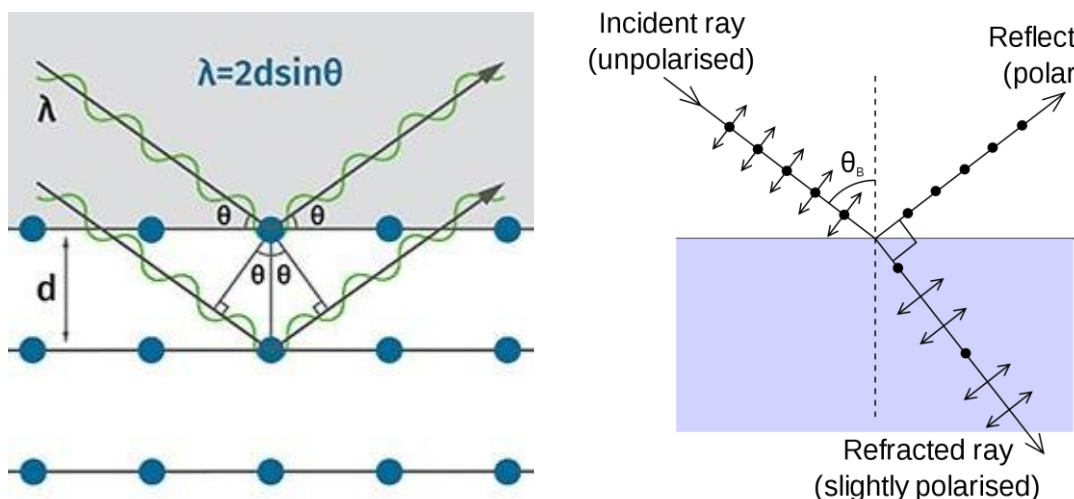
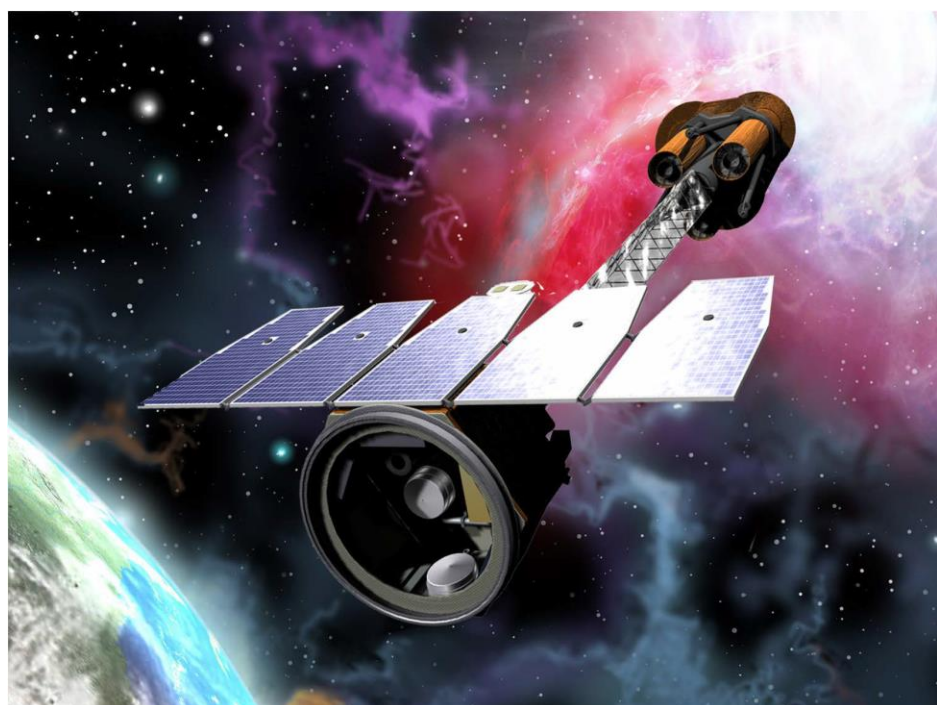


Polarized X-ray sources for calibration of the IXPE X-ray telescopes

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Application

- Polarized X-ray sources are needed to calibrate the Imaging X-ray Polarimetry Explorer (IXPE) this Fall at the Stray Light Test Facility (SLTF) at MSFC
- Highly polarized X-rays are produced via 45° Bragg crystal diffraction



Goals

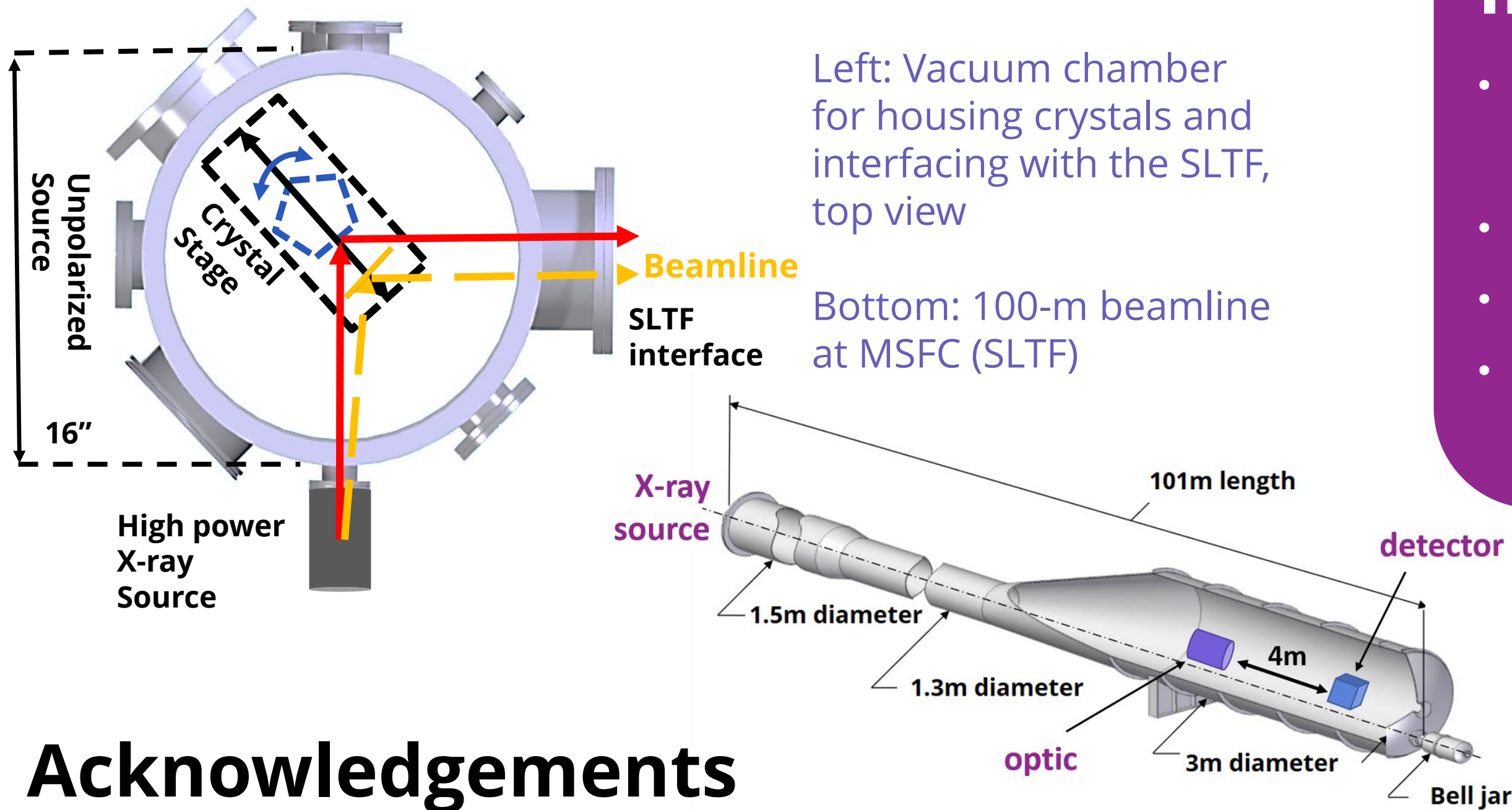
- Interface with SLTF
- Highly polarized X-ray beam
- Produce 10-150 cts/s on the IXPE detector
- Three energies within IXPE bandpass (2-8 keV)

Design

- Chosen energies are 2.70 keV, 4.51, and 6.40 keV
- Crystals will attach to SLTF via vacuum chamber

X-ray line	Energy (keV)	Crystal	2d (Å)	θ_{Bragg}^*	Polarization %*
Rh Lα1	2.70	Ge (111)	6.532	44.71°	99.28
Ti Kα1	4.51	LiF (200)	4.027	43.02°	92.97
Ti Kα1	4.51	Si (220)	3.840	45.69°	99.94
Ti Kα1	4.51	CaF2 (220)	3.862	45.35°	99.40
Fe Kα1	6.40	LiF (220)	2.848	42.81°	89.95
Fe Kα1	6.40	Abraded Si (400)	2.715	45.46°	99.92

Table 1: Configurations under consideration for the polarized source with theoretical θ_{Bragg} and P% from *Henke 1993.



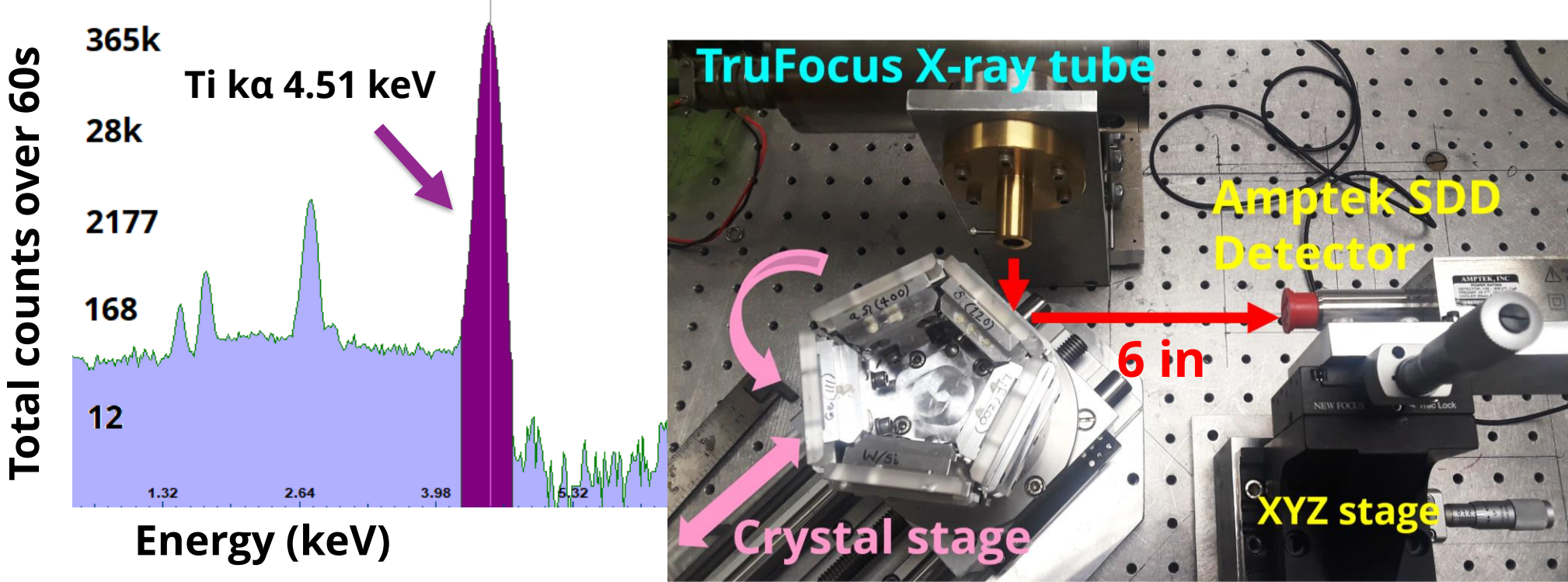
Acknowledgements

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Laboratory Testing

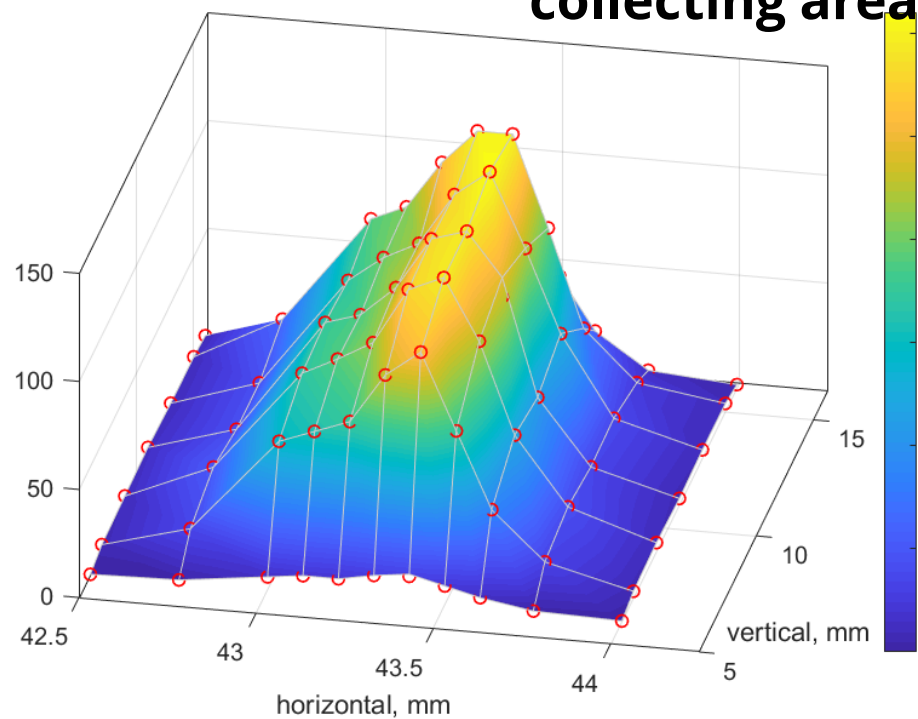
Goal: Measure flux and beam shape/spreading

Measured Ti 4.51 keV+LiF(200) spectrum

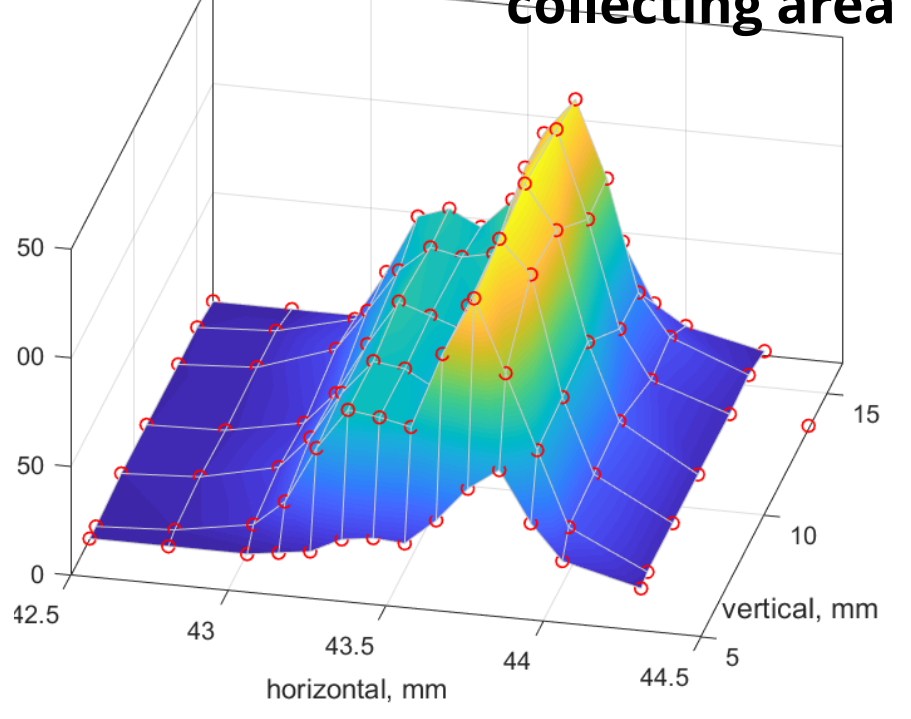


Ti+LiF(200) spectrum (left) collected with lab setup pictured right. 6 in between tube anode and crystal, 6 in between crystal and detector.

Measured Ti+LiF(200) beam, 78.5 μm^2 collecting area



Measured Ti+Si(220) beam, 490 μm^2 collecting area



Beam cross sections for Ti+LiF(200) and Ti+Si(220).

Results

X-ray line	Energy (keV)	Crystal	Anticipated beam diameter on mirror at SLTF (in)	Max anticipated count rate at SLTF (cts/s)
Ti Kα1	4.51	LiF(200)	horizontal: 9 vertical: 11.9	47,400
Fe Kα1	6.40	aSi(400)	horizontal: 10.3 vertical: 11.9	714

Table 2: X-ray and crystal combinations with promising beam spreading across IXPE mirror. Mirror is 11.9 inches in diameter. Anticipated count rates are based on laboratory measurements and scaled for high power X-ray source at SLTF.

Flux and beam shapes have been characterized for all Ti and Fe crystals.

Impact and Ongoing Work

- Chosen source configurations are Rh Lα1 + Ge(111), Ti Kα1 + LiF(200), and Fe Kα1 + aSi(400)
- Beam spreading to be further investigated via data analysis
- P% to be measured with polarization sensitive detector
- Polarized source to be assembled in vacuum chamber and tested at SLTF this Fall