Updates of experimental activity on crystals for Mu2e

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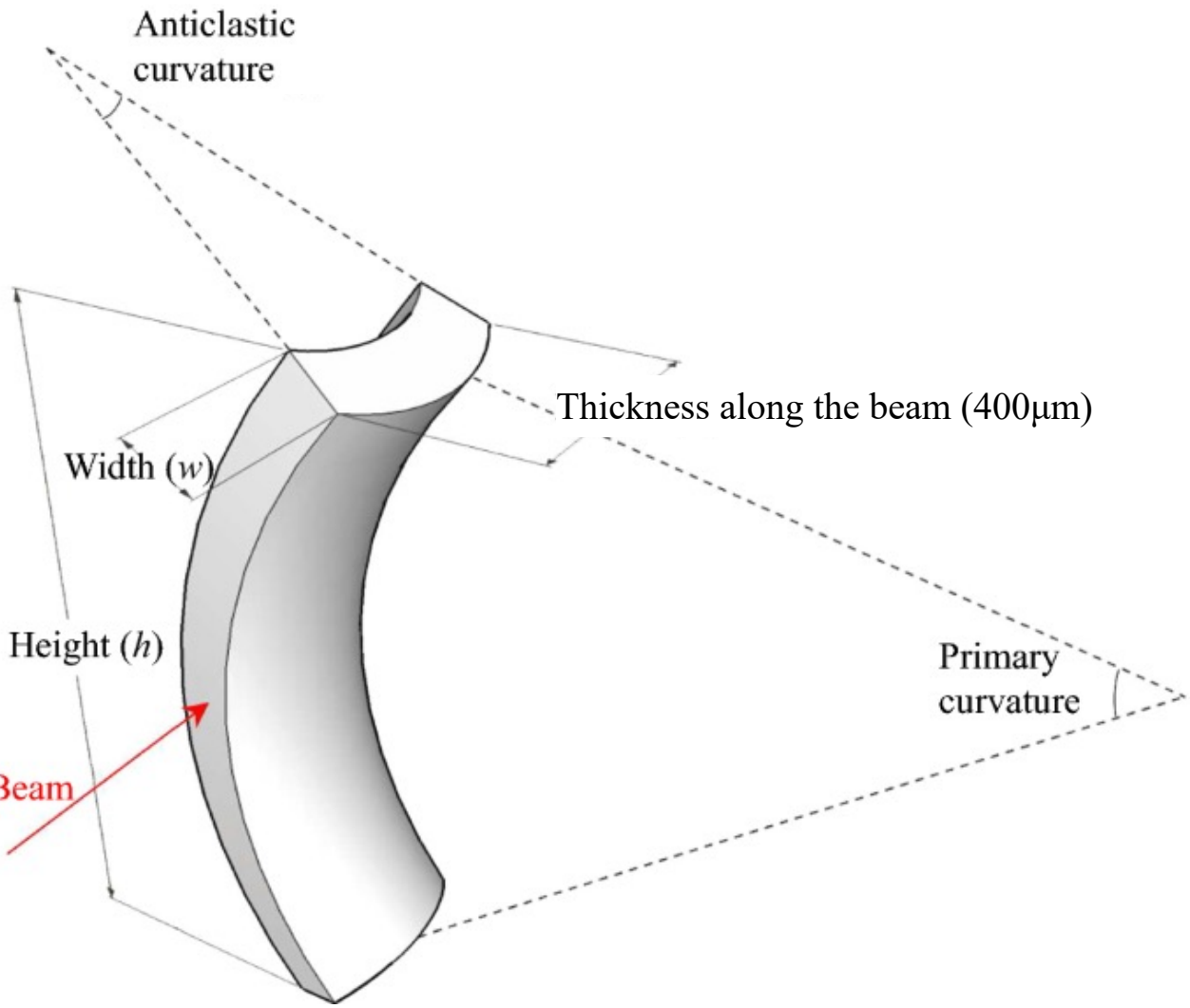
Anticlastic bending

- In order to achieve deflection θ=300μrad with crystal thickness along the beam of t=400μm, the anticlastic radius of curvature is

$$R_{Anticlastic} = \frac{400\mu m}{300\mu rad} = 1.333\ m$$

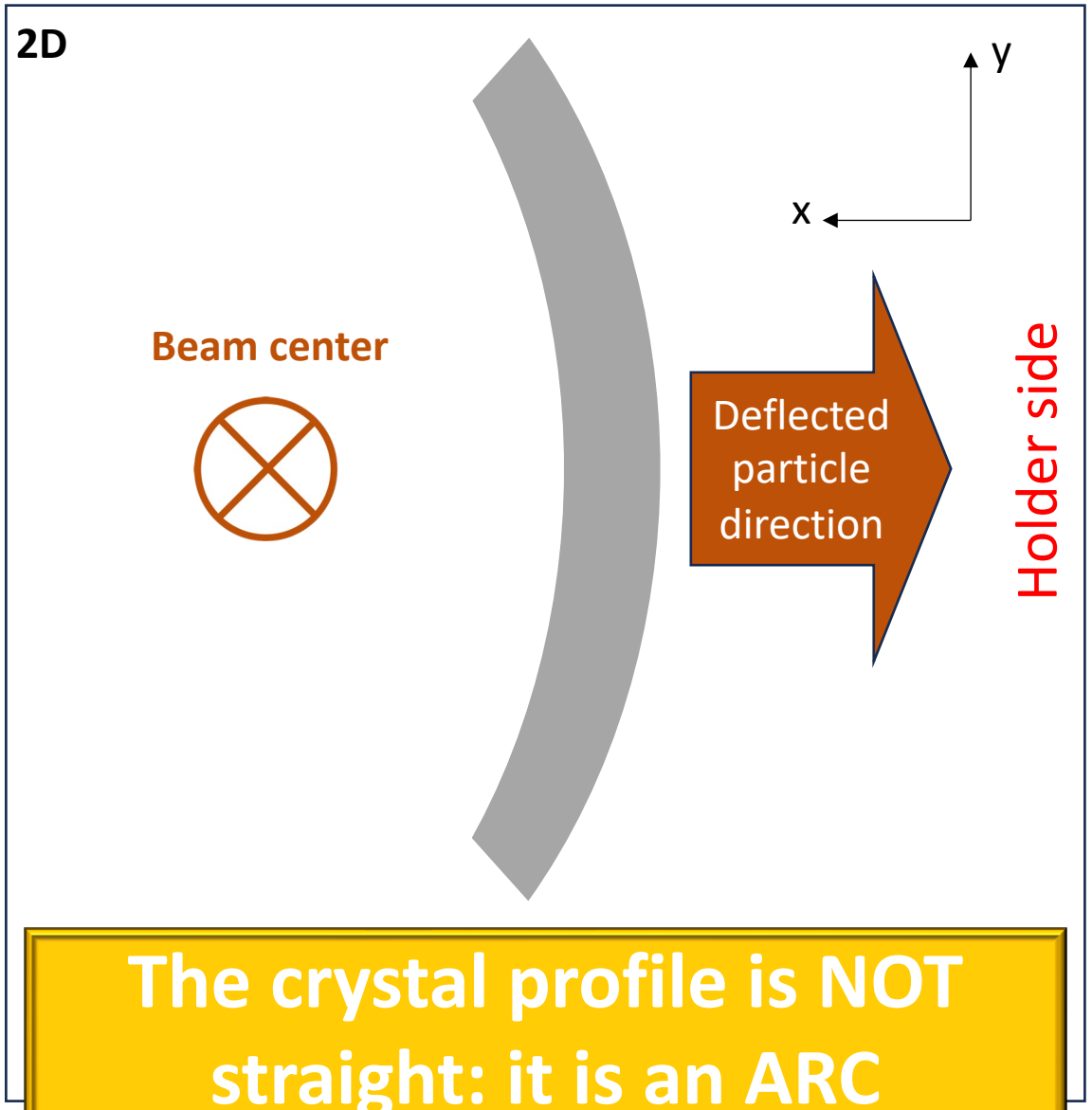
- Thus, the primary bending radius for the (110) planes would be

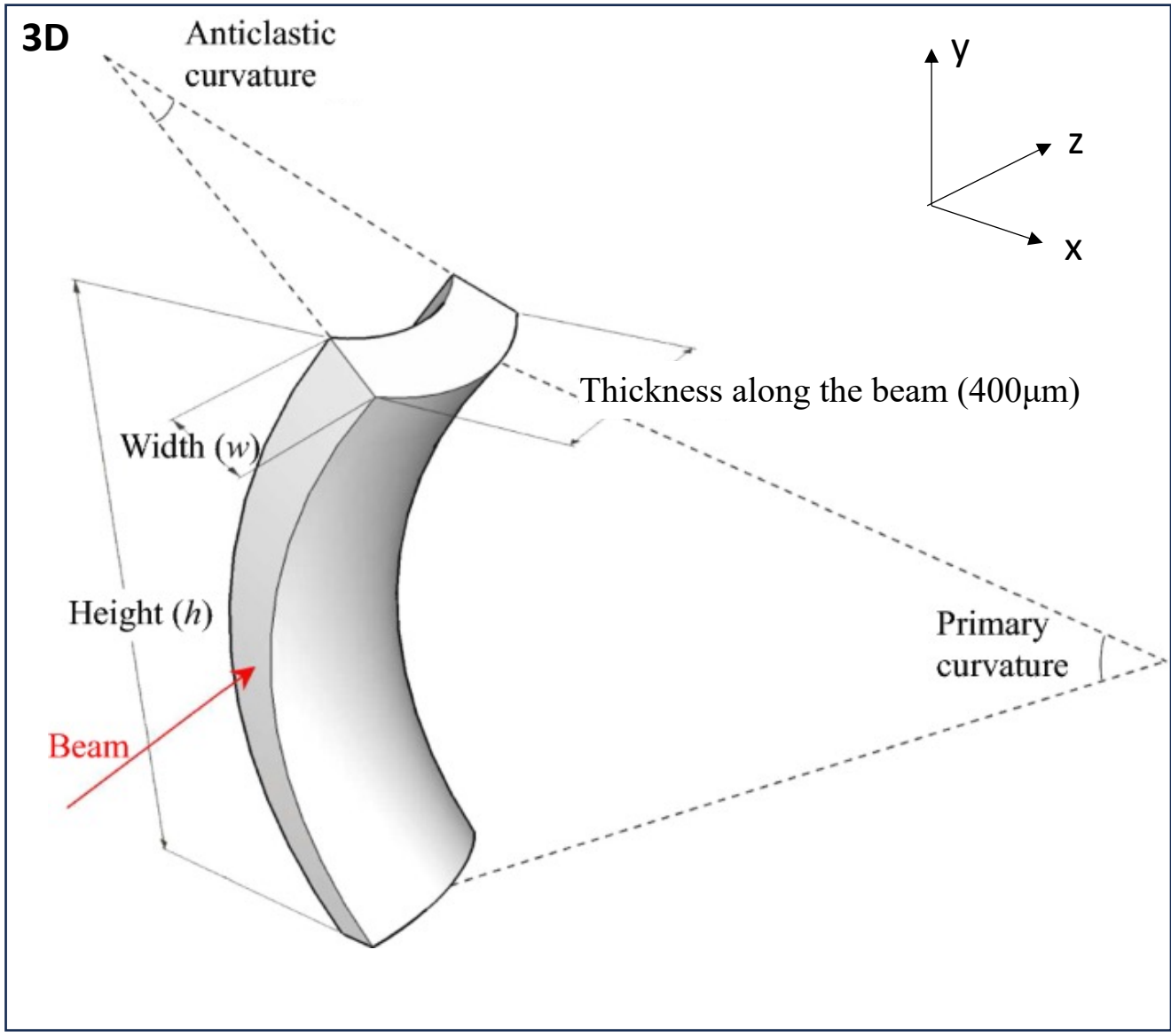
$$R_P = \frac{R_A}{Poisson\ Ratio} = \frac{1.333m}{3.59} = 0.37140\ m$$



Slides from discussion with Nagaslaev on November 16 and following weeks

Anticlastic bending section





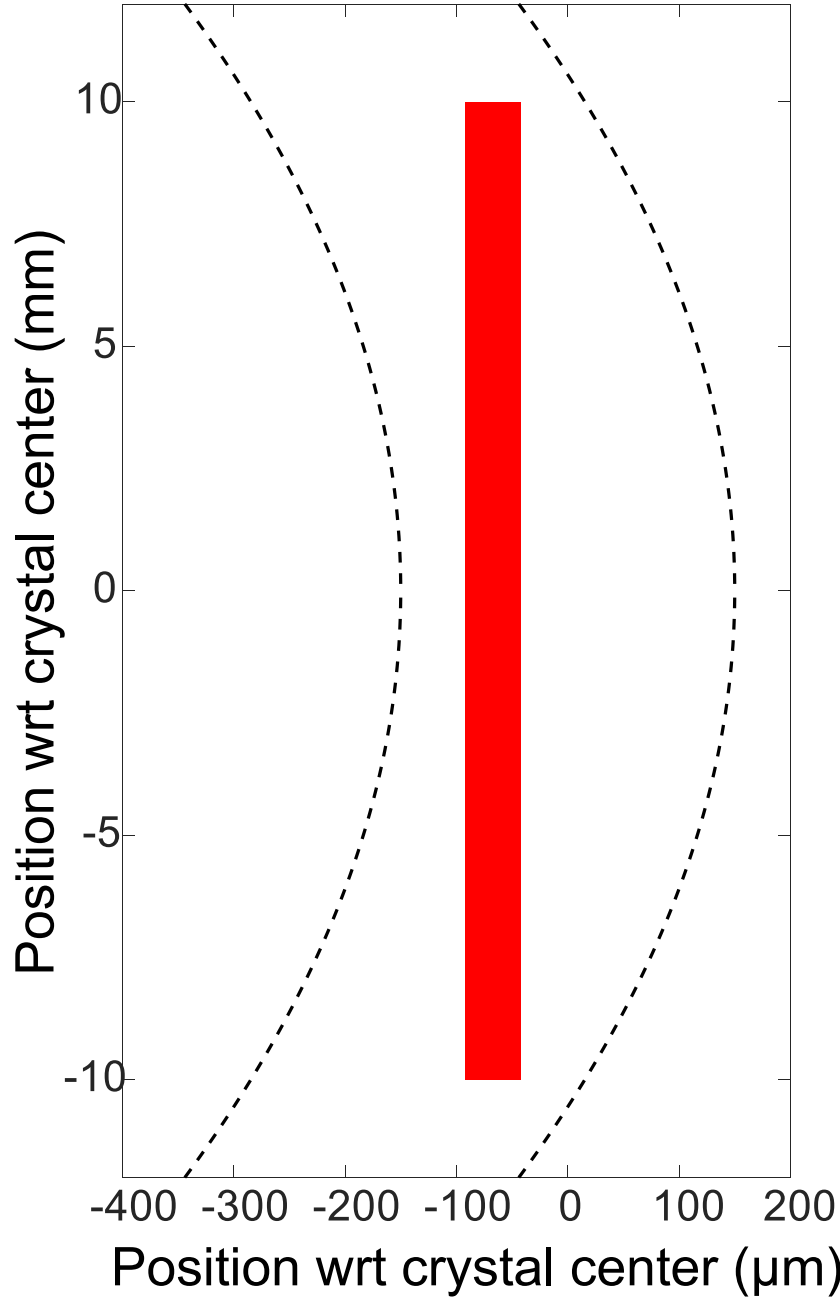
Arc shadow for straight septum

- Area to shadow:
  - Horizontal(H): Septum width 50µm
  - Vertical (V): Beam vertical size 20mm

- Condition for full shadowing

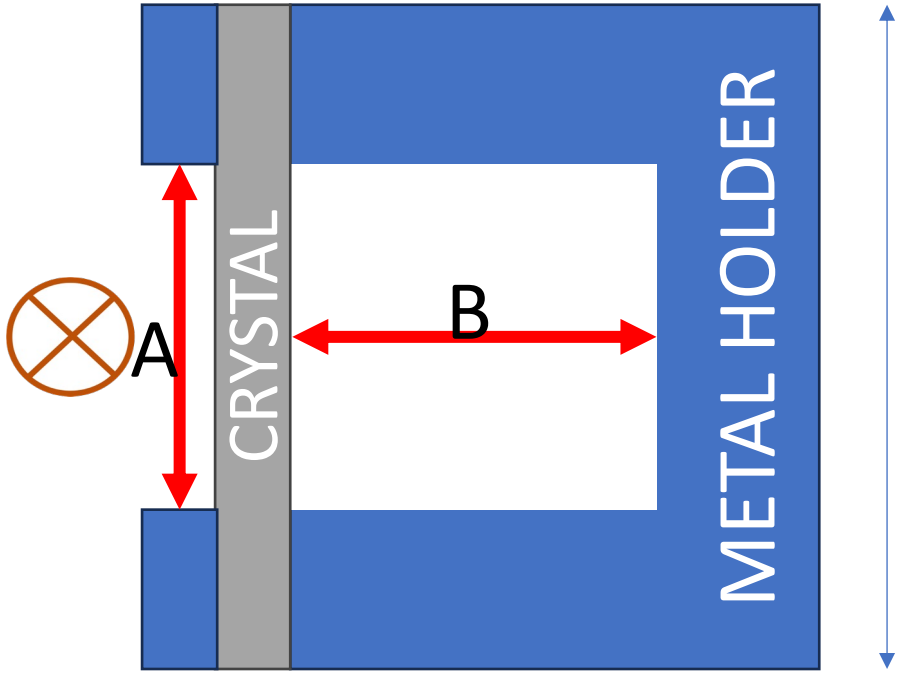
$$R_P - \sqrt{R_P^2 - \left(\frac{V}{2}\right)^2} \leq width_{CRYSTAL} - width_{SEPTUM}$$

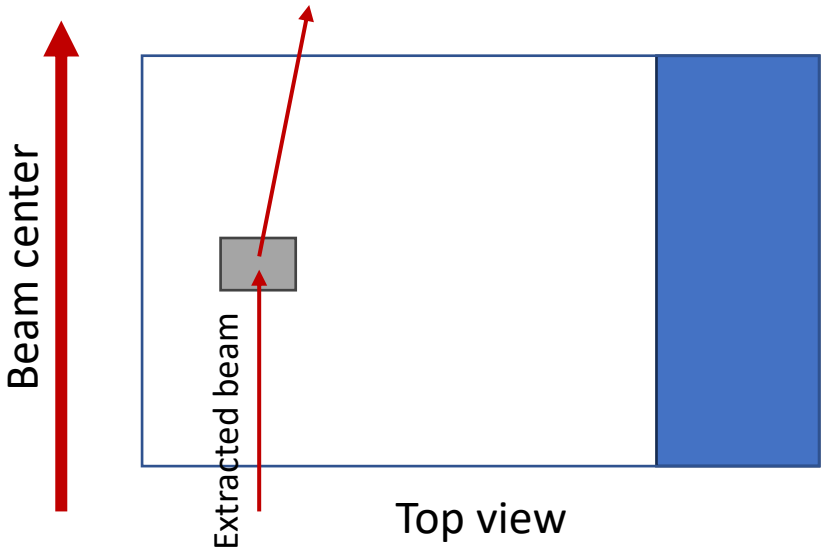
- Given the radius of curvature and width of crystal, the maximum vertical size for full shadowing is 27.25mm



Profile crystal + holder

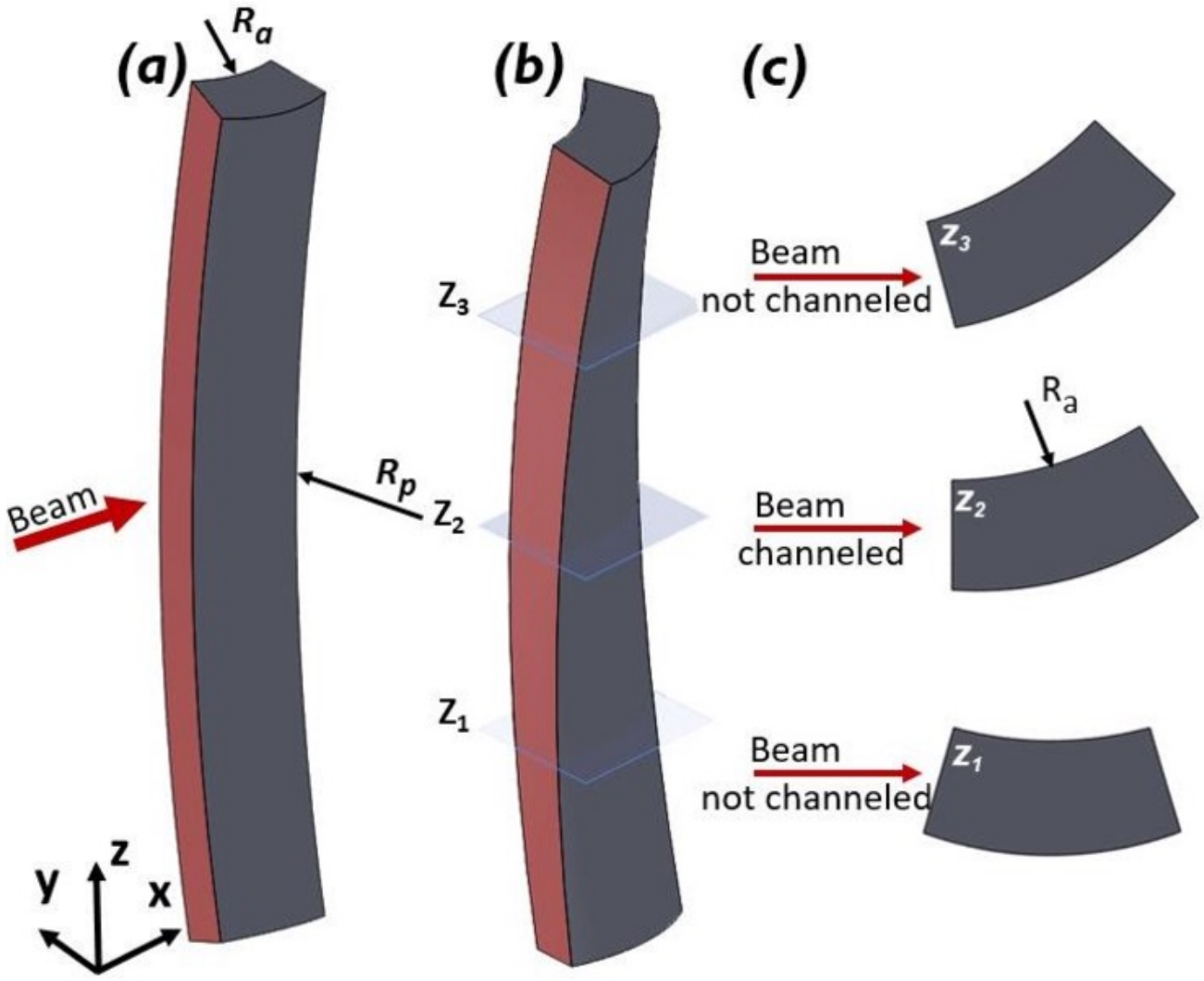
- A=Height of the portion of crystal free of metal clamping = >30mm
- B=distance between crystal and metal holder = >20mm
  - Assumes the holder is placed on the opposite to the beam side





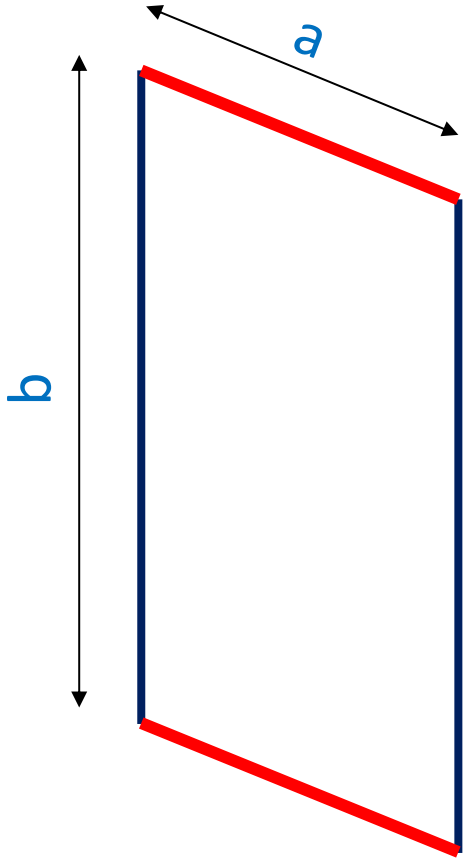
Torsion

- When flexed, a crystal may be subjected to torsion
- Torsion changes alignment between crystal and beam along the vertical direction, decreasing the total channeling efficiency
- What is the maximum amount of torsion acceptable in µrad/mm?
  - See next page



What is the maximum amount of torsion acceptable in T [µrad/mm]?

I realized this is not easy! That means how parallel you can keep the ends of red sides “a” between top and bottom at the distance of “b”.
That would be



$$\delta x = T \cdot a \cdot b$$

For $\delta x = 10\mu m$

$$T = \frac{10\mu m}{5cm \cdot 5cm} = 4\frac{\mu R}{mm}$$

Summary table

Deflection Angle	300 µrad ±20µrad
Crystal Thickness along the beam	400 µm
Crystal Width across the beam (H)	300 µm ±20µm or better
Crystal Torsion	2 µrad/mm
Distance between crystal and holder	>20 mm (somewhat flexible)
Height of crystal free of clamping	>30mm
Holder Material	Aluminum alloy Stainless preferred
Bake-out cycle	No