HRPPD ageing

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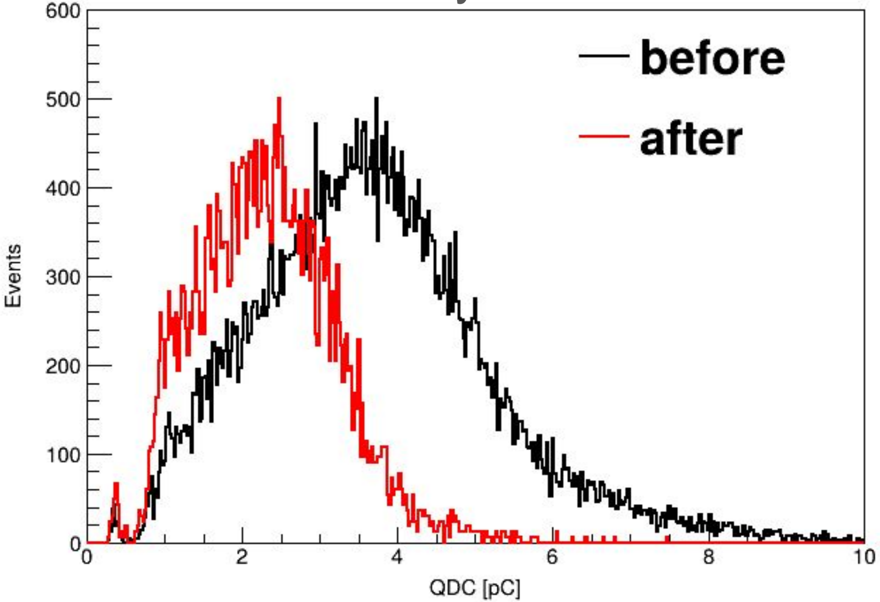
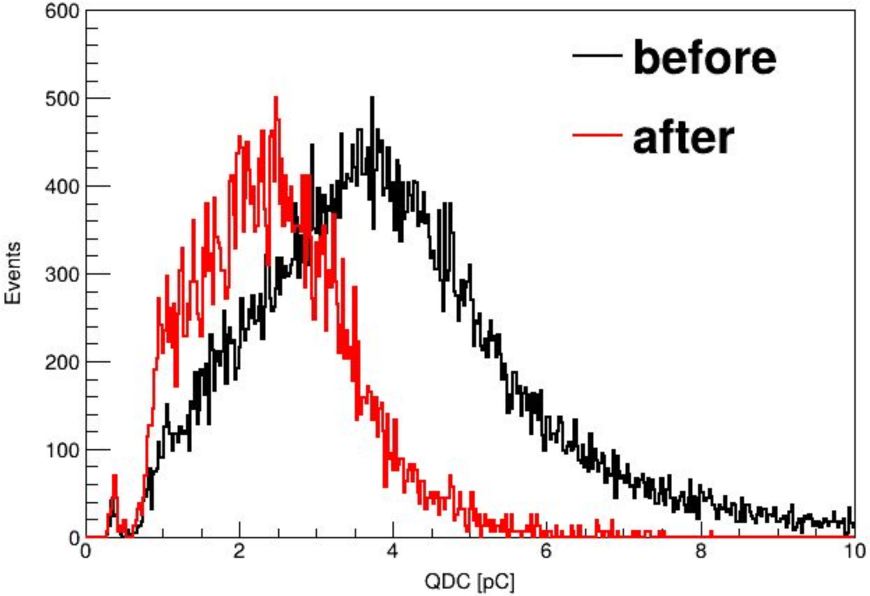
Gain variation due to ageing

- ageing spot region: V2_X100p1_Y41p0;
- before = August (second week);
- after = September - gain is ~42% lower.

ch10 only



Total sum



Signal amplitude variation after ageing

- before ageing λ=0.22, SPE amplitude =78 mV, ends at ~150 mV;
- after ageing λ=0.055 (-75%), SPE amplitude =51 mV (-35%), ends at ~110 mV;
- Was laser intensity really constant?

at 200 V δ is large, should not affect PDE

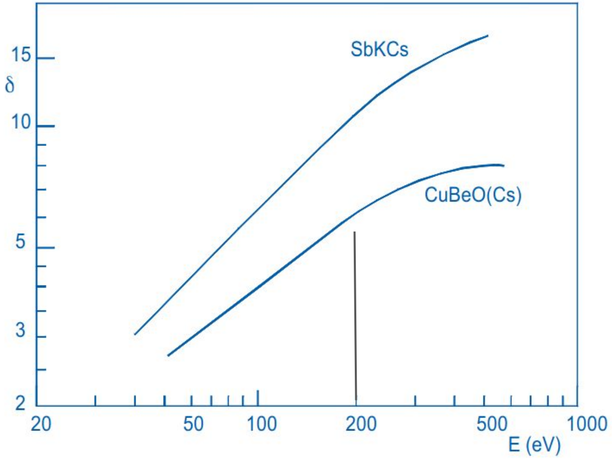
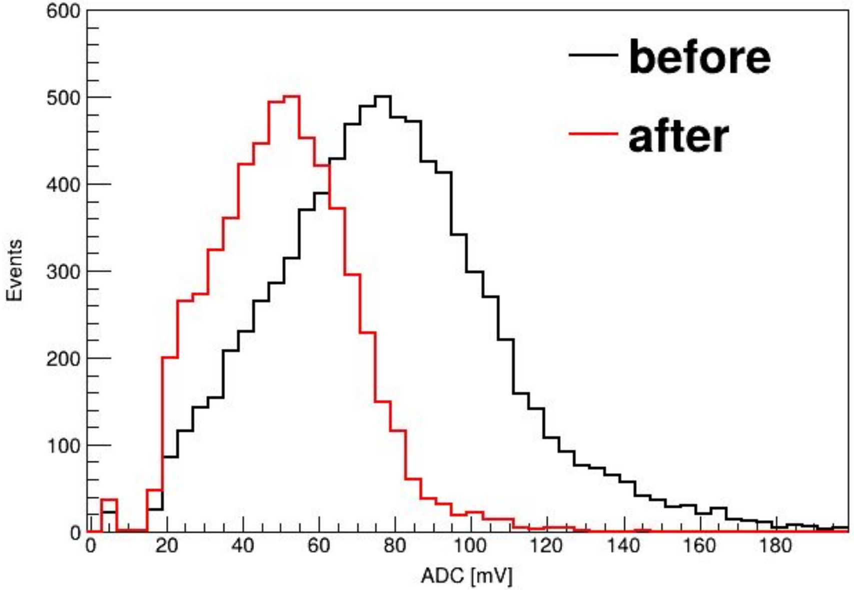
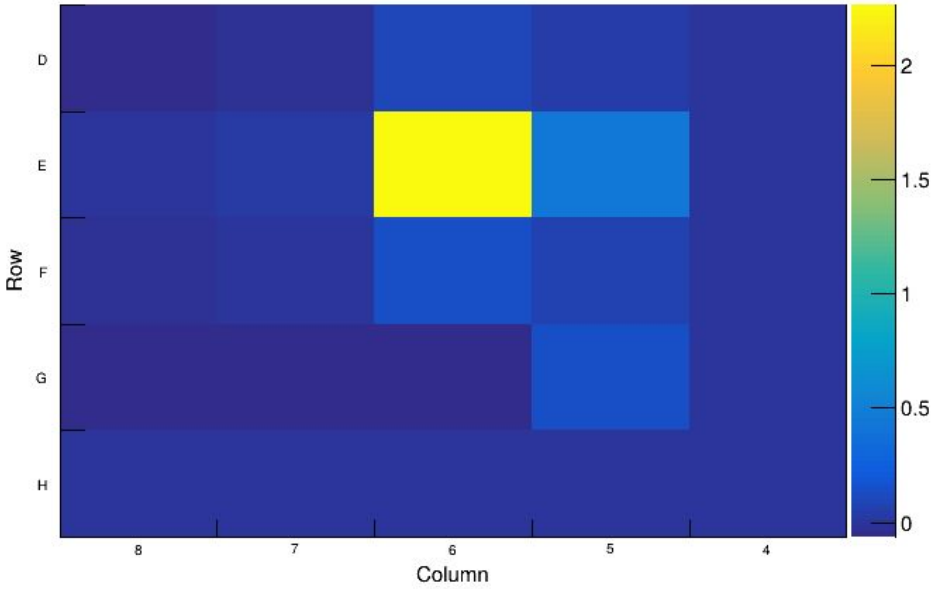


Fig.9 Secondary emission coefficients, δ, of the commonly used dynode materials, as functions of incident primary-electron energy, E.



Light spot projection

- read out 4x4 array of pads;
- the main spot pad is clearly seen;
- charge sharing is small, maximum <20% in pad 23 (ch11) - close to the edge of the readout array.



AfterPulses: time of arrival

- assuming uniform electric field E=200 V/1.1 mm, and zero initial velocity of ion at the entry MCP face we obtain:

$$t = \sqrt{\frac{2LM}{qE}} = \sqrt{\frac{2 \times 1.1mm \times AGeV/c^2}{Z \times 200V/1.1mm}} = 11.6ns\sqrt{\frac{A}{Z}}$$

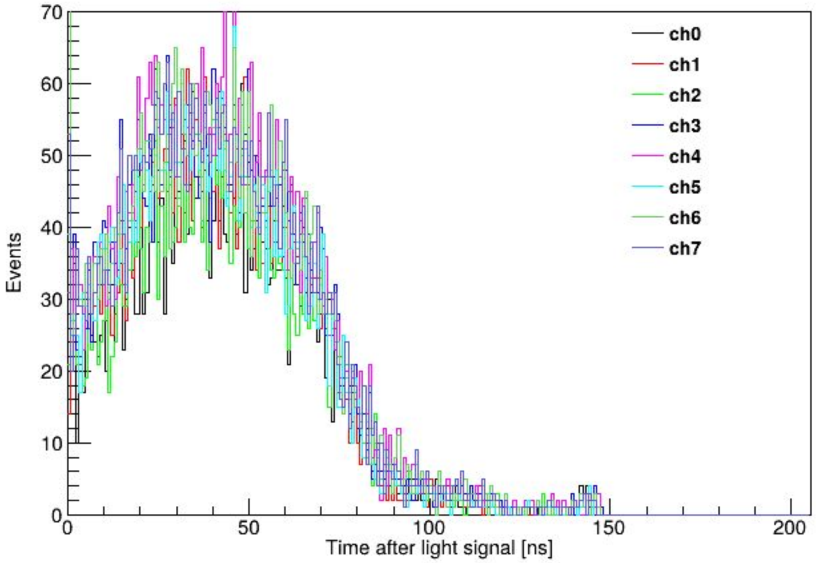
- thus, for major elementary ions in the MCP:

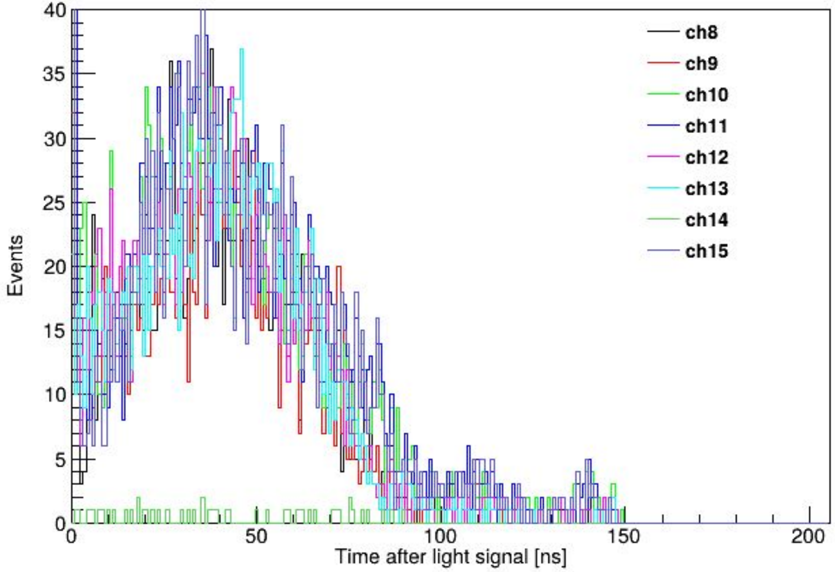
$$t_H = 11.6ns \quad t_{Al} = 60.2ns \quad t_{Mg} = 56.8ns$$

- no ion feedback at t<11 ns, having 200 eV kinetic energy we expect ion impact to produce signals with many photo-electrons.

AfterPulses with small amplitude

- using: “POST_TRIGGER 50” the laser trigger comes at sample 230 -275, while signal at sample 250-305; could be reduced by ~180 samples=36 ns;
- useful time window=140 ns (could be 180 ns) should include H, Mg/Al ions;
- using nominal threshold =40 samples (=10 mV) <SPE (50 mV) observe many small afterpulses, but without any structure - scattered PE, noise+reflections.

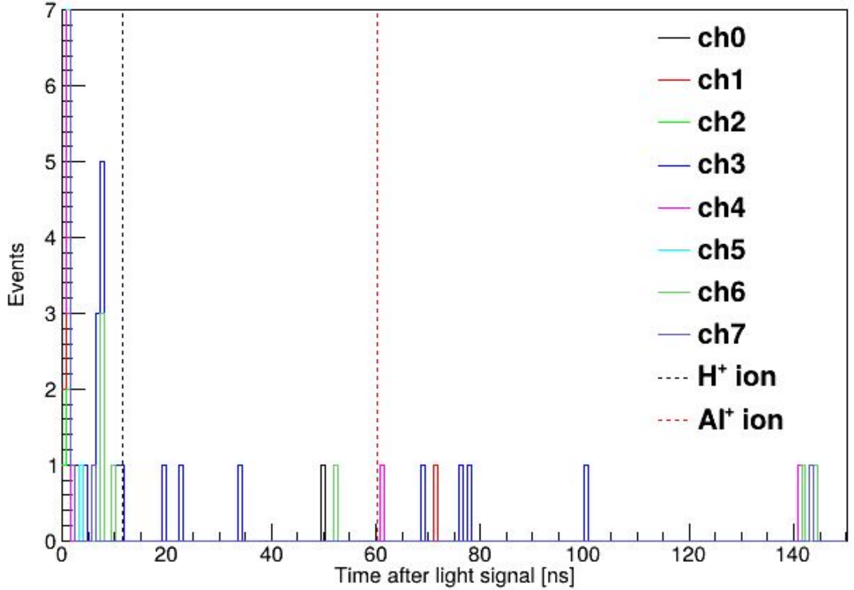


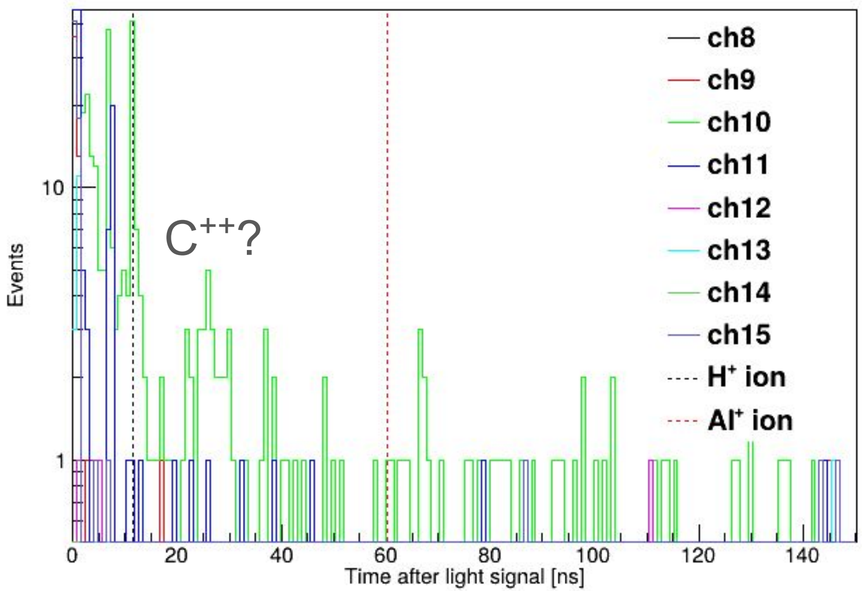


AfterPulses with >=1 p.e. amplitude

- using high threshold =5*40 samples (=5*10 mV) >=SPE (51 mV) observe few afterpulses, but without clear structure;
- most afterpulses are seen in the laser spot ch10;
- Seems to observe H^+ peak, and peaks at 6.7 ns and 26 ns.

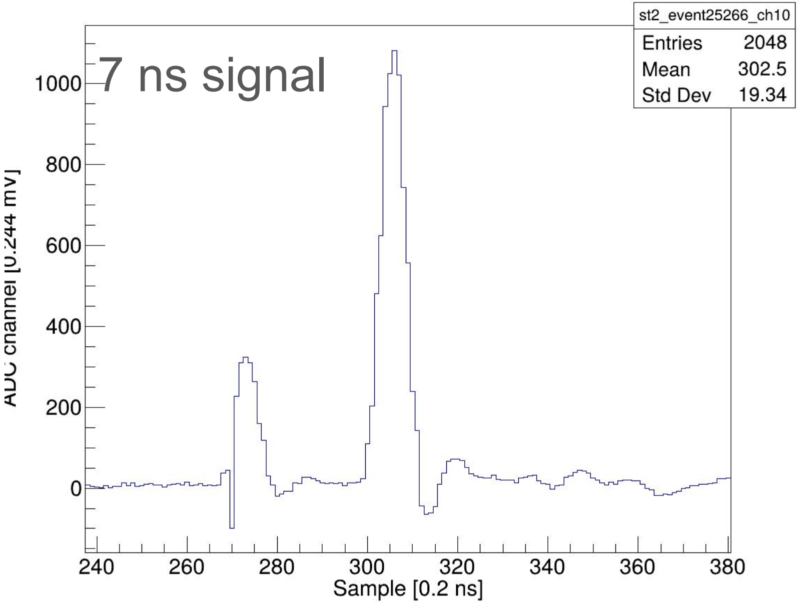
10^5 pulses, λ=0.22



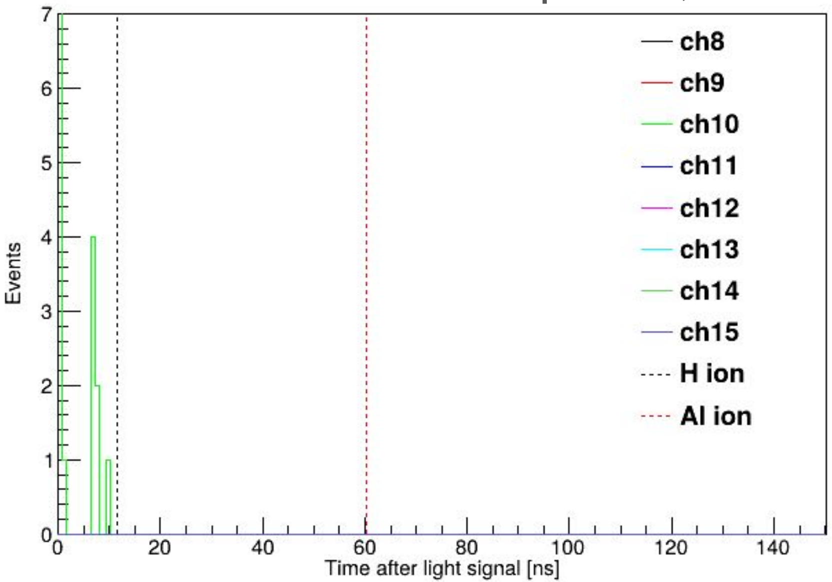


AfterPulses with >=2 p.e. amplitude

- using very high threshold =10*40 samples (=10*10 mV) >SPE (51 mV) observe few afterpulses, but without clear structure;
- most afterpulses are seen in the spot ch10;
- few events are at 7 ns, not related to ion feedback;
- why 2 p.e. ion feedback signal probability is so low?



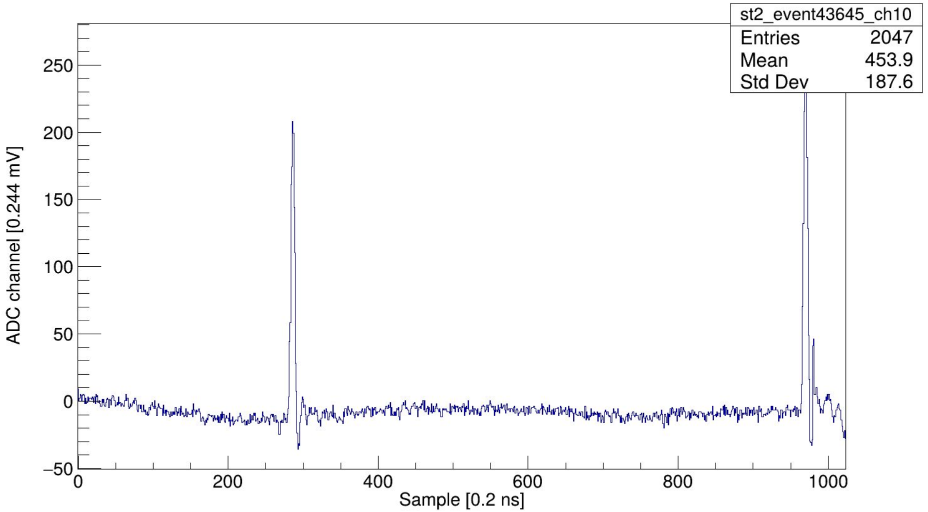
10^5 pulses, λ=0.22

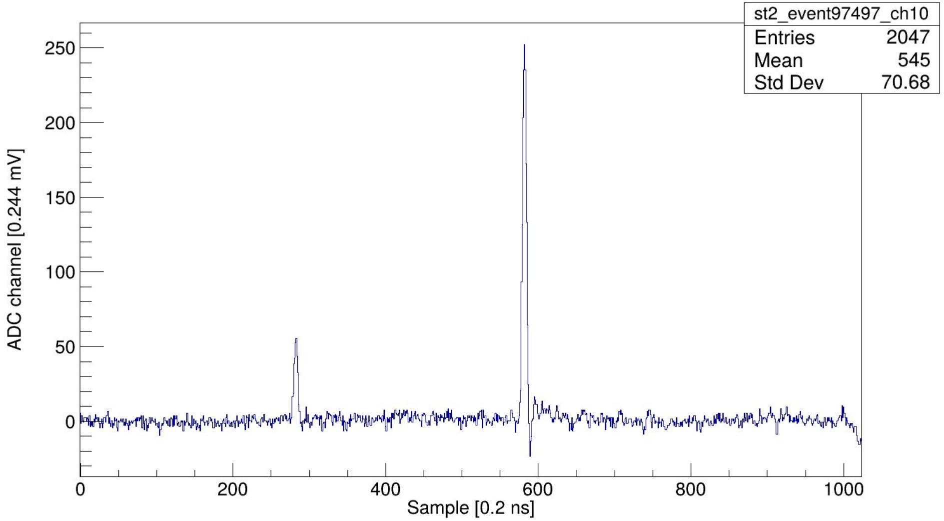


AfterPulses with high amplitude: waveforms

- afterpulses are clearly visible in the acquired waveforms;
- before: 210 events (>10 ns delayed, >=SPE) of 25472 signals =0.8%;
- after: 26 events (>10 ns delayed, >=SPE) of 6403 signals =0.4%;
- noise rate 2 kHz/cm^2*9 mm^2 with time gate of 140 ns and trigger rate 600 Hz we can estimate accidental coincidence contribution =0.17 Hz/31 Hz=0.55%, close to the observed.

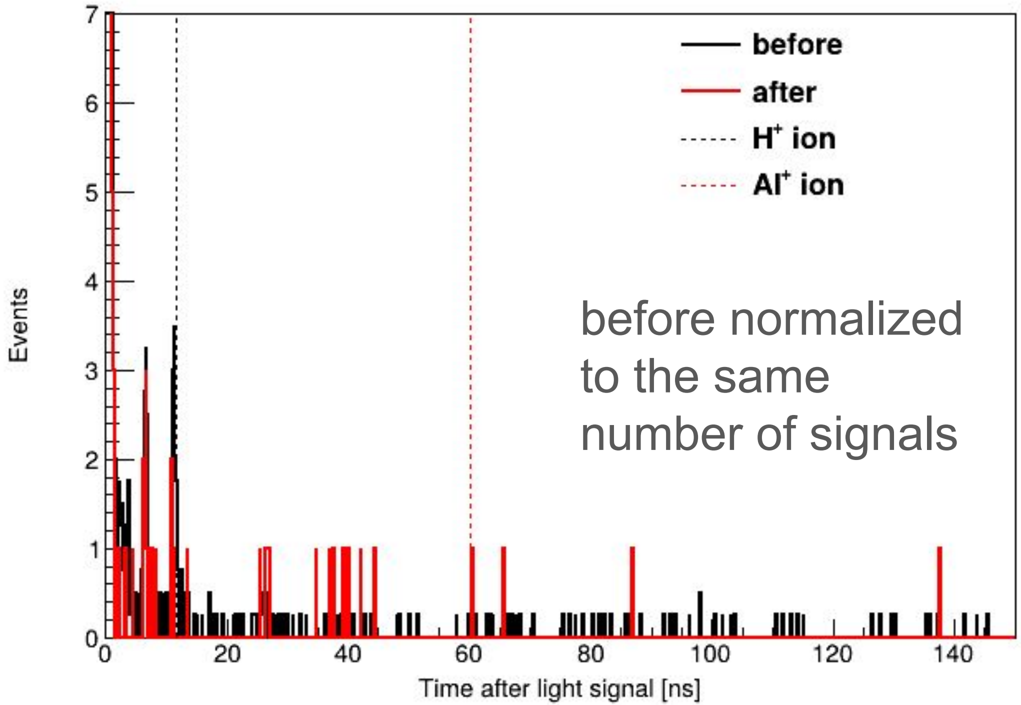
$$R_{acc.} = DCR \times R_{sig} \times \Delta t = 2kHz \times 600Hz \times 140ns = 0.17Hz$$





AfterPulses before and after ageing

- ion feedback afterpulses can be selected only taking >=1 p.e. amplitude;
- observe more H^+ afterpulses before ageing than after.



before normalized to the same number of signals