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Title: MeVXRay-23A: We aim to increase the laser-driven MeV x-ray yield to ~ 4-6 Rads/shot (~2-3X increase) using novel target designs suitable for weapons radiography

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MeVXRay-23A: We aim to increase the laser-driven MeV x-ray yield to ~ 4-6 Rads/shot (~2-3X increase) using novel target designs suitable for weapons radiography

- **Purpose:** Evaluate enhanced laser-plasma coupling using near-critical foam padded tungsten cube targets and it's effect on the laser-driven MeV x-ray dose

- **Motivation:** Compact MeV x-ray sources with <200μm source size in the several Rads/shot are needed for weapons radiography.

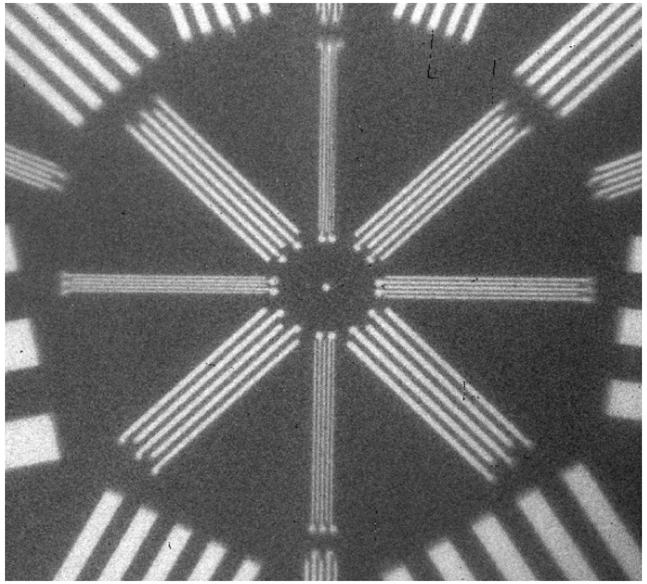
- **Goal:** Increase laser-driven MeV x-ray dose by ~2-3X

- **PI/Designer:** S. Palaniyappan, D. C. Gautier, J. Strehlow, B. J. Albright, L. Yin, J. Hunter

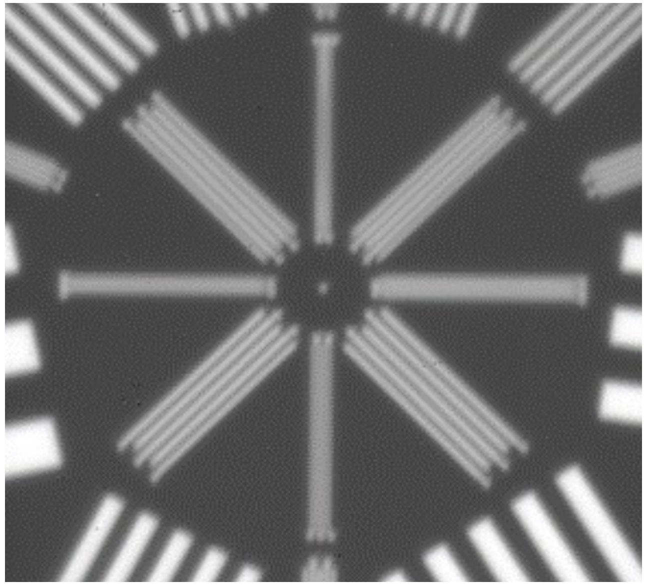
Summary Shot Table	***Q1FY23***	***Q2FY23***	***Q3FY23***	***Q4FY23***
Total shots			***12***	

Motivation: We are developing laser-driven MeV x-ray radiography for LANL weapons applications

Radiograph of high-resolution test object

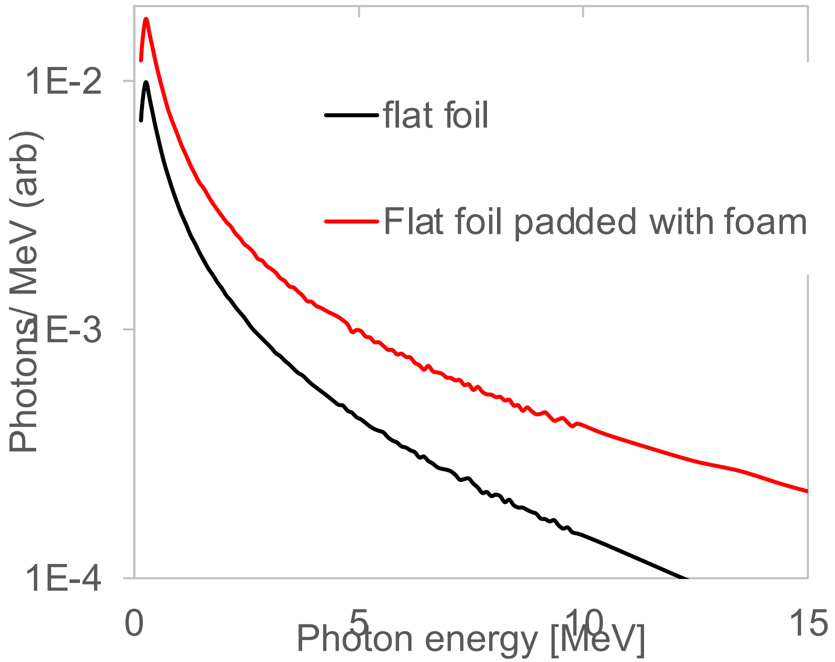


Trident Laser-driven source (source size <100 μm)

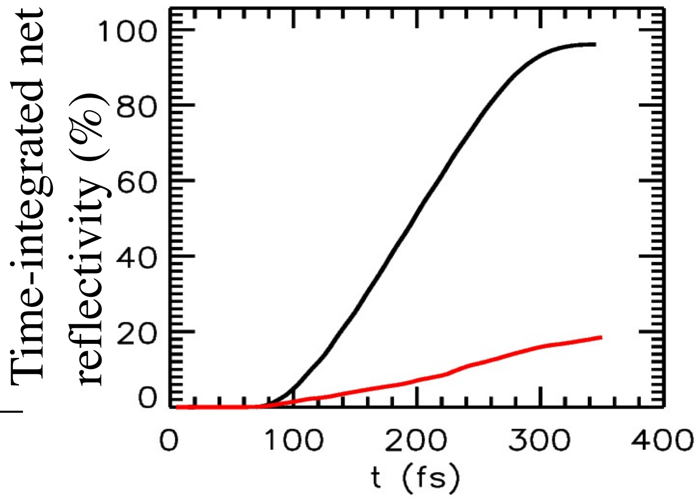


Microtron (source size ~mm)

X-ray spectra (PIC/MCNP)



Simulations indicate that MeV x-ray yield can be significantly enhanced by padding the ~mm thick tungsten cube with near-critical foam on the laser interaction side that increases the laser-plasma coupling by 16X (5% coupling in bare foil Vs 80% coupling with foam padding.



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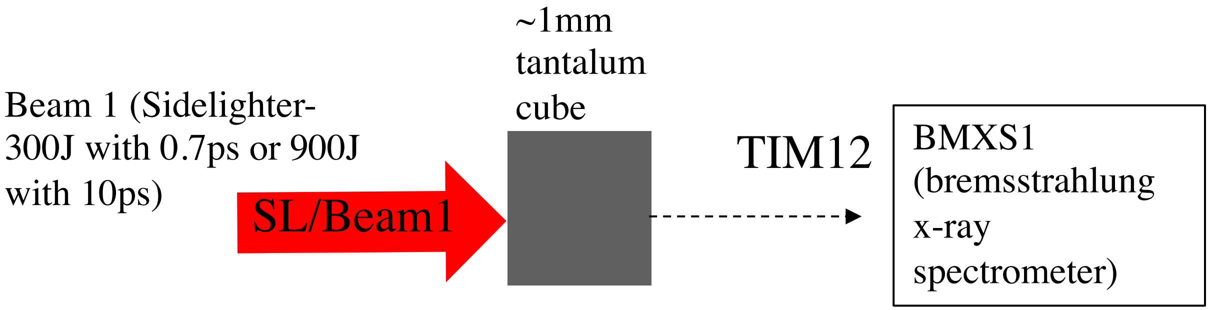
Expt Configuration: We will alternate between the sidelighter and the backlighter beams repeating shots every 45 minutes to increase the shot rate

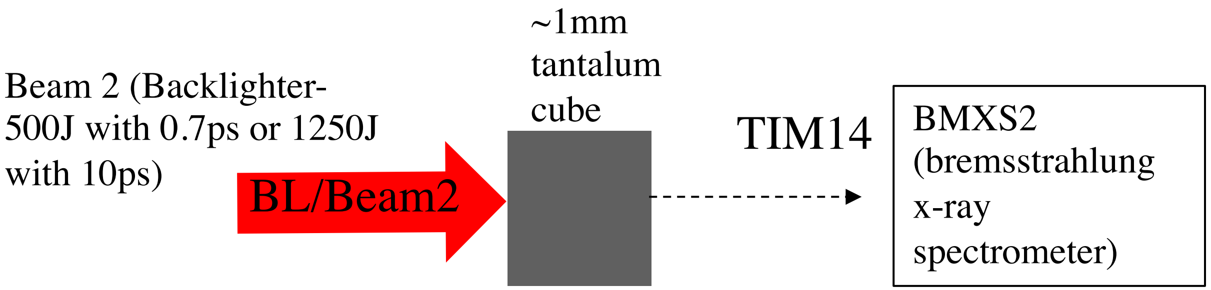
Configuration #1



Laser configuration

Beams	**Pulse**	**Energy**	**Debris shield**	**DPP**
Beam1 (SL)	0.7-10ps	MAX	None	None
Beam2 (BL)	0.7 -10ps	MAX	None	None

Configuration #2



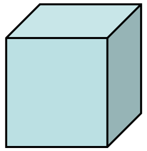
Diagnostic	**TIM**	**priority**
BMXS	TIM12	1
BMXS	TIM14	1
4ω Probe Diagnostic (4WPD)	Fixed	1

Research Approach: Systematically vary the foam density and thickness to optimize the x-ray yield

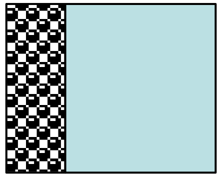
- The x-ray spectra/dose from flat foil will serve as the baseline measurement
- We will vary the foam density from 15 mg/cc to 60 mg/cc (i.e., ~5 $n_{critical}$ to 20 $n_{critical}$) and thickness from 25 μm to 300 μm) to optimize the x-ray source.
- We believe the density plays a major role than thickness. This parameter space will be further narrowed down before our experiment using integrated x-ray models using xRAGE/PIC/MCNP codes.
- We will also leverage on our upcoming Texas Petawatt experiment (Spring 2022) to narrow down this parameter space to increase the likelihood of success of the proposed OMEGA EP experiment.
- As a stretch goal, we will also explore the possibility of padding the flat foil with nanostructures which can also increase the laser-plasma coupling.

Target Section: The targets are type ‘c’

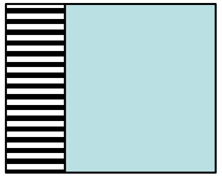
Main target: Type C



~ bare $1mm^3$
tungsten cube



Foam padded
tungsten cube



Nanostructure
padded
tungsten cube

- *Type A: Developmental e.g. never been made before*
- *Type B: Complex e.g. produced before but has some schedule risk due to complex processes involved*
- *Type C: Routine/Simple e.g. hohlraums, witness plates, backlighter disks,…*