Windows activation

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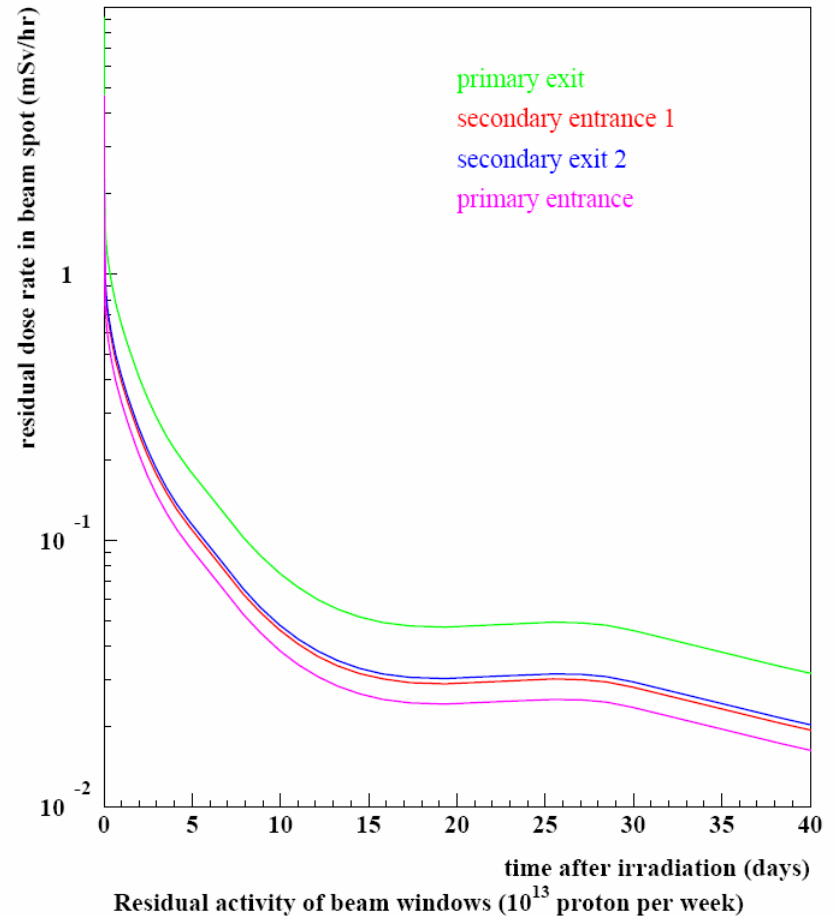
Beam windows residual activity

- MARS calculates contact residual dose using so called ω-factors. In this approach linear dimensions of irradiated object should be much larger than γ-ray interaction length (3.7 cm in windows). In such model activation is proportional to star density. For beam size much smaller windows transverse dimension this approach leads to residual dose proportional to 1/volume. Therefore maximum dose is in smallest primary entrance and minimal is in secondary exit #2.

- Such approach provide activity averaged on windows volume. It is supposed that total window is irradiated.

- In thin windows activation are much lower. Approximative model used to take into account this difference.

- 100 short pulses (10^{11} protons in each) during week create lower activity than continues irradiation during week with same number of protons. Residual dose from long-lived nuclides (decay time >> 2 hours) is practically same, residual dose from short-lived isotopes becomes much smaller for 100 pulse per week scenario. So, our continues approximation is valid starting from 10 hours of cooling.

Residual activity of beam windows (10^{13} proton per week)
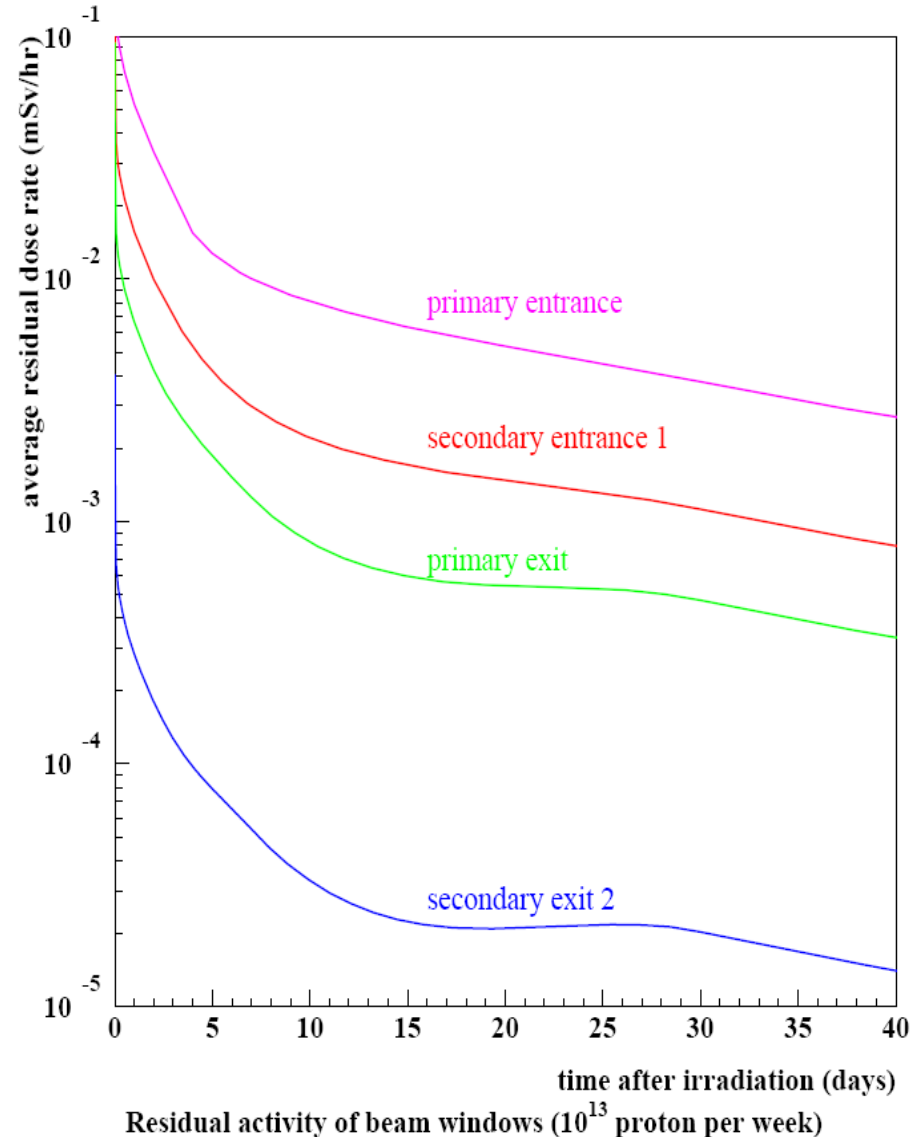
Dose in air

- Beam creates small spot of residual activity on windows. Spot size is about $r_0 = 2$ mm.
- Dose rates in beam spot area (D_{max}) is simply proportional to window size along beam (7.83 mm – primary exit, 1.22 mm – secondary entrance, 1.22 mm- secondary exit, 1mm – primary entrance).
- Dose in air (D_{air}) at distance R from beam spot could be estimated using simple formula

$$D_{air} = D_{max} (r_0/R)^2$$

- Result of calculation does not depend on used spot size r_0 because $D_{max} \sim 1/r_0^2$.

primary exit
secondary entrance 1
secondary exit 2
primary entrance

residual dose rate in beam spot (mSv/hr)

time after irradiation (days)

Residual activity of beam windows (10^{13} proton per week)

Energy depositions in detectors. No target.

- Detector 1: -90 degree
- Detector 2: -45 degree
- Detector 3: -22 degree
- Detector 4: -10 degree
- Detector 5: -7.5 degree
- Detector 6: -4.7 degree
- Detector 7: 4.7 degree
- Detector 8: 7.5 degree
- Detector 9: 10 degree
- Detector 10: 45 degree
- Detector 11: 90 degree
- Detector 12: 9 degree
- Detector 13: 0 degree