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Monochromators

2019 CSNS McStas School

Monochromators

- Purpose of monochromators
- McStas implementation and advise
- Component overview:
  - Monochromator
  - Monochromator_curved
  - Single_crystal

- Exercise

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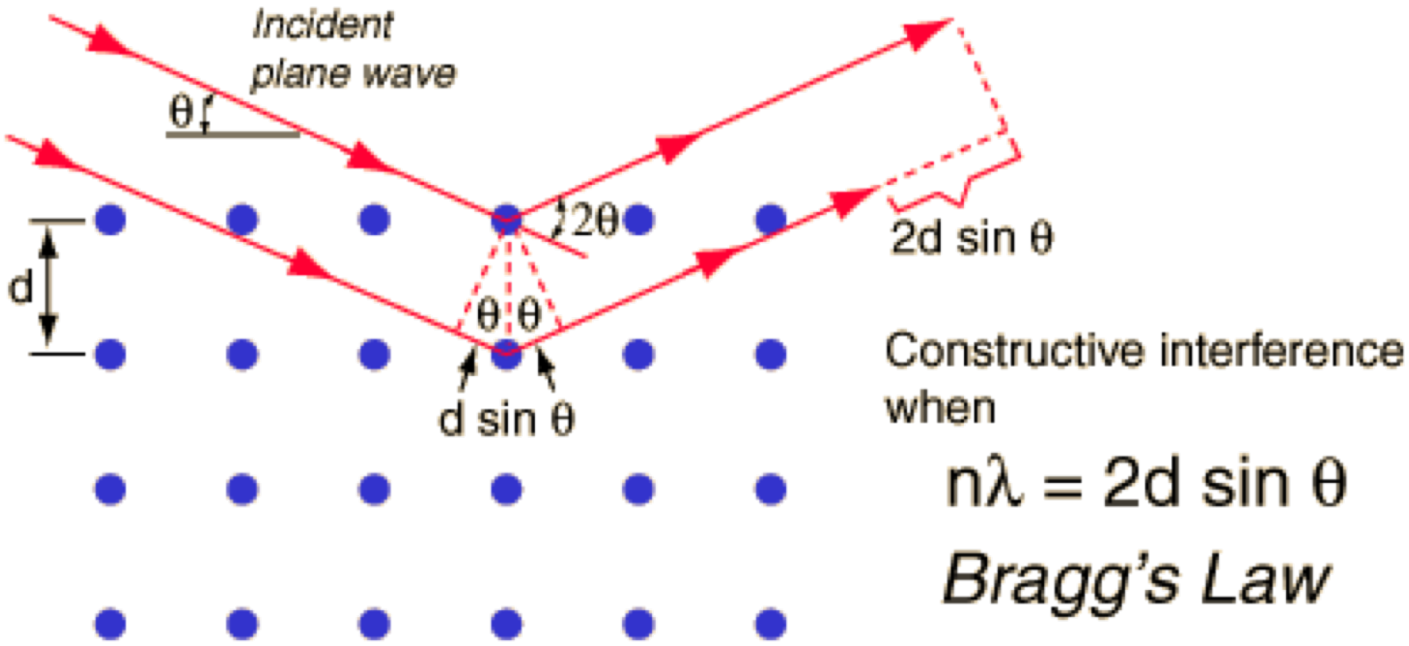
Monochromators: Braggs law

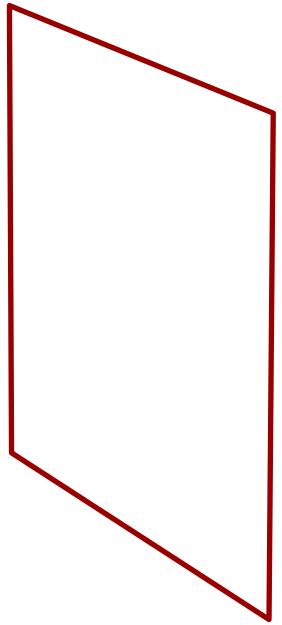
- Uses crystal with certain lattice spacing d to select the approrpiate wavelength
- Wave / interference phenomonem
- Described with Braggs law



Monochromator_flat

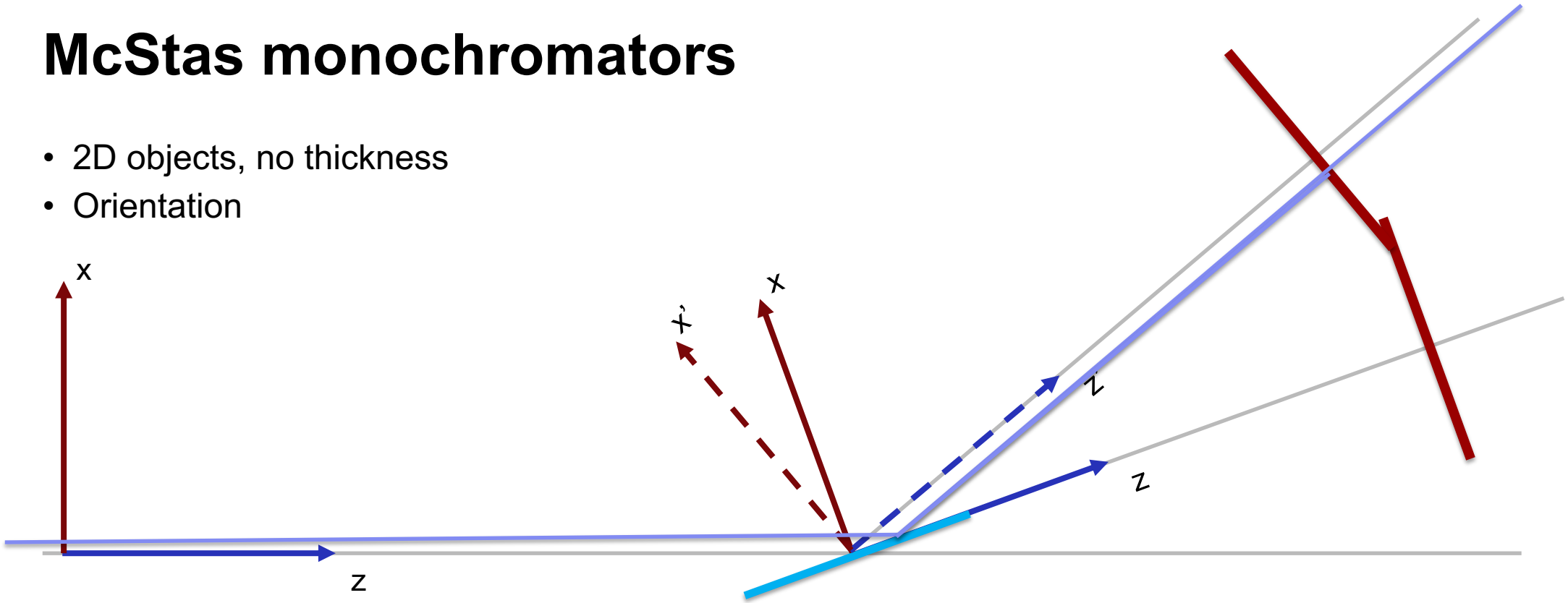
- Simple monochromator, 2D rectangle
  - Dimensions zwidth and yheight, oriented in yz plane
  - Q or DM: $Q = 2\pi/DM$
  - Can give mosaicity and maximum reflectivity

- Limited functionality, does not contain multiple scattering, or higher orders
- Easy to use



McStas monochromators

- 2D objects, no thickness
- Orientation



COMPONENT Source()
AT (0,0,0) ABSOLUTE

COMPONENT Mono()
AT (0,0,1) RELATIVE Source
ROTATED (0,theta,0) RELATIVE Source

COMPONENT beam = Arm()
AT (0,0,0) RELATIVE mono
ROTATED (0,theta,0) RELATIVE mono

COMPONENT Monitor
AT (0,0,1) RELATIVE beam

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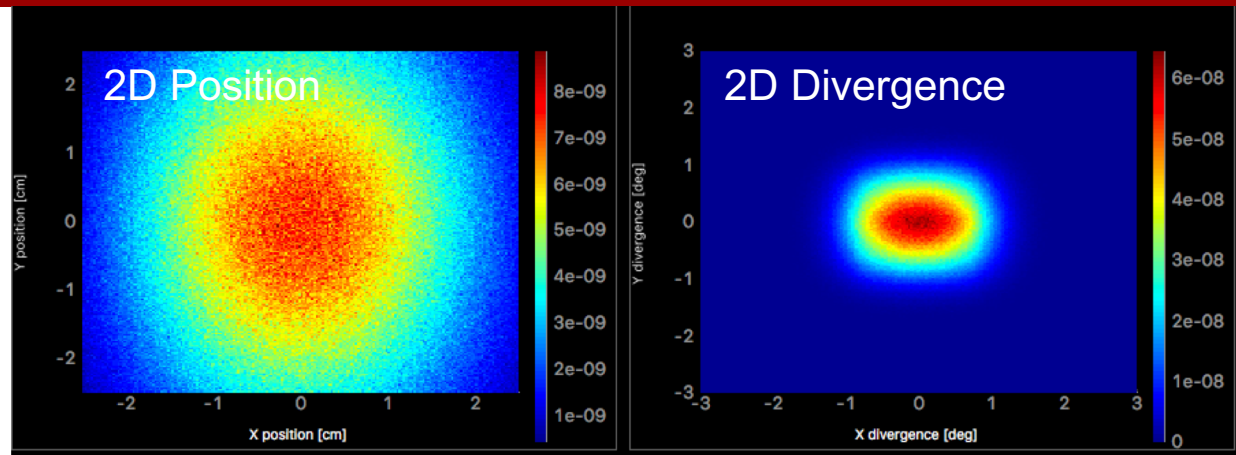
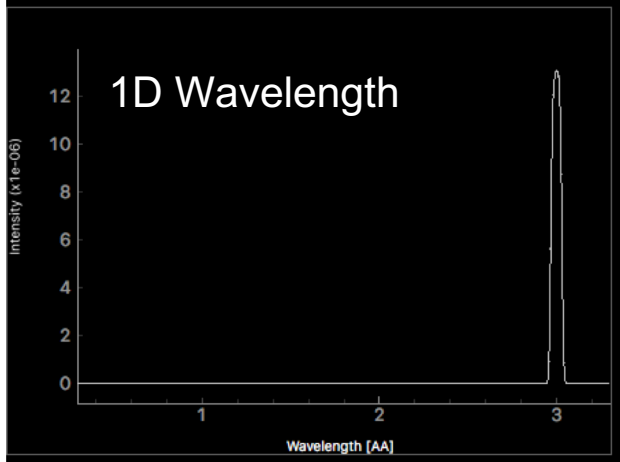
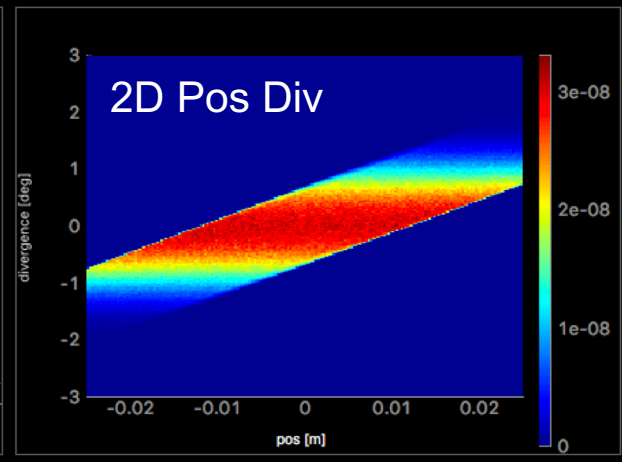
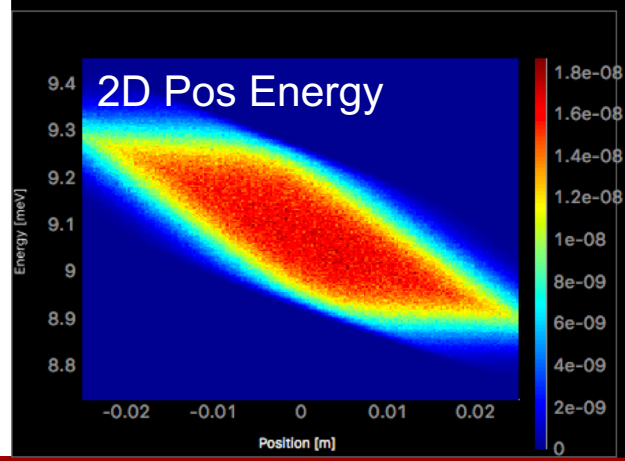
Monochromator_flat

- Homogeneous spatial distribution
- Small divergence distribution
- Only first order simulated
- Correlated position and divergence
- Correlated divergence and energy









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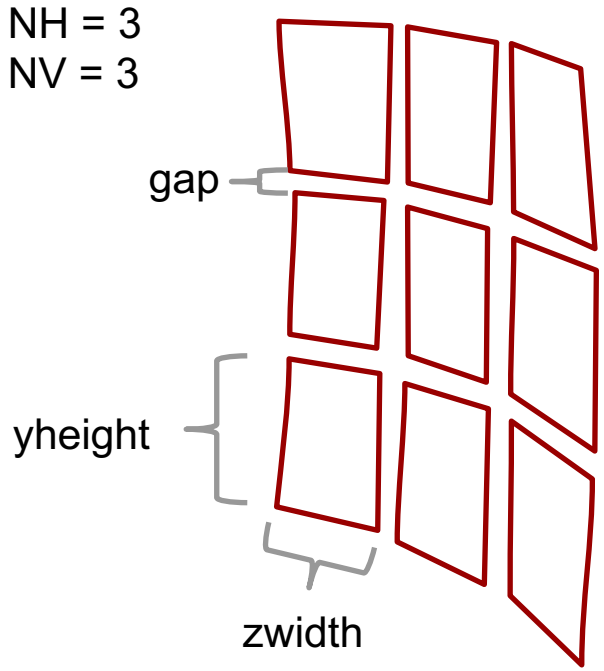
Monochromator_curved

- Many flat monochromators, 2D rectangles
  - Dimensions zwidth and yheight, NH x NV
  - Q or DM: $Q = 2\pi/DM$
  - Can give mosaicity and maxium reflectivity

- Limited functionality, but does have higher orders
- Easy to use



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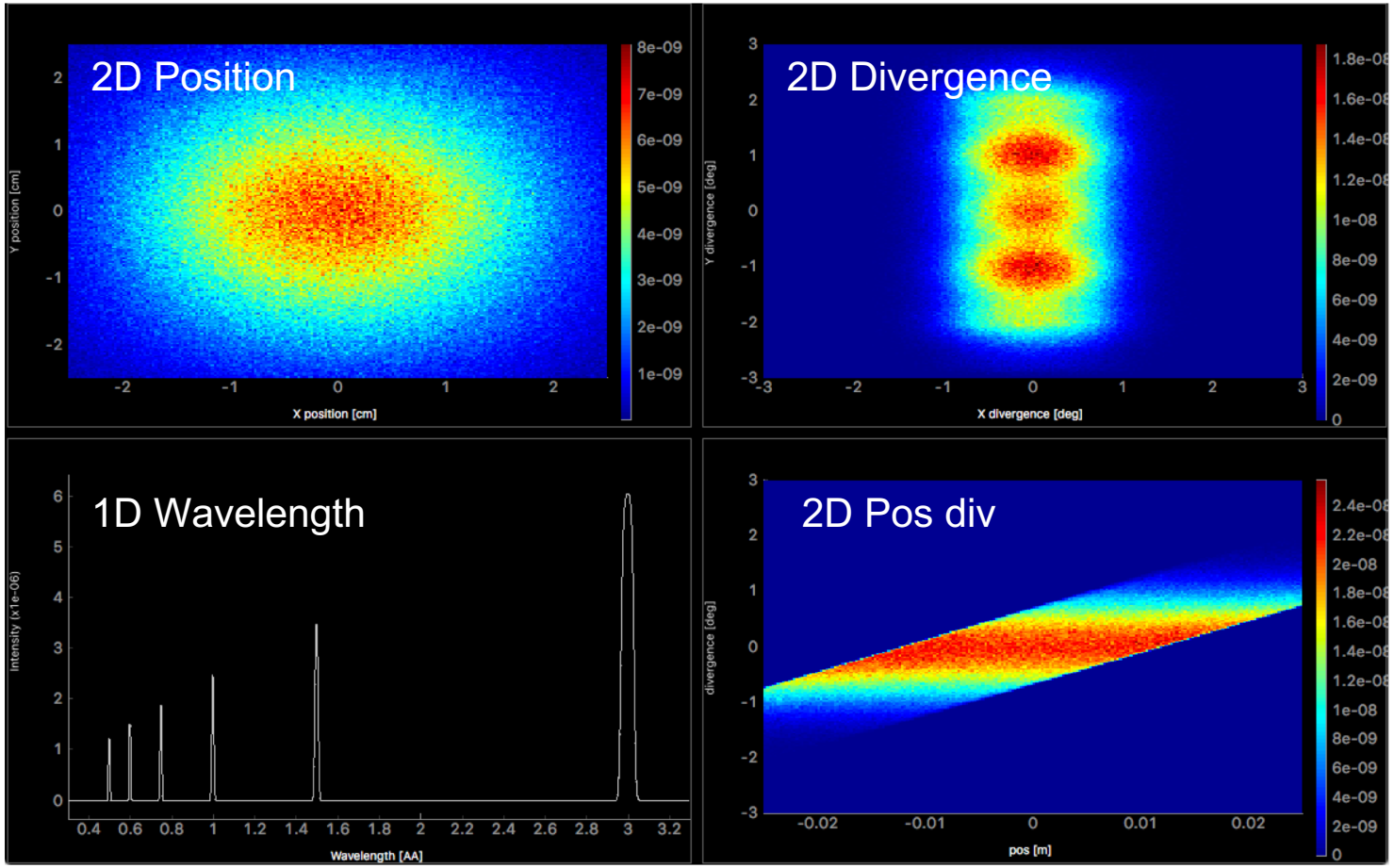
Monochromator curved example

- NH = 1
- NV = 5
- Higher vertical divergence
- Several Bragg orders



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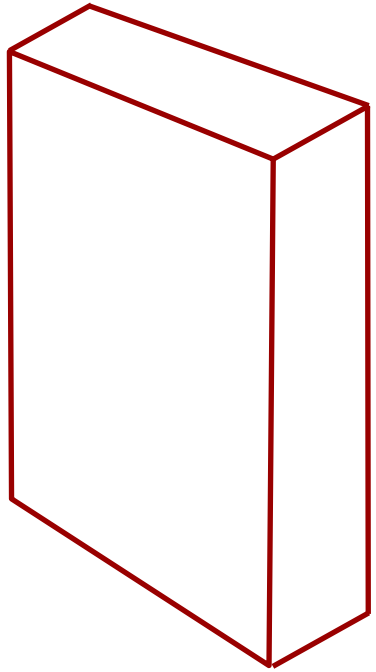
Single_crystal



- Sample component that describes a single crystal with mosaicity
  - Box geometry appropriate for monochromator
  - Have to set crystal parameters (other reflections available)
  - Simulates transmission and absorption

- Simulates multiple scattering and higher orders of Braggs laws
- Not as easy to use
- Have to set up focusing by using many of these together!

- Will be explained in tomorrows sample session

Solution on github, use if you are stuck

Monochromator exercise

- Add a monochromator_curved after your guide from previous exercise
  - Set orders = 0 to simulate all orders of Braggs law
- Define selected wavelength as input parameter
- Calculate theta angle for monochromator in initialize section
- Remember extra arm to define new beam direction
- Confirm that multiple orders are observed in the output

- Extra tasks
  - Experiment with focusing parameters, NH, NV, RV, RH
  - Experiment with the distance between guide and monochromator