

## PbWO<sub>4</sub> blocks Transmission

09 April 2015

- I have analyzed longitudinal and transverse transmission measurements data for all 10 SICCAS crystals (spring 2014 delivery) measured before Idaho tests, and 5 new crystals (December 2014 delivery) measured recently.
- For all measurements have been used Carl Zorn's setup in ARC building.

### Longitudinal Transmission

In Fig.1 are shown Transmissions for the group of crystals (1-5; 6-10 and 11-15) along the longitudinal axis (20 cm, central axis).

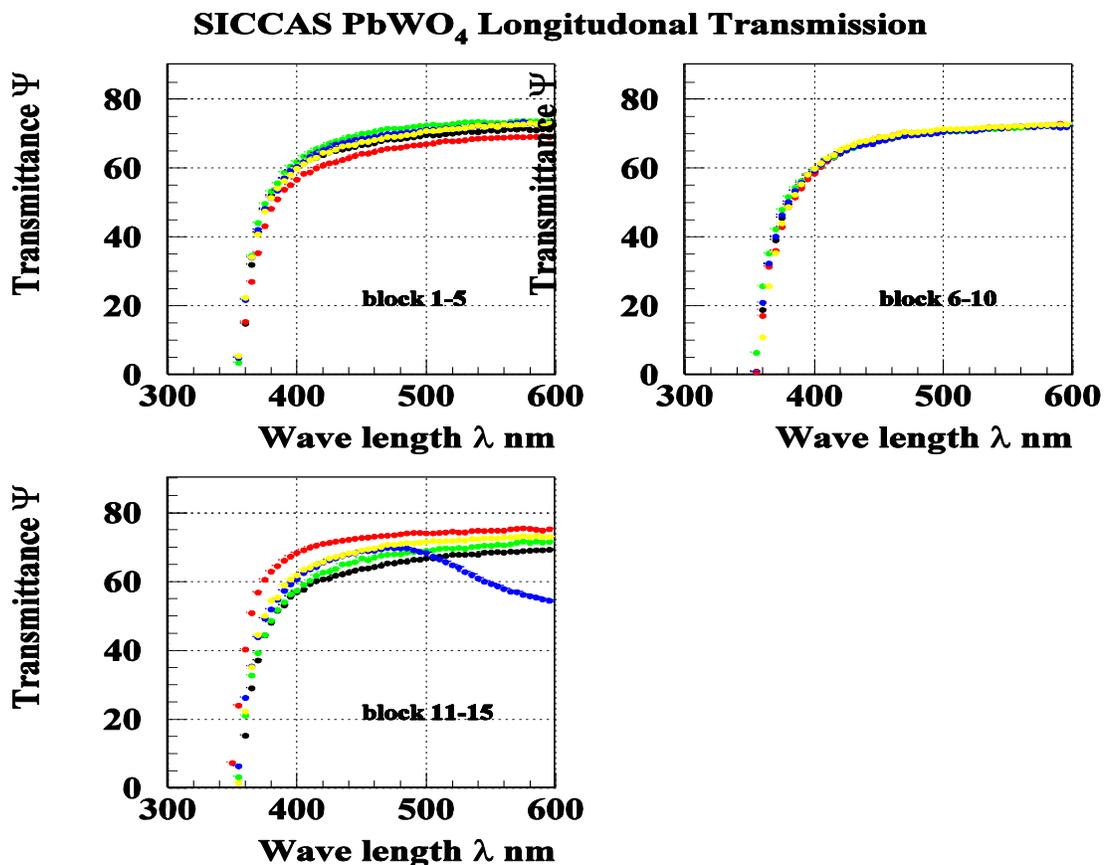


Fig.1: PbWO<sub>4</sub> Longitudinal Transmissions (20 cm along central axis) as a function of Wave-Length. Colors in panels are: Black  $\rightarrow$  Block #1, 6, and 11; Red  $\rightarrow$  block #2, 7 and 12; Green  $\rightarrow$  block #3, 8 and 13; Blue  $\rightarrow$  Block #4, 9 and 14; Yellow  $\rightarrow$  block #5, 10 and 15.

## Transverse Transmission

- Transmission in transverse direction (2 cm thickness) have been measured at several distances from the face of the crystals (5, 15, 25, 35, 45 and 55 mm)

In Fig.2a and Fig.2b are shown Transverse Transmissions (through 2 cm thickness) for the same group of crystals (1-5; 6-10 and 11-15) at distance 15 mm and 25 mm from the face.

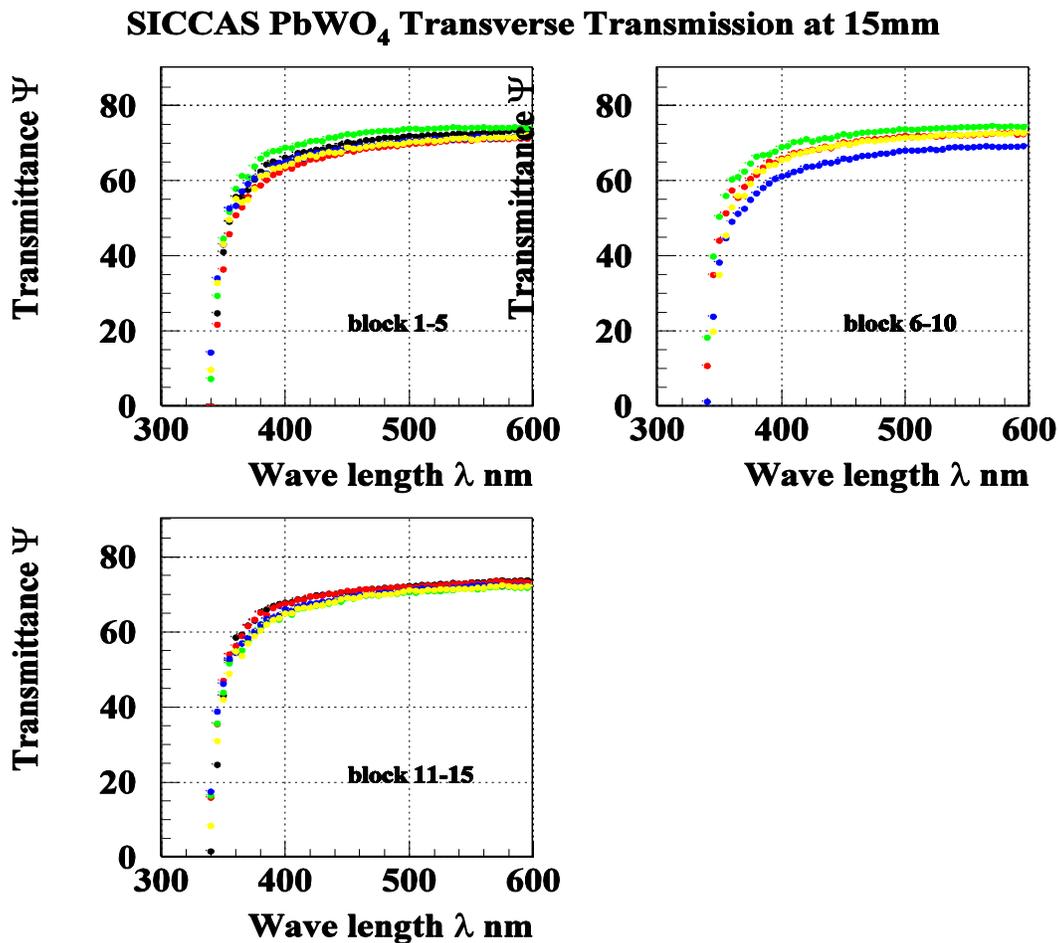


Fig.2a: Transverse Transmissions (through 2 cm thickness) for the group of crystals (1-5; 6-10 and 11-15) at distance 15 mm from the face. As in Fig.1, colors in panels are: Black  $\rightarrow$  Block #1,6, and 11; Red  $\rightarrow$  block #2, 7 and 12; Green  $\rightarrow$  block #3, 8 and 13; Blue  $\rightarrow$  Block #4, 9 and 14; Yellow  $\rightarrow$  block #5, 10 and 15.

In Fig.2b: are shown Transverse Transmissions (through 2 cm thickness) for the same group of crystals (1-5; 6-10 and 11-15) at distance 25 mm from the face.

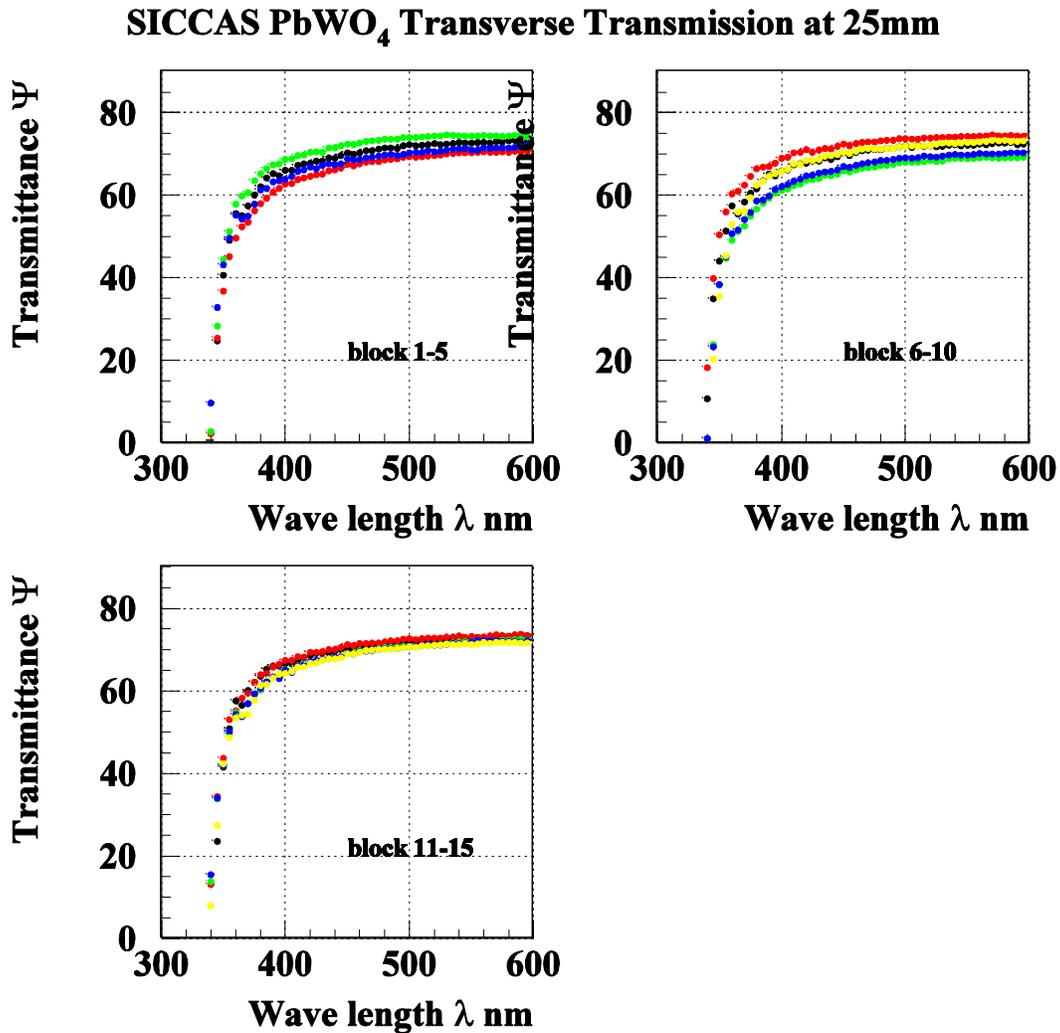


Fig.2b: Transverse Transmissions (through 2 cm thickness) for the group of crystals (1-5; 6-10 and 11-15) at distance 25 mm from the face. As in Fig.1, colors in panels are: Black  $\rightarrow$  Block #1,6, and 11; Red  $\rightarrow$  block #2, 7 and 12; Green  $\rightarrow$  block #3, 8 and 13; Blue  $\rightarrow$  Block #4, 9 and 14; Yellow  $\rightarrow$  block #5, 10 and 15.

### Transmissions at wave-length 370, 420 and 500 nm

I made simple plots to compare all our blocks longitudinal and transverse transmissions at 370, 420 and 500 nm. Note, blocks 1-10 are from Spring 2014 delivery, while blocks 11-15 from delivery December 2014.

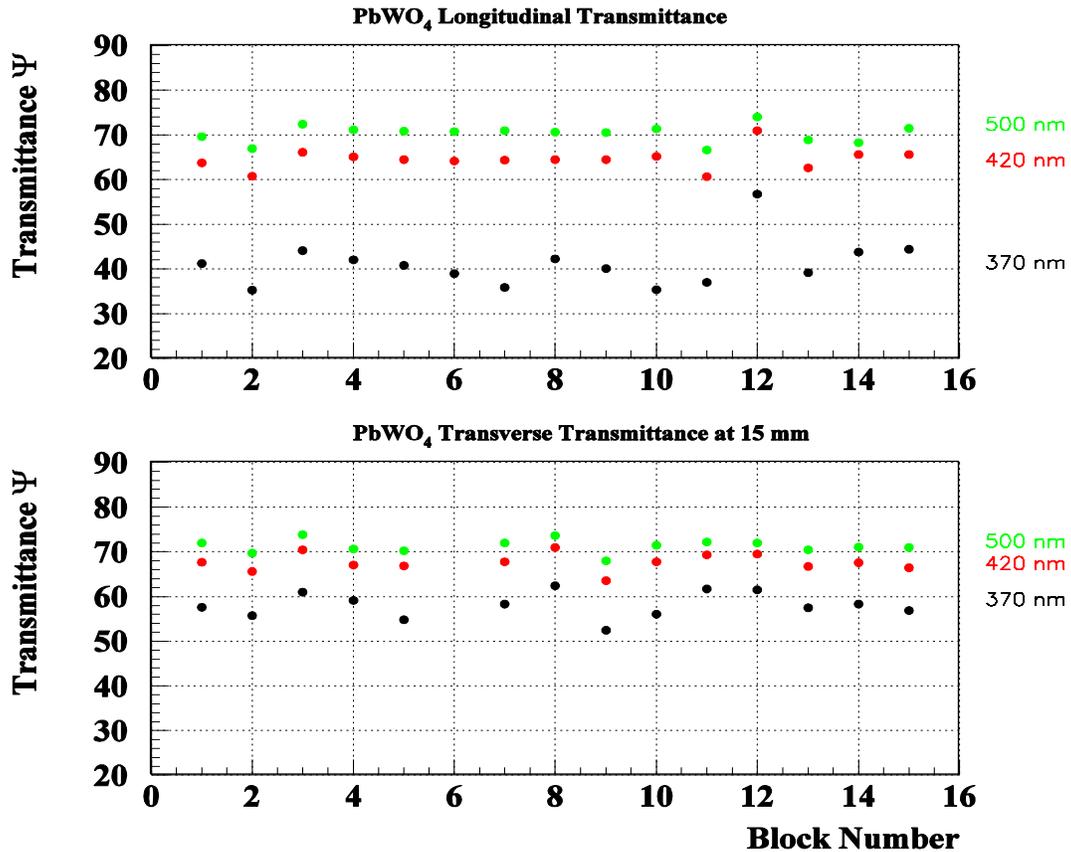


Fig.3: Longitudinal (along 20 cm central axis) and Transverse (along 2 cm thickness) transmittance for all 15 crystals at wavelength 370, 420 and 500 nm.

These data show that:

- Longitudinal transmissions of the blocks at 420 nm vary from 60% to 70%;
- For group #6-10 Longitudinal transmissions are very similar, while their transverse transmission vary from 60% to 70%;
- Similarly, for group #11-15 longitudinal transmissions vary from 60% to 70%, while transverse transmissions are very close;
- Lower longitudinal transmission have crystals #9. (But our earlier data show that crystal #8 was worse one ?);
- Longitudinal Transmission for Crystal #14 above show completely different behavior above 500 nm (transmission drops down) than all other crystals. Arshak's double measurements conformed this behavior.

After receiving irradiated blocks from Idaho, Arshak did longitudinal and transverse light transmission measurements for blocks 2,3,6,8 and 9 to compare with measurements done before irradiating them in Idaho.

For measurements Carl Zorn's setup in ARC building was used.

In Fig.4 is shown block N2. On right edge it can be seen, it has brownish colour, which is due to  $\sim 2\text{Mrad}$  radiation dose, with dose rate of  $1.3\text{ MRad/h}$ .

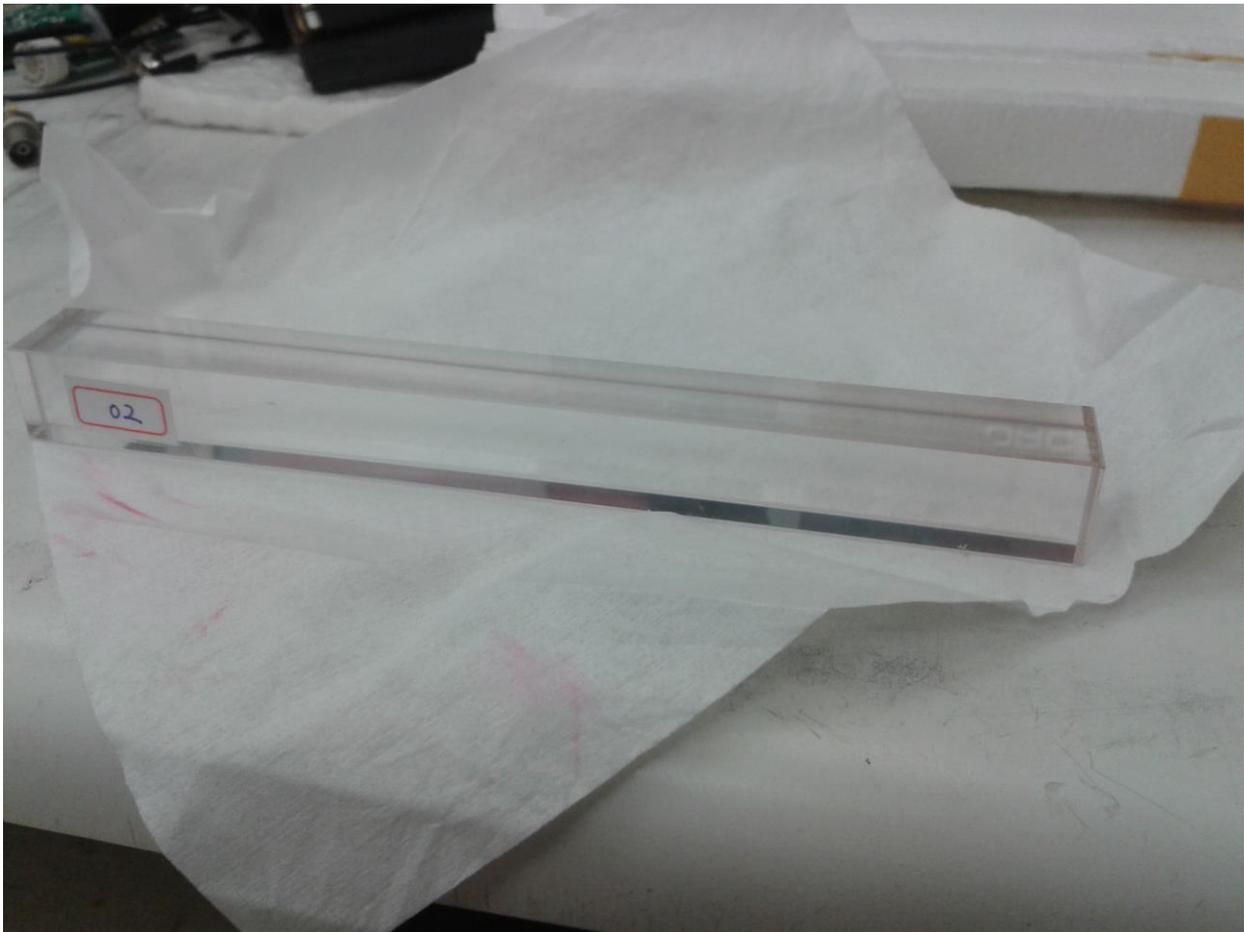


Fig.4: Block N2 after irradiation  $\sim 2\text{Mrad}$  radiation dose, with dose rate of  $1.3\text{ MRad/h}$ .

Longitudinal light transmittance for crystal N-2 show that it is less than 60% for 600nm wavelength, and less then 50% for 470nm wavelength, but for other crystals there is no any significant change for light transmission.

Some tests with curing systems:

- first started from IR curing system, for 4 (950nm) IR LEDs the current was applied 75mA, distance between crystal and LEDs were 1cm, left for curing for ~12 hours,
- then measured the longitudinal transmission for block N2. The green data points shown in Fig.5 are for IR curing results, and
- then cure the crystal N2 with blue 360nm LEDs, by applying 50mA current for 4 LEDs for 3 hours. Results are showed in same figure with blue data.

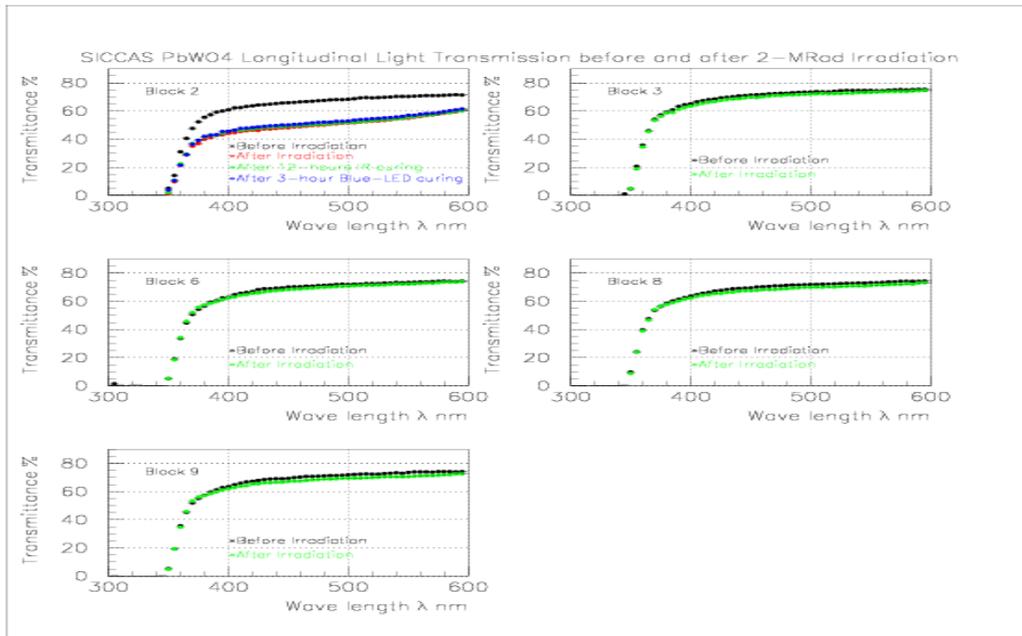


Fig.5: Longitudinal light transmittance for crystal N-2 after 2 MRad doses, and after different curing with IR and Blue lights.

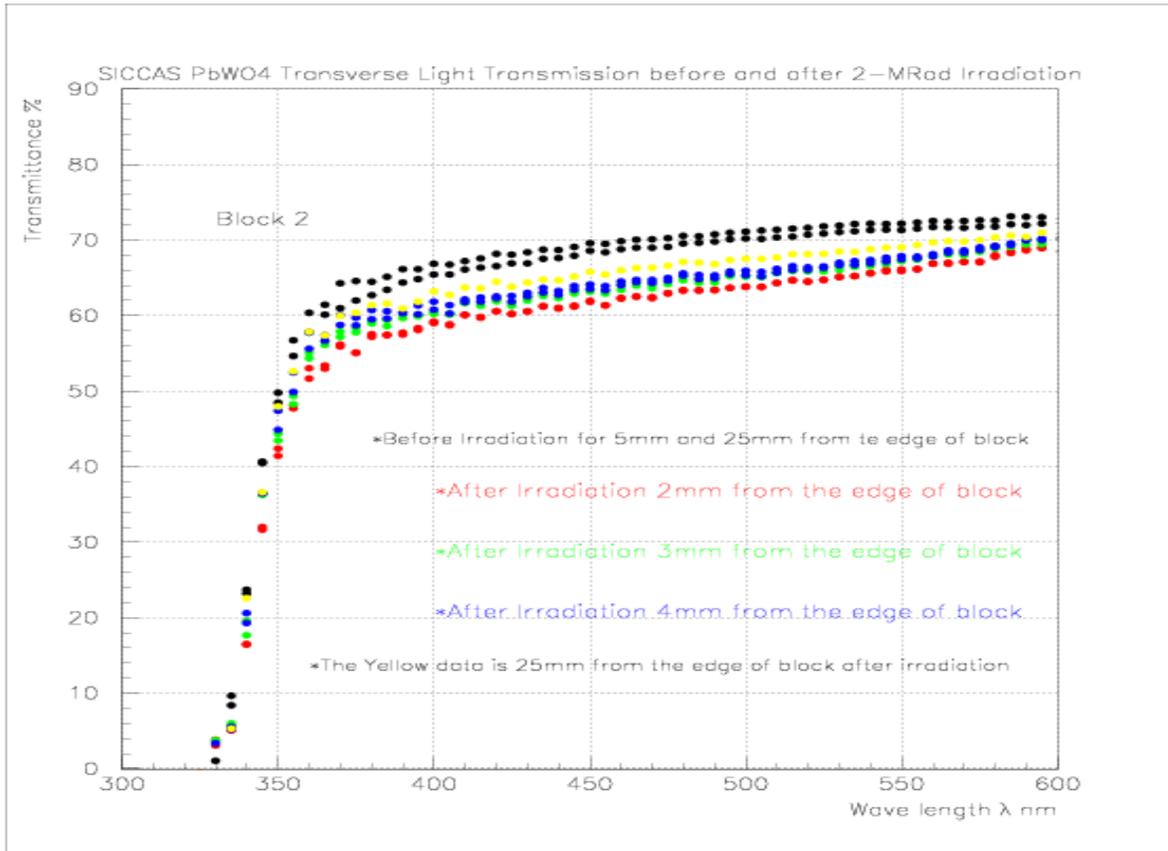


Fig.6: Transverse light transmission for block N-2. In black it is results for 5 and 25 mm from the edge of block before irradiation, and the colourful data is after irradiation for 2,3,4,5,6,15 and 25mm from red to yellow respectively.

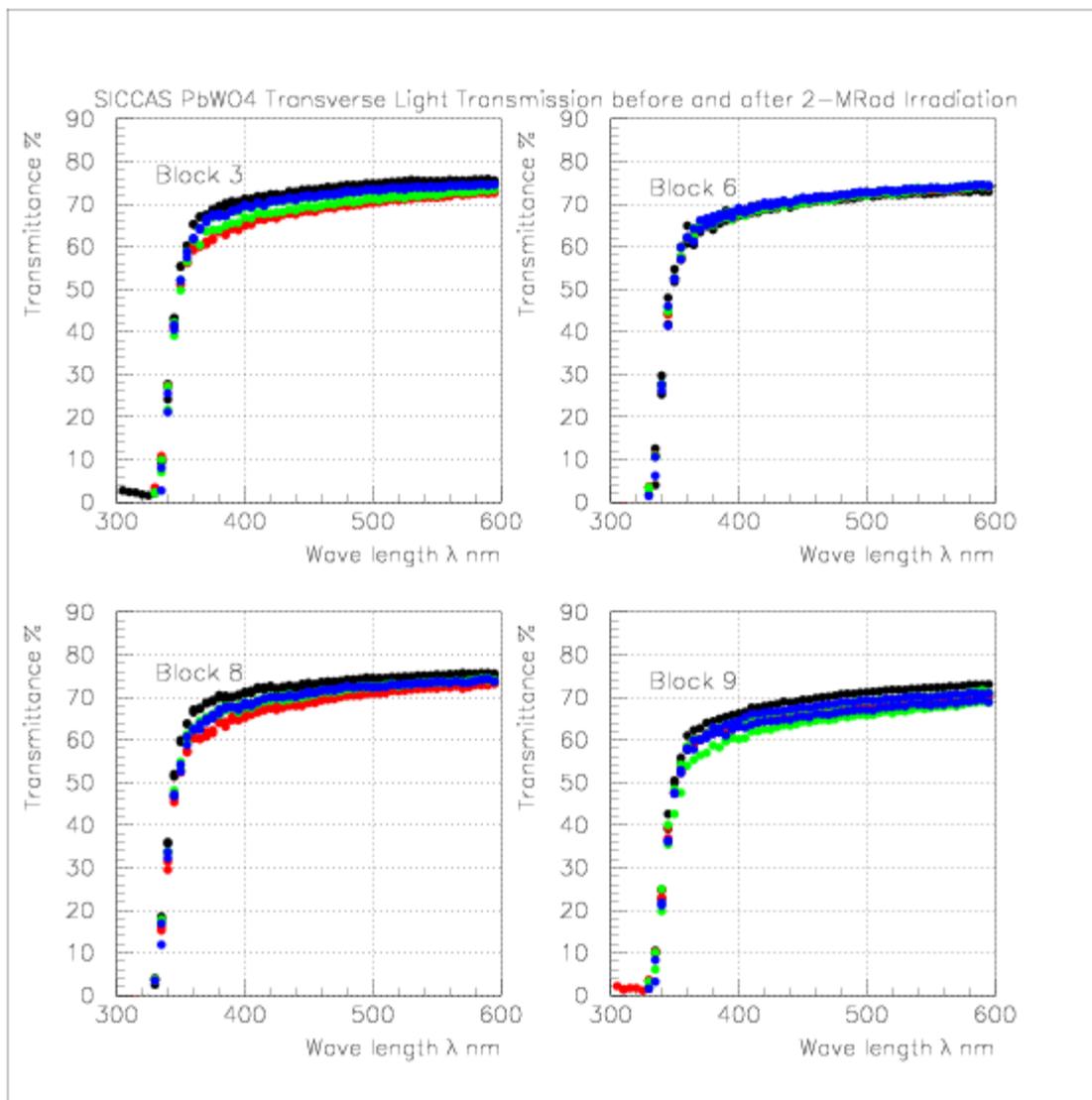


Fig.7: Transverse light transmission measurements for blocks 3,6,8 and 9 for same distances as for block #2.