Parametric X-ray radiation in the backward geometry under interaction of relativistic electrons with crystalline and polycrystalline structures

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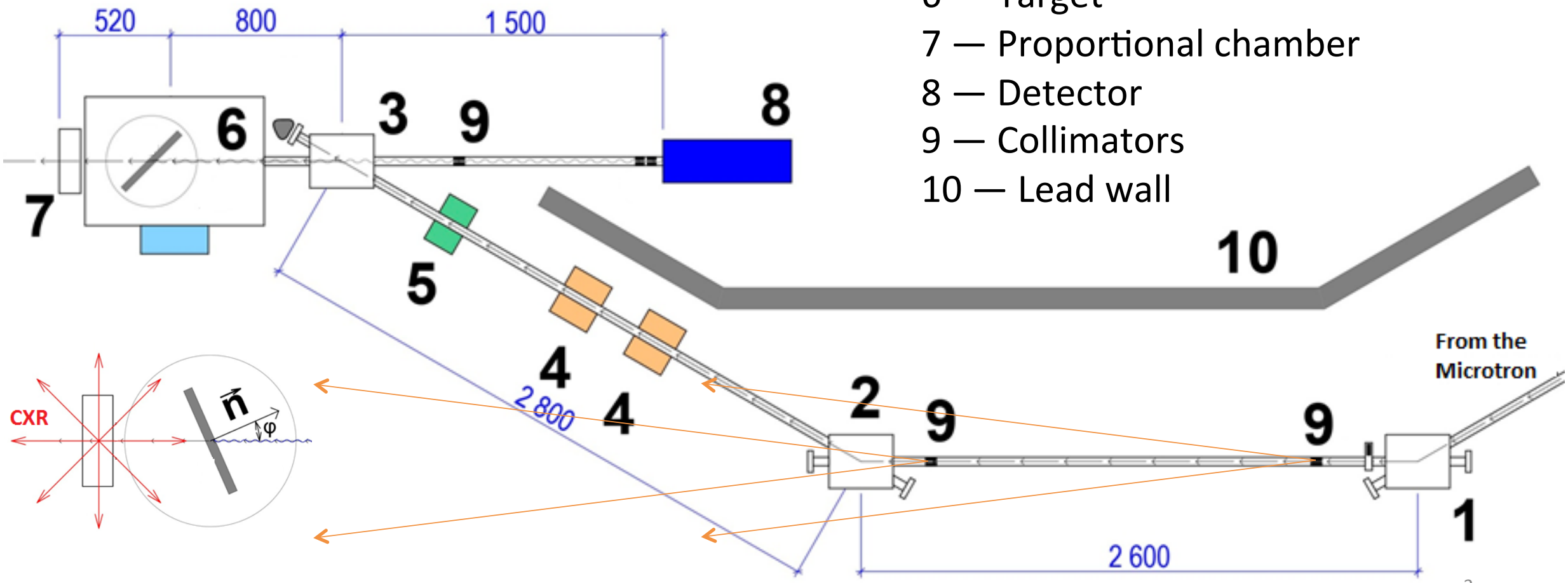
Plan

- Experimental setup
- PXR in:
  - Polycrystals (Nickel and Molybdenum)
  - Textured polycrystals (Nickel and Tungsten)
- Orientation dependence and the observation angle
- Conclusion

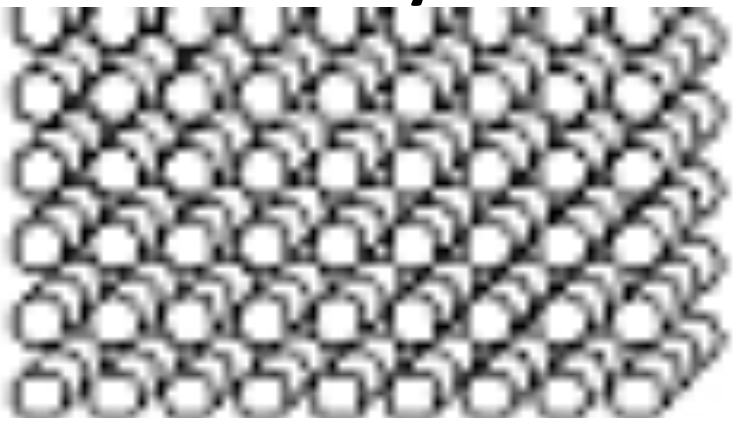
Experimental setup

1,2,3 — Bending Magnets
4 — Quadrupole lenses
5 — Corrector
6 — Target
7 — Proportional chamber
8 — Detector
9 — Collimators
10 — Lead wall



Crystals

Parametric X-ray Radiation (PXR)



Mosaic crystals

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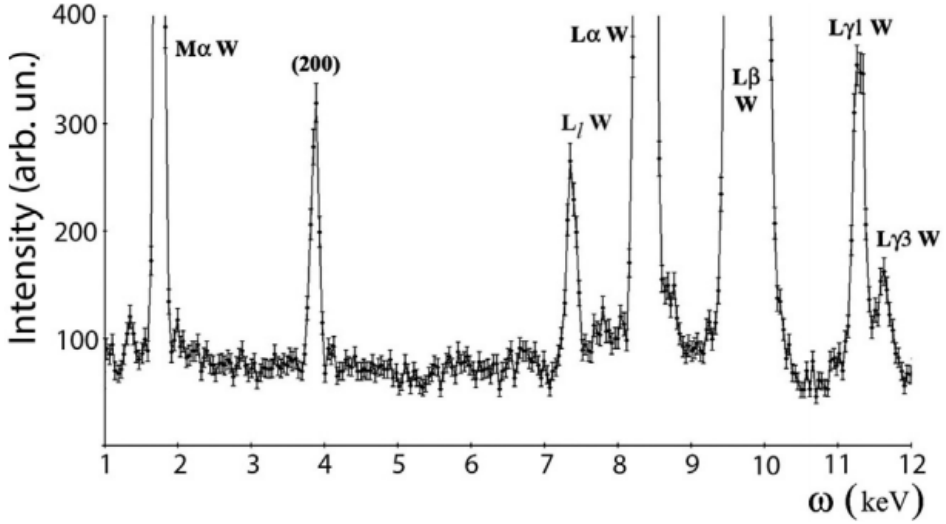


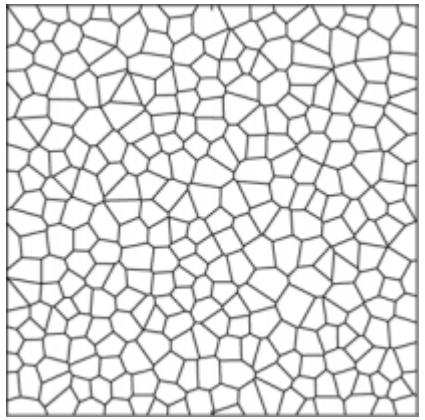
Fig. 9. The PBBS spectrum measured from W polycrystalline foil.

Tungsten Polycrystalline foil

Polycrystals

Polarization Bremsstrahlung (PB)

Textured Polycrystals



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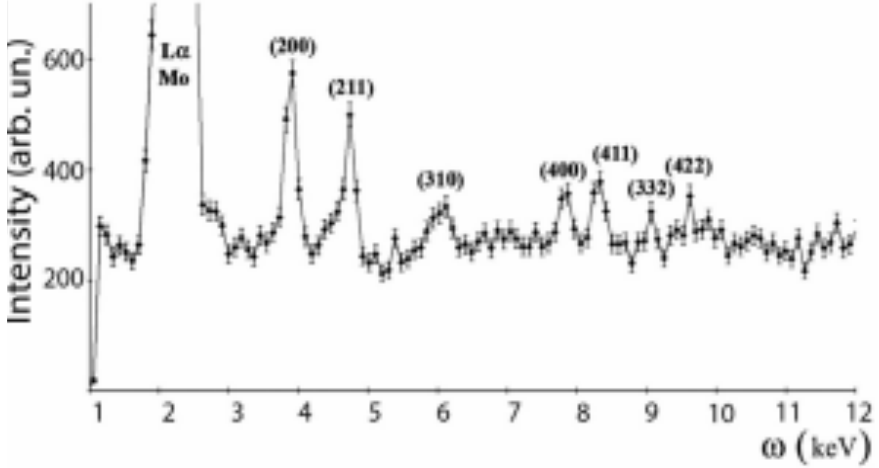

Fig. 8. The PBBS spectrum measured from Mo polycrystalline foil.

Molybdenum Polycrystalline foil

Nickel polycrystalline foil

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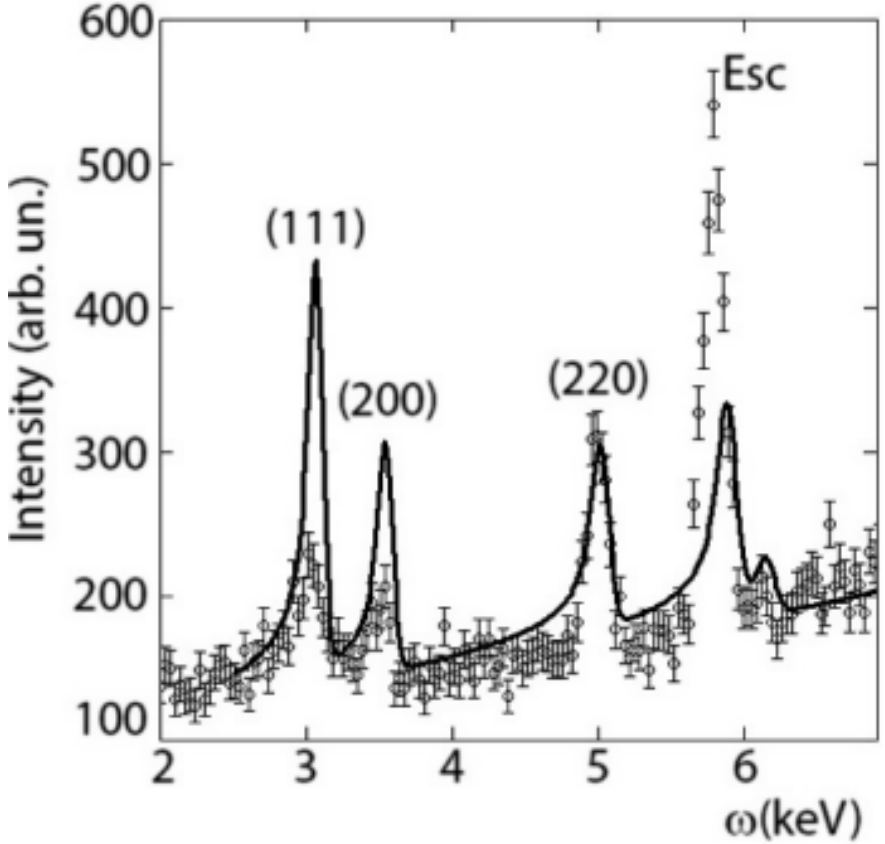
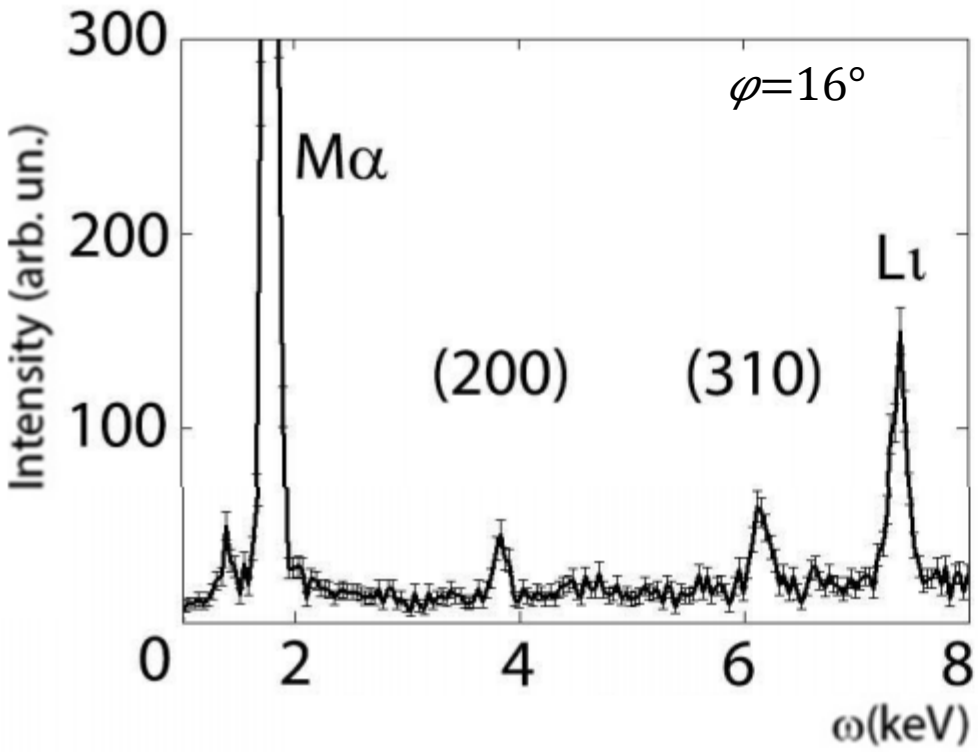
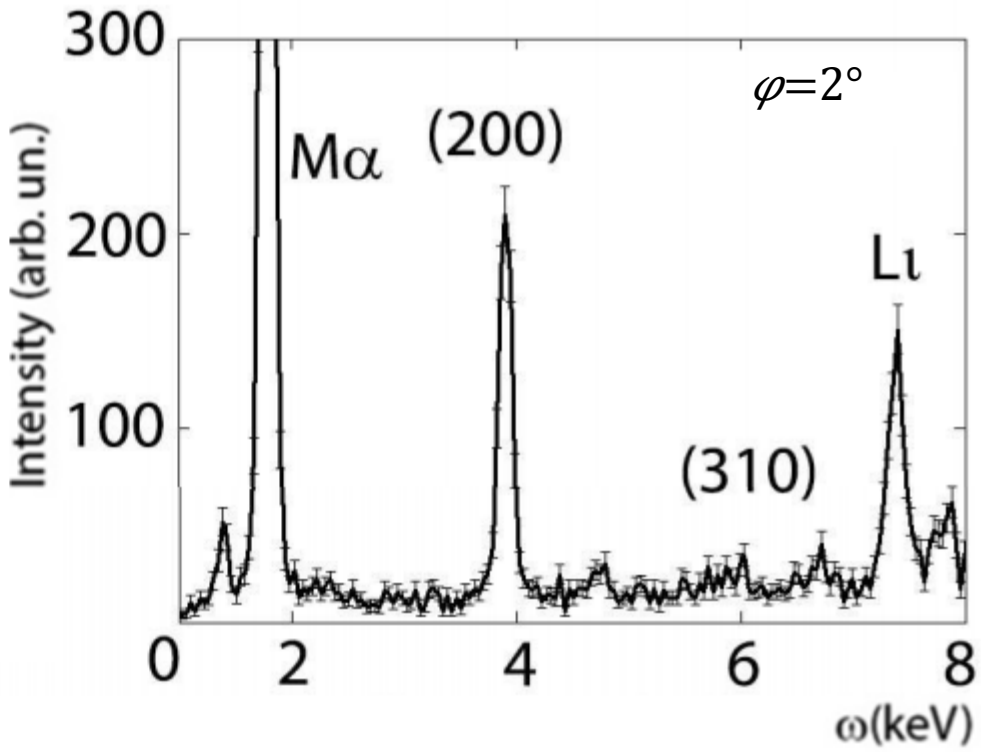


Fig. 6. The PBBS spectrum measured from Ni polycrystalline foil with average grain size about 300 nm.

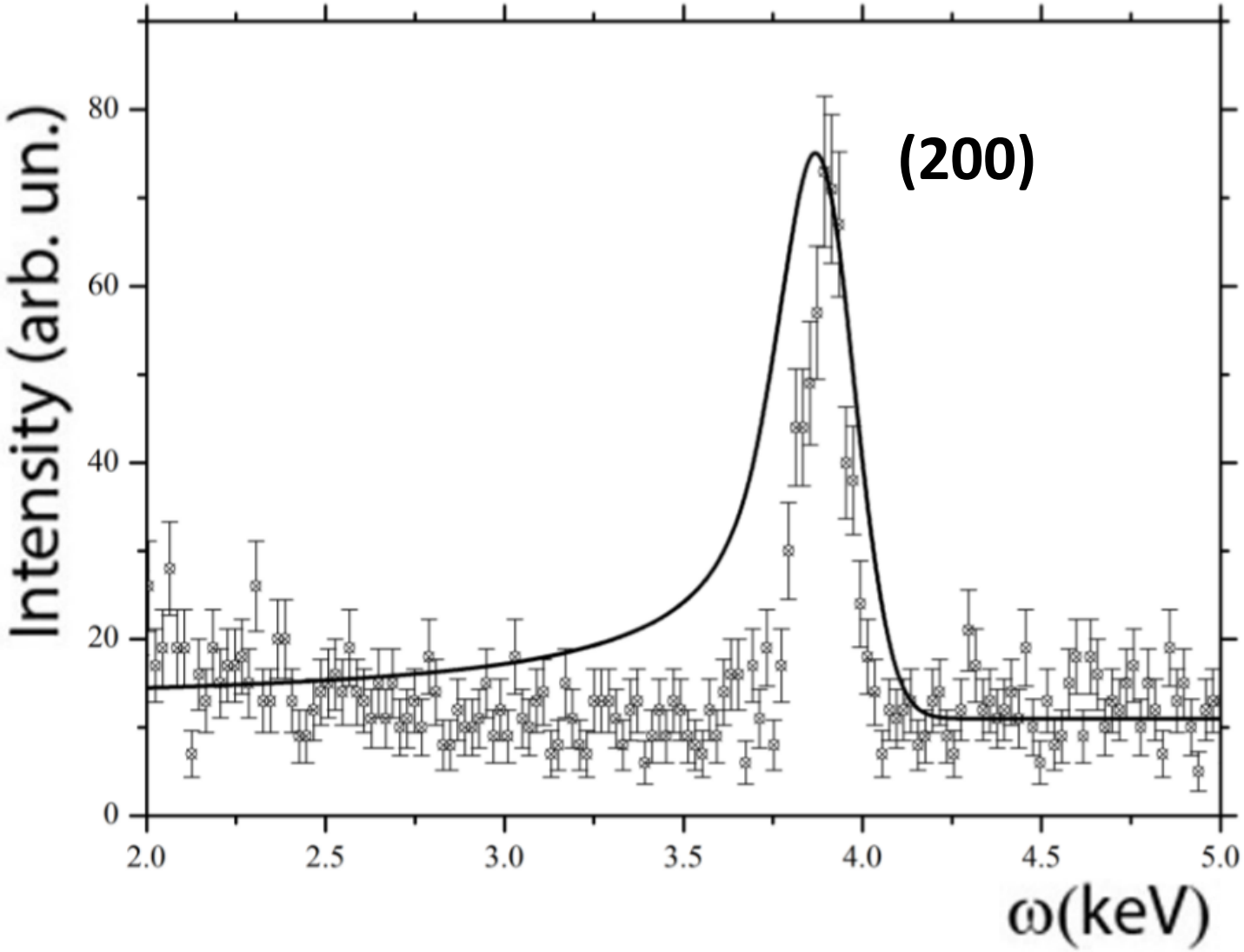
Theoretical peak position (220)	$4.97\ keV$
Experimental peak position (220)	$4.940\ keV \pm 7\ eV$
Full Widht Half Maximum (FWHM)	$159\ eV \pm 18\ eV$

Textured polycrystalline foil of Tungsten

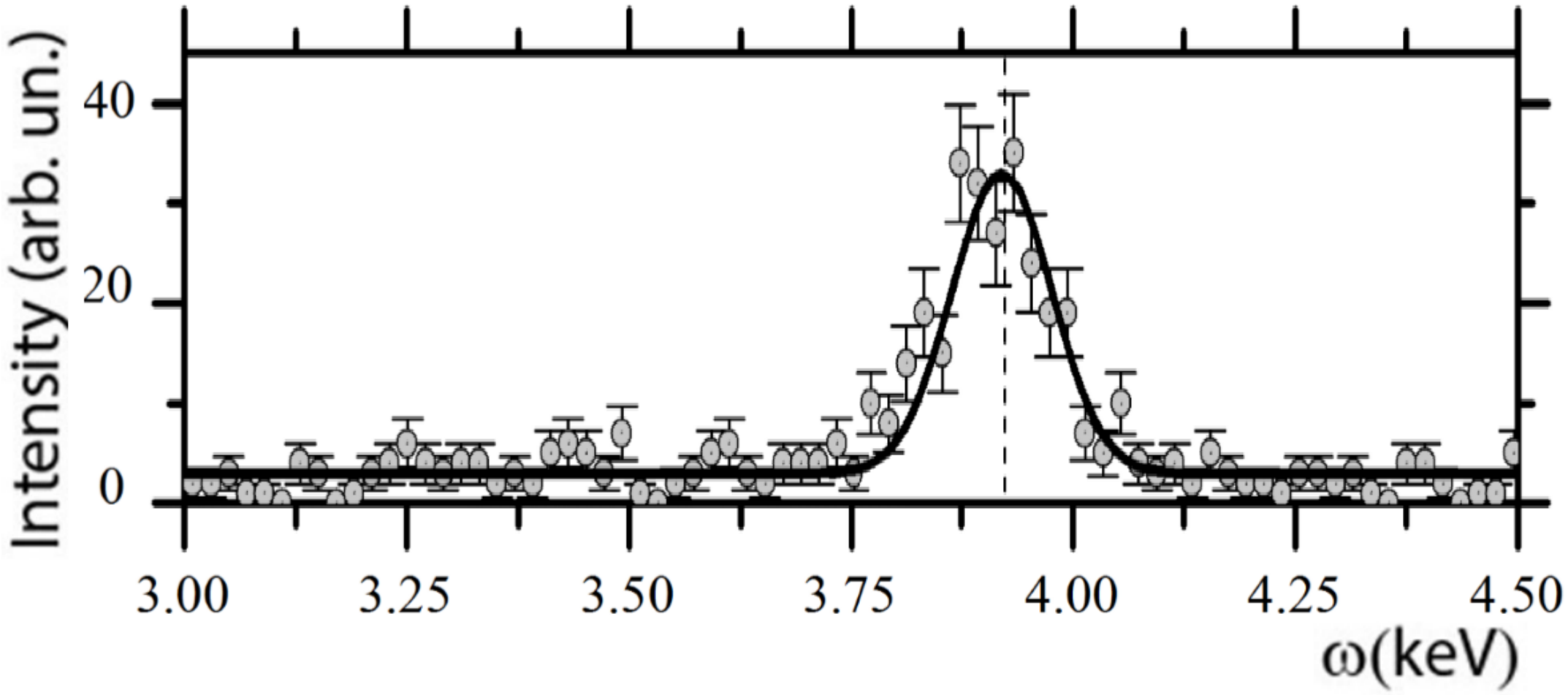


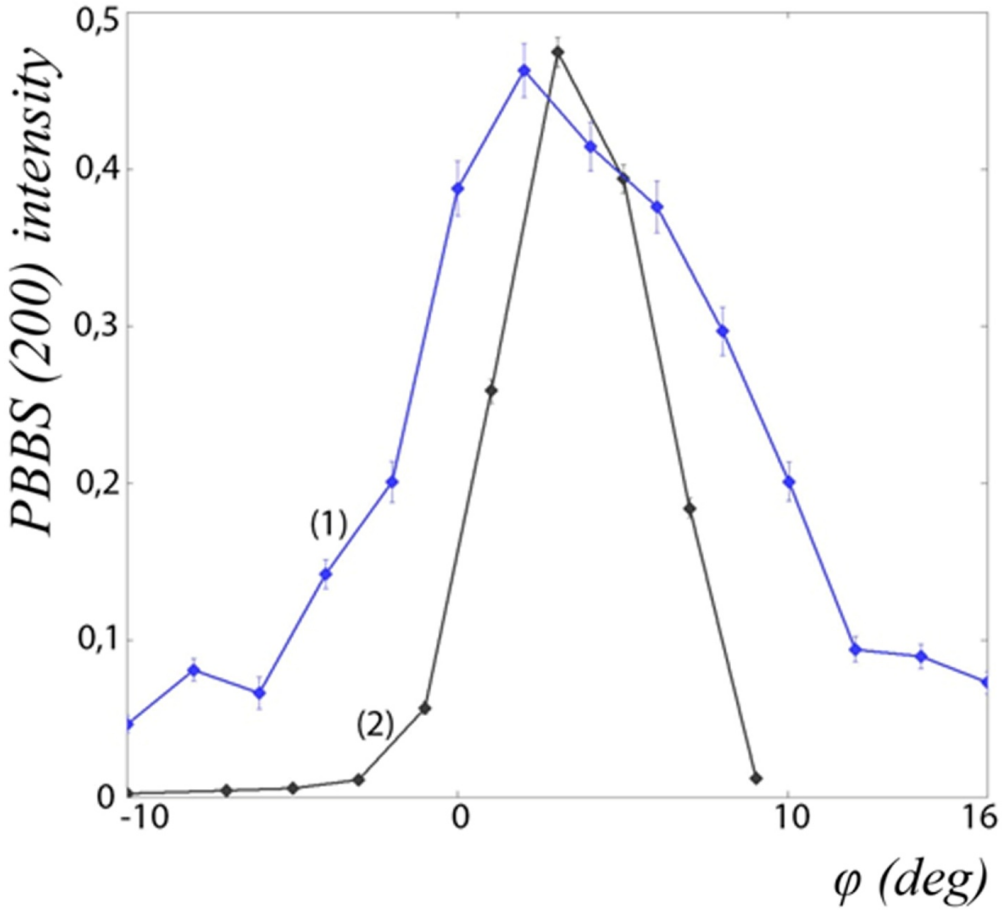


Tungsten polycrystalline foil



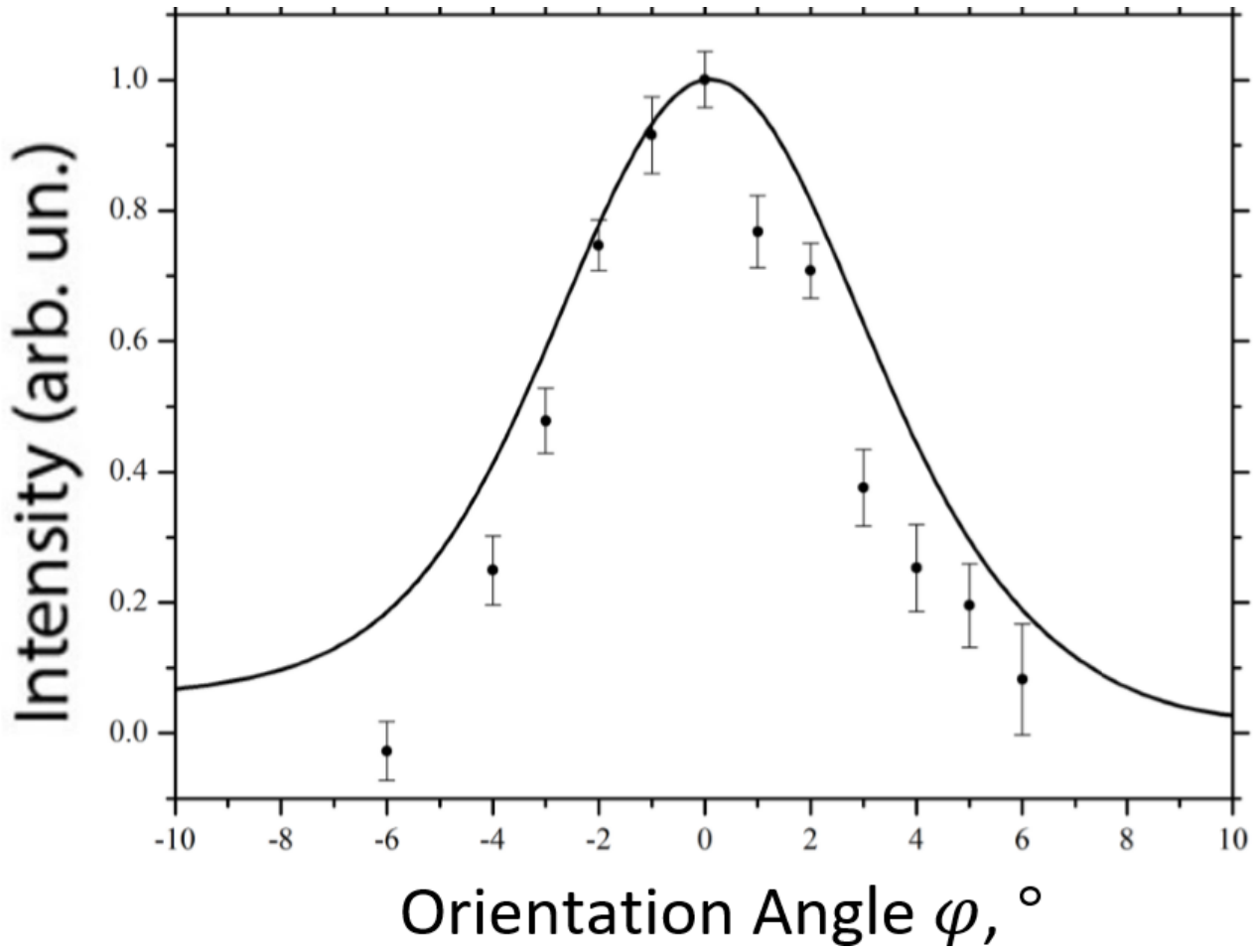
Tungsten polycrystalline foil





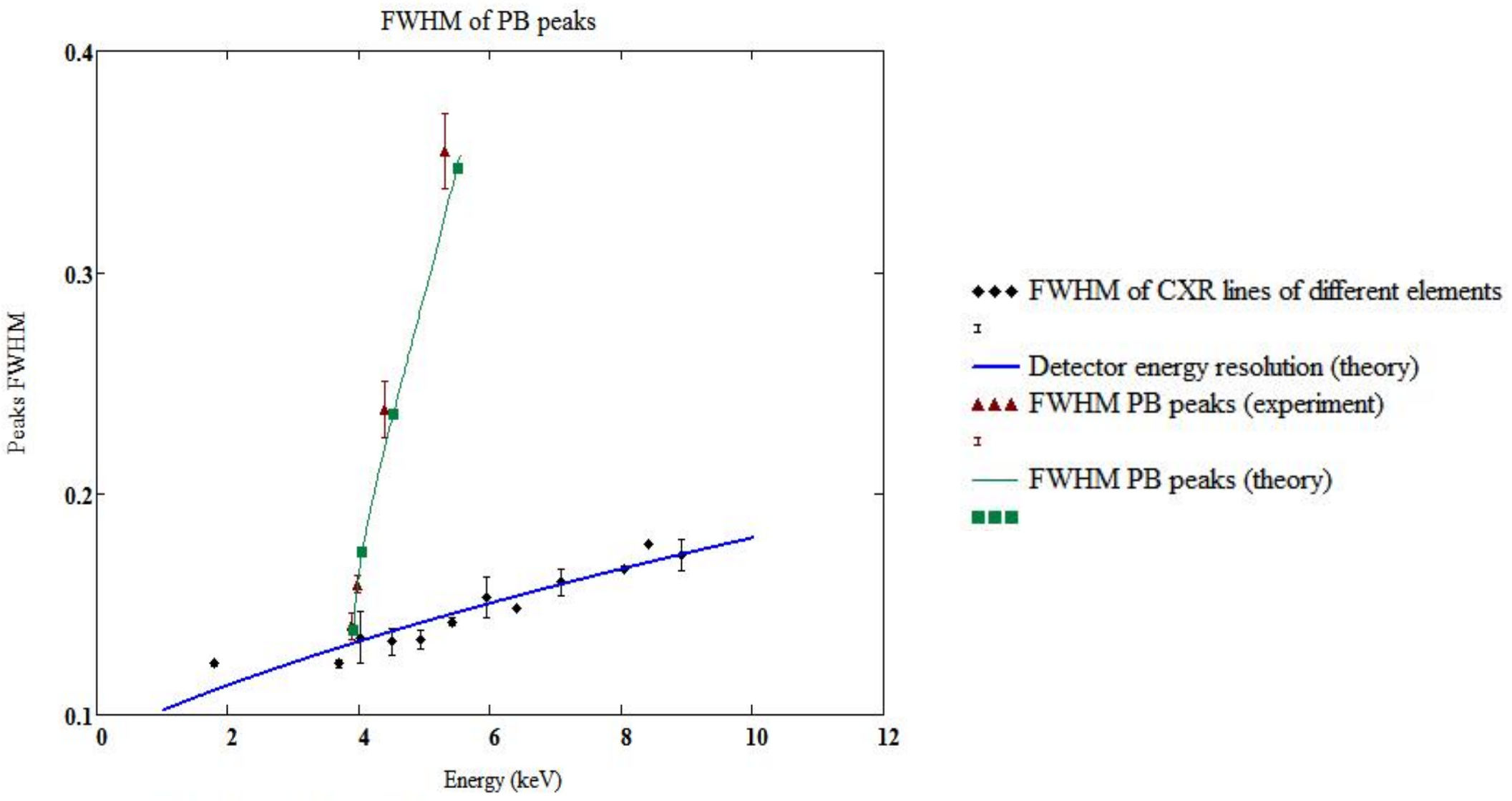
The orientation dependence of PBBS peak (200)
from W textured polycrystalline foil (1). The comparison with XRD (2).

PBBS (220) distribution width	XRD distribution width
10.2°	**5.4°**



Orientation dependence of the (200) plane of the tungsten polycrystalline foil for an observation angle of 90.8°

PXR (220) distribution width (Backward geometry)	PXR (220) distribution width (Backward geometry)	XRD distribution width
10.2°	**5.7°**	**5.4°**


FWHM of PB peaks
Peaks FWHM
Energy (keV)
0.4
0.3
0.2
0.1
0
2
4
6
8
10
12
FWHM of CXR lines of different elements
Detector energy resolution (theory)
FWHM PB peaks (experiment)
FWHM PB peaks (theory)

Conclusions

- A deviation between the existing theories and measurements is observed for textured polycrystals which can be considered as a transition structure between crystals and polycrystals.
- The FWHM of the orientation dependence changes when the observation angle changes.
- Is the backward geometry the most suitable to diagnostics polycrystalline materials using PXR?

Thank you for your attention!