ECAL for GEp5
UV version

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SBS Meeting 12/04/13

GOAL

We need to prove that periodic UV irradiation of more than 1744 lead glass bars is a viable option to maintain a given level of transparency during the 150x8h shifts of GEp(5)

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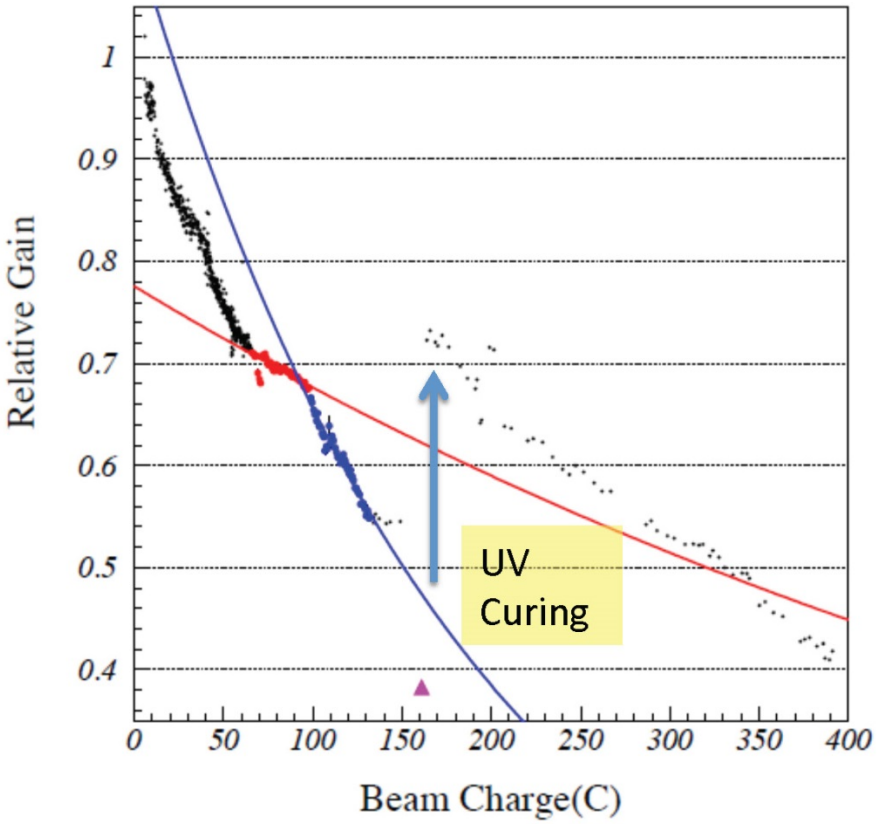
UV Curing



Hall C Experience:

- UV cured the BigCal for 3 days on each ¼ of the detector.
- Improved the gain from 39% to 74%
- Rate of improvement is 1.24%/hr

GEp5:

- Need to be cured 6% /hr
- Will increase UV intensity by x5
- UV cure for 1hr after 7 hours of running. (Need to have HV off)

UV lamp in GEp(3)

GEp(3) used OSRAM DULUX L 24W/67

(…) compact fluorescent lamps DL 24W/67 have a total UVA-power (315…400nm) less than 50 mW. The total output between 400…550nm is about 5.5W.

Werner Halbritter

OSRAM GmbH
Central Laboratory for Light Measurements

Recovering time for GEp(5)

- GEp(3)

  Recovering time ~1%/h, making use of lamps with 50mW UVA output and PMT HV off.

- GEp(5)

  WE NEED to recover at a rate of ~8%/h => intensity light should be >400 mW

UV lamps

- Search for UV sources with better UVA output w.r.t. total light emission.
  - Minimal power in the visible range
  - At least 1W below 400nm

UV lamp

(…) UVA lamps (color 78) have 15…20% UVA output of about the rated electrical lamp power (e.g. 18W lamp => 3W UVA). Blacklight lamps (color 73) have a similar UVA output without any visible radiation.

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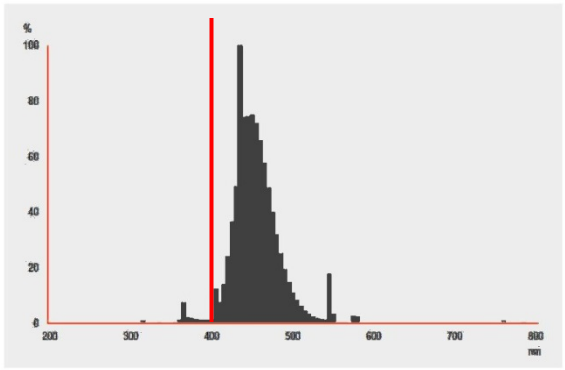
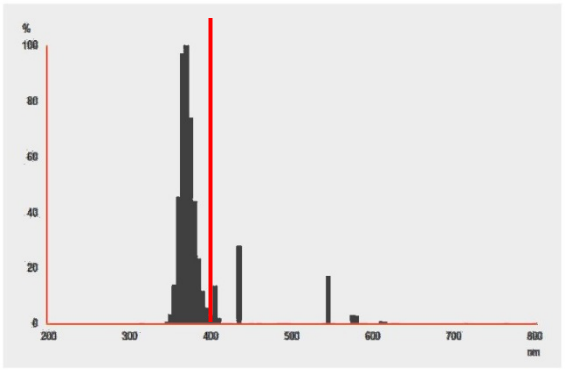
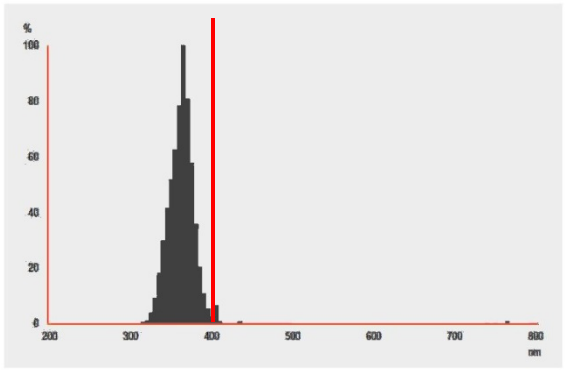
spectral power distribution:



Color 67



Color 78



Color 73

Source: OSRAM Lab

UV lamps ordered

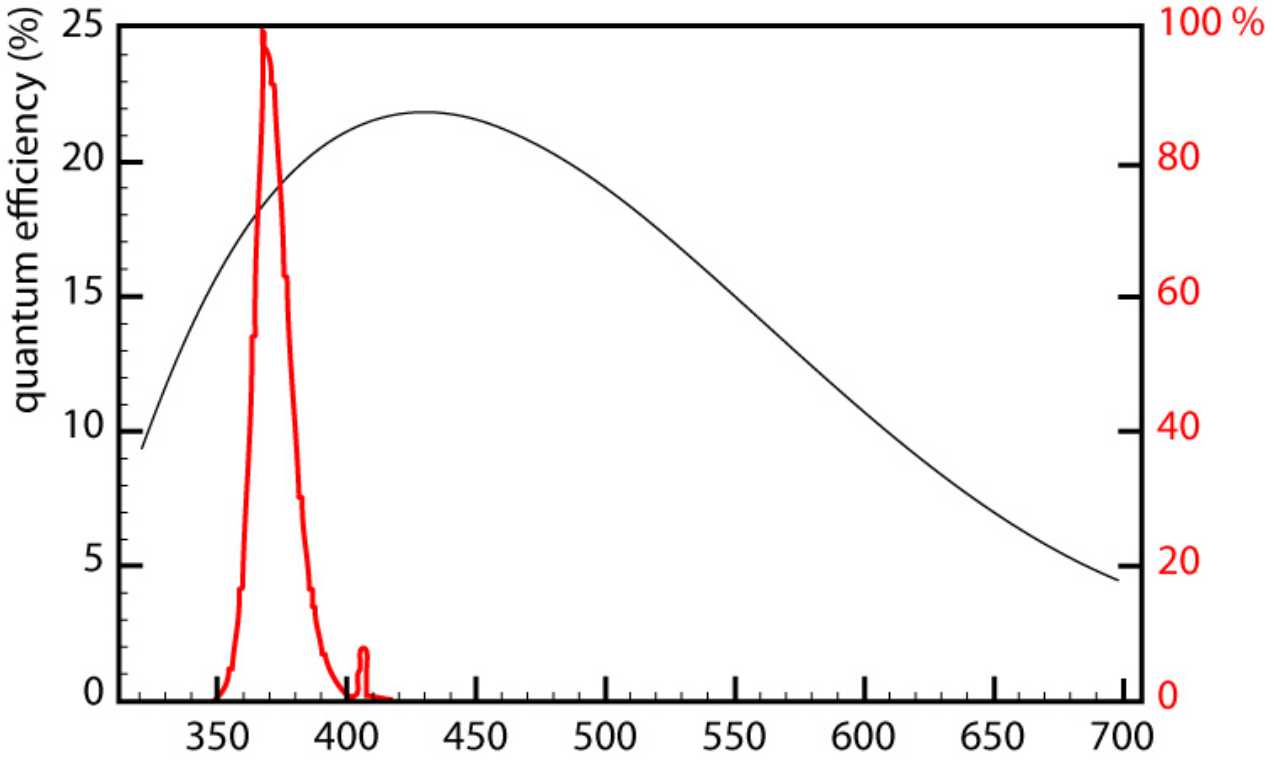
- Lamps:
  - OSRAM
    - DULUX L 18W/**78**. CFL, similar shape and base as the one used in GEp(3), but slightly smaller
    - Color **73** Only large fluorescent tubes (>0.5 m length)

Power = 18W
UVA (315-400 nm) = 3 W
Length = 225 mm (without ballast)
Radiation Intensity = 1.5 W/m^2

General Electric and Phillips have BL lamps but not of the compact size. These are options for real experiment

Tests to be done 1

- Possible damage to PMT with HV on



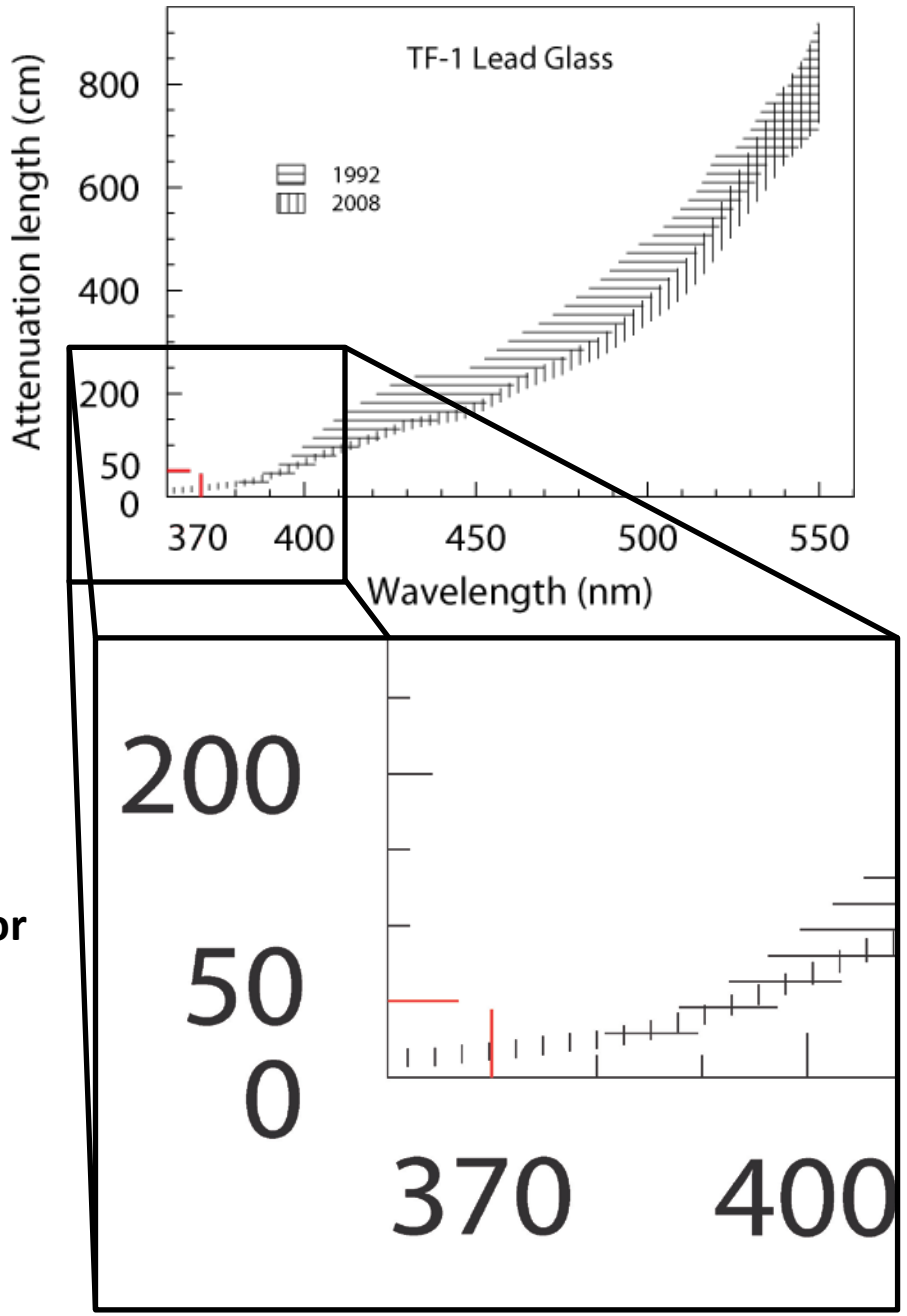
- FEU 84-3 QE plot from HALL D wiki (B. Zihlmann)
- Emission spectra from OSRAM lab

Photocathode of FEU 84-3 is quite sensible in the range of the lamps

Attenuation length in lead glass

UVA range of the lamps (350-390 nm)
=> AL $\leq$ 50cm

Some UVA still reach the PMT although the bar attenuate a huge quantity of light-> UV filters?



The lead-glass electromagnetic calorimeters for the magnetic spectrometers in Hall C at Jefferson Lab
H. Mkrtchyan, et.al.
arXiv:1204.6413

Tests to be done 2

With the use of radiated bars from Idaho:

- Transparency analysis or depth cleaning of the bars versus exposure time

  Such tests will be done in collaboration with C. Zorn and H. Mkrtchyan. They will provide instrumentation and experience for this measurements

- Accumulative effects

  Some references show annealing could left some residuals after every process, i.e. the transparency is not recovered to the state before radiation (e.g. **On optical bleaching of barium fluoride crystals.** D. Ma and R. Zhu. NIMA 332 (1993) 113-120)

Further decisions

- Choose a UV tube suitable for ECAL definitive layout with the desirable characteristics

- Make live check with radiated bars in similar conditions to the experiment, i.e. soft photons from 8.8 GeV e^- beam on some target

- Design of the frame for the chosen lamps according to the final layout of ECal

Inventory, schedule and Manpower

- Inventory
  - 1744 lead glass bars (1024 Protvino + 720 Yerevan)
  - PMT with two different bases
  - 25 lamps OSRAM DULUX L 18W/78 (minimum quantity ordered)
  - DAQ similar as used for Shakshlik + specialized instrumentation provided by C. Zorn
  - Place: EEL 126 (+ ARC bldg?)

- Schedule:
  - Preparation of the black box and DAQ, in progress
  - UVA lamps estimated time arrival, **January 2014**
  - PMT tests under UVA light, **January-February 2014**
  - Transparency analysis
  - Accumulative effects

  Start depends on the availability of the irradiated bars

  July 2014 -> FINAL DISCUSSION

- Manpower
  - C. Ayerbe, E. Brash, M. Jones, A. Losada, C. Perdrisat, V. Punjabi
  - Junior/Senior student from W&M
  - H. Mkrtchyan, C. Zorn will provide technical support and experience

Common procedure

For any annealing procedure chosen, all lead-glass bars should be characterized (dimension), label and wrap again (in Mylar (UV annealing)/steel (IR annealing))

=> extra time to add to the whole process