LANL's HED NSLS Calibration Uses

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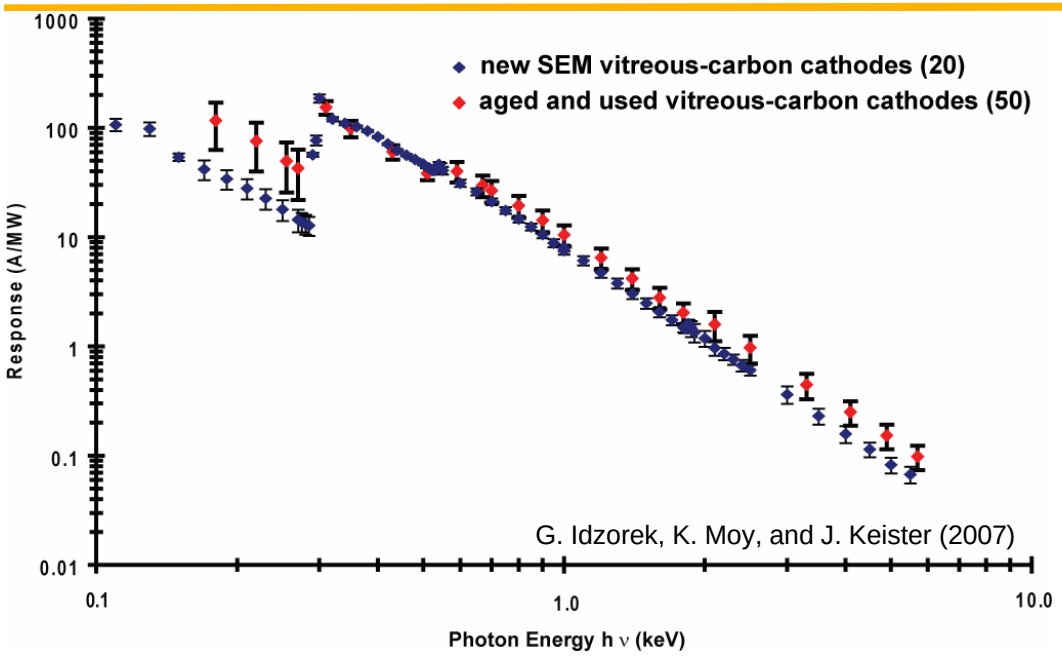
X-ray Diode Calibrations for Sandia Z diagnostics

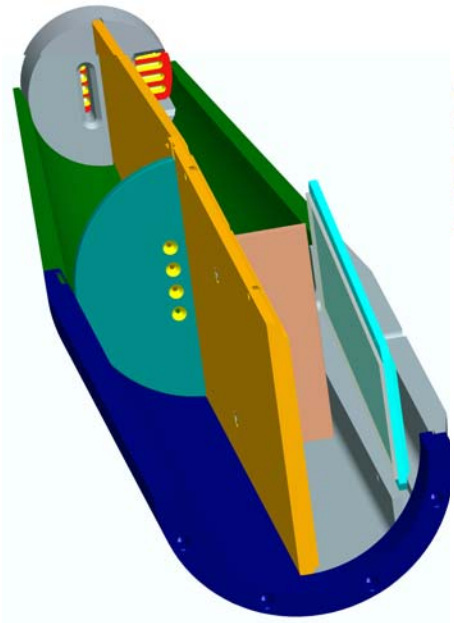


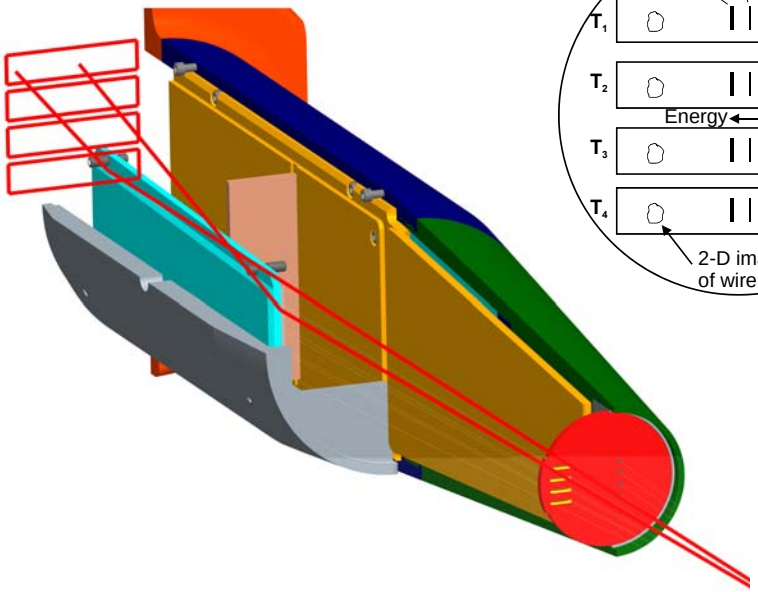
Significantly reduced uncertainty using new, inexpensive vitreous-carbon SEM cathodes

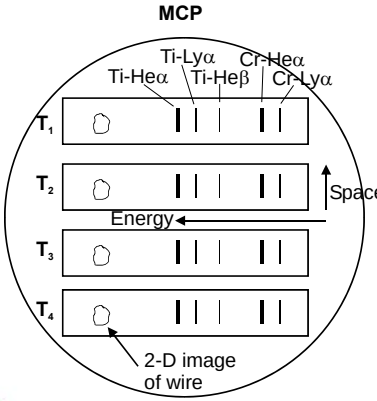
50-250 eV, 20 eV steps
250-300, 5
300-500, 20
500-540, 5
550-1000, 50
1000-1700, 100
1700-1800, 10
1800-2400, 100
2500-6000 eV, 500 eV steps

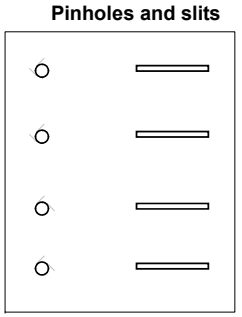
- **Need to resolve higher-order light problem on U3c to reduce uncertainties near absorption edges [attempting to secure a TGS to make measurements].**
- **Transmission calibrations are done with two detectors, in front and behind filter. This method limits to transfer standard accuracy (about 10%). Using a single detector behind filter and moving the filter in and out of the beam will improve accuracy (probably 1%).**
- **More calibrations will be required to test aging (and use-deposition) response of these detectors. Might be possible to calibrate only a few in a batch and rely on reproducibility.**

Grazing Incidence Spectrometer (GIS)





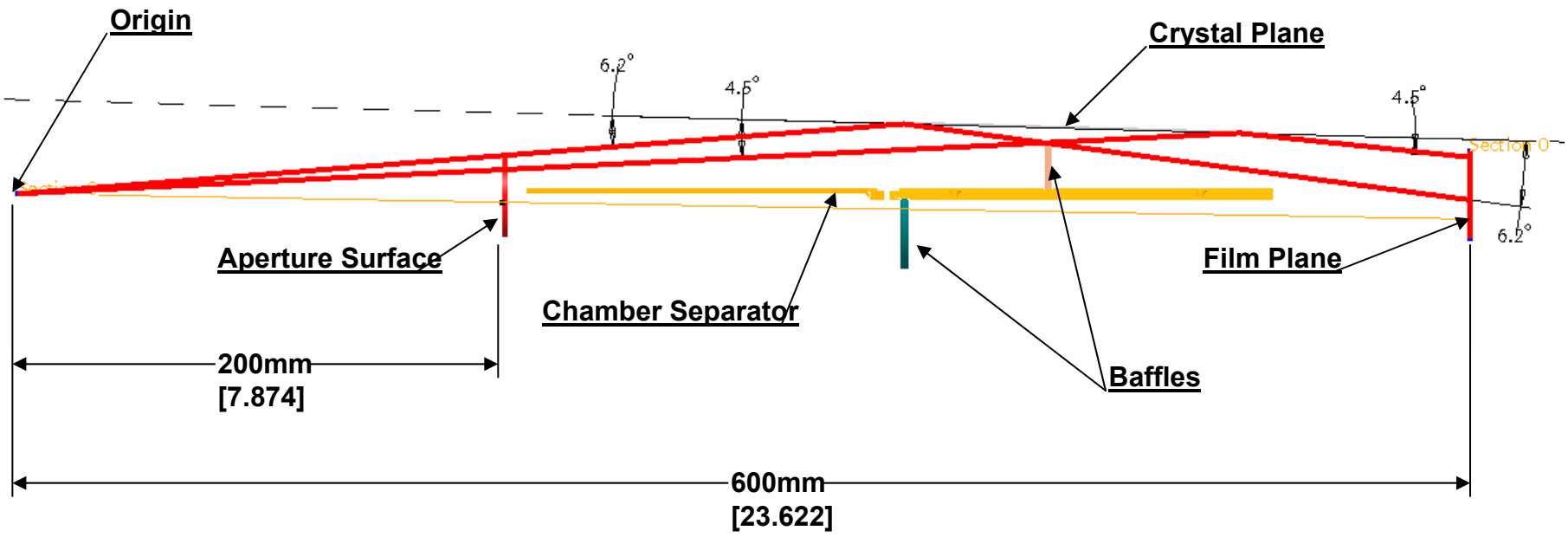




Schematic Layout of Data on MCP

- **Relative reflectivity in the range 3-6 keV with 5 eV steps with 1 eV or better near 1-2, 1-3 transitions in titanium, scandium, and vanadium**
- **Absolute reflectivity at 4-6 points in the 4-6 keV range.**

The GIS uses a grazing incidence mirror to relay "spectrally-resolved" and 2-D images to MCP



DEF Film Replacement Calibrations*

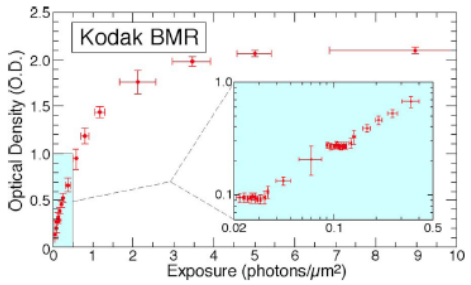


FIG. 4. The Kodak BMR response curve for 4.73±0.02 keV photons. The single side emulsion exhibits strong saturation at exposures near 2.0 photons/μm^2.

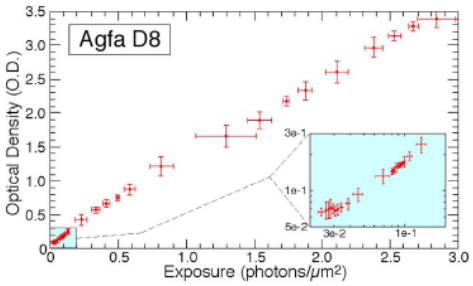


FIG. 5. The Agfa D8 response curve for 4.73±0.02 keV photons. A double-sided film, D8 sensitivity is equivalent to Kodak BMR without the early saturation.

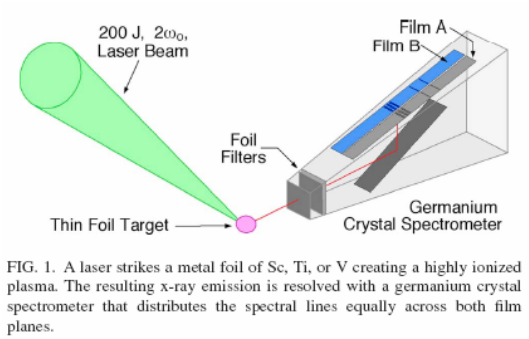


FIG. 1. A laser strikes a metal foil of Sc, Ti, or V creating a highly ionized plasma. The resulting x-ray emission is resolved with a germanium crystal spectrometer that distributes the spectral lines equally across both film planes.

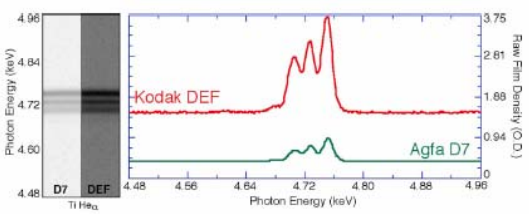


FIG. 2. Spectrometer data from shot 17 971 showing the He-like titanium emission (left). The average spectra (right) clearly show that DEF is much more sensitive, but with significantly more fog, than D7.

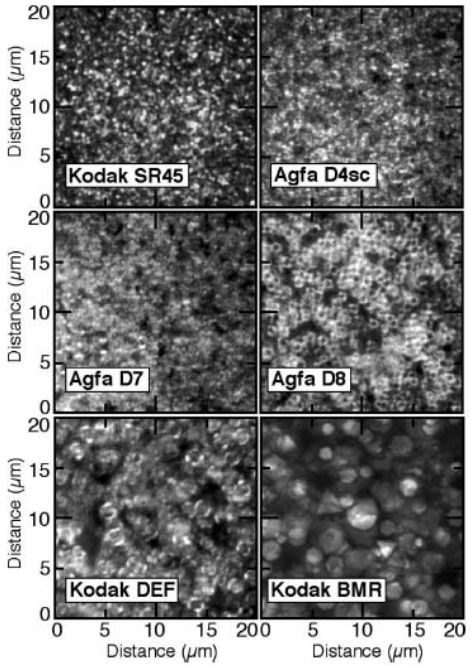
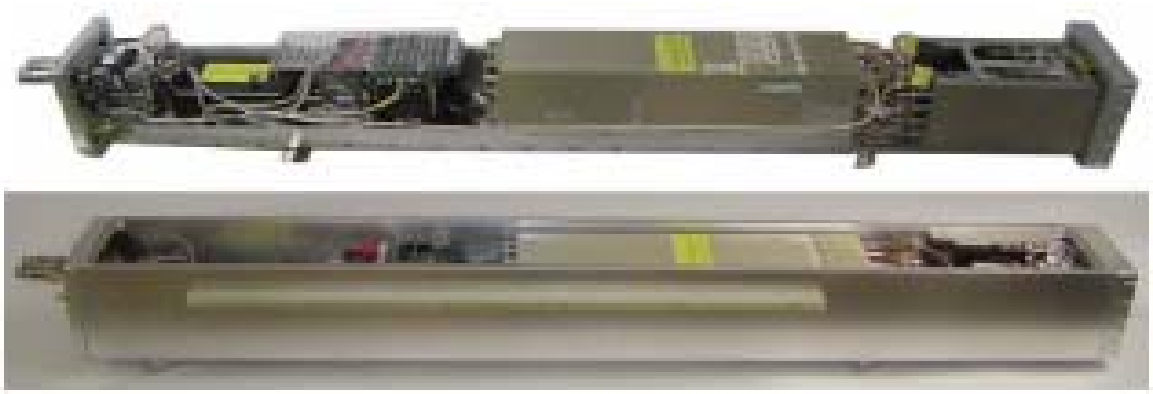


FIG. 9. High magnification face-on images of SR45, D4sc, D7, D8, DEF, and BMR emulsions. The silver halide grains appear as white spots. Their average grain sizes were measured to be 0.3, 0.4, 0.7, 0.9, and ~2.0 μm, respectively. Though they appear large, the BMR grains have a flakelike structure and are, in fact, very thin (Ref. 17).

- **Absolute (few locations) and relative response characteristics of AGFA D4, D7, and D8 and Kodak SR45 films from 2 to 20 keV**
- **Similar wavelength-dependent calibrations would be desirable for Fuji Image Plates**
- **Used at OMEGA, ZR, TRIDENT, JANUS/TITAN, and NIF**

*From N. Lanier, Cowan, and Workman, Rev. Sci. Instrum. **77**, 043504 (2006)

NIF diagnostic -- Gated X-ray Detector (GXD)



- **Need NSLS calibration of response, sensitivity, and noise (electrons from the ccd/ eV) for pulsed MCP operation with large x-ray flux in range 5-20 keV.**
- **Will combine with flat fielding data and system MTF across GXD face for x-ray energies 5,10,15, 20 keV at few irradiance levels [1 , 2, 4,10 photons/micron or per MCP channel].**

Future desirable calibrations

- High Energy X-ray Imager response up to 50 keV
- High energy x-ray CCD Camera with 2” X 2” fiber-coupled fluor, wavelength responsivity up to 50 keV… most likely at Sm Kα at 40 keV.
- Snouts for streaked x-ray spectrometers, e.g. OMEGA’s SCC-A, as well as the camera, in the 1-10 keV range.
- 2-D imaging cameras with spectroscopic snouts in the 1-10 keV range