

Detector Zoology

8th X-ray Scattering School

Apurva Mehta



U.S. DEPARTMENT OF
ENERGY

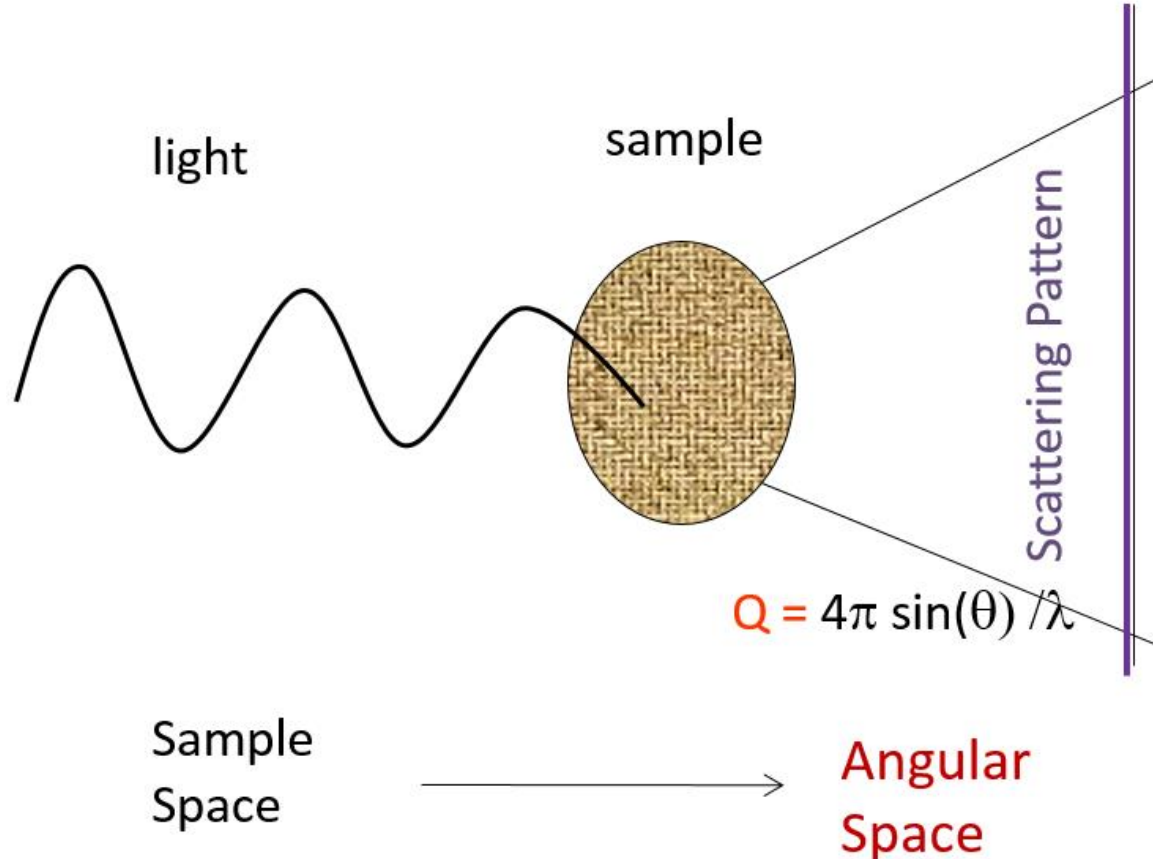
Office of Science



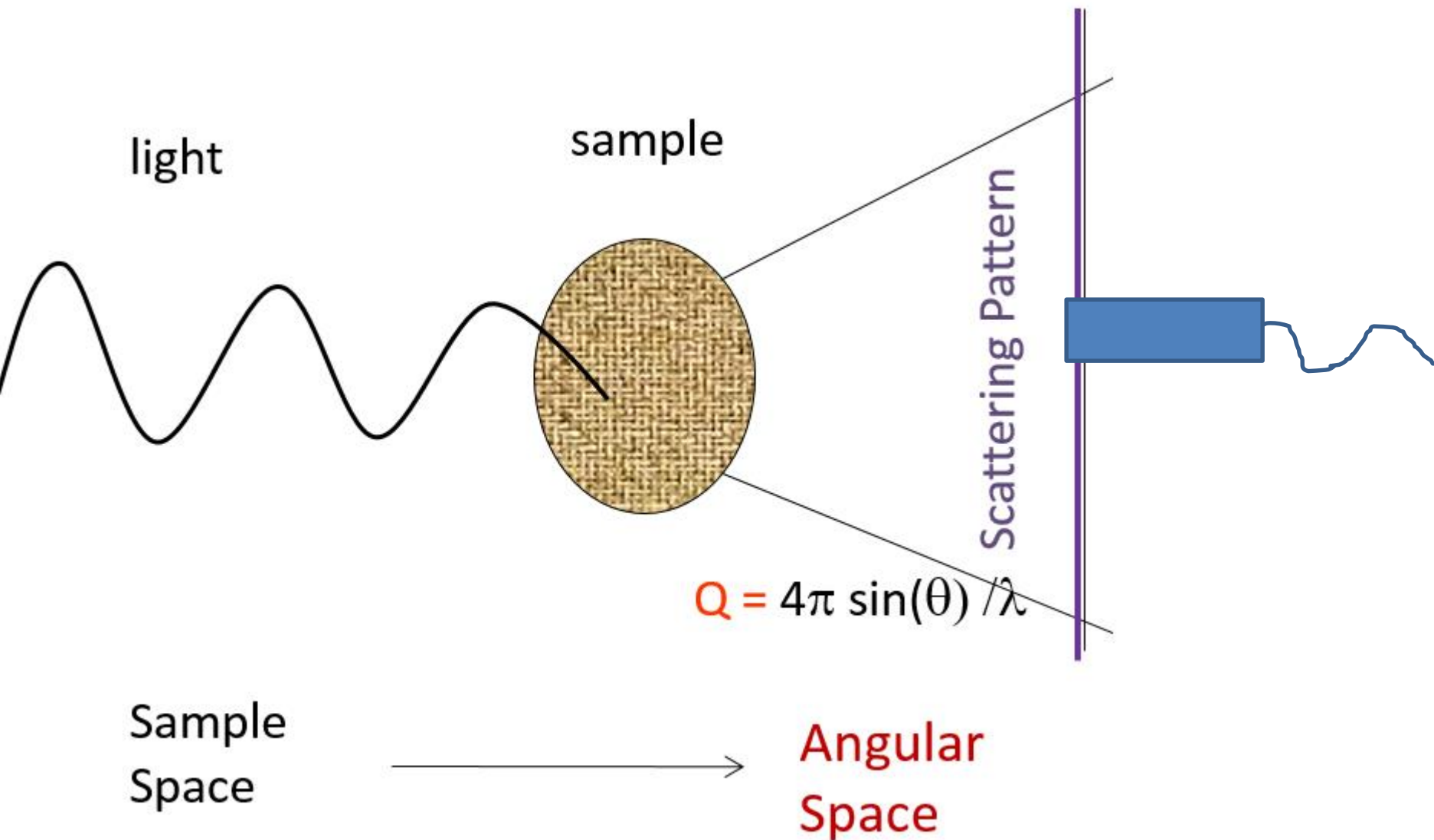
SLAC NATIONAL
ACCELERATOR
LABORATORY

Scattering Measurement

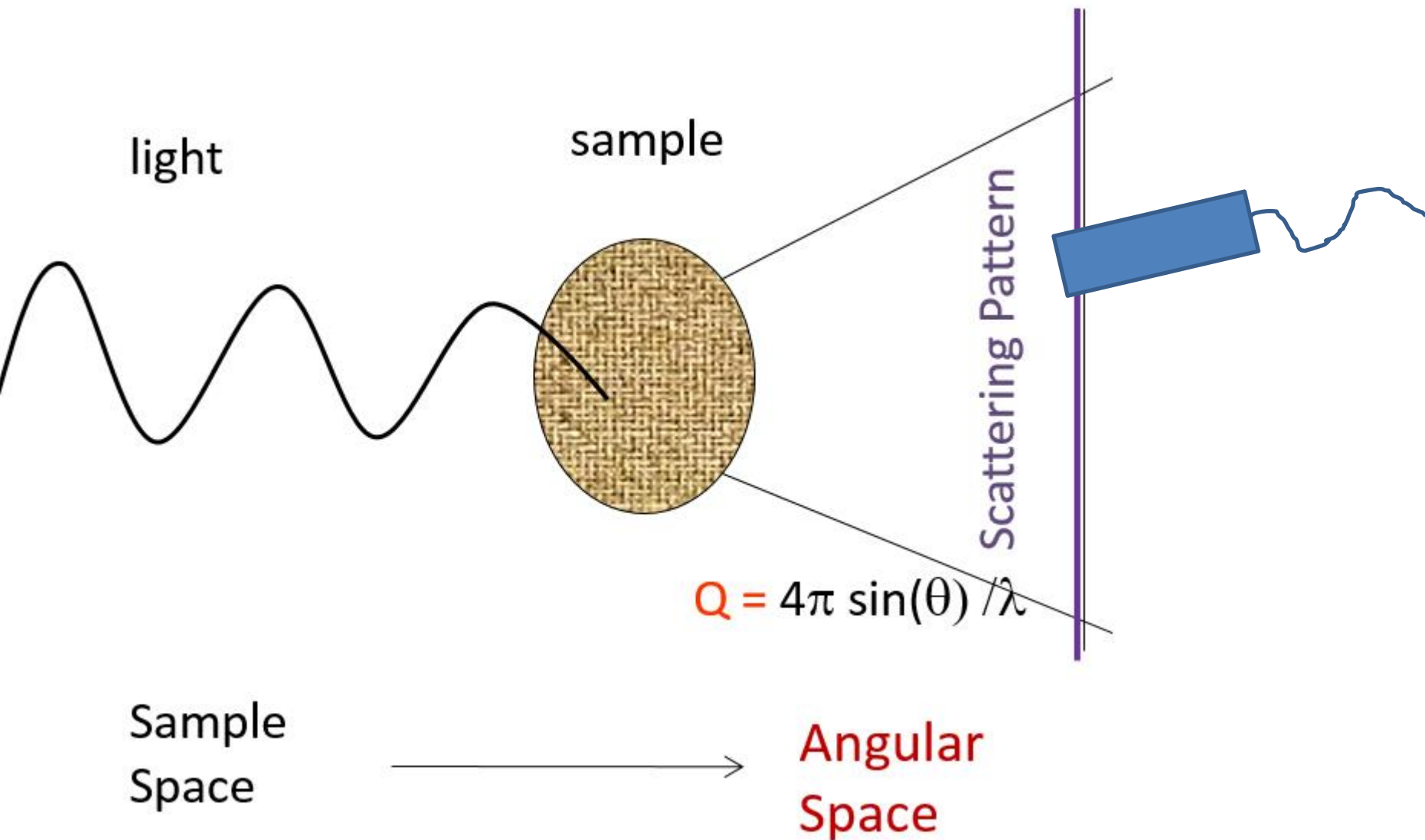
Intensity as a function of scattering angle



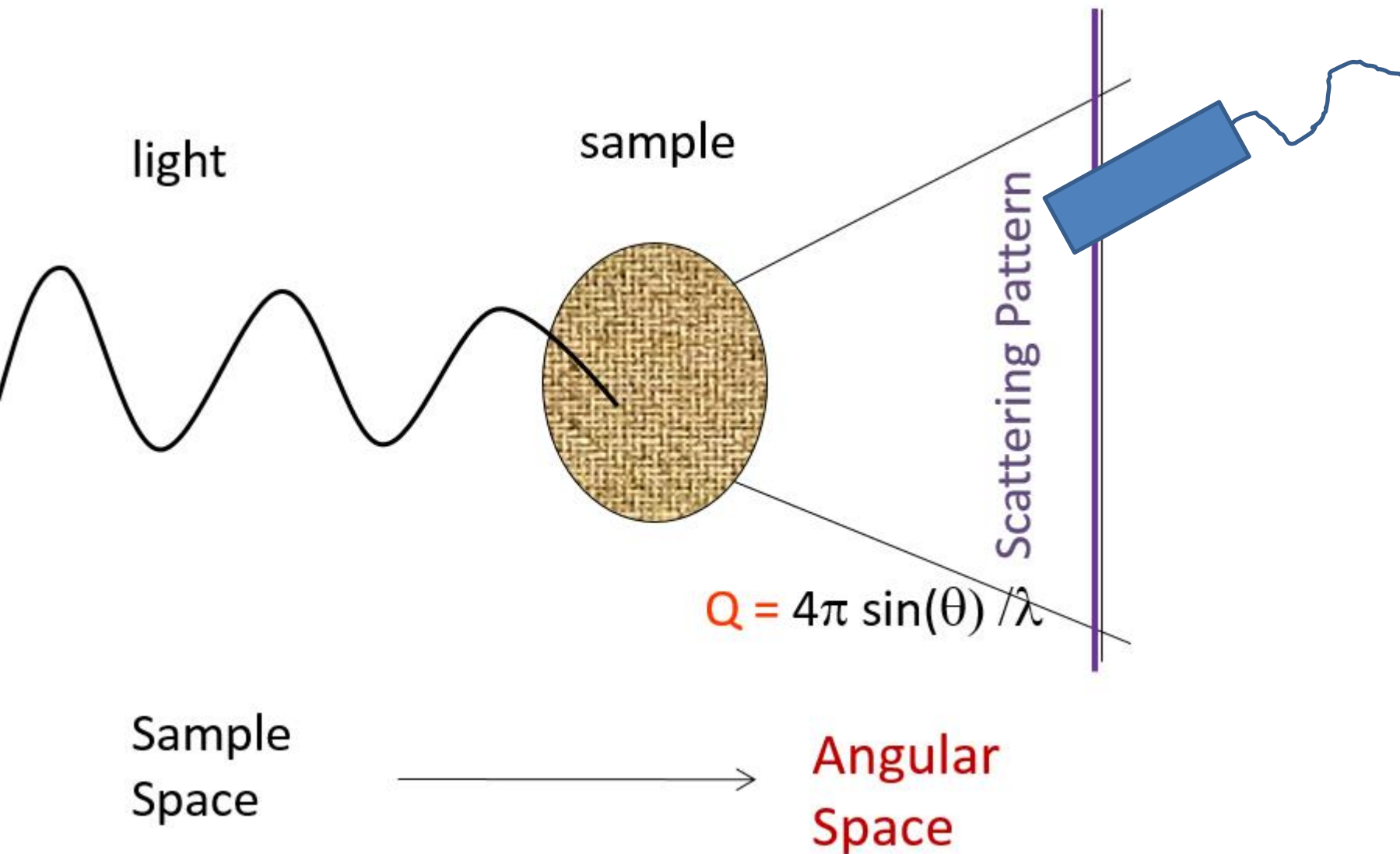
Traditionally



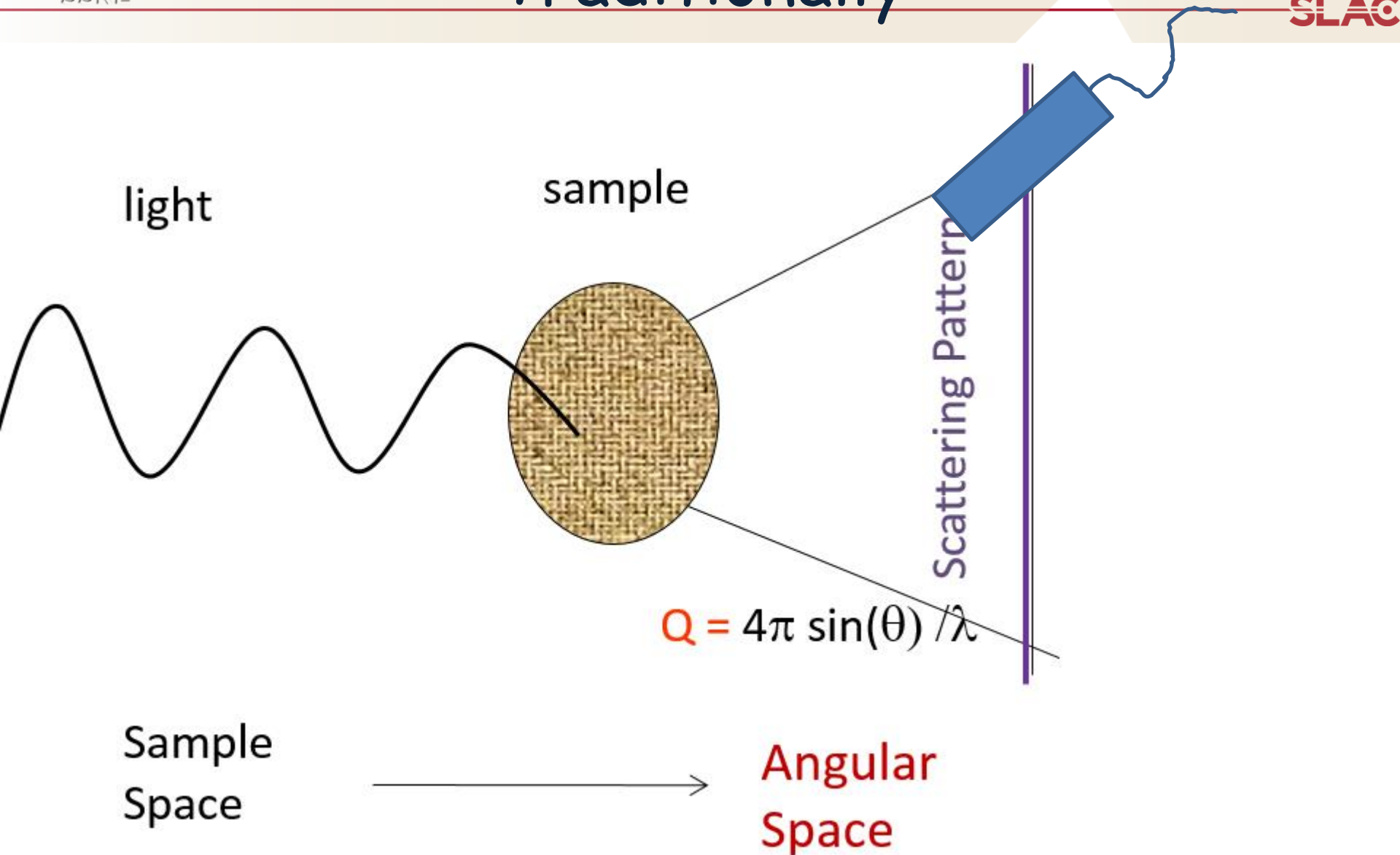
Traditionally



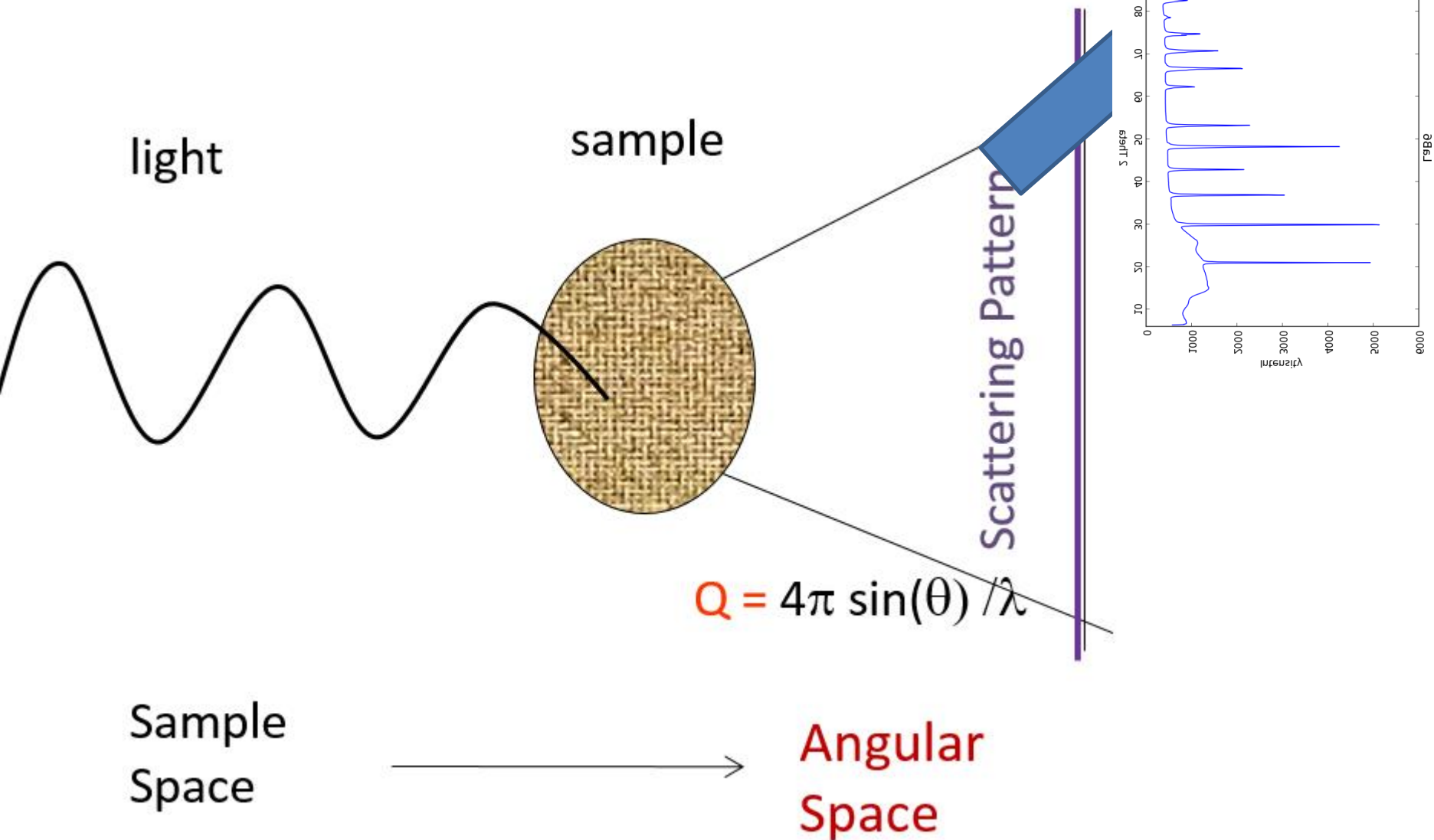
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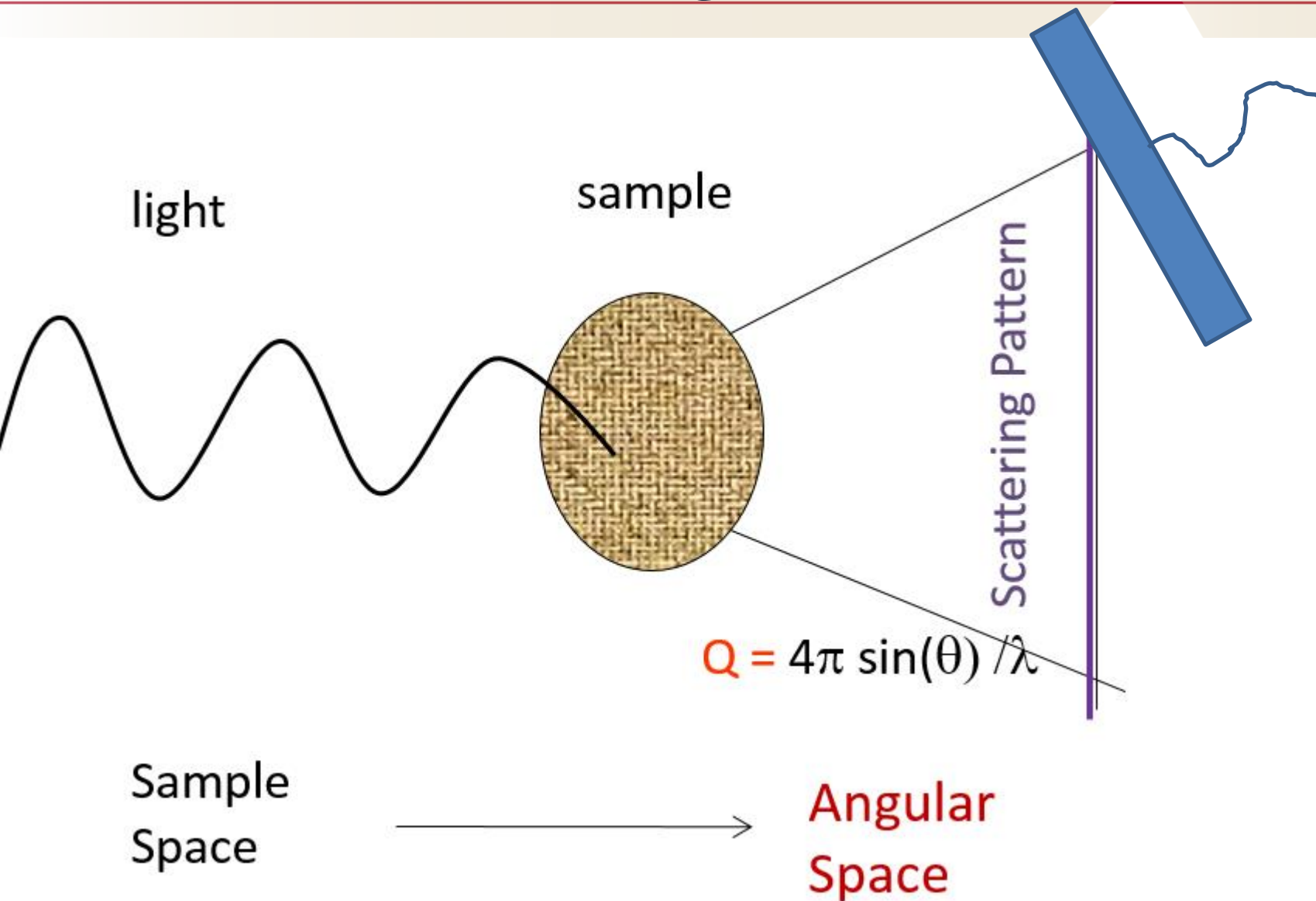
Traditionally



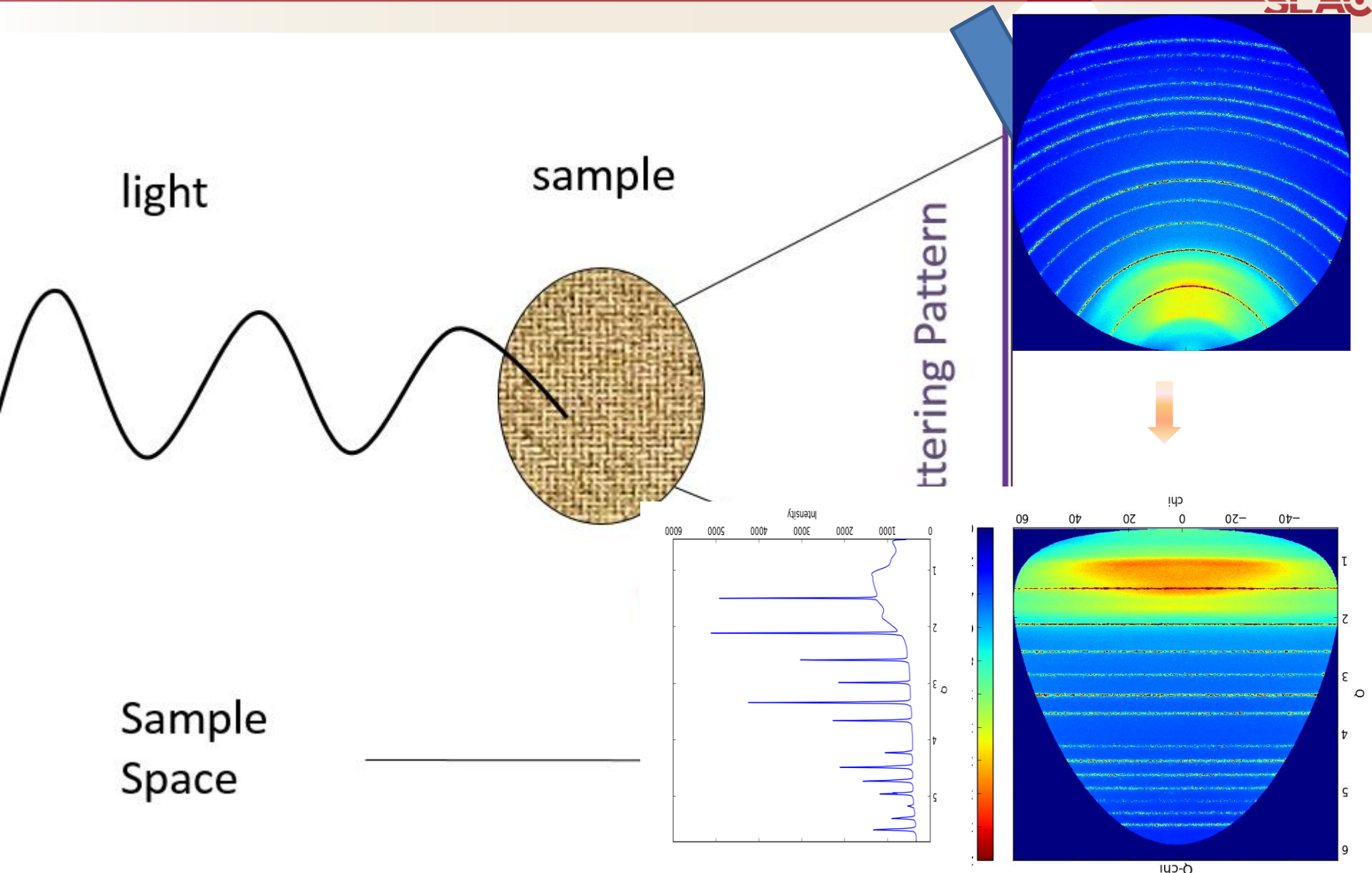
Traditionally



Area Detector



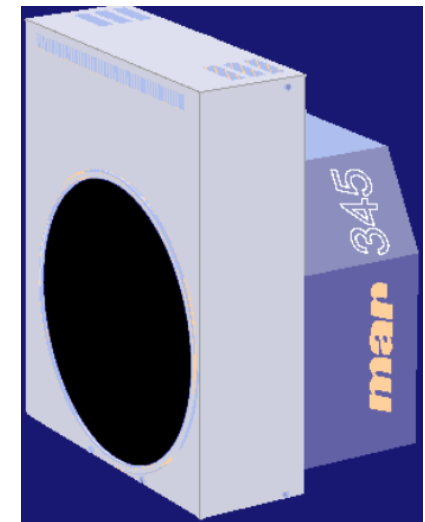
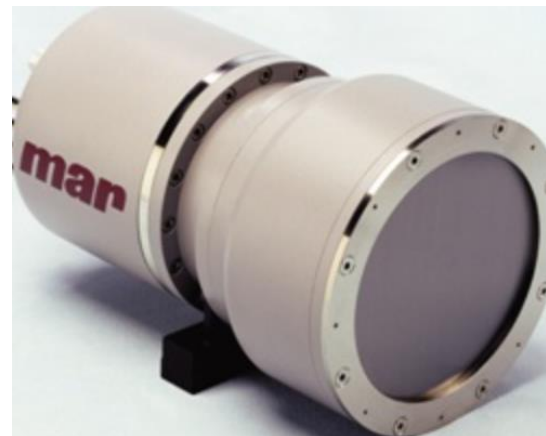
Area Detector



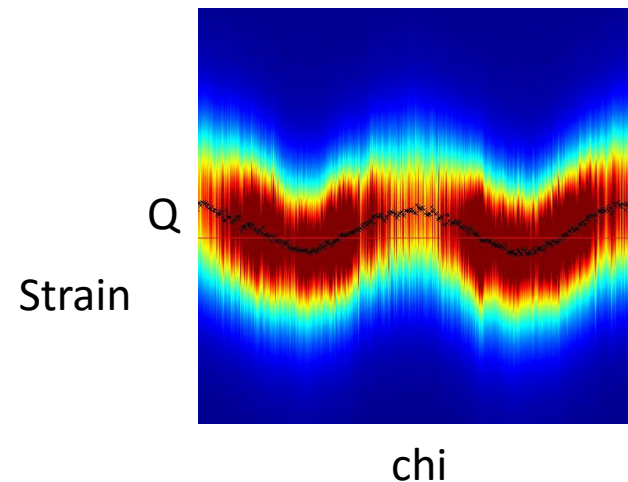
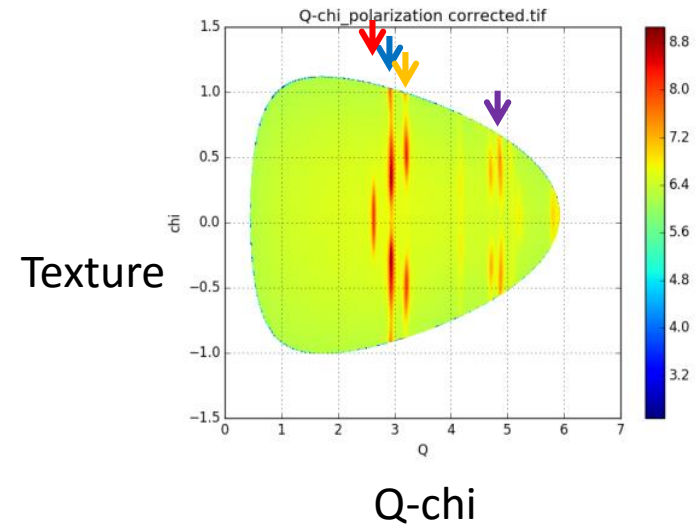
- Point Detectors
- Photomultiplier, Solid State detector, ion chamber



- Area Detectors
- MAR345, MARCCD, Pilatus



- parallel data collection.
 - Fast
 - In-situ
- 2D
 - Azimuthal coverage
 - Texture
 - Strain





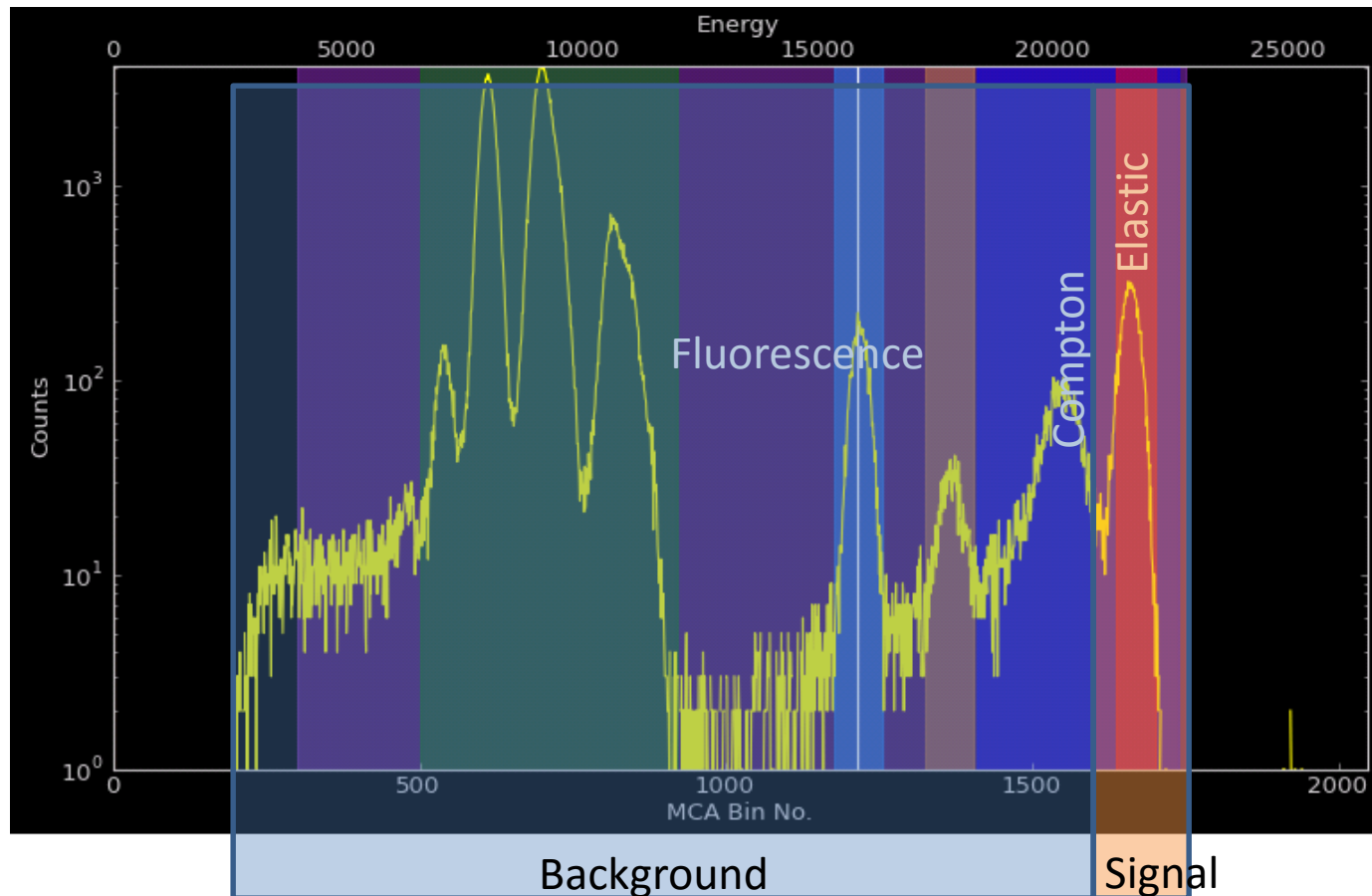
Why not always use a 2D detector?

SLAC

- Energy Discrimination:
- Collimation (separation of different sources of scatter)
- Need for Parallel Beam Geometry

Why not always use a 2D detector?

- Energy Discrimination: 2D detectors have poor E resolution



Vortex



SSRL

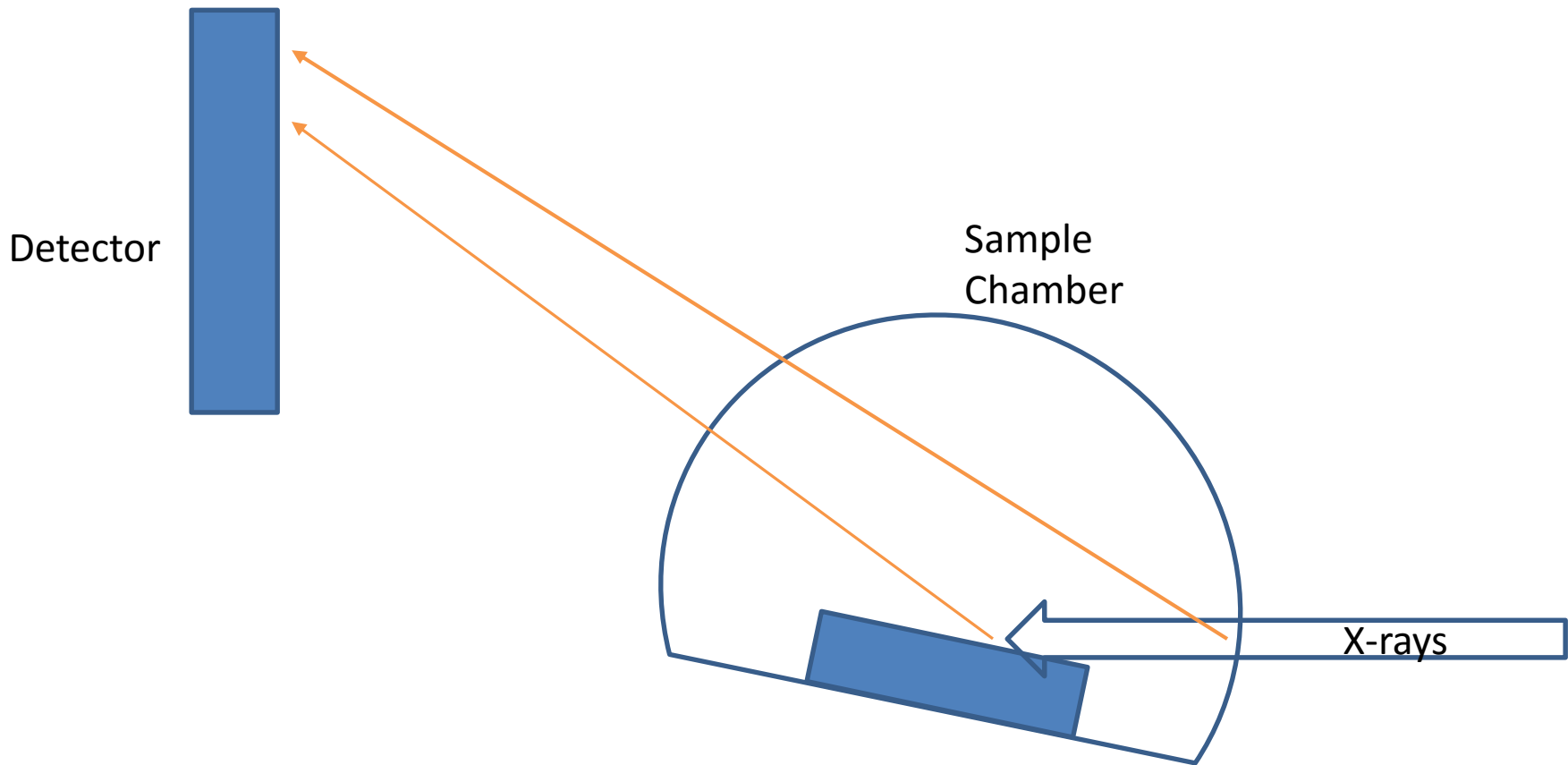
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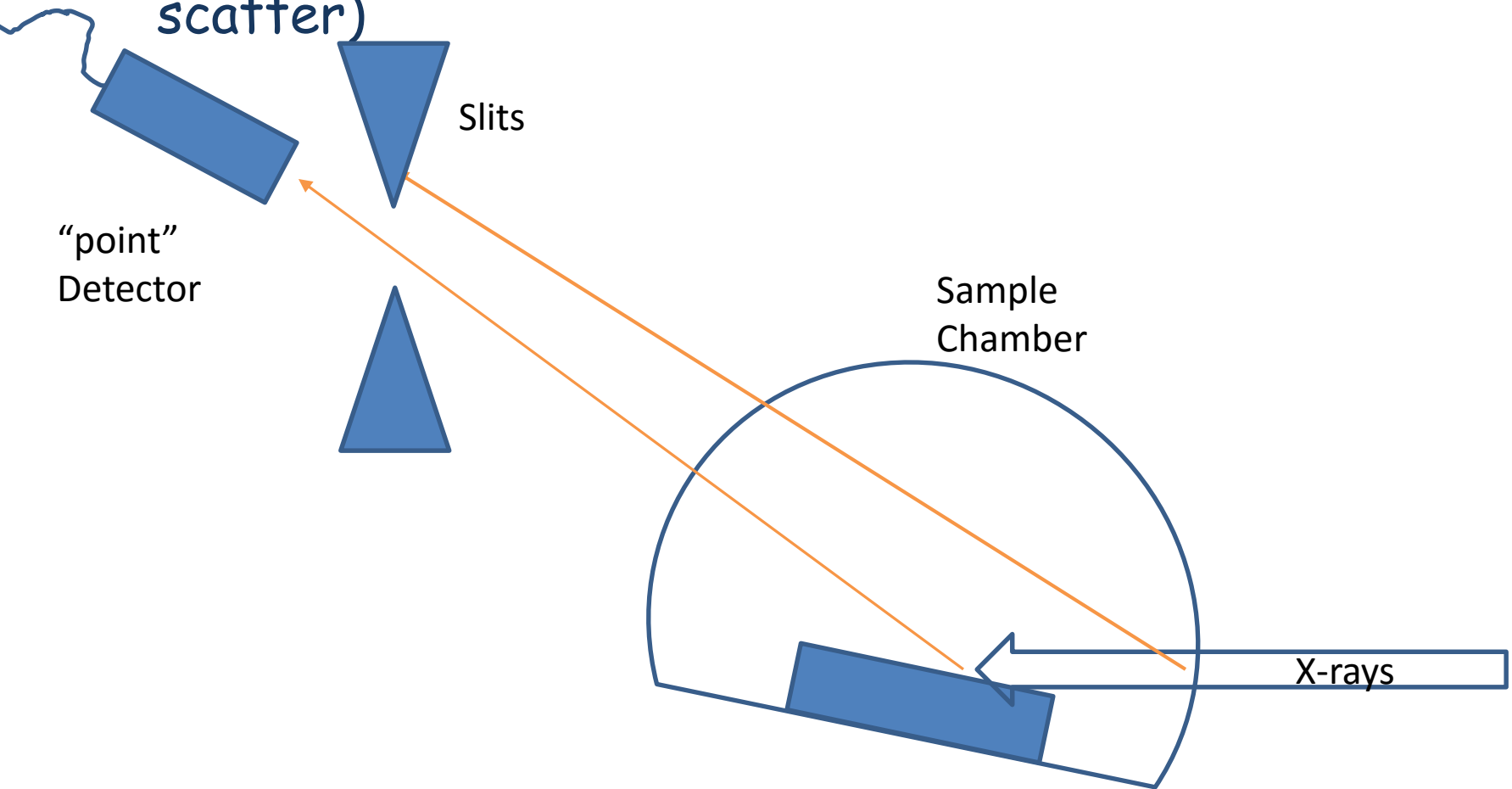
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- Collimation (separation of different sources of scatter)





SSRL

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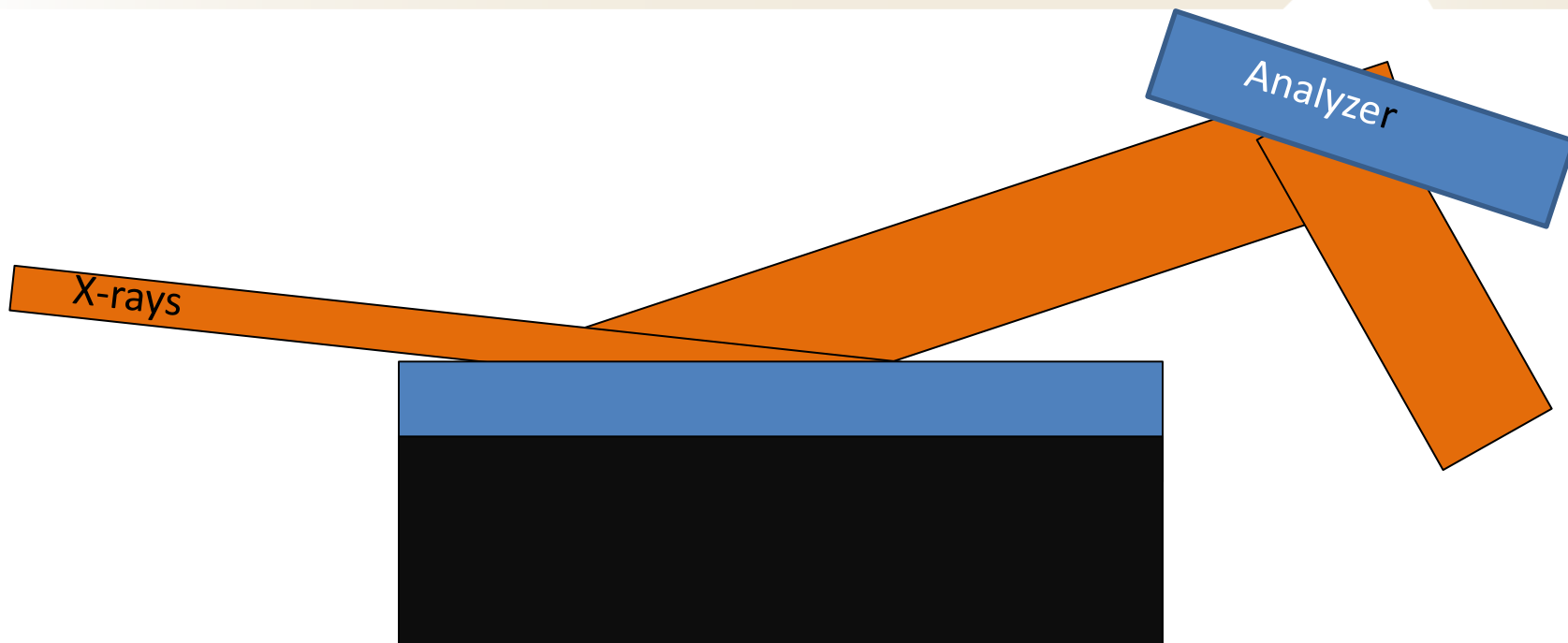
SSRL

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SLAC

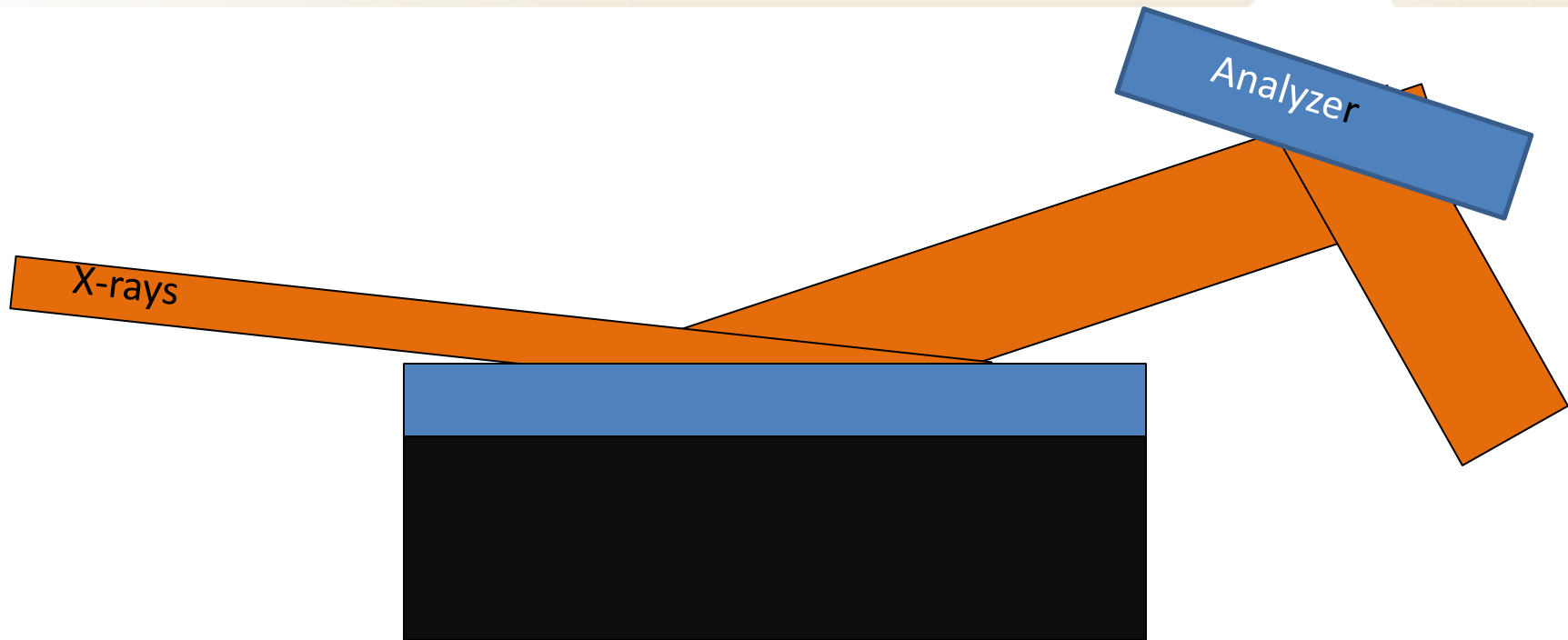
- Need for Parallel Beam Geometry

Parallel Beam Geometry



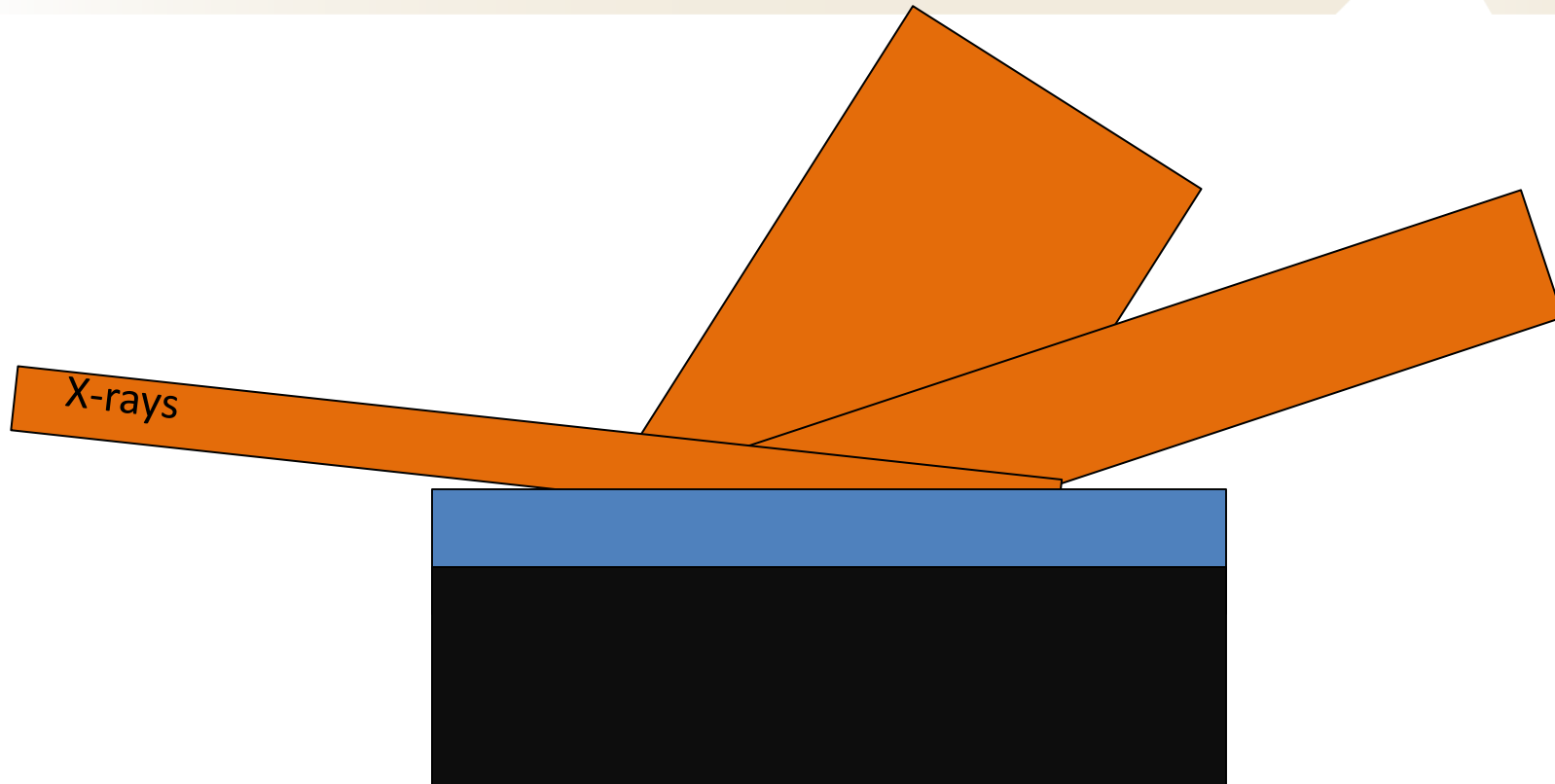
Detect the angle of the diffracted beam not the position

Advantage of Parallel Beam Geometry



Sample Moves \rightarrow Diffracted Beam Moves \rightarrow Diffraction Angle Doesn't

Advantage of Parallel Beam Geometry



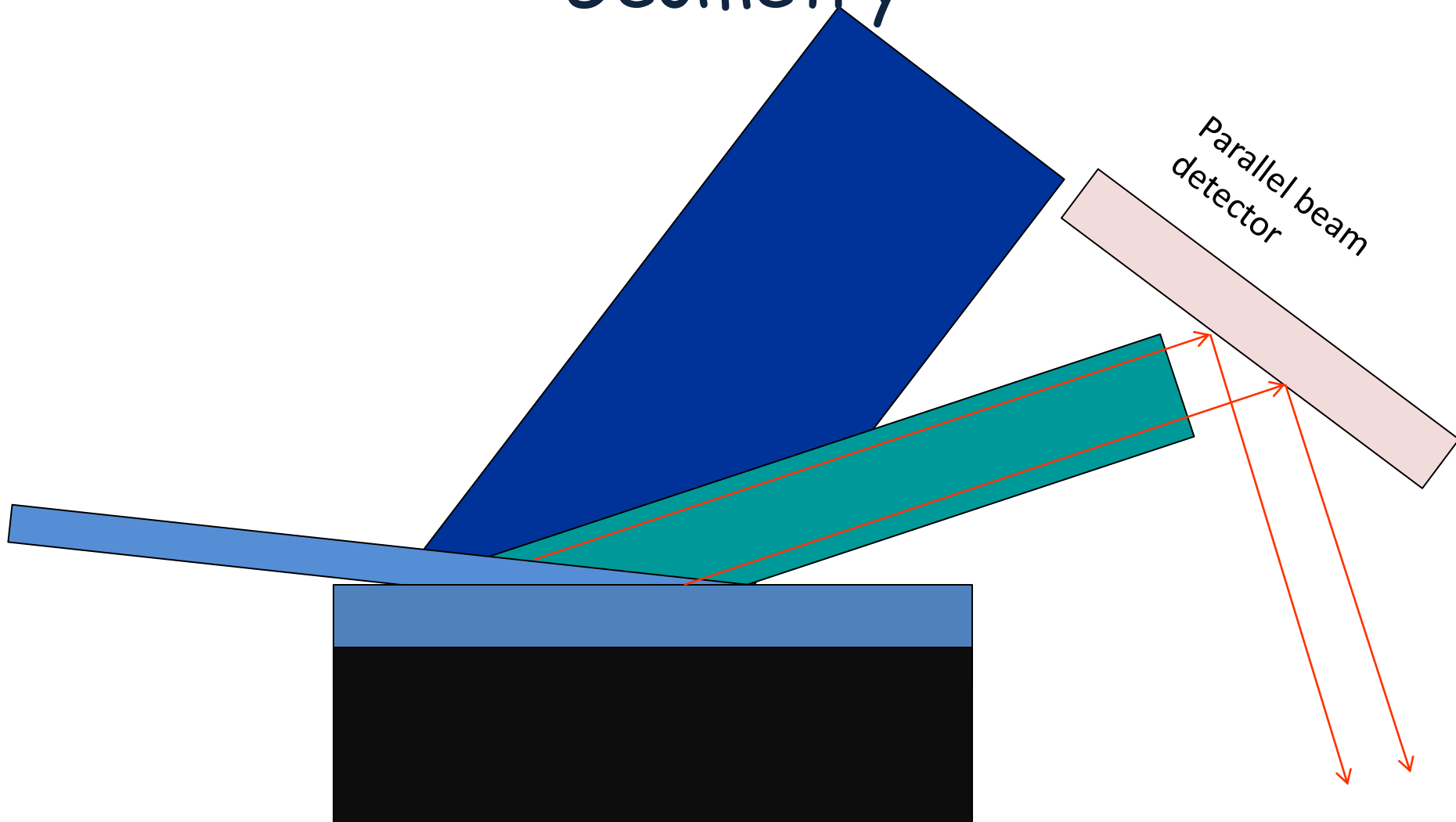
In Grazing Incidence Geometry higher angle peaks are broaden due to asymmetric geometry



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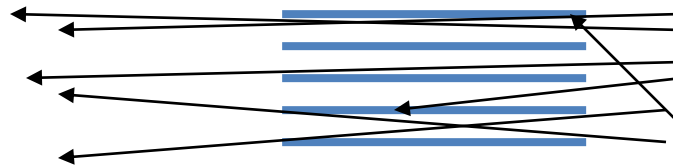
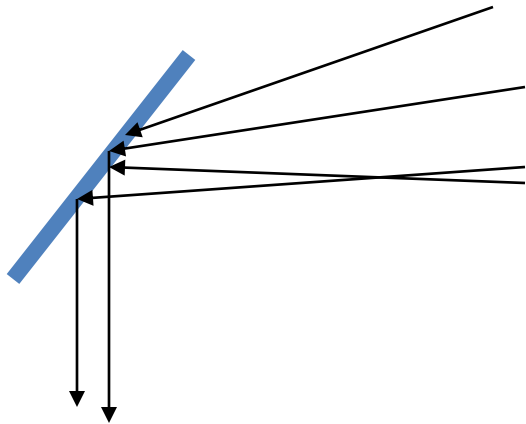
Grazing Incidence in Parallel Beam Geometry

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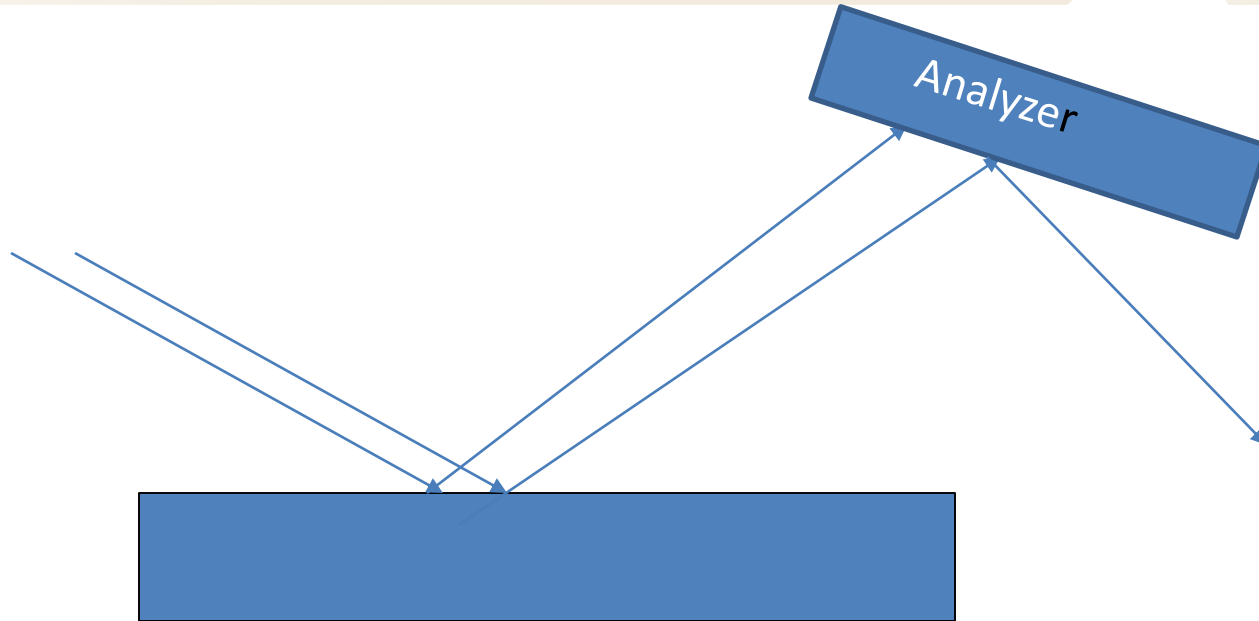


Parallel beam detection

- Crystal Analyzer
 - Perfect crystal (Si or Ge)
- Soller Slits



Parallel Beam Geometry with an analyzer



Gives the highest angular resolution

But Still the use of area detectors is on
the rise

Question?