Agenda for the HENEX 65% Design Review

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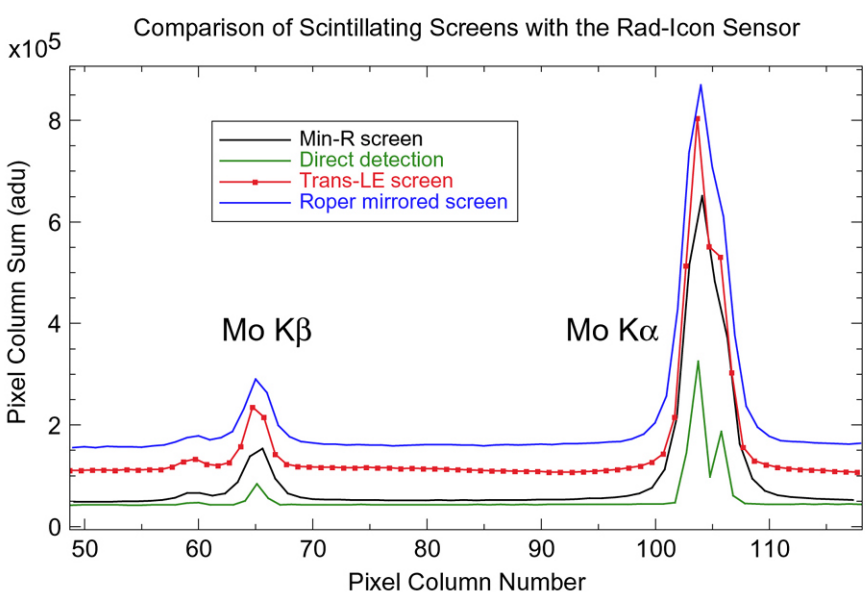
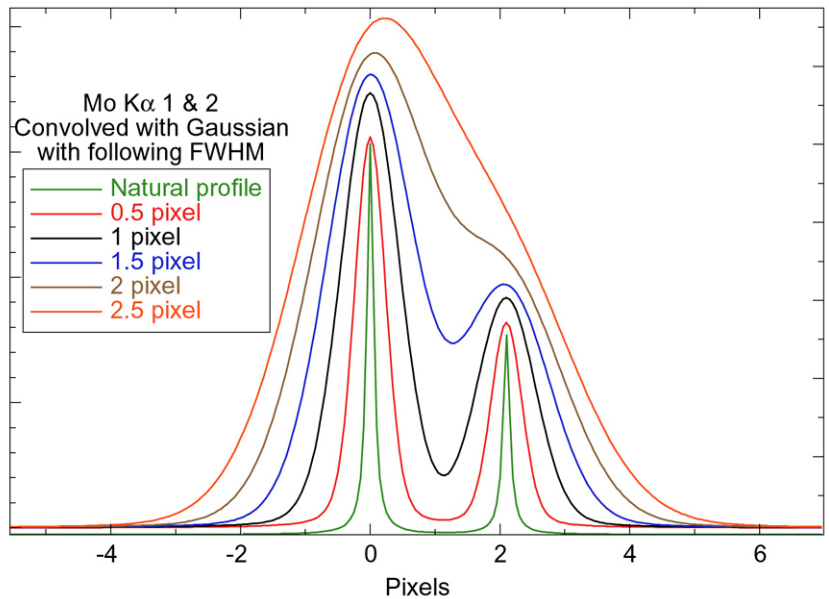
1. Opening (Tina Back, tinaback@llnl.gov)
2. Design Overview (John Seely, john.seely@nrl.navy.mil)
3. Mechanical Design (Layne Marlin, lmarlin@ssd5.nrl.navy.mil)
4. Optical Design (Larry Hudson, larry.hudson@nist.gov)
5. Electronic Design (Rob Atkin,ratkin@tigerinnovations.com)
6. Interface/Sensor (Glenn Holland, gholland@ssd5.nrl.navy.mil)
7. Project Schedule (Perry Bell, e061547@popeye.llnl.gov)

Questions/comments: Please refer to presentation number 4.

Determination of detector resolution element





Transmission crystal provides pinhole image and redundancy

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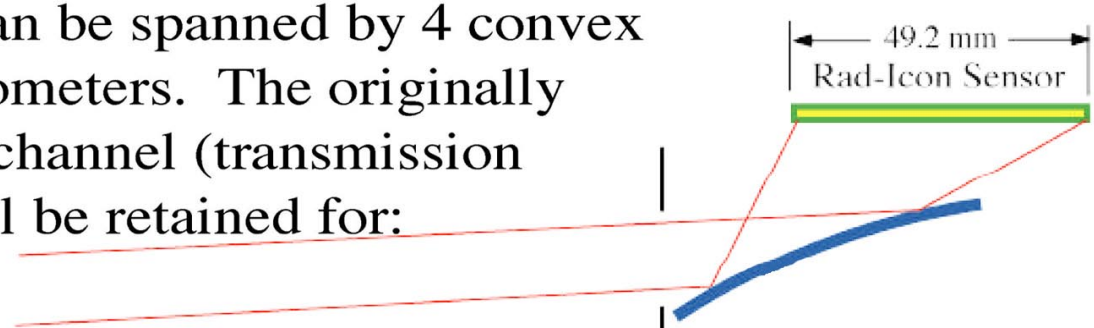
Because of the 49.2 mm length of the proposed CMOS detector, the range of 1 to 20 keV can be spanned by 4 convex crystal spectrometers. The originally proposed 5th channel (transmission geometry) will be retained for:



- Pin hole camera along center axis of entire instrument to track relative source position
- Redundancy in coverage of 11 to 20 keV
- Low resolution spectral coverage up to 44 keV
- Future option to add pin diodes in the dispersed beam for time dependent studies

Optical layout of the spectrometers

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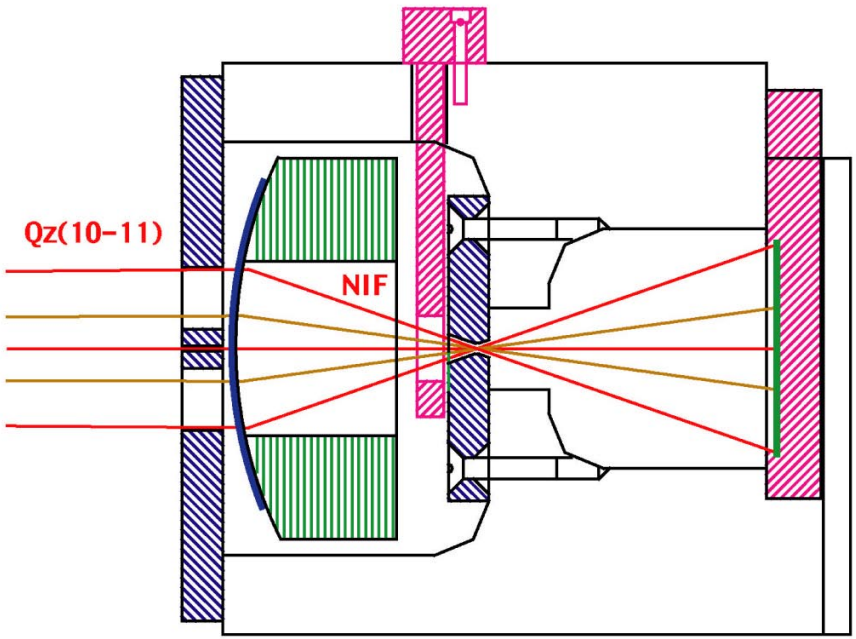
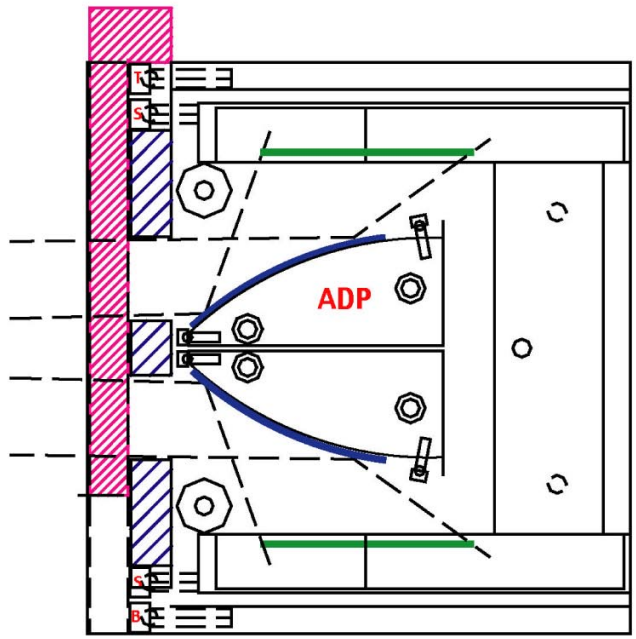
5 HENEX Channels shown in side views = plane of dispersion

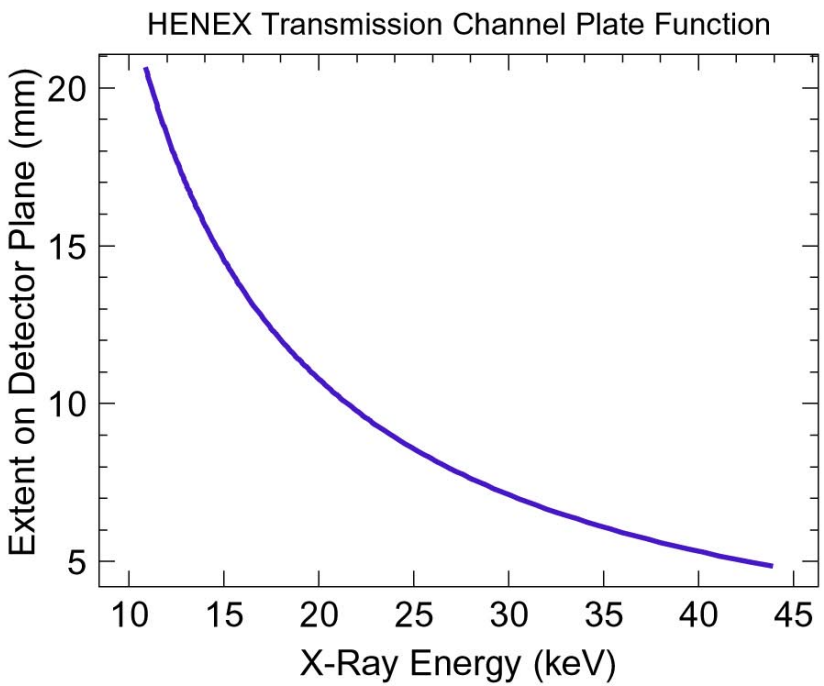


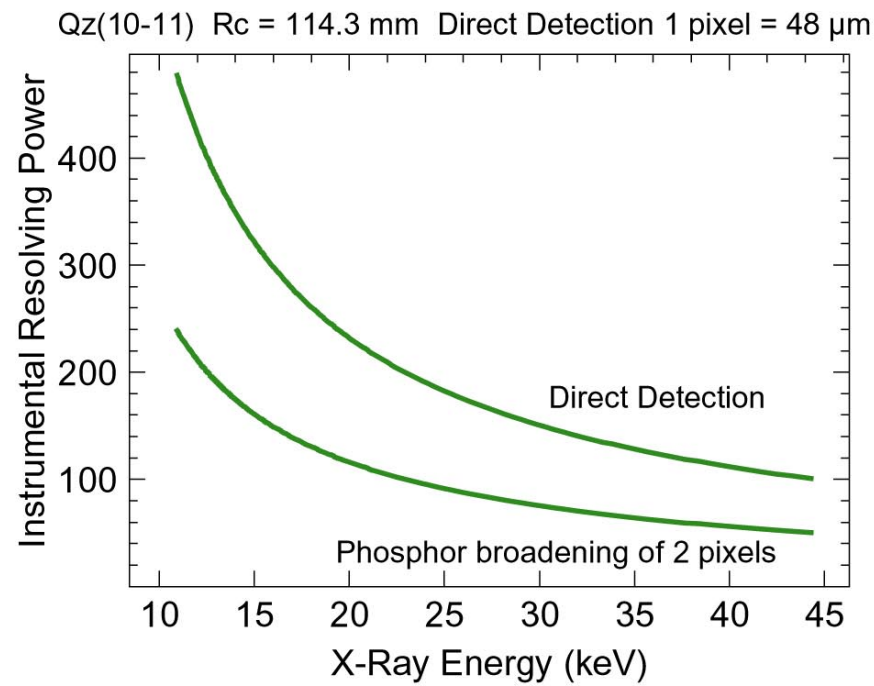


1 Transmission Channel
Radius of curvature = 4.5 inches

4 Reflection Channels
Radius of curvature = 5.0 inches

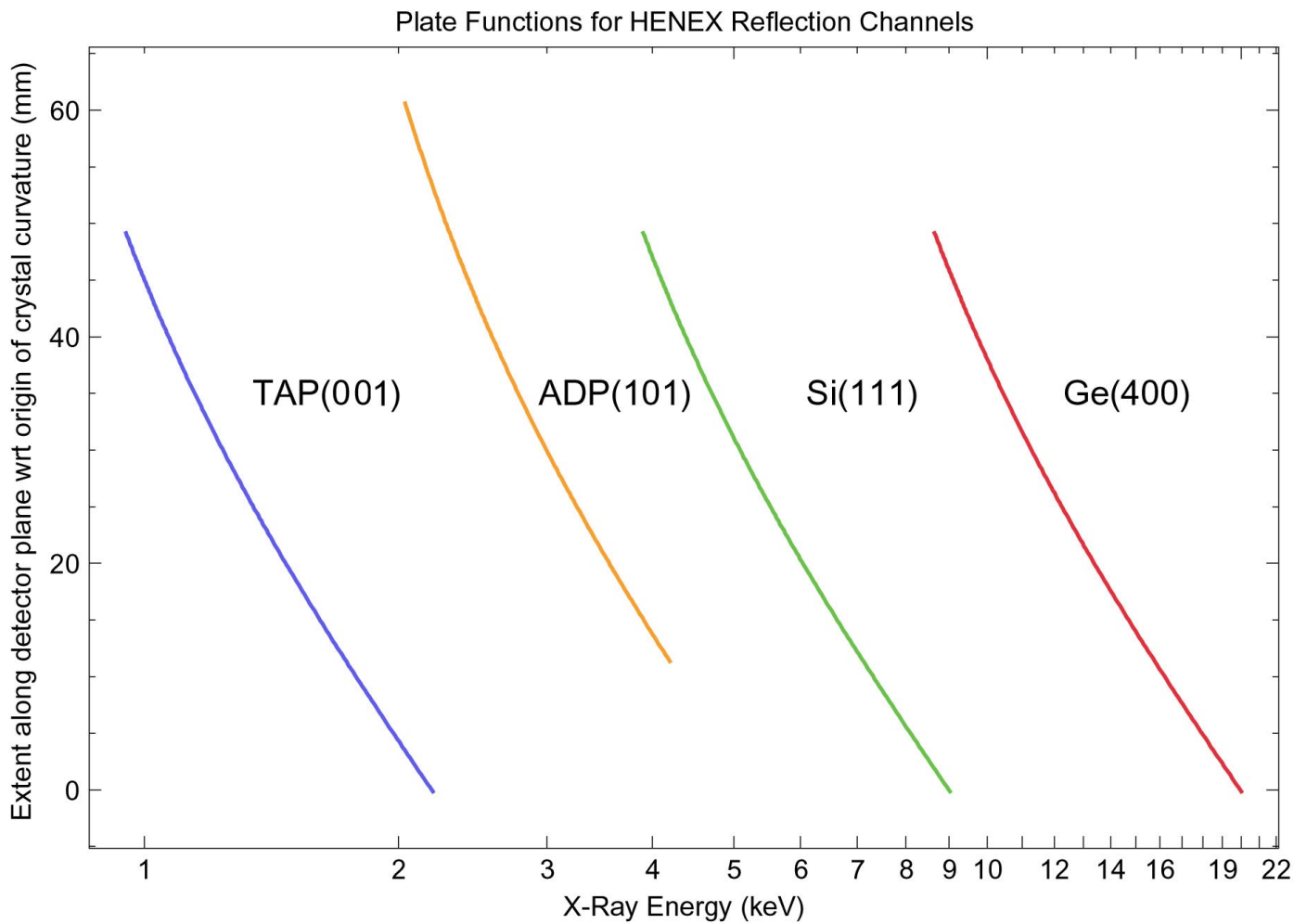
Transmission crystal channel



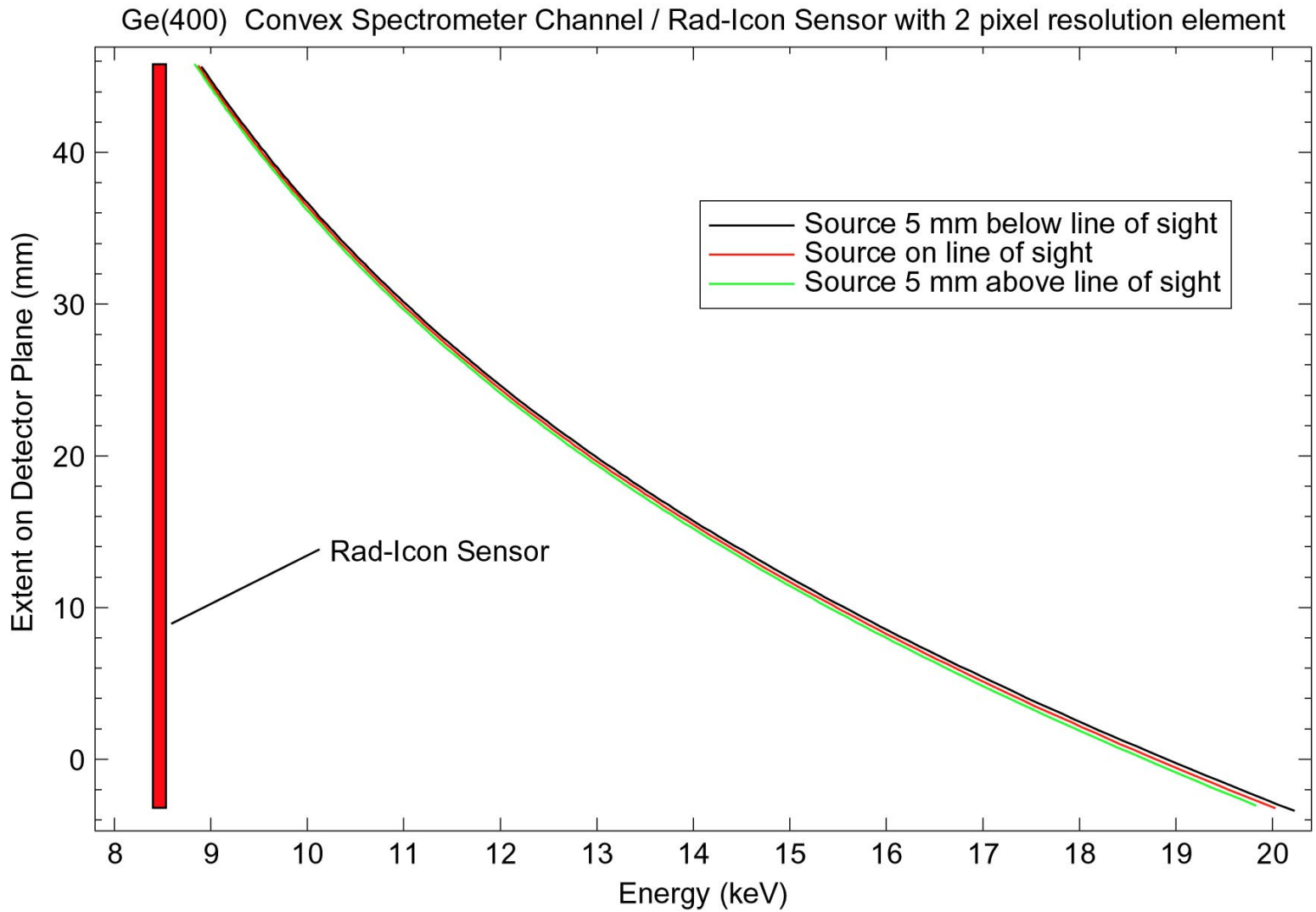


Reflection crystal channels

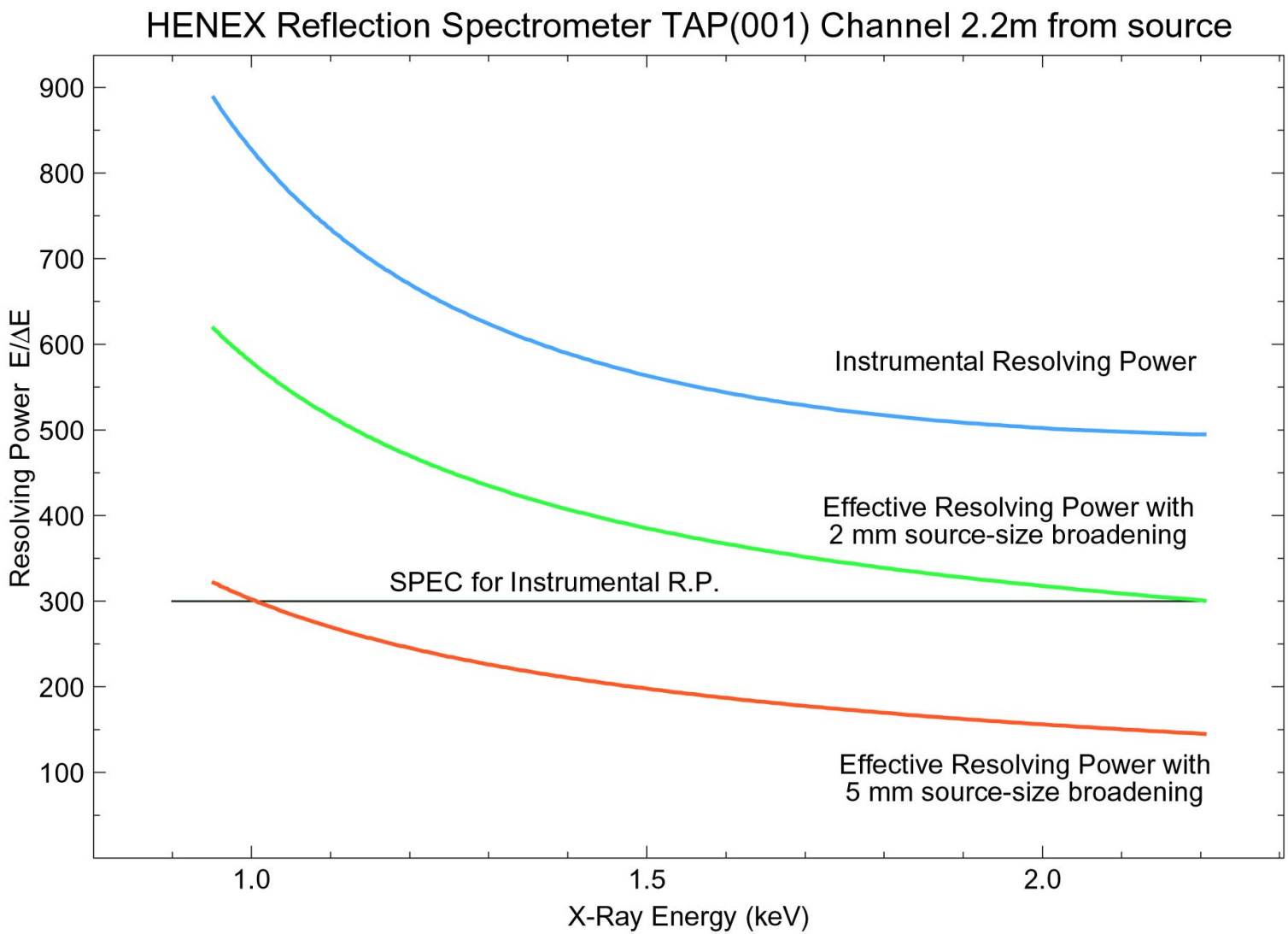
- The crystal choices were re-considered after the HENEX CDR.
- Crystals for the two low-energy channels will be the focus of early tests.



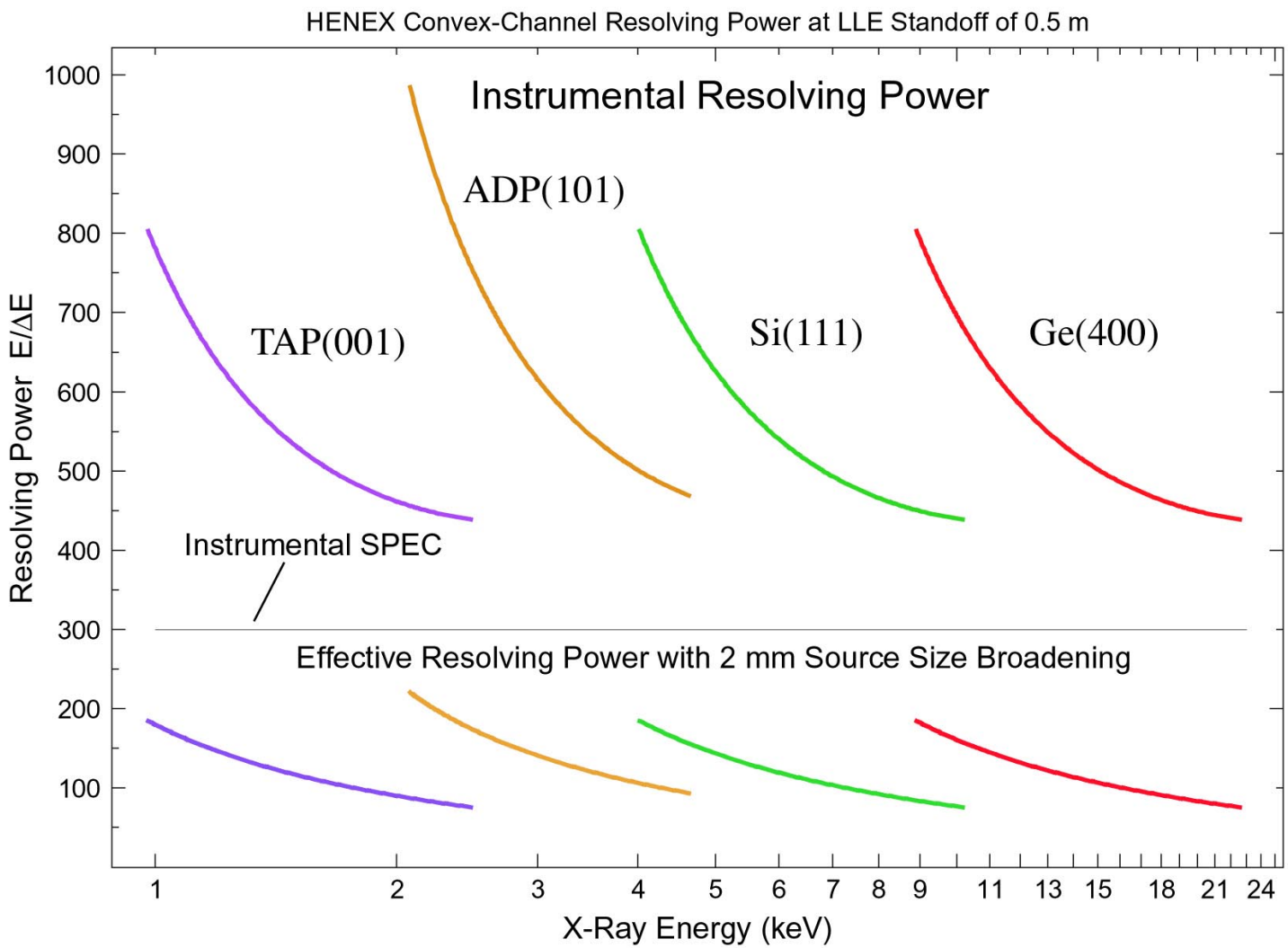
Field of View



Source-size broadening



HENEX at LLE standoff



Summary of Optical Design

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HENEX Spectrometer channels at NIF Standoff Distance of 2.2 m

Crystal	Channel Number	Type	Energy Coverage (keV)	Instrumental Resolving Power*	Effective R.P. with 2 mm source size	Effective R.P. with 5 mm source size
TlAP(001)	1	Reflection	1.0 – 2.2	888 - 495	619 - 301	322 - 145
ADP(101)	2	Reflection	2.0 – 4.2	1092 - 524	745 - 346	382 - 174
Si(111)	3	Reflection	3.9 – 9.0	888 - 495	619 - 301	322 - 145
Ge(400)	4	Reflection	8.7 – 20.0	888 - 495	619 - 301	322 - 145
Qz(10-11)	5	Transmission	10.9 – 15.9	477 – 300	308 @ 15 keV	267 @ 15 keV
Qz(10-11)	5	Transmission	15.9 – 44.3	300 – 100		

HENEX Spectrometer channels at LLE Standoff Distance of 0.5 m

Crystal	Channel Number	Type	Energy Coverage (keV)	Instrumental Resolving Power*	Effective R.P. with 2 mm source size
TlAP(001)	1	Reflection	1.0 – 2.5	803 -439	185 - 76
ADP(101)	2	Reflection	2.1 – 4.6	985 - 469	221 - 94
Si(111)	3	Reflection	4.0 – 10.1	803 -439	185 - 76
Ge(400)	4	Reflection	8.9 – 22.4	803 -439	185 - 76
Qz(10-11)	5	Transmission	10.8 – 15.7	471 - 300	226 @ 15 keV
Qz(10-11)	5	Transmission	15.7 - 44.8	300 - 99	

Estimated Crystal Sensitivities

Crystal	Bragg angle Range (deg)	Reflectivity (rad) at E specified (for flat crystal geometry)	Relative Reflectivity at LLE standoff (curved crystal)	Relative Reflectivity at NIF standoff (curved crystal)
TlAP(001)	12.7 – 30.4	2.5 e-4 @ 1.5 keV	The bent crystal sensitivities differ from that of the flat crystal due to geometrical factors, changes in mosaicity, extinction depths, and, in the case of quartz, the anisotropy of the inelastic stress tensor.	
ADP(101)	16.1 – 34.9	2.5 e-5 @ 3 keV		
Si(111)	12.7 – 30.4	4.6 e-5 @ 6 keV		
Ge(400)	12.7 – 30.4	1.8 e-5 @12 keV		
Qz(10-11)	2.4 – 9.8	2e-5 @ 15 keV		

*For channel 5, divide resolving powers by 2 if direct detection (no phosphor convertor) is used.