Sector 19 Beam Position Monitor

Developed by
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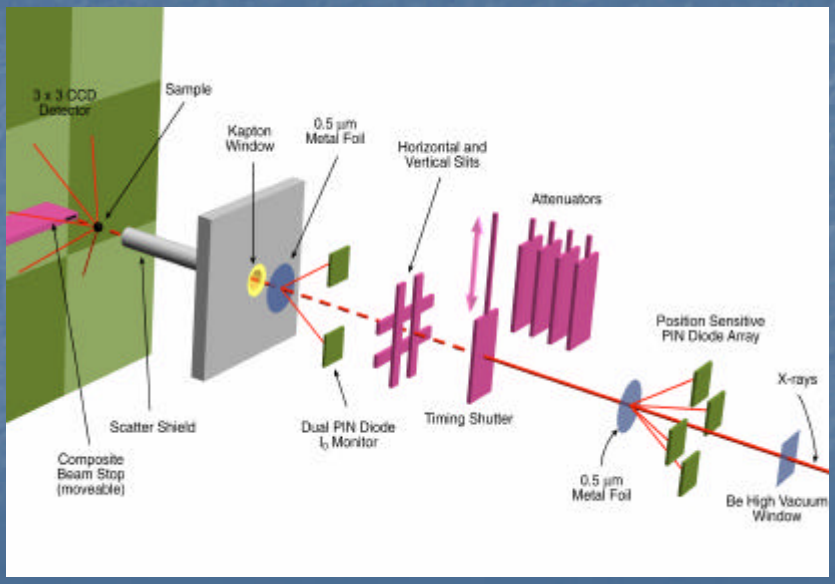
J. Synchrotron Rad. (2000) 7, 61-68.

BPM Design Parameters

- Large opening ~10 x 10mm
- Monochromatic 6-20keV energy range
- Fast readout
- Vacuum compatible
- Center-of-mass detection
- High position sensitivity

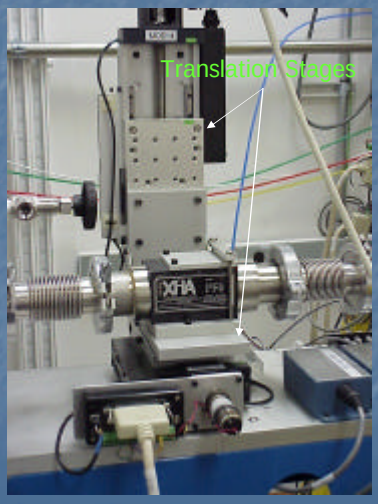
19ID End-Station Schematic

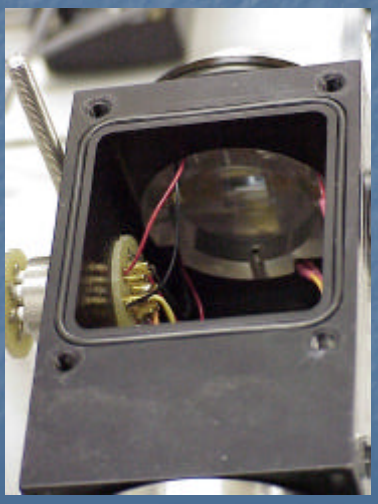


Typical Device Construction

- 10mm x 10mm opening
- Four 1cm x 1cm diodes on pc card
- 0.5µm thick metal foil -- Cr or Ti typical
- Diodes 1cm upstream of foil
- Foil surface smooth, pre-mounted to holder

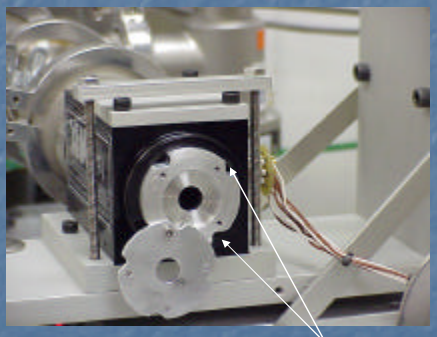
BPM on Translation Stage

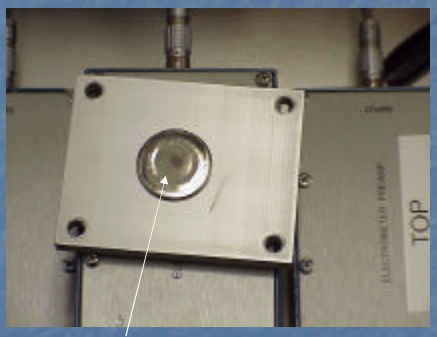




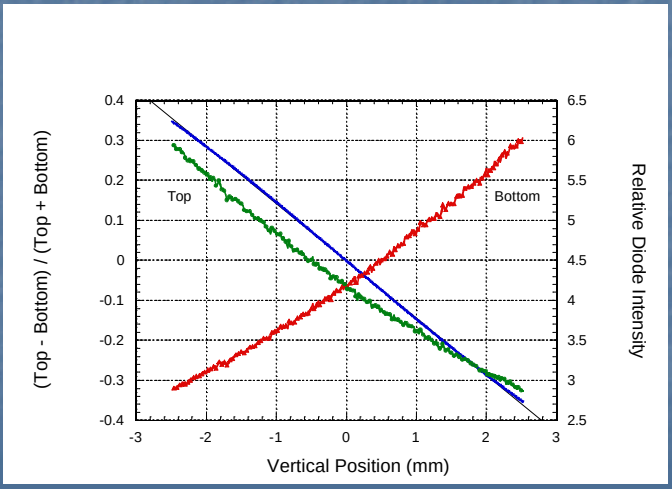
Foil Holder

0.5µm thick metal foil on ss washer

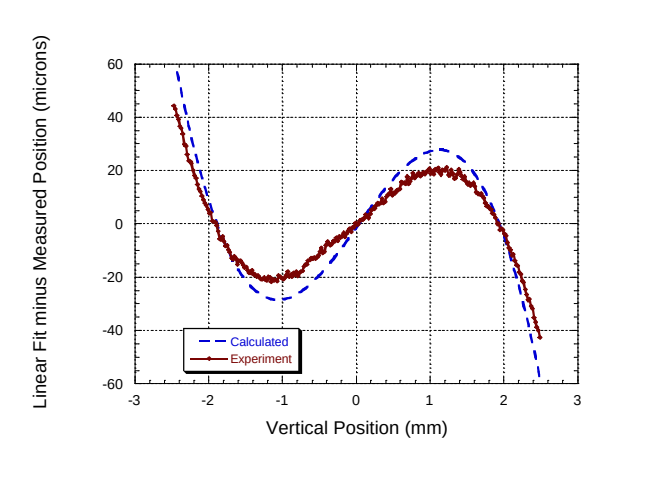




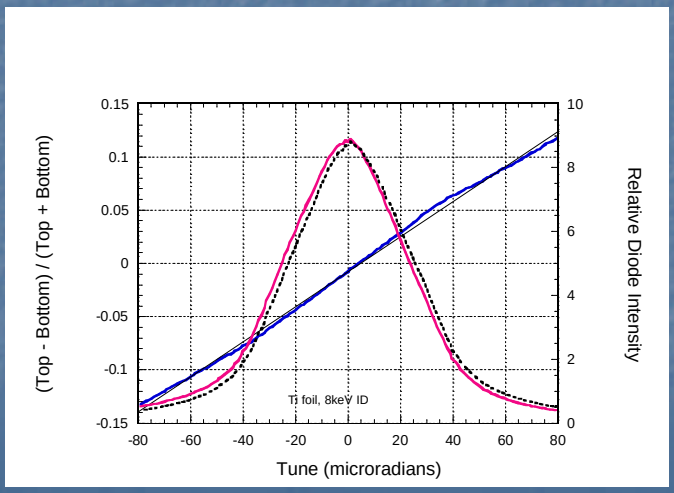
Vertical Calibration Cr foil



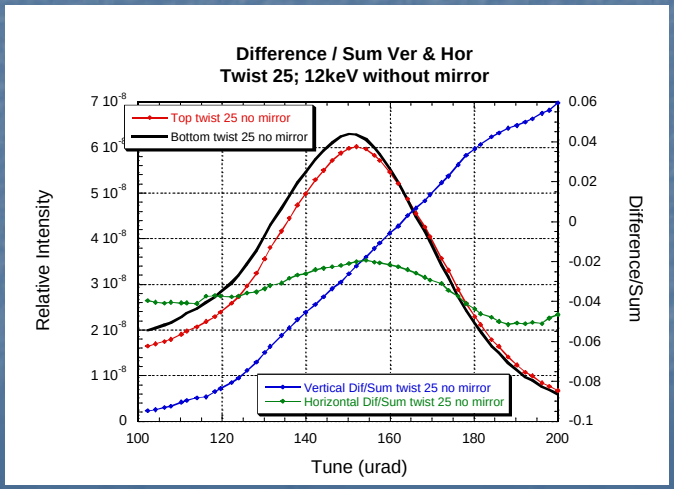
Linear Fit Difference (μm)



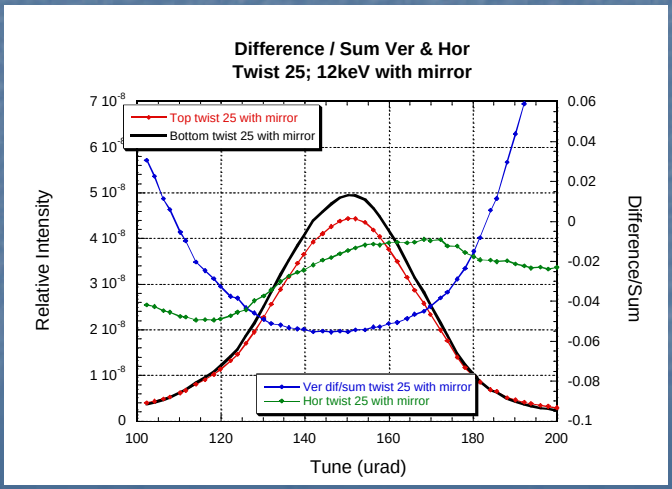
Ti Vertical Dif/Sum vs Tune 8keV



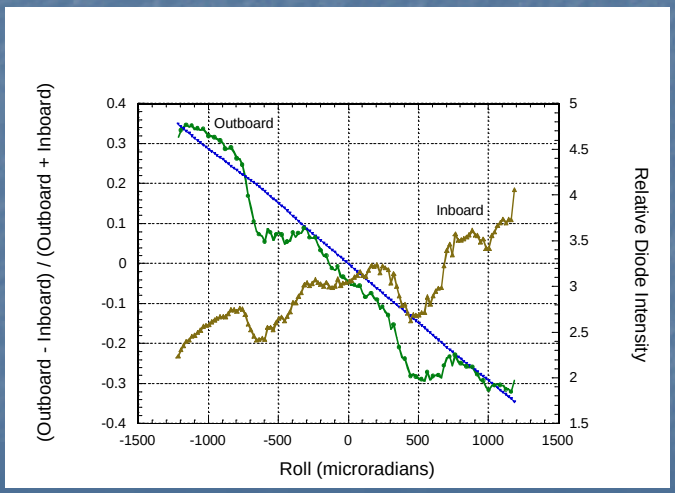
12keV Vertical & Horizontal Difference / Sum without mirror



Beam Overfilling Mirror



Horizontal Position vs Roll



BPM Advantages

- Low cost – simple design
- Tunable energy range with foil selection
  - Typical foils Ti, Cr, Fe, Ni, Co, Cu
- BPM gives direction for feedback
- Center-of-mass detection
- Operates over a wide >5mm range

BPM Advantages

- Low foil absorption – no need to remove it
- High current output (Cr 0.42μA at 12keV)
  - Not dependent upon gas flow
- Fast response time
- Large dynamic range
- Small device footprint
- Vacuum compatible

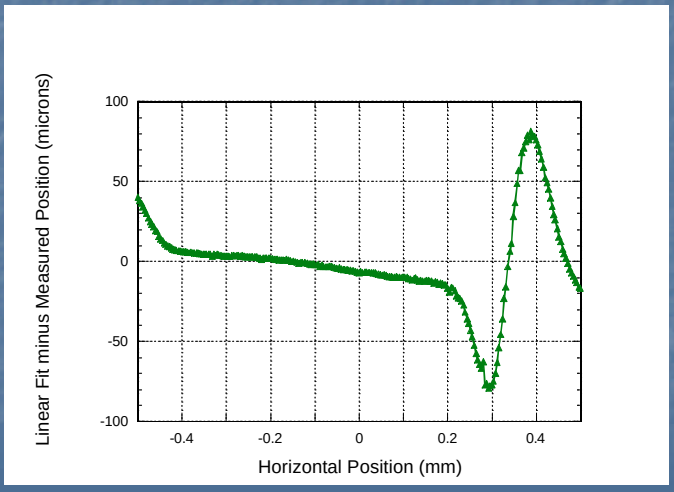
What to watch out for

0.5µm thick Foils:

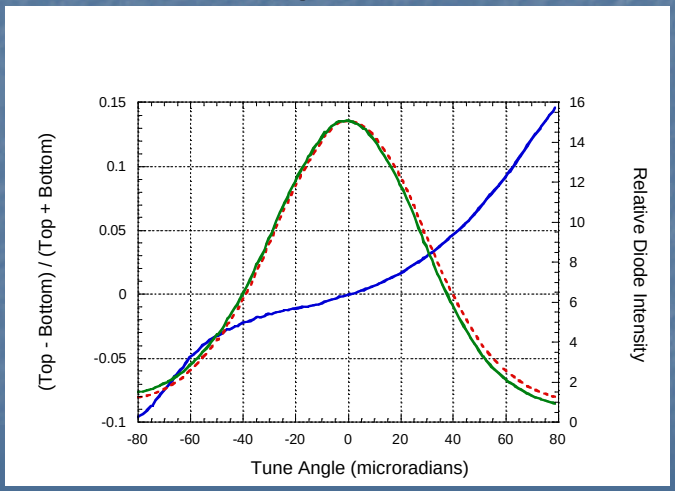
- Differential pressure will break foil
- Rippled foils lead to positioning errors
- Carbon build-up may occur over time
- Kapton backed foils respond with different energy dependence

Diodes: Sensitive to light from ion gauges

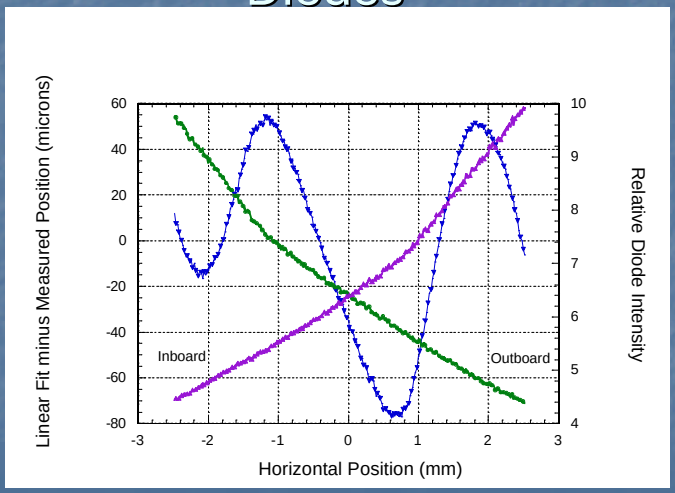
Errors Introduced by Foil Ripples



Tune with Water-Cooled ID 1st Crystal



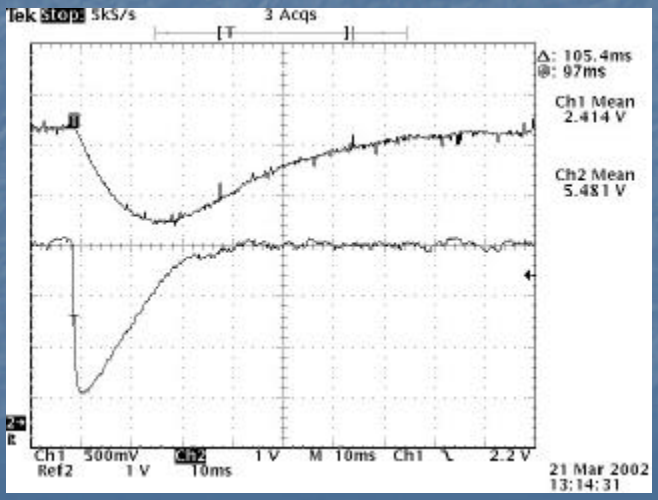
Errors Due to Foil Upstream of Diodes



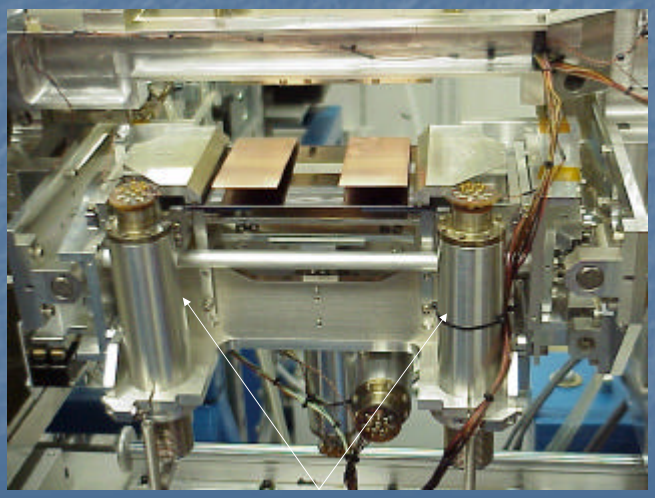
BPM Uses

- Tuning feedback
- Horizontal positioning --2nd crystal twist
- Measure angles with two devices
  - Energy sensitive operations with two devices requires both have the same type foil
- Timing operations
- Intensity monitoring after slits

Ion chamber vs Diode Top-up Injection

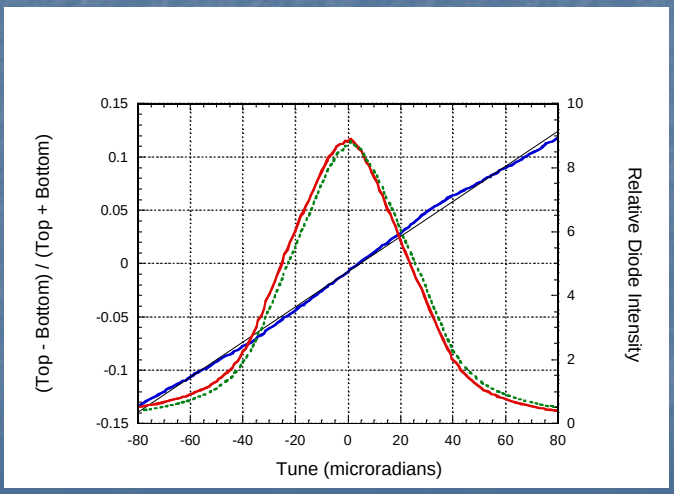


19BM 2nd Crystal Assembly

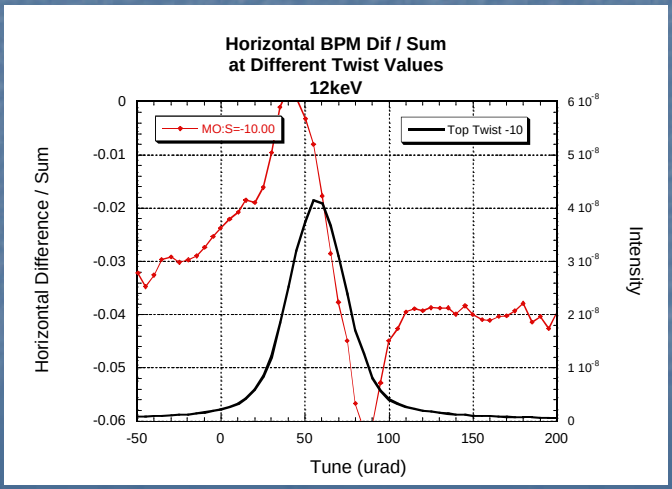


Tune - Twist Motors

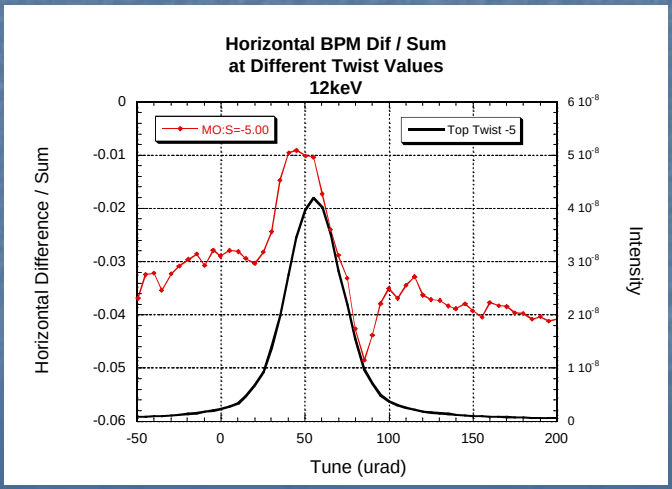
8keV Tune Calibration



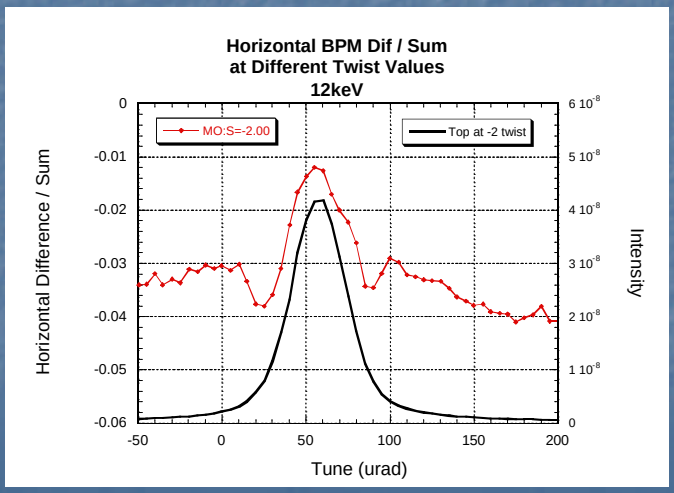
Horizontal Position vs Twist



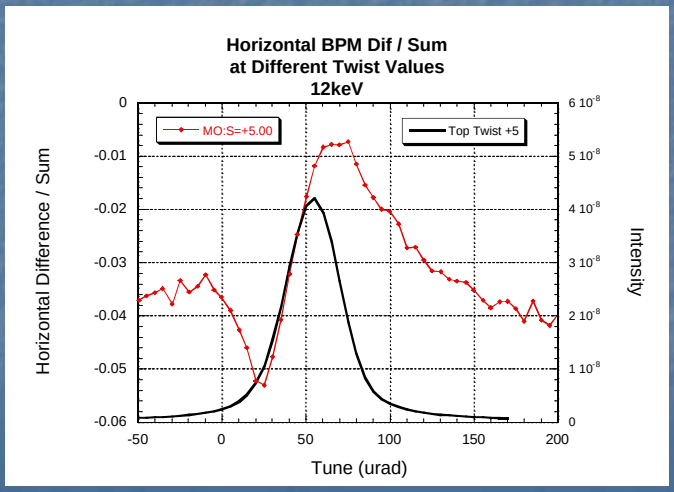
Horizontal Position vs Twist



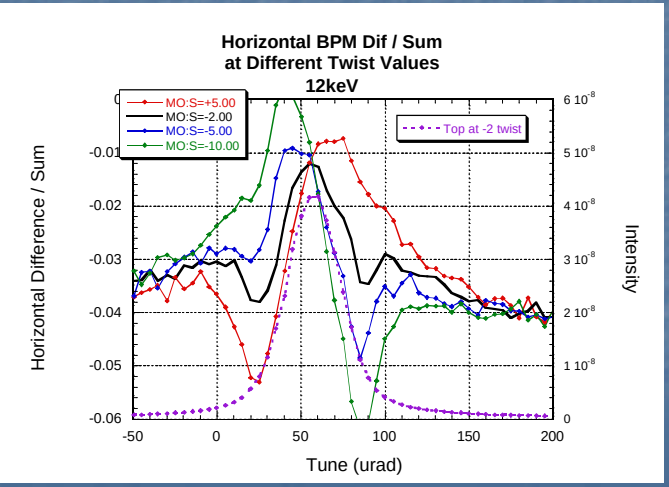
Horizontal Position vs Twist



Horizontal Position vs Twist



Horizontal Position vs Twist



BPM Improvements

- Separate foil from diode array
- Multiple foil selector with open slot
- Large aperture diode array for BM ops

Foils on Pneumatic Actuator; Diodes on Separate Translator