

PWO₄ Studies for EIC Calorimeter

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Outline

- 1 BNL R&D funds for EIC (proposal submitted & approved last July)
- 2 Irradiation tests of PbF_2 crystals at IAC for DVCS (2010)

High resolution calorimetry

R&D proposal submitted to BNL in July 2014
(CUA, IPN-Orsay, CalTech and BNL)

Goal:

- 1 Develop **procedures to determine the quality** of PbWO_4 , regarding their light yield (resolution) and their radiation hardness.
- 2 Study different **methods of recovering radiation damage** in crystals. Characterize their performances and applicability during experiments.

(All quality crystals so far were produced by BTCP, out of business since 2008)

- New technique company (Cythur) is interested in performing R&D and try to provide high quality crystals

Funds & practical goals

- The proposal has been awarded \$80k for 1 year, renewable according to progress and needs.

Goals:

- Setup a test bench to measure transparency of PbWO_4 blocks
 - Measure light yield of blocks
 - Irradiation tests
 - Test optical recovery (blue, infrared light), temperature recovery
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- Initial blocks + PMTs could be borrowed from Giessen to get started
 - New blocks could be ordered from Cythur early 2015
 - A spectrometer to measure transparency to be purchased.

Tentative timeline

(Purchase of spectrometer)

- Set-up test bench: (Jan–Feb'15)

(Purchase of new blocks)

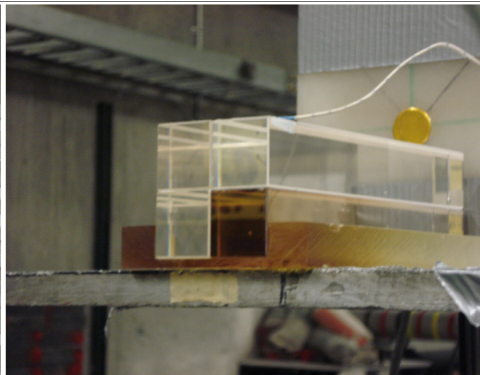
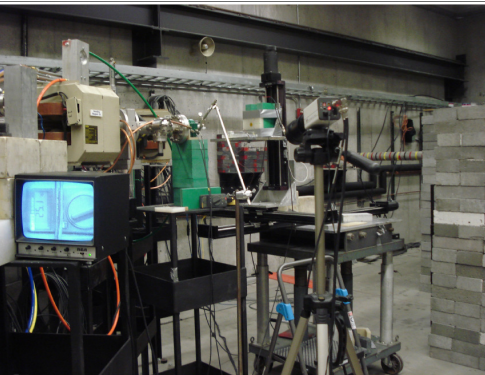
- Transparency and light yield measurements on Giessen blocks: (Mar–Apr'15)
- Measurements on new blocks: (Jun–Jul'15)
- Investigate radiation damage and curing (?? *optional this year*) (IAC, ALTO-Orsay [50 MeV e 10 μ A]...)
- *Simulations (counting rates, radiation doses, etc) for EIC setup (Jan–Sep'15)*

Master and/or PhD student can help with
transparency measurements and analysis/simulation of data

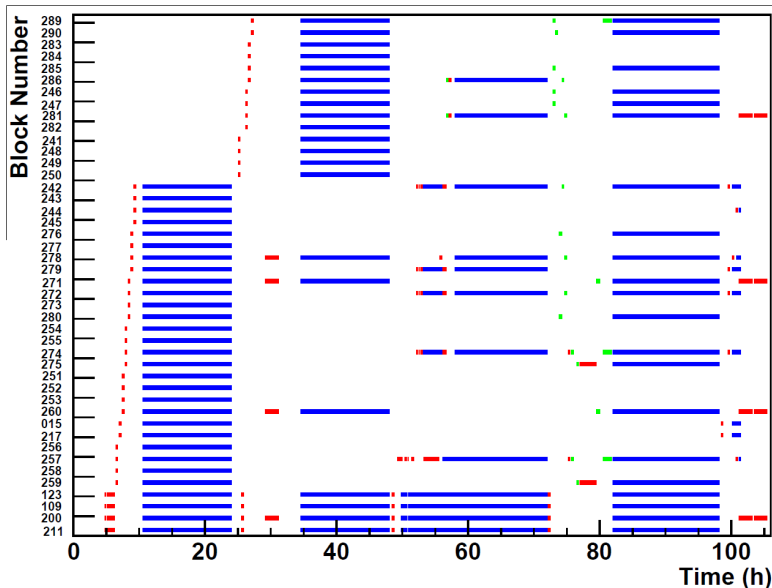
Idaho Accelerator Center: irradiation setup

Beam energy:	20 MeV
Repetition rate:	100 Hz
I_{peak} :	111-112 mA/pulse
Pulse width:	100 ns

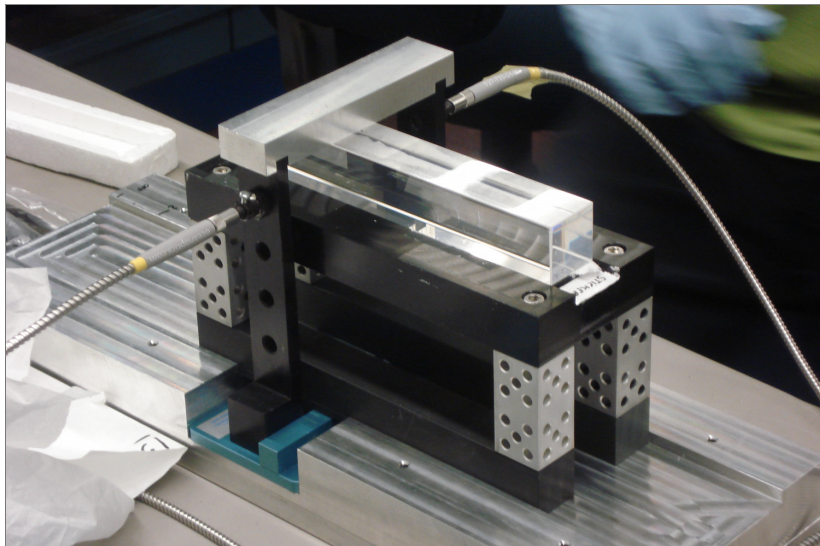
3.6 kGy = 360 krad in 20 min
(fyi, NPS is expecting ~ 1 krad/h
at the smallest angle)



IAC tests: overview of irradiation/bleaching sessions



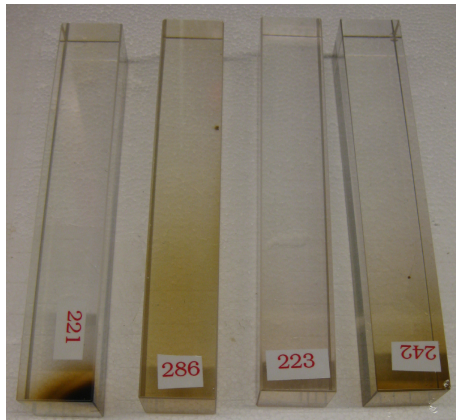
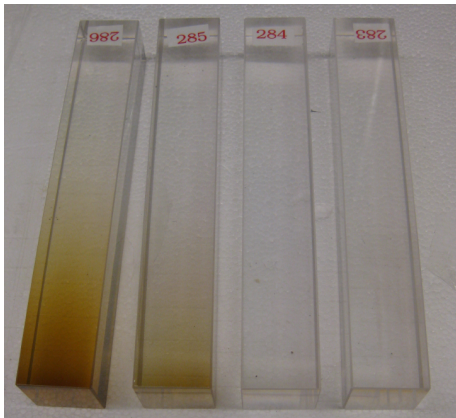
Transmittance measurements



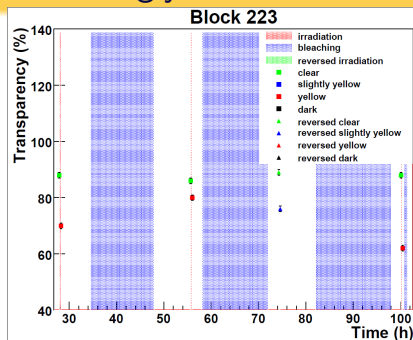
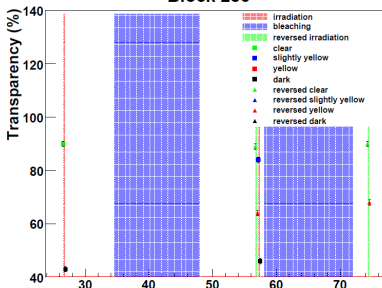
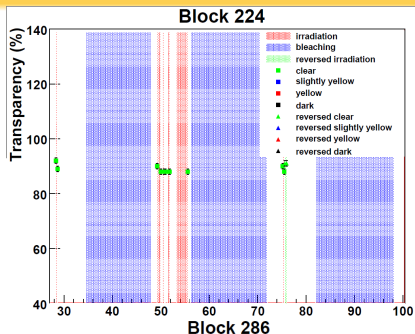
Measurements performed at 2.5 cm from irradiated face

Visual inspection

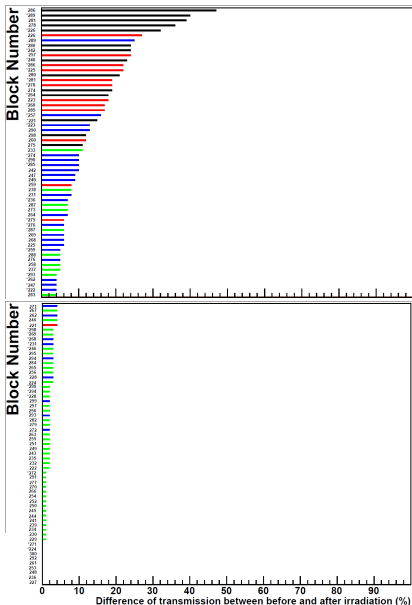
Very different response to 20 min of irradiation



Crystals: the good, the bad and the ugly...



Summary of results



Conclusions:

- A few minutes of irradiation are enough to observe large effects
- Large spectrum of radiation hardness observed
- Optical transmittance measurements correlate well with visual inspection

Poor man's quality requirement:

Discard as many blocks as spares you could afford. . .

Back-up

Backup: lamp spectrum

