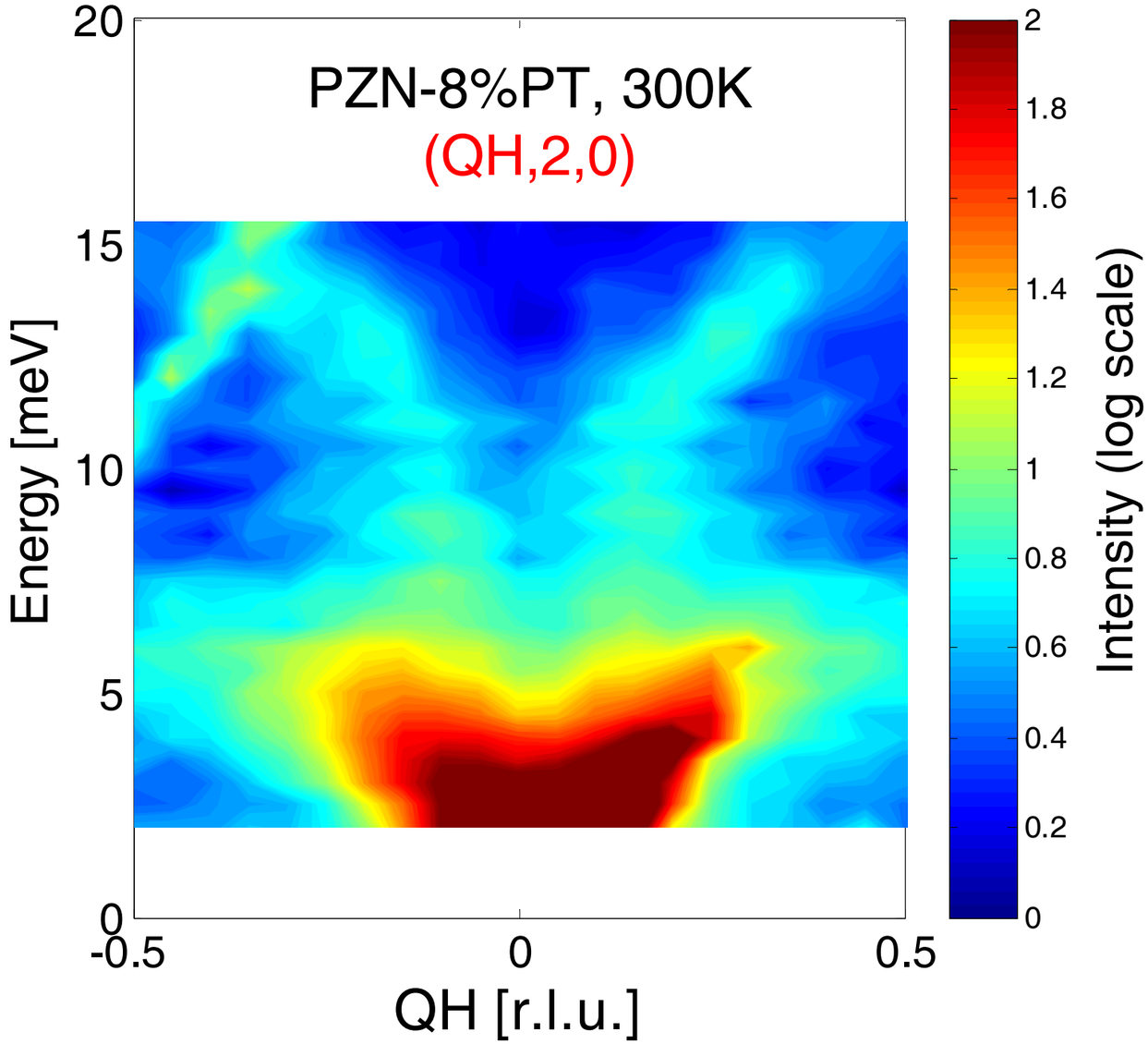


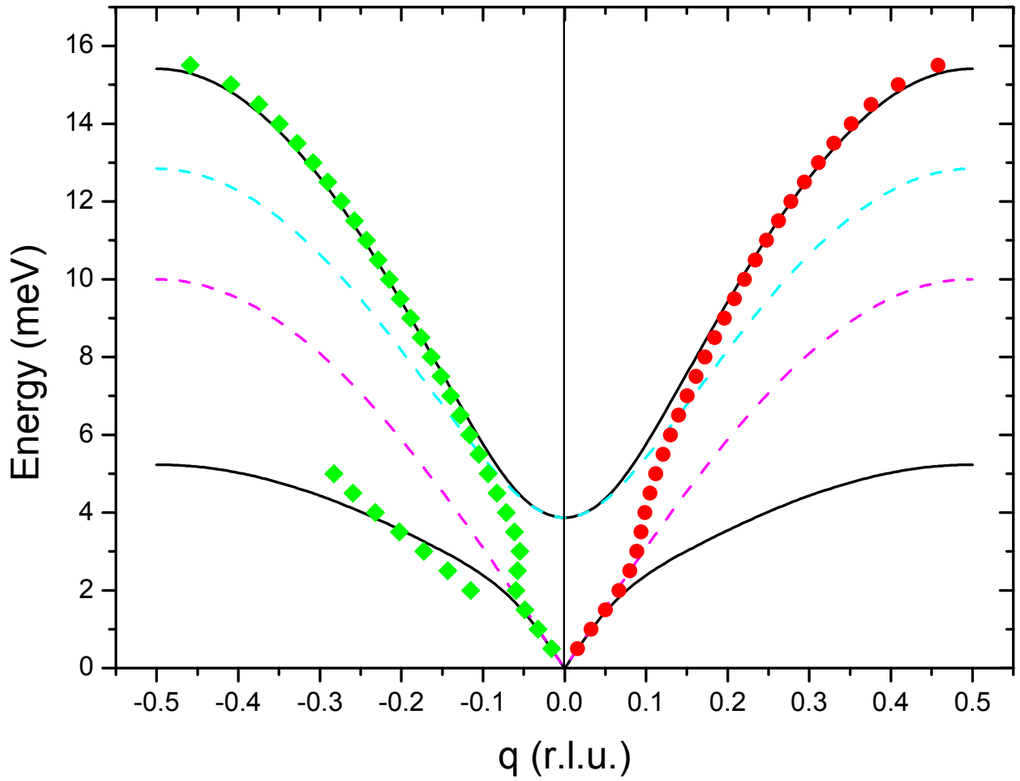


[1] J. Hlinka, S. Kamba, J. Petzelt, J. Kulda, C.A. Randall and S.J. Zhang, *Phys. Rev. Lett.* **91**, 107602 (2003)

The Waterfall effect

Q-E space: experiment and calculations

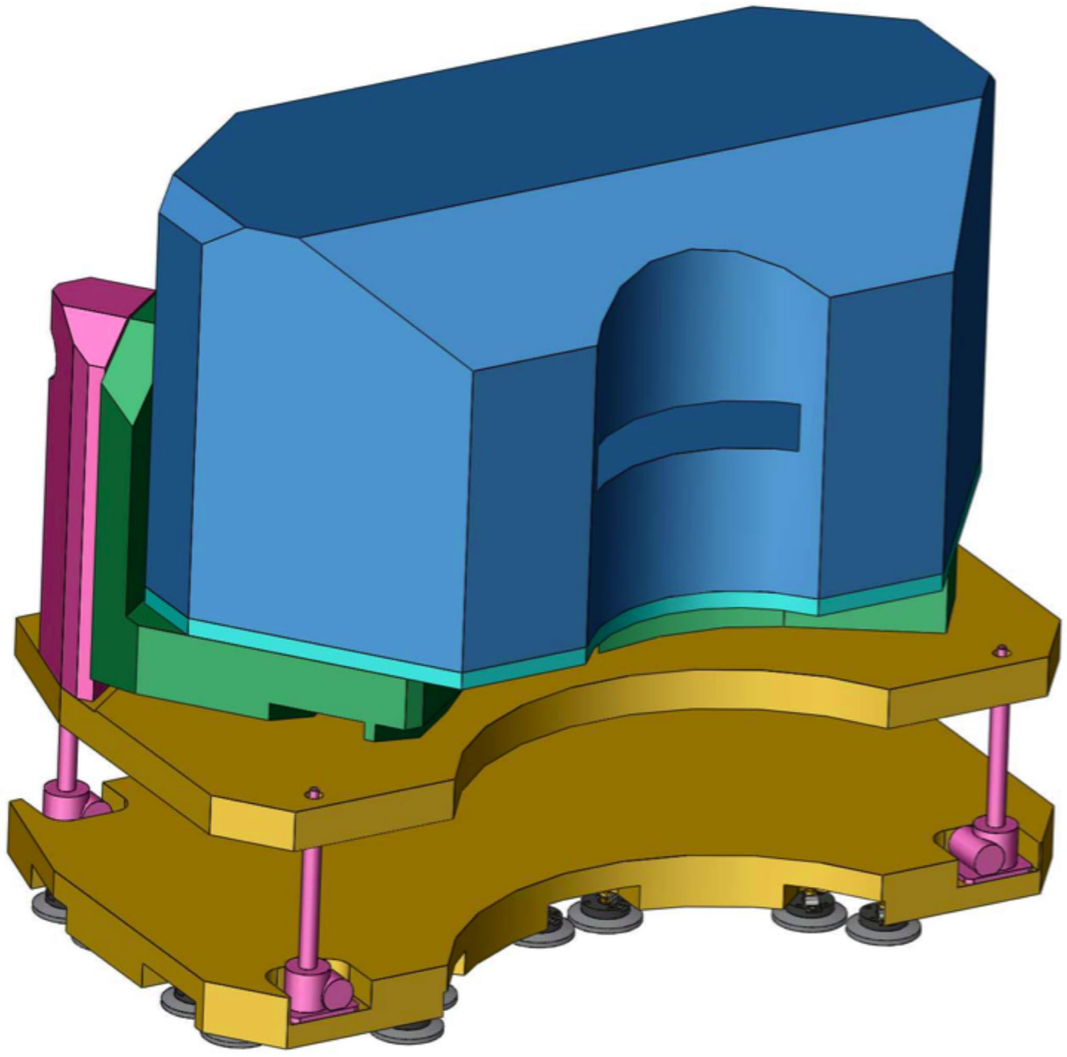


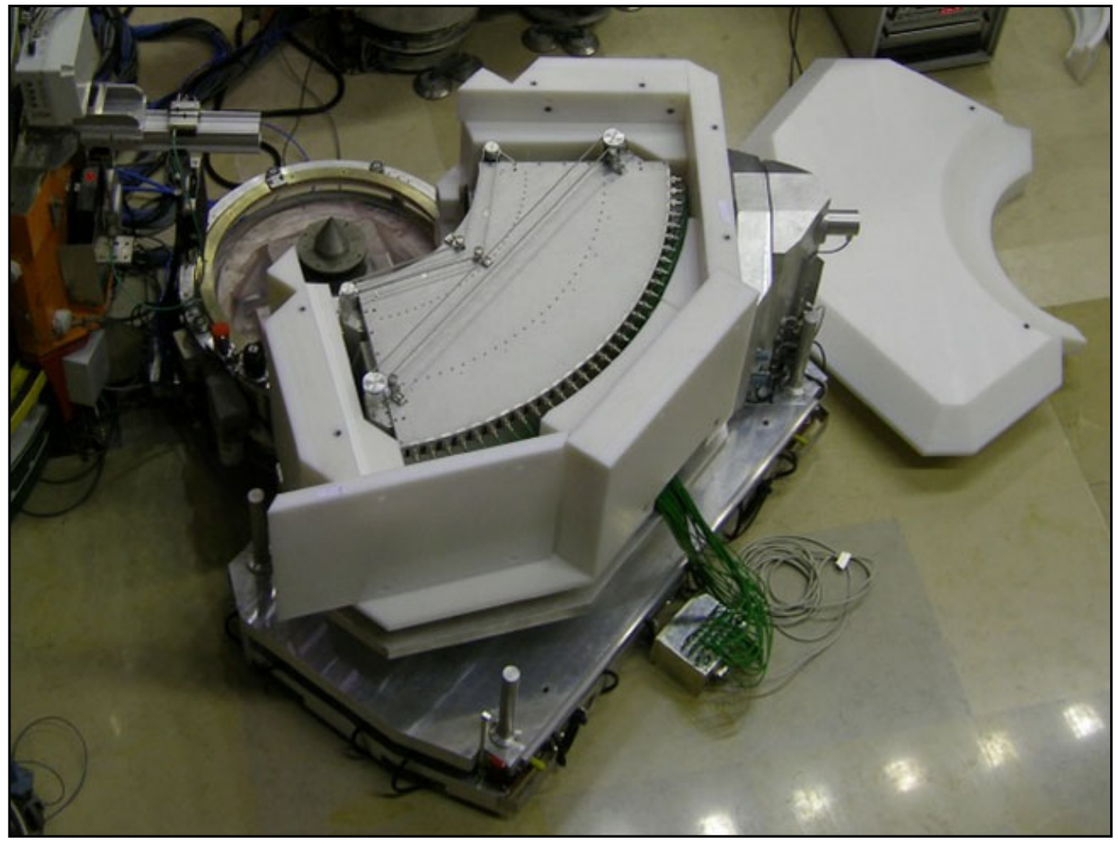


Dispersion curves calculated
from the model in [1]. The critical wavevector
depends on the dynamical structure factor
of the bare acoustic branch.

[1] J. Hlinka, S. Kamba, J. Petzelt, J. Kulda, C.A. Randall and S.J. Zhang,
Phys. Rev. Lett. **91**, 107602 (2003)

Perspectives with *FlatCone*

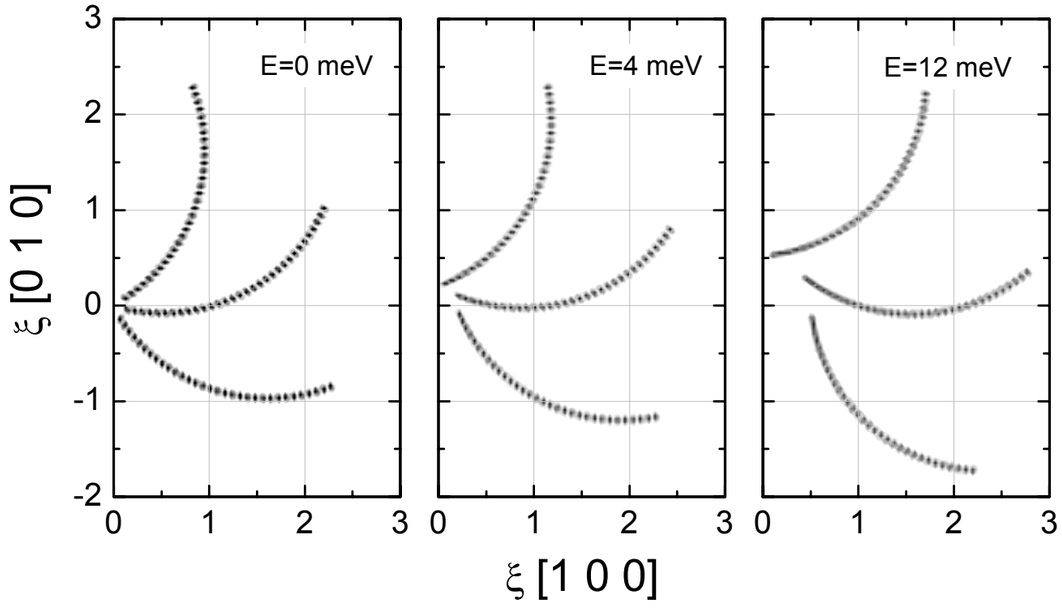




main advantages:

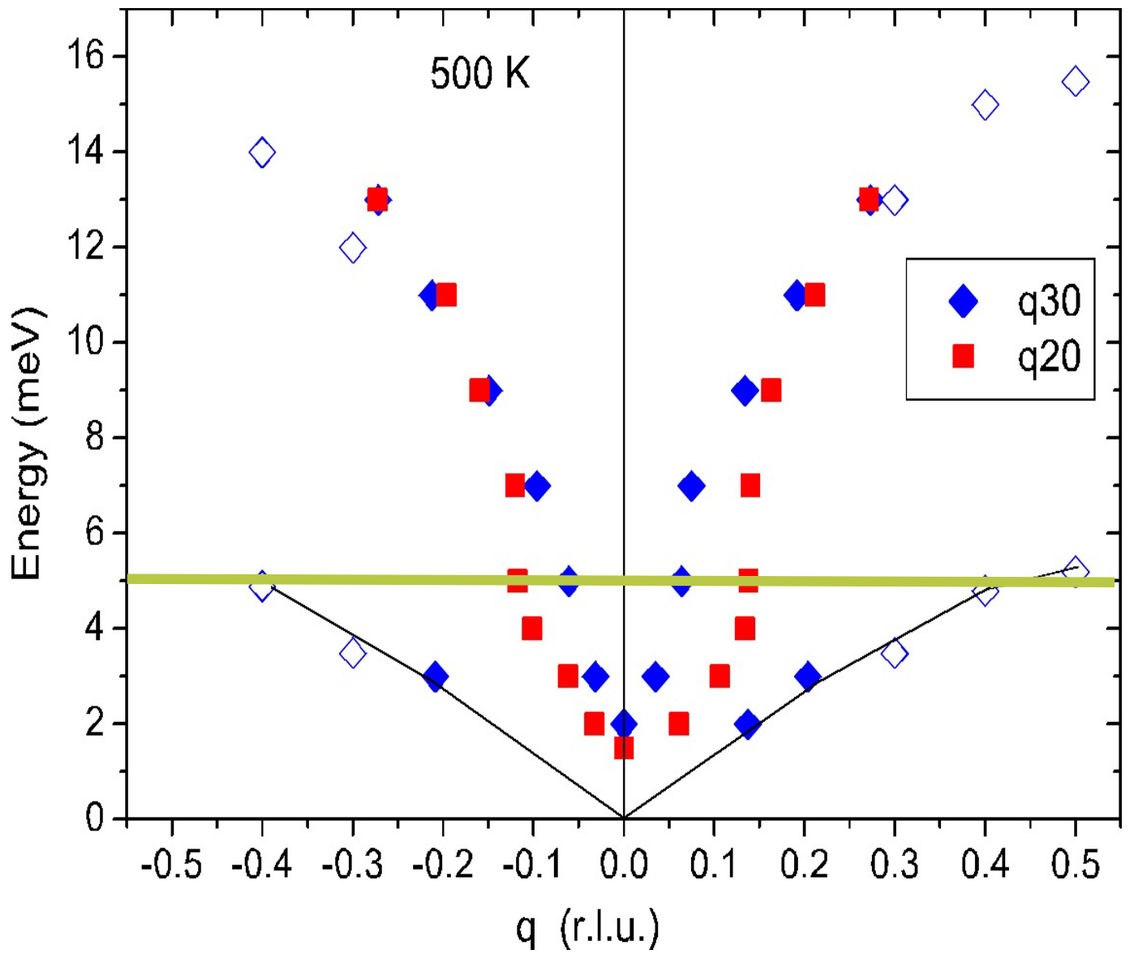
-faster measurement

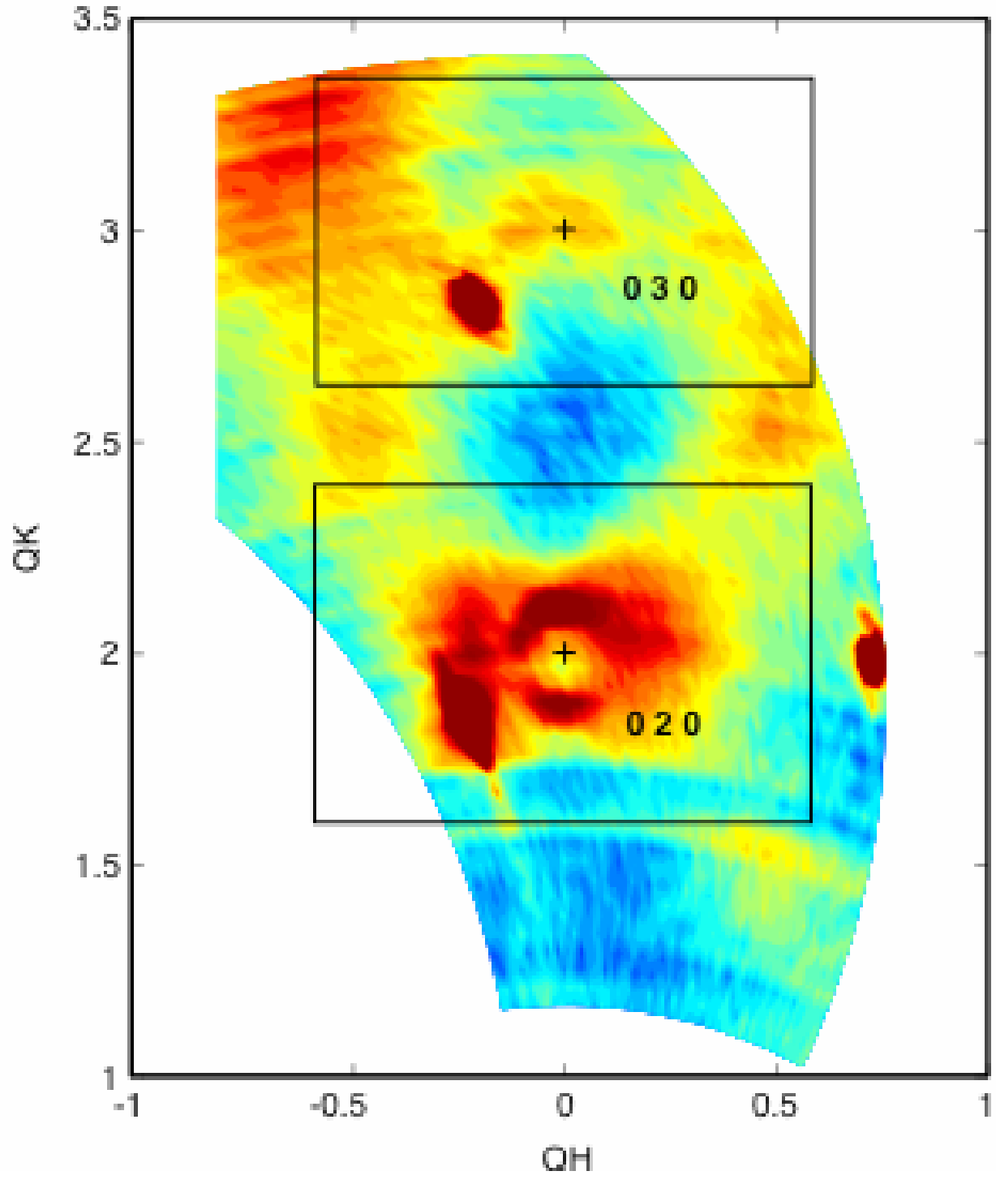
- improved momentum resolution



Perspectives with *FlatCone*

- ideal for constant - Energy scans





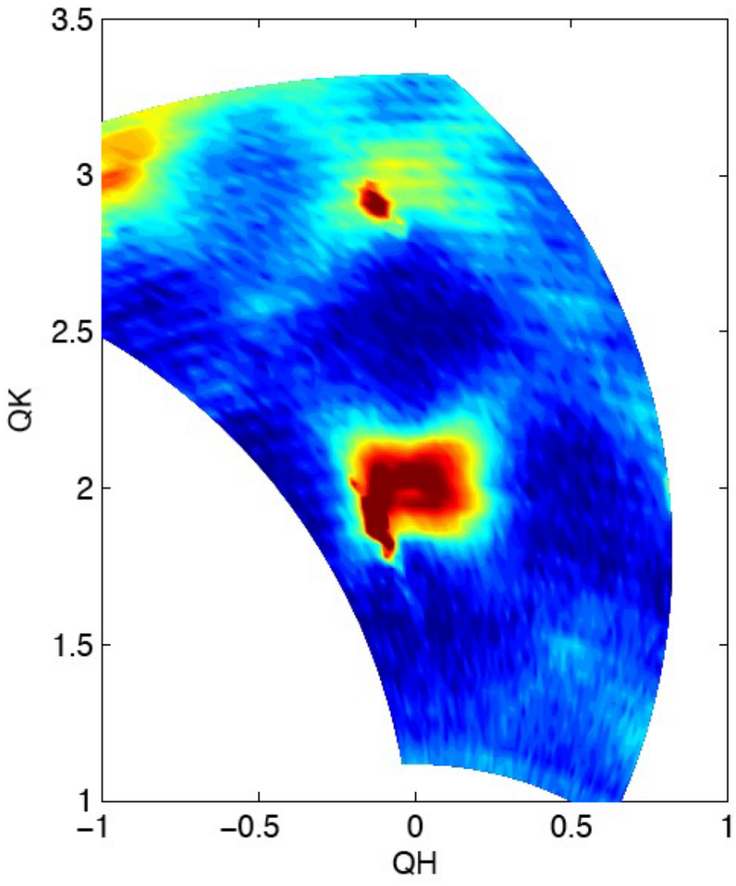
[1] J. Hlinka, S. Kamba, J. Petzelt, J. Kulda, C.A. Randall and S.J. Zhang, *Phys. Rev. Lett.* **91**, 107602 (2003)

ΔE = 5 meV

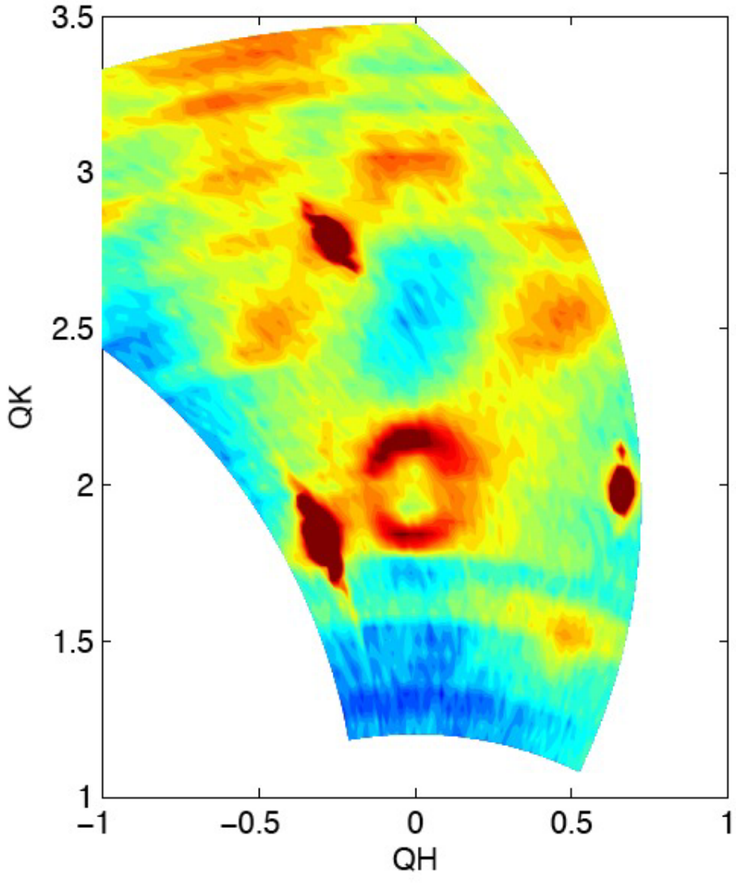
k_f = 3 Å^{-1}

First results from *FlatCone*

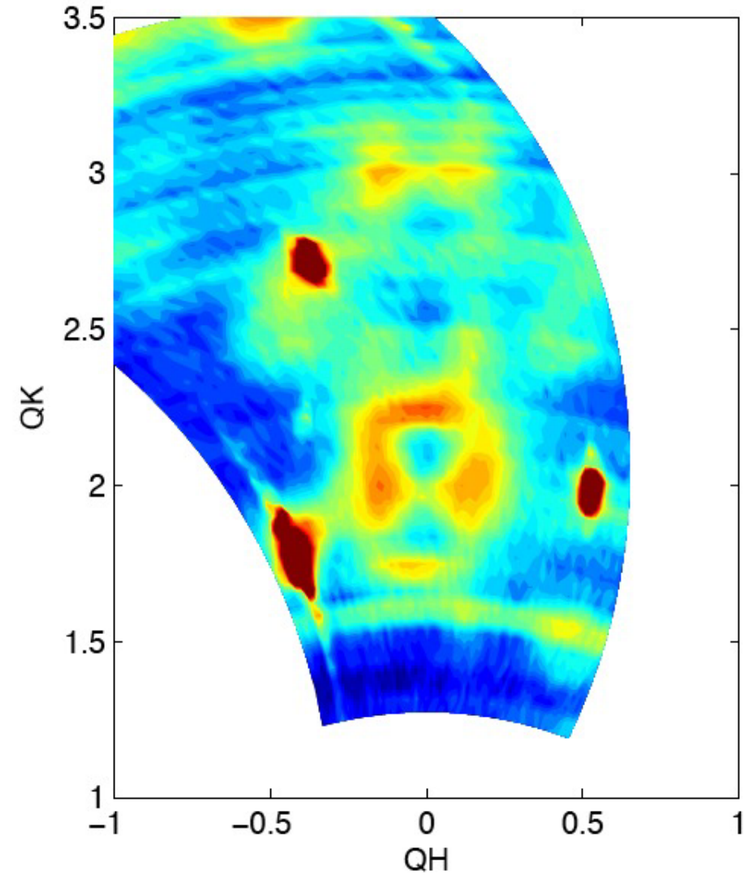
constant - Energy cuts of the reciprocal space



ΔE = 3 meV



ΔE = 7 meV



ΔE = 10 meV

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FlatCone

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