New indirectly cooled monochromator crystals at 20-ID

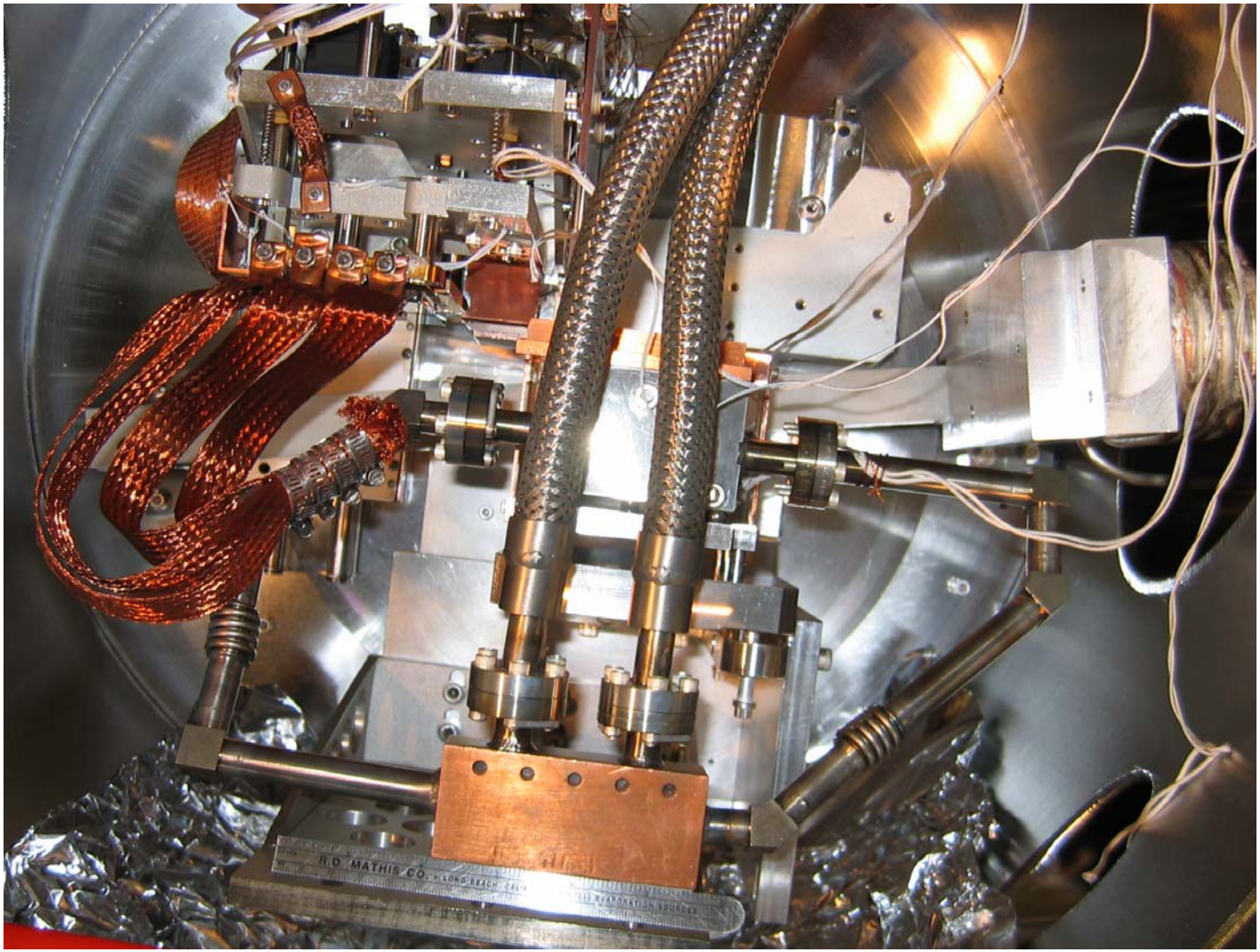
Steve Heald, PNC-CAT, July 21, 2005

- Description of previous system
- Some basics on indirect cooling
- New design and performance

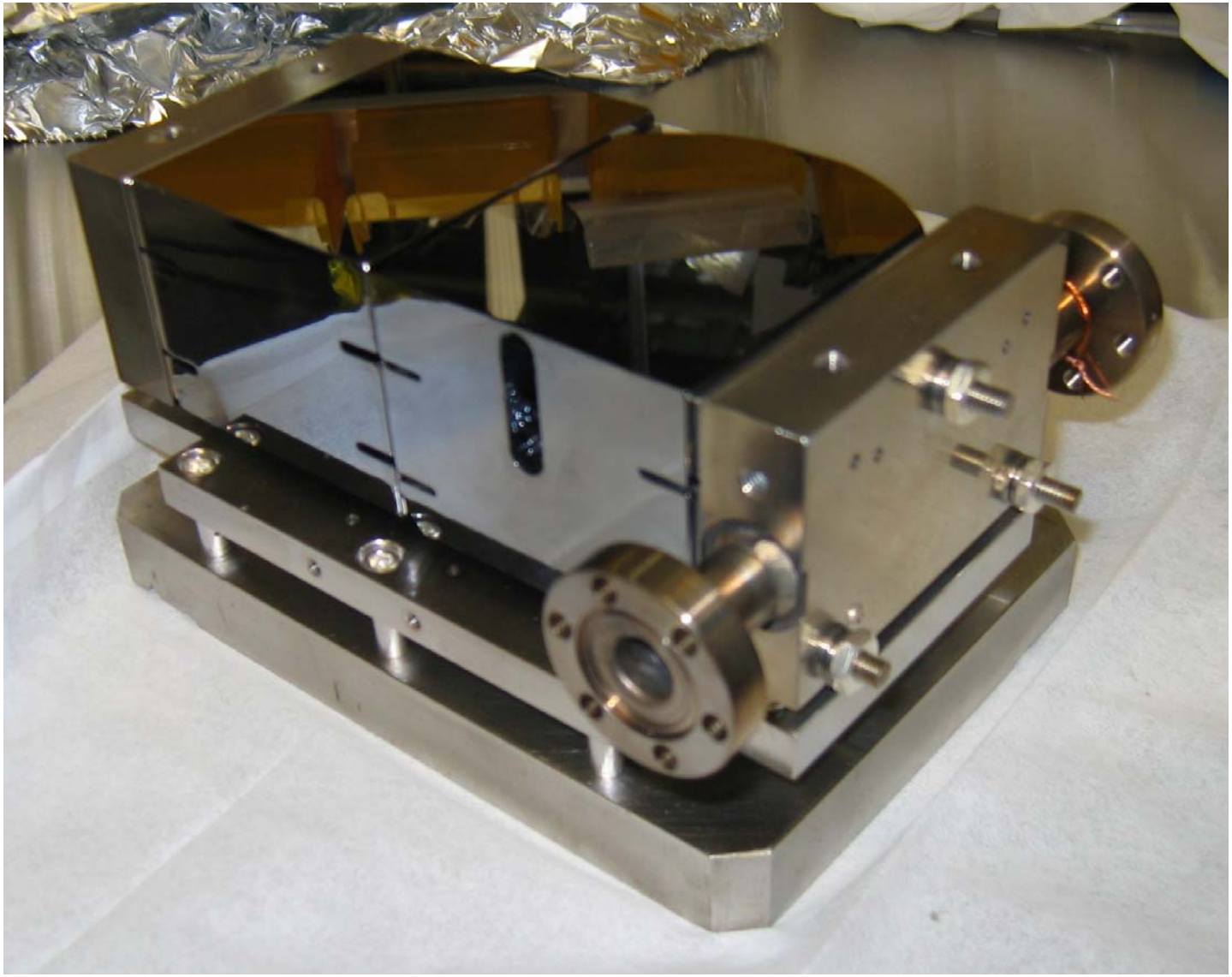
Old design

- Based on APS standard directly cooled crystal
- Two side by side crystals
  - 111 and 311
  - Crystal change by translating entire monochromator 60 mm
- Worked reasonably well, but some small vibrations and some sensitivity to LN2 pressure
- Difficult to get leak tight

Old crystal mount



Old crystal mount - crystals



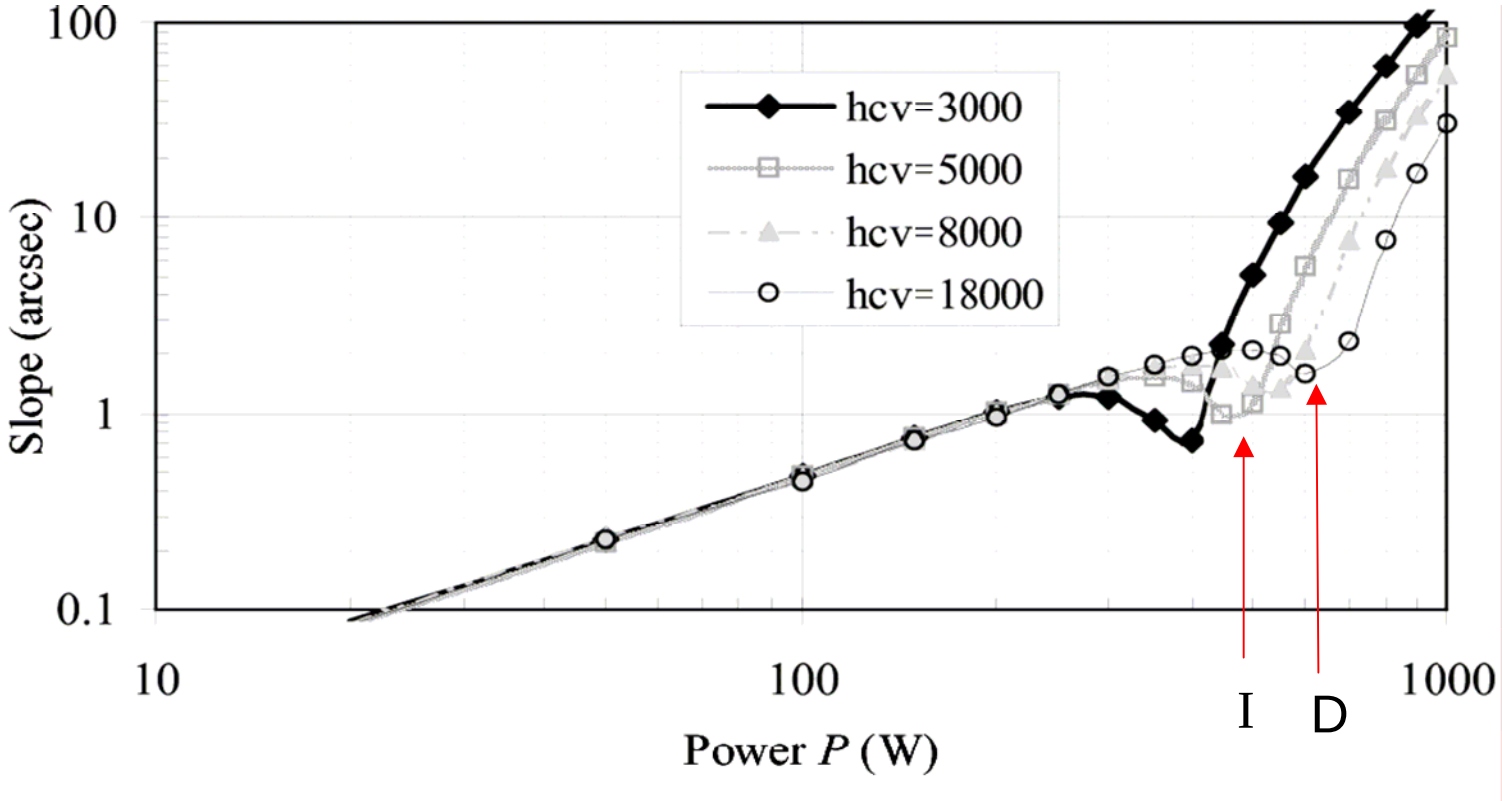
Indirect versus direct cooling

- See Chumakov etal JSR 11, 132 (2004) for basic design
- Direct: transfer through Si, transfer through Si/LN_2 interface
- Indirect: trans. thru Si, Si/In/Cu interface, trans thru Cu, Cu/LN_2 interface
- Main difference is the Si/In/Cu interface
  - Good contact gives about 10^4 W/m^2/K
  - 4x8 cm sides with 300 W gives temp rise of about 5K

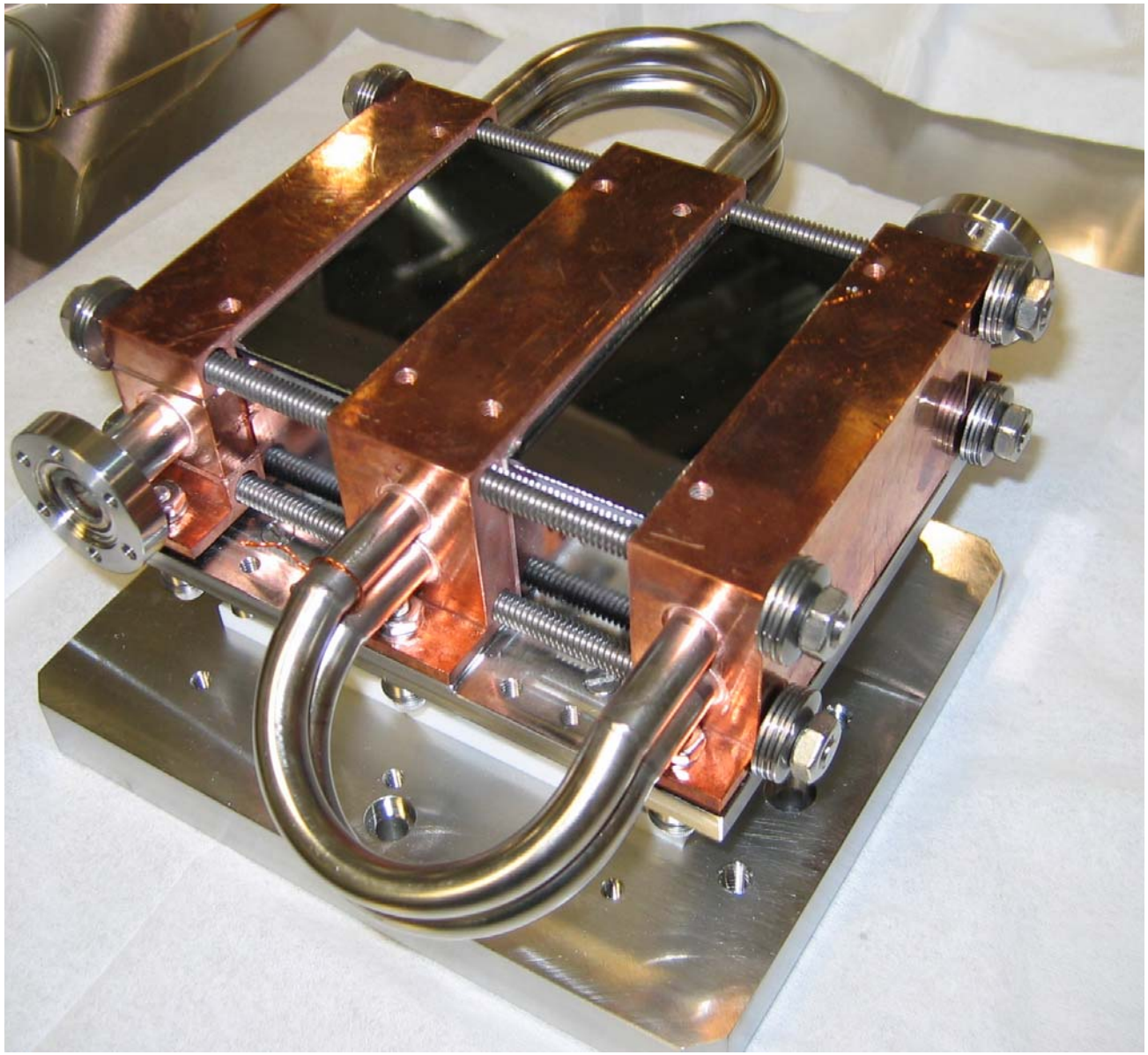
Indirect cooling should have similar performance to direct cooling using LN_2 about 5K warmer.

FEA calculations

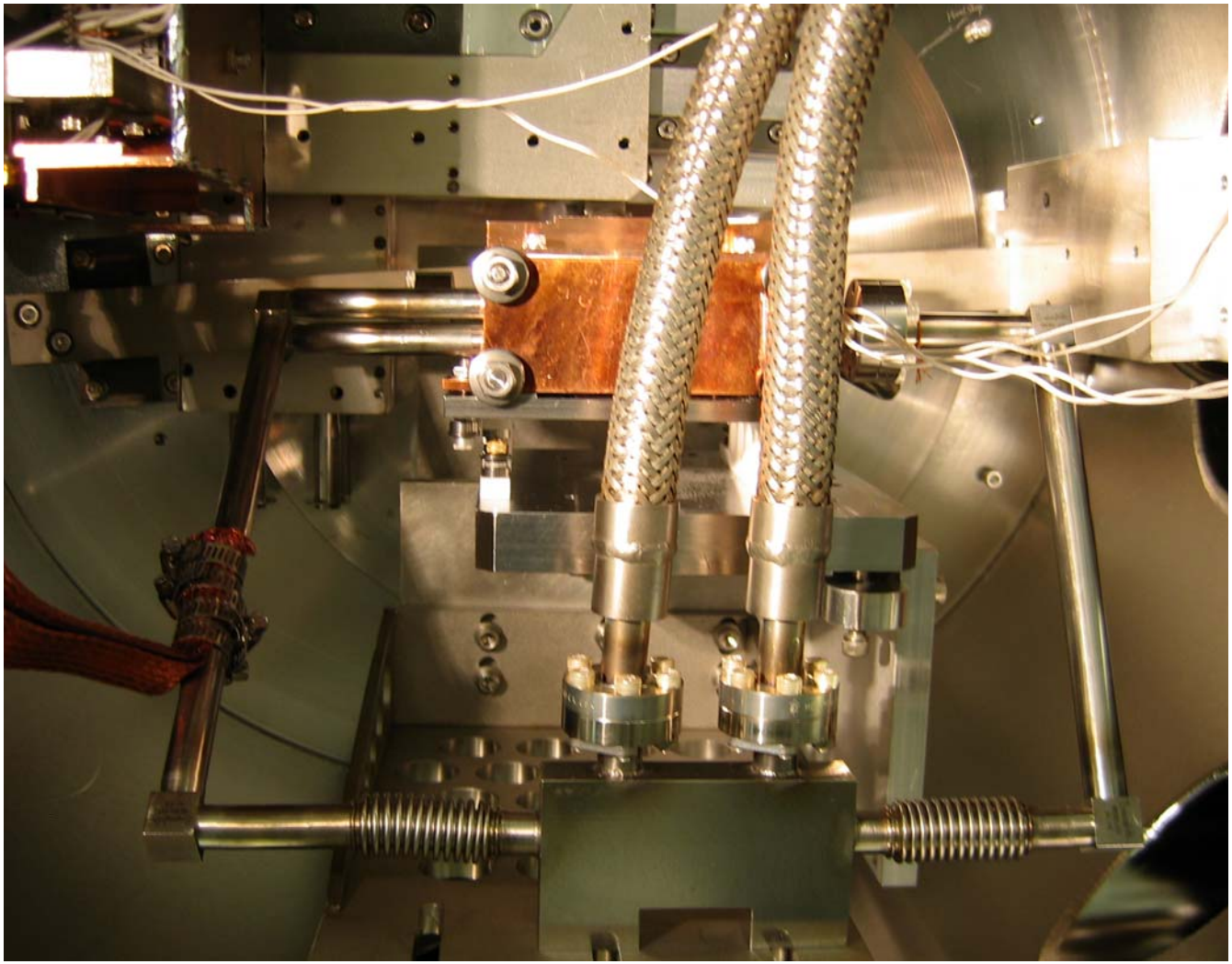
Zhang etal JSR 10, 313 (2003)



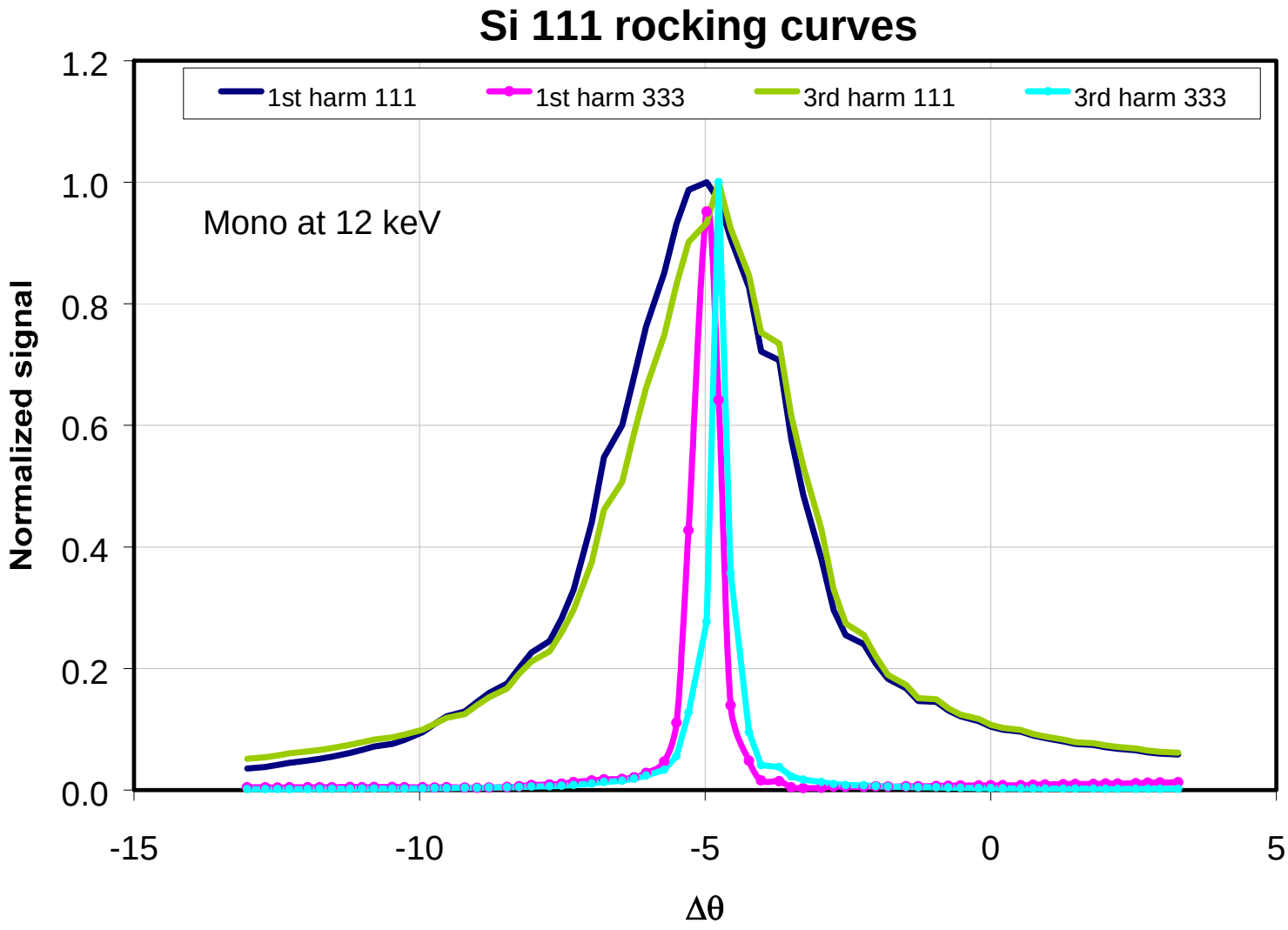
New Crystals



New crystals installed



Performance at high power



Conclusions

- Indirect cooling easily handles current heat load
- No visible vibrations remain in beam when imaged at high magnification
- I_0 fluctuations reduced about 5x
- LN_2 pressure changes of 5-10 psi made negligible change in tuning