Light transmission of SF5 lead – glass after irradiation

A large number of SF5 lead – glass blocks is available from experiments performed in the 1970s at the ISR.

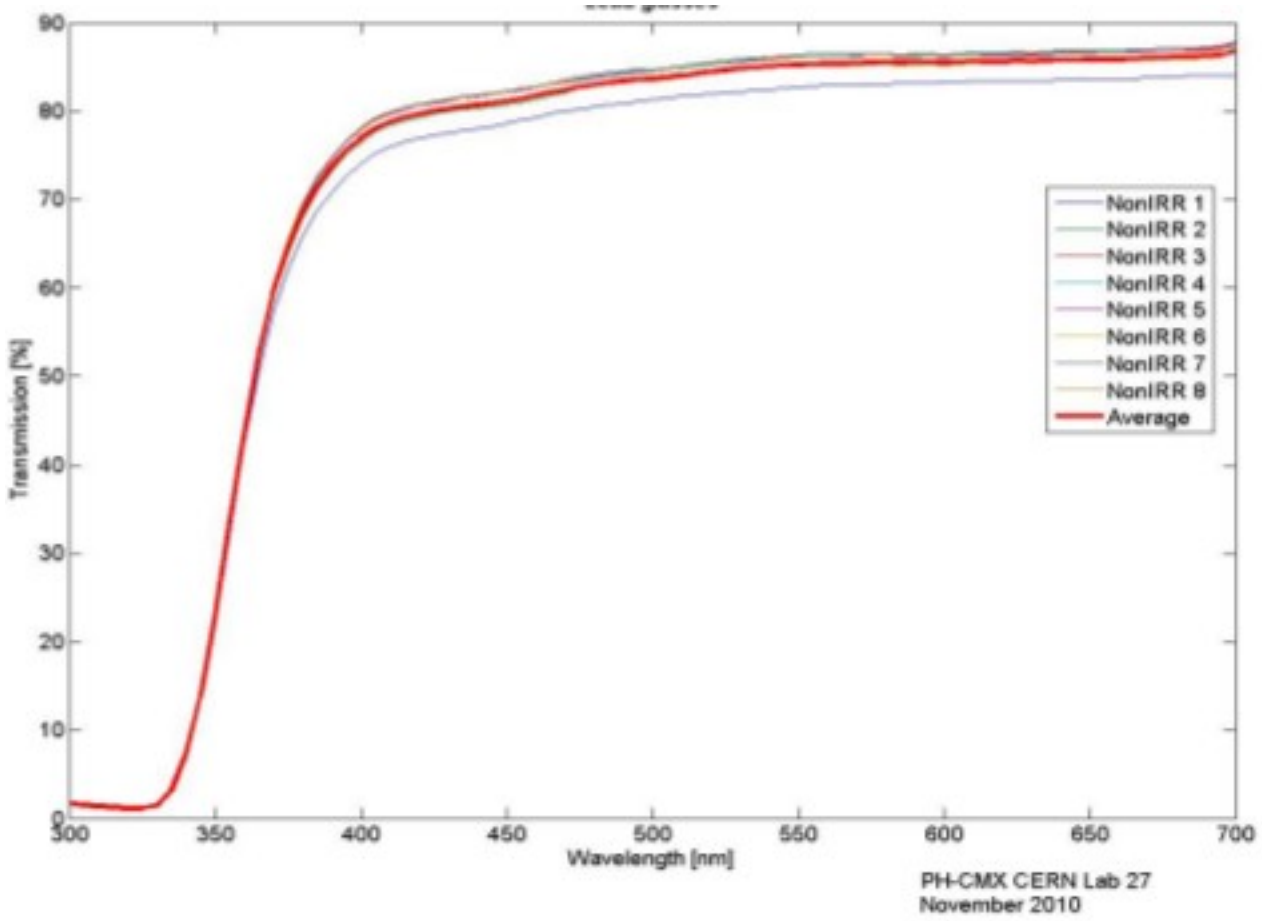
Can this glass be used for IRC / SAC ? Is its light transmission still acceptable after receiving a dose of ~50 Gy, as expected after one year of NA62 data – taking?

Contradictory data can be found in the literature, so it was decided to measure a few SF5 samples before and after irradiation.

To this purpose, 16 samples, each 3 cm long, with a square 1 x 1 cm section, were obtained from an old block:

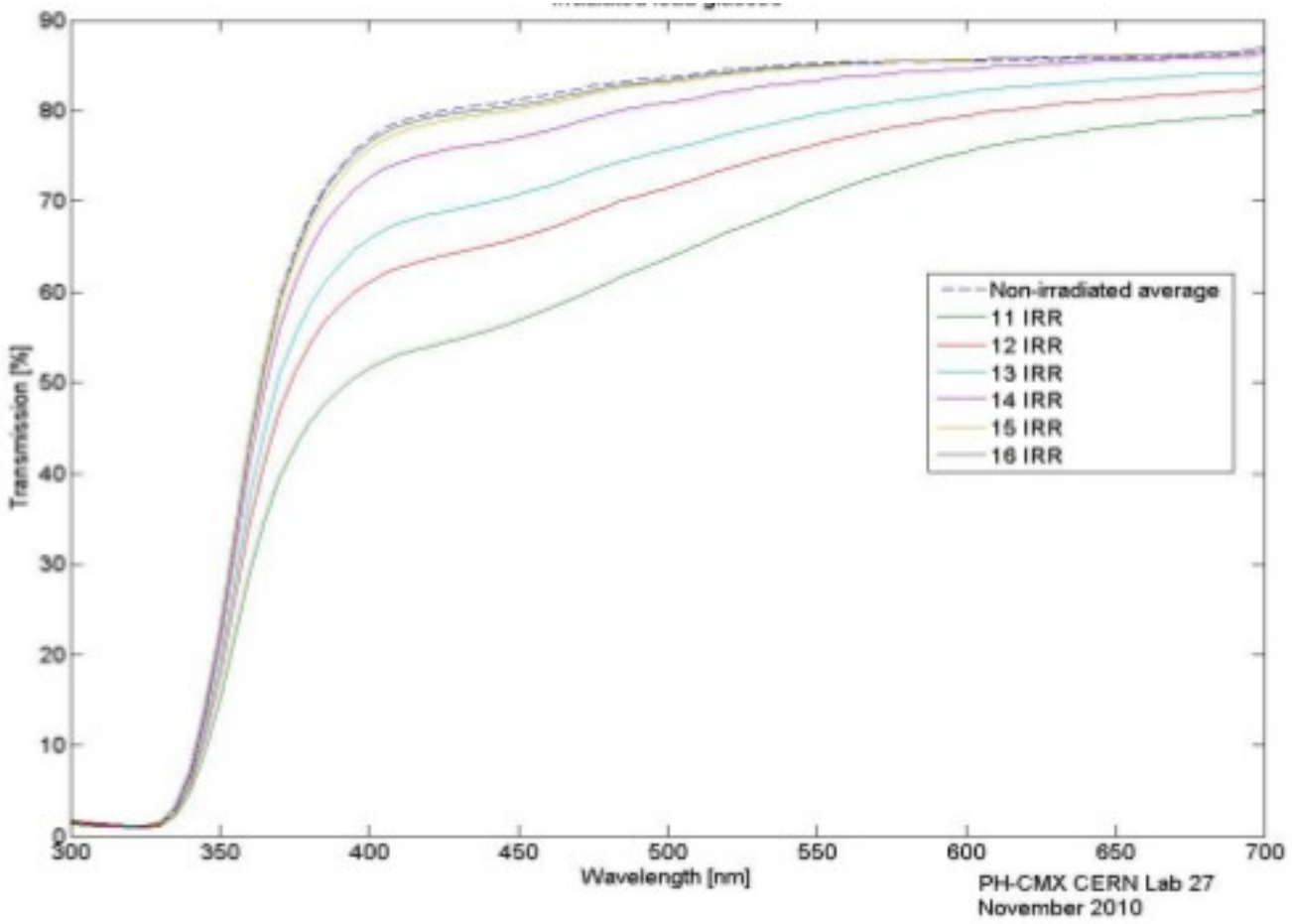
Miranda van Stenis (PH/DT) cut the samples and polished the two 1 x 1 cm surfaces;
Maurice Glaser (PH/DT) exposed 6 samples in the special PS irradiation area;
Etiennette Auffray (PH/CMX) measured all the samples.

Transmission versus wavelength for non irradiated samples



The < 100% transmission at long wavelengths is mostly due to light reflections at the two surfaces

Transmission versus wavelength for the 6 irradiated samples



Received doses

(presently only known to ±30% - more precise values will be available in January 2011)

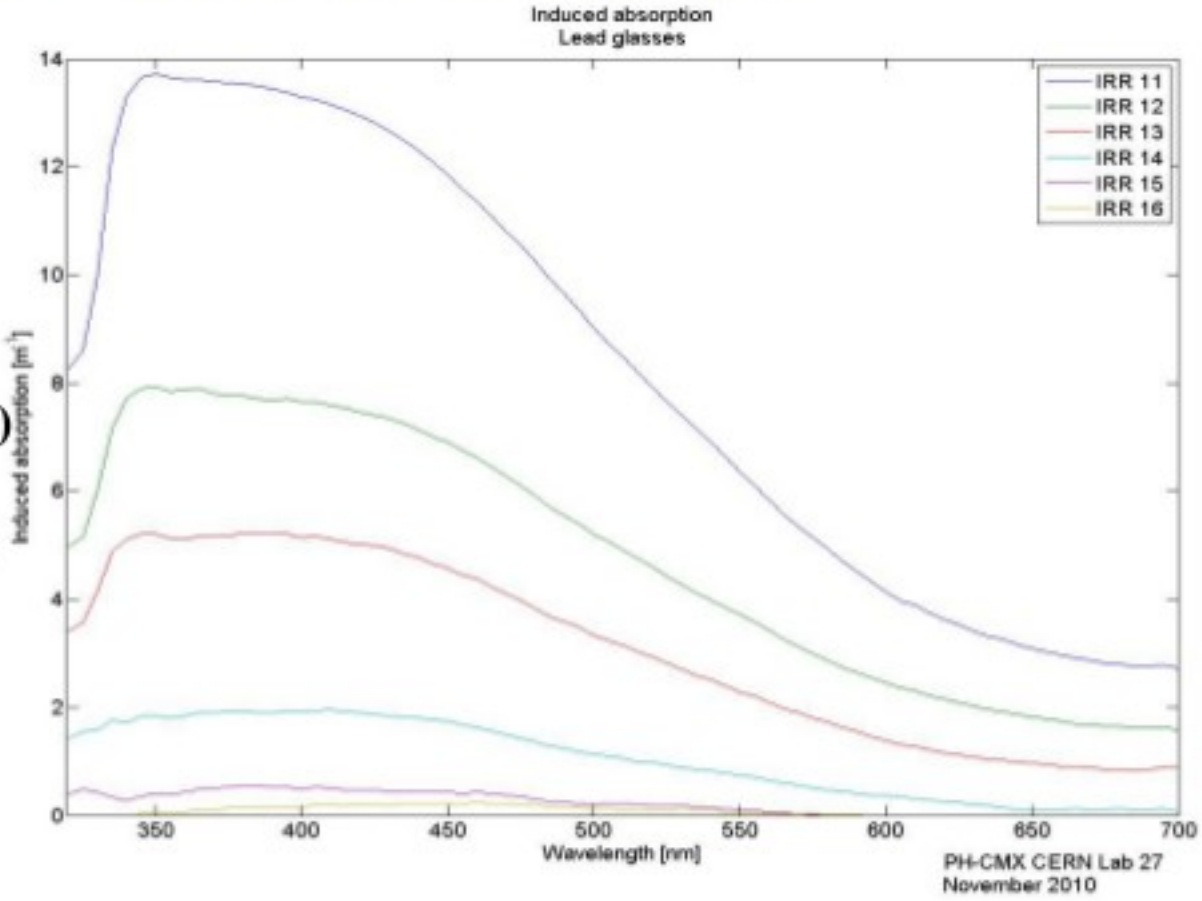
Sample 11: 55 Gy; Sample 12: 24 Gy; Sample 13: 16 Gy;
Sample 14: 6.3 Gy; Sample 15: 3.3 Gy; Sample 16: 1.9 Gy

Effect of radiation on light transmission

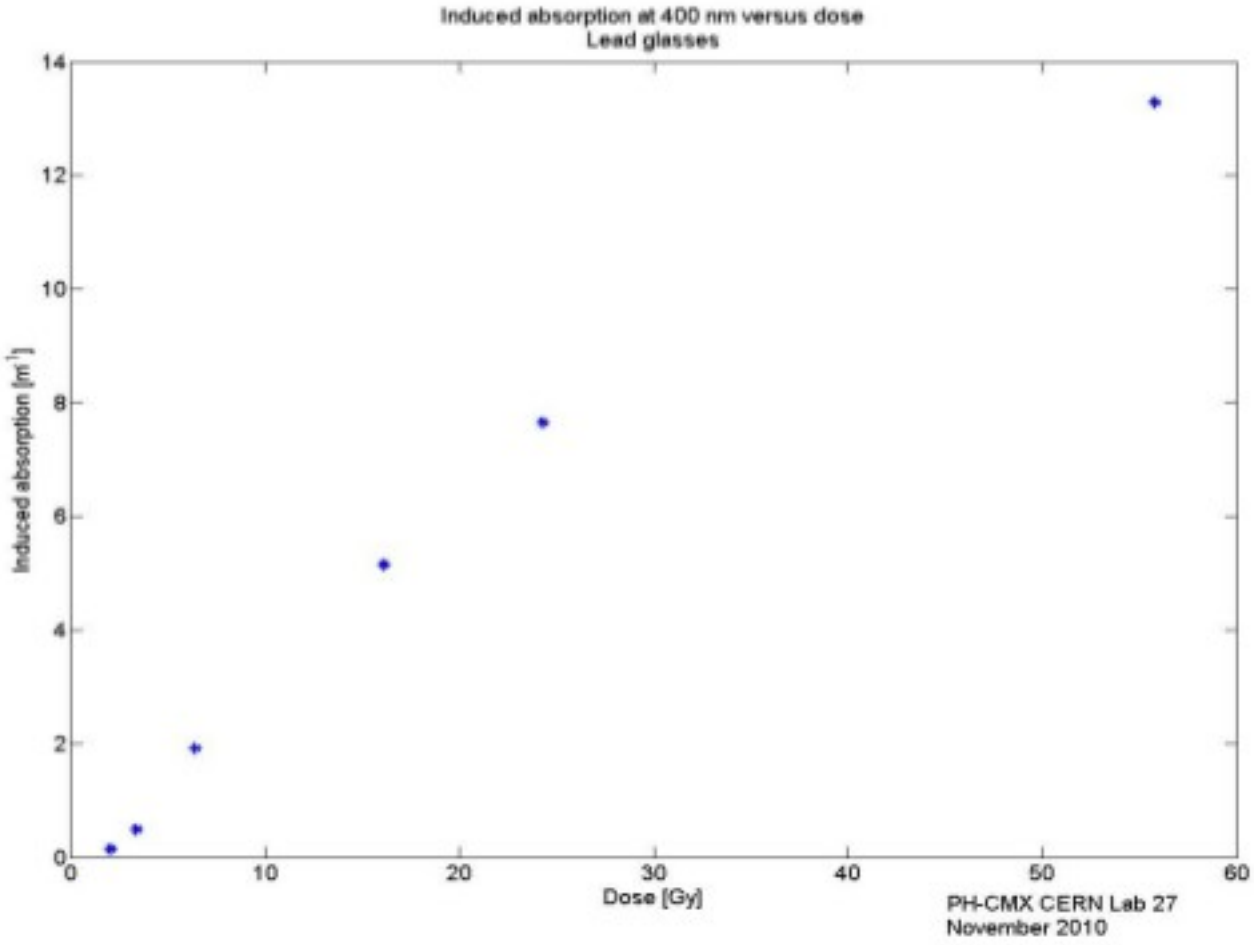
To calculate the induced absorption (μ_{ind}), we used the average value of the longitudinal transmission obtained with 8 non irradiated samples

$$\mu_{ind} = \frac{1}{L}\ln\left(\frac{T_i}{T_{irr}}\right)$$

With
L the length of sample (3cm)
T_i initial transmission
T_{irr} transmission after irrad



Induced absorption versus dose at λ = 400 nm



For a 30 cm SF5 block (X/X0 = 11.8) the light transmission T at λ = 400 nm after a dose of ~50 Gy is given by

$$T = \exp(-\mu_{ind} L) \approx \exp(-12 \times 0.3) \approx 2.7\%$$

→ **SF5 lead glass cannot be used for IRC / SAC**