Xe doping analysis update

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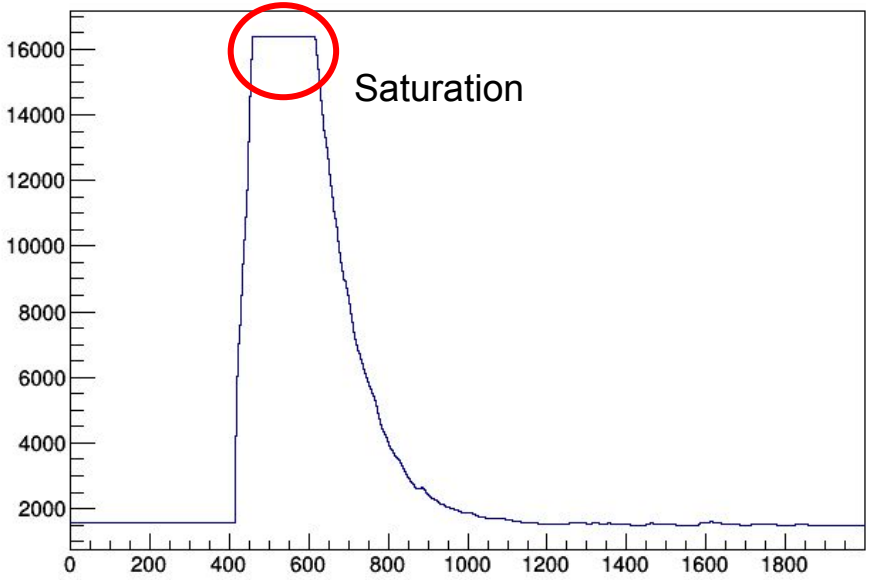
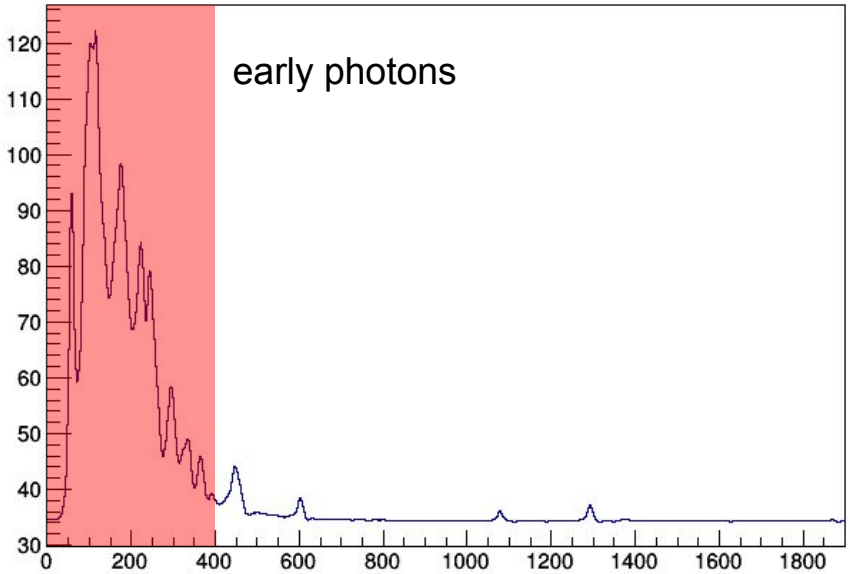
Event selection in the D1 to D5 data analysis





Discarded events by

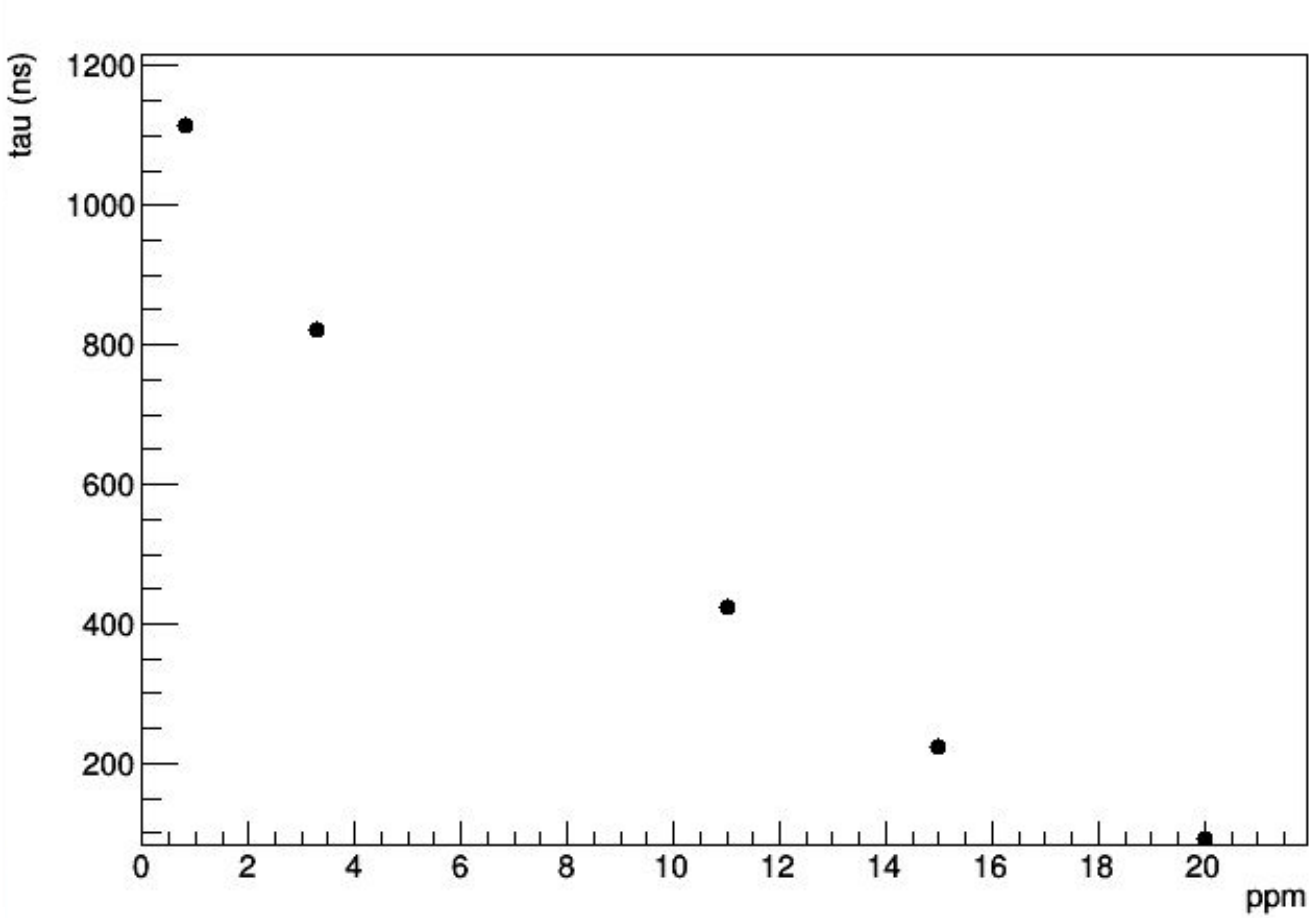
- Saturation cut : events with saturation at 16000 ADC in the raw wfm
- Early cut: events with 10 or more photons in the pretrigger

Accepted events

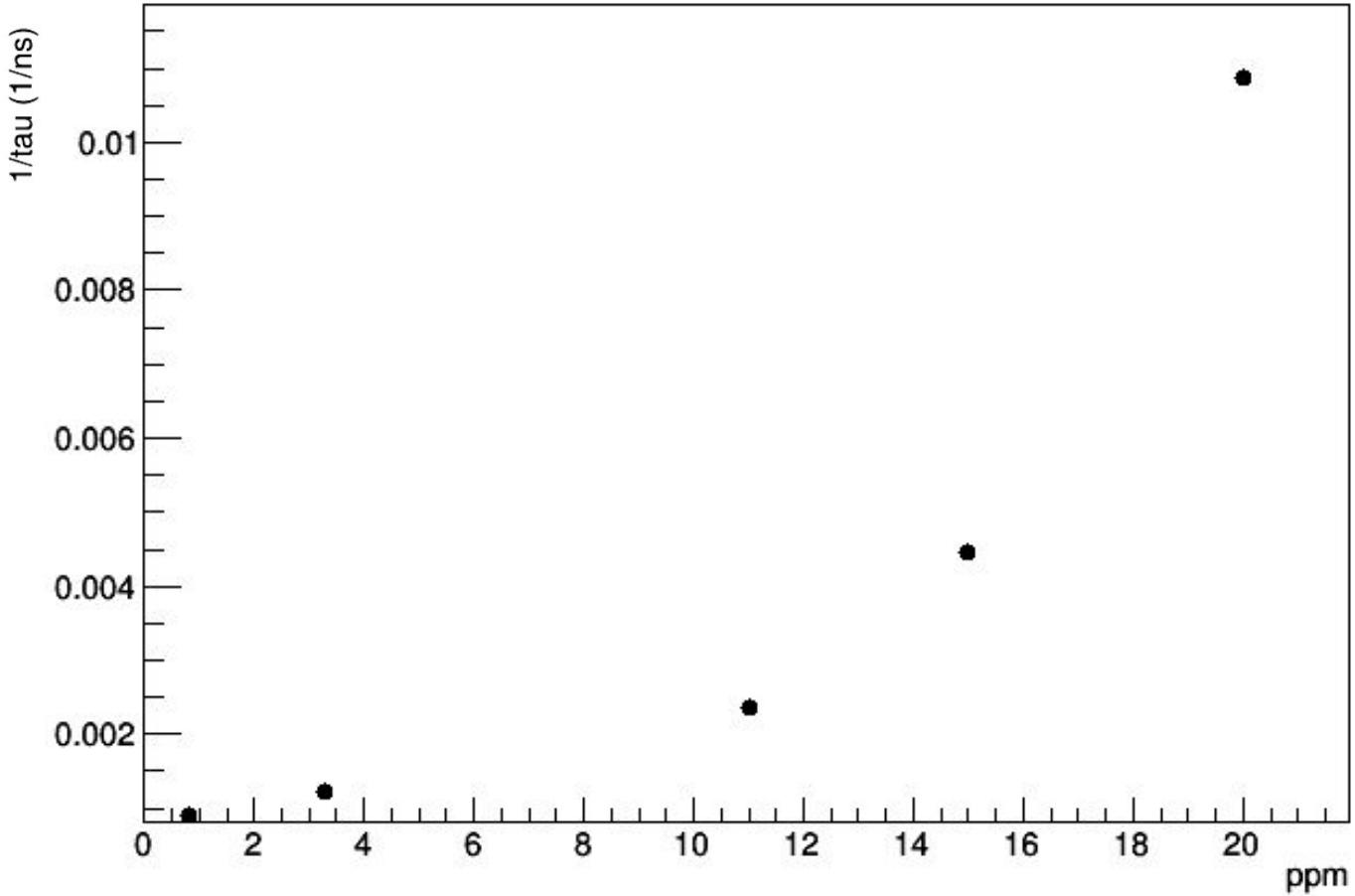
- Late photons events (>10 ph)

Fixed! Wasn't correctly implemented last time!

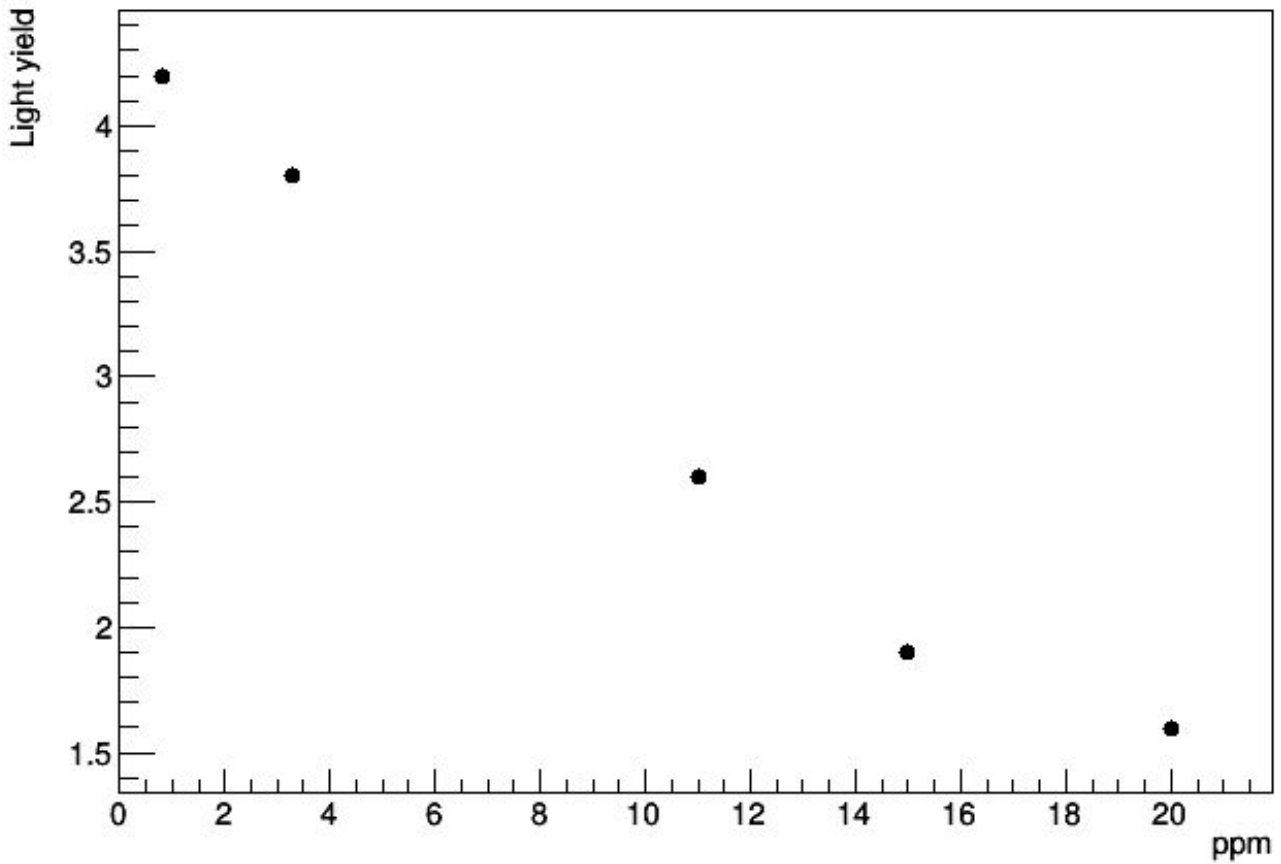
Ar τ_{slow} vs Xe concentration



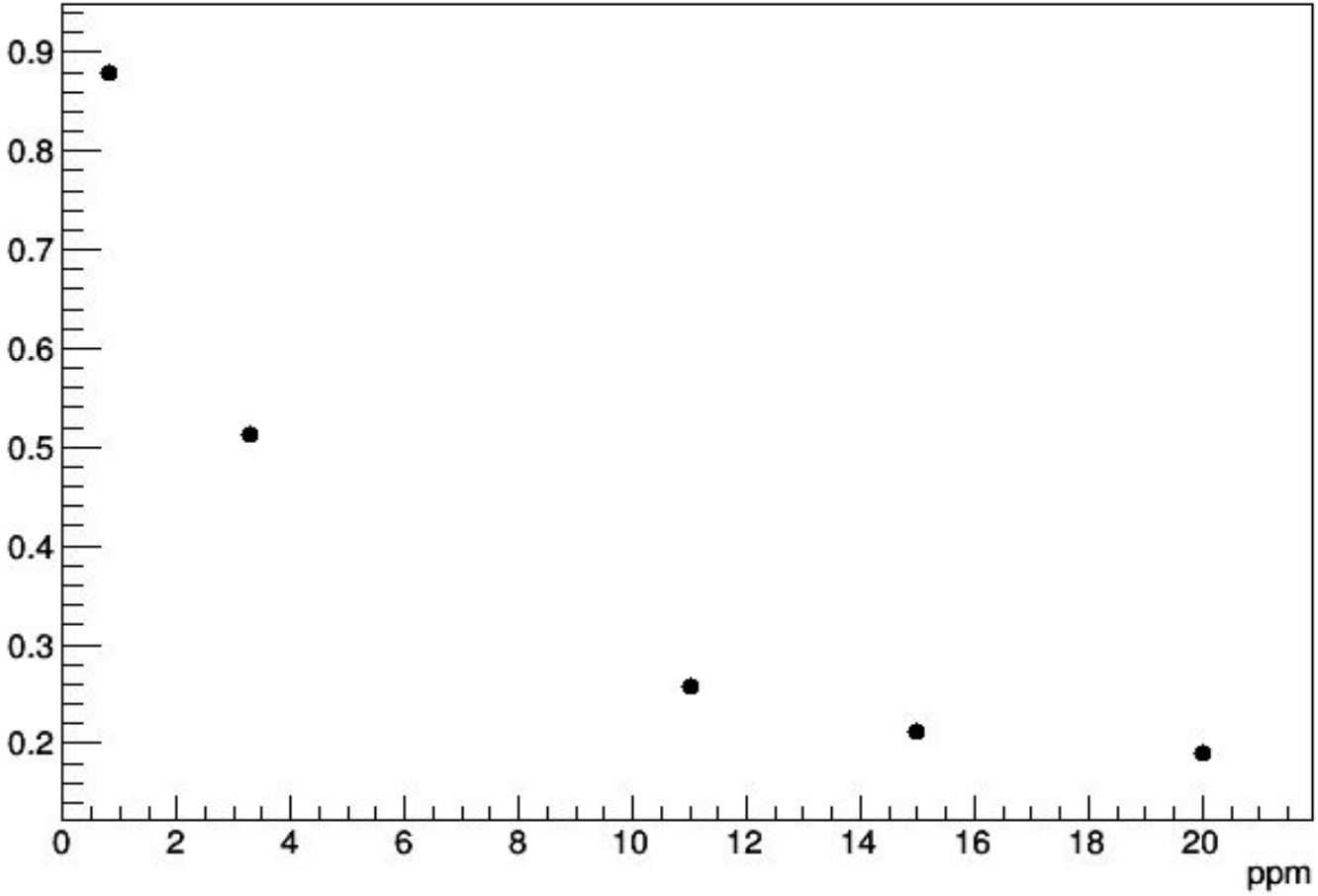
Ar $1/\tau_{slow}$ vs Xe concentration



Ar light yield vs Xe concentration
(integral of (<wfm>$_Q$/0.87) /<wfm>$_{NQ}$)

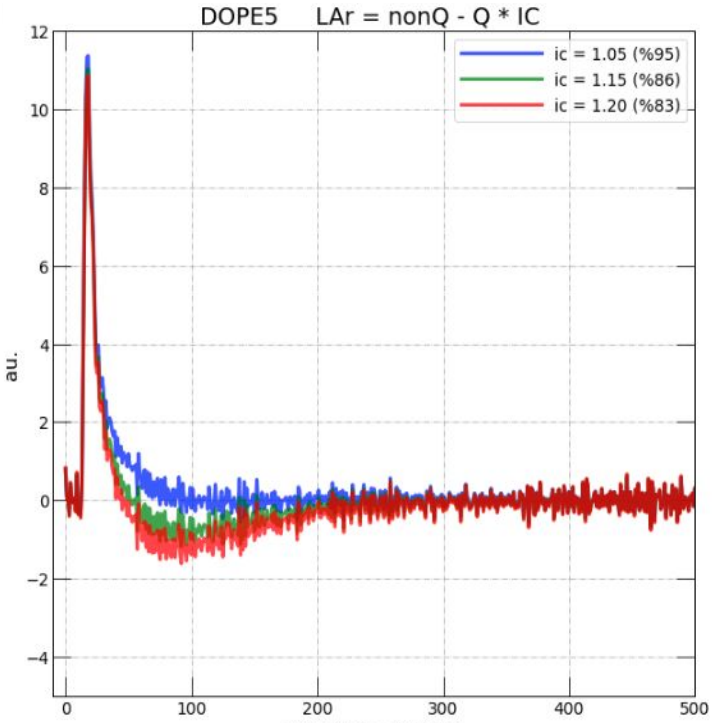


Ar/Xe light yield ratio vs Xe concentration



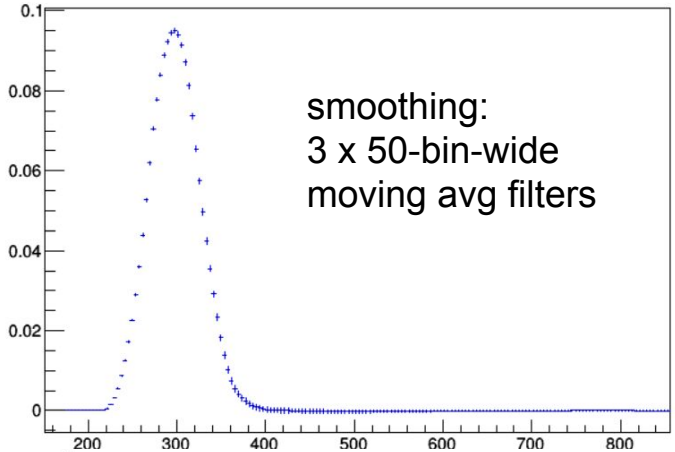
- we are exploring the fit of τ_{XX} and τ_{AX}

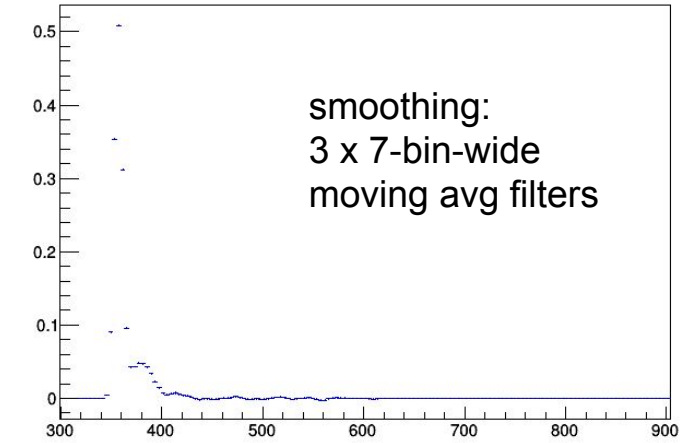
Undershoot problem in <wfm> subtractions

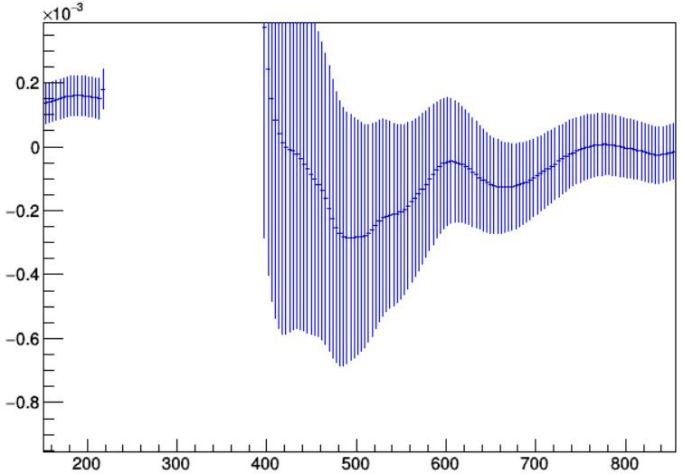


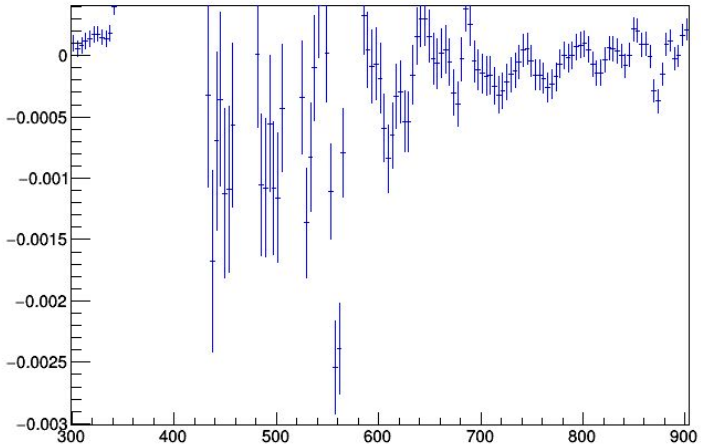
- An undershoot has been evidenced in other analyses (Furkan, Fatma) if the previously found ic value (0.87) is used
- the problem is fixed empirically by setting ic=0.95
- $U.S._{MIN}$ / wfm_{MAX} ~= 0.1

Undershoot problem: comparison with our analysis



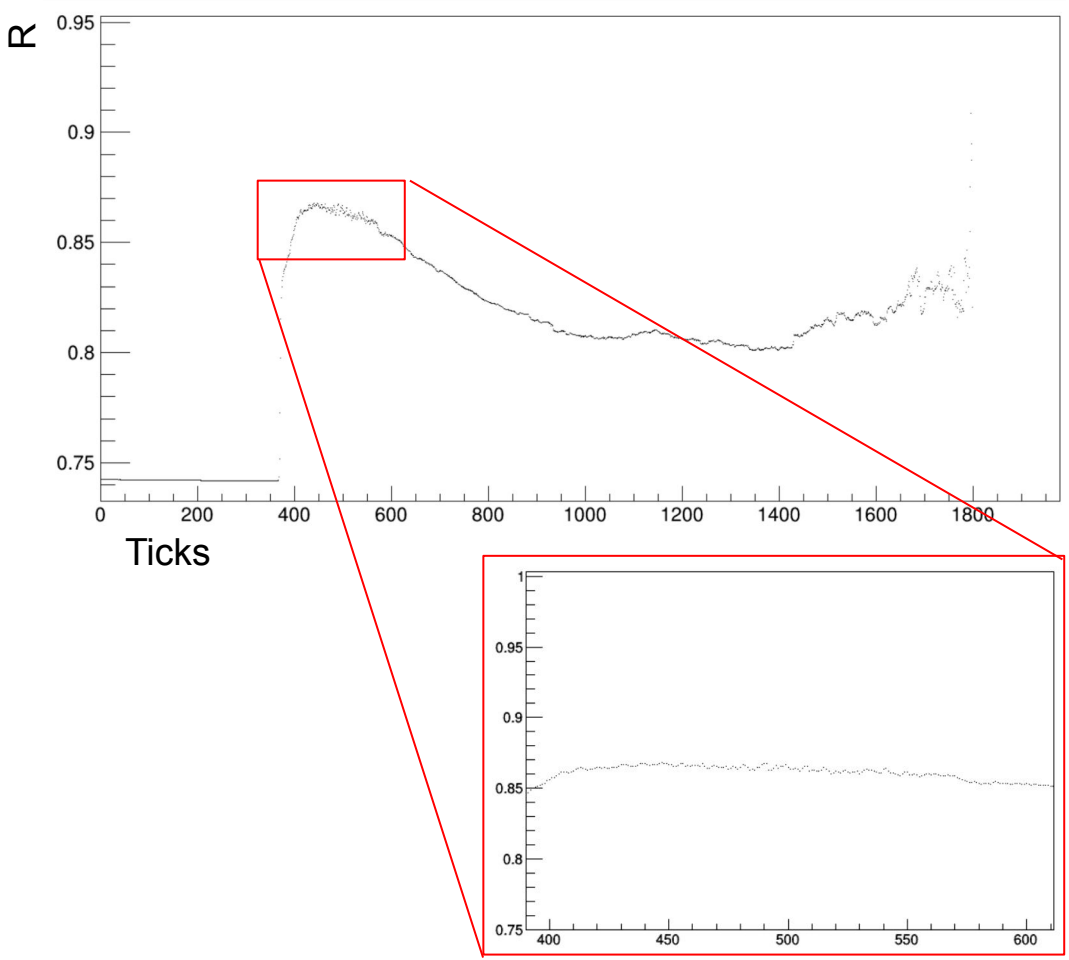






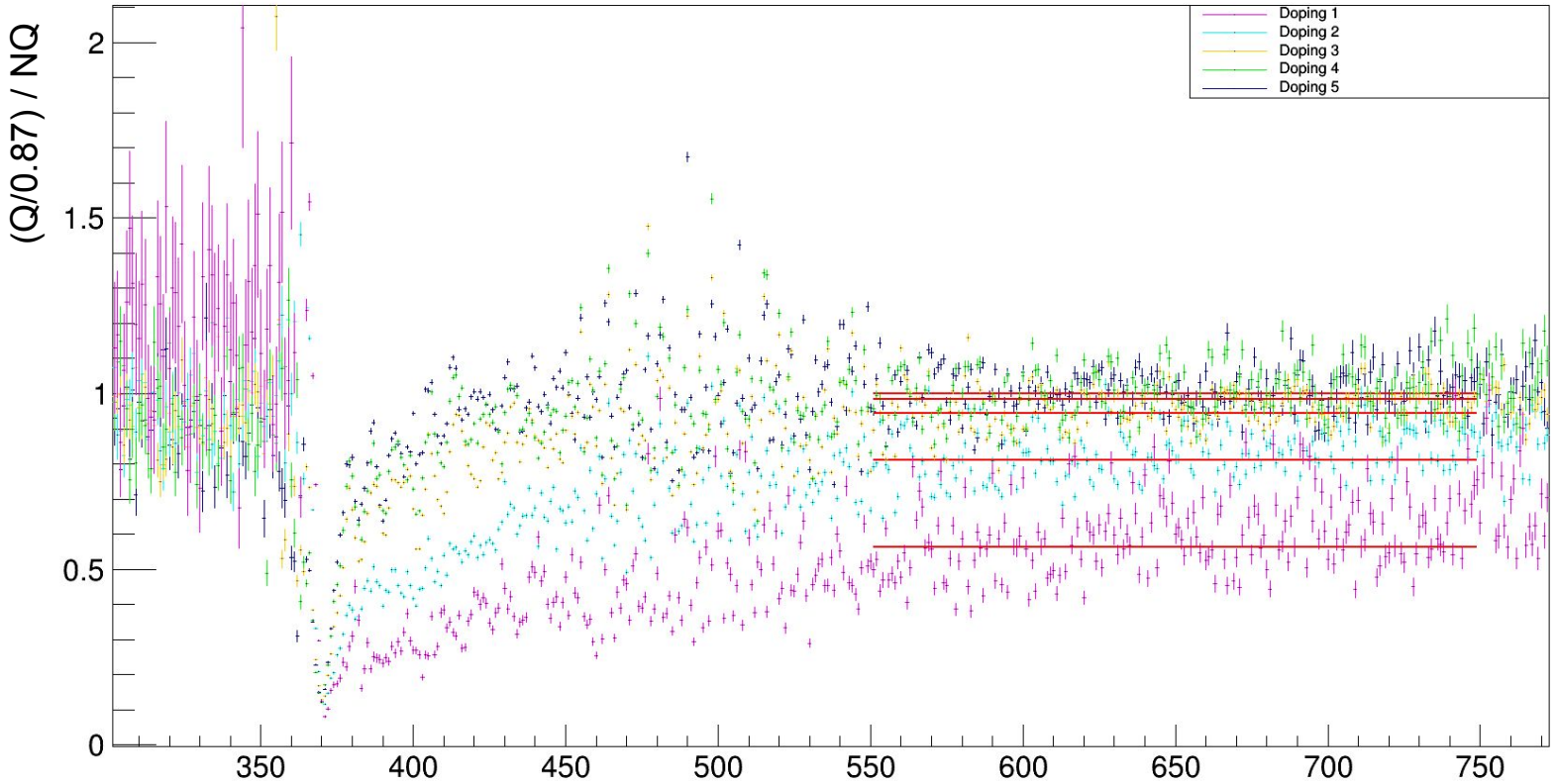
- keeping ic=0.87, nothing of the same magnitude arises
- slight undershoot
- $U.S._{MIN}$ / wfm_{MAX} ~= 0.003
- the result doesn't change with smoothing

Undershoot problem: Q/NQ integral ratio



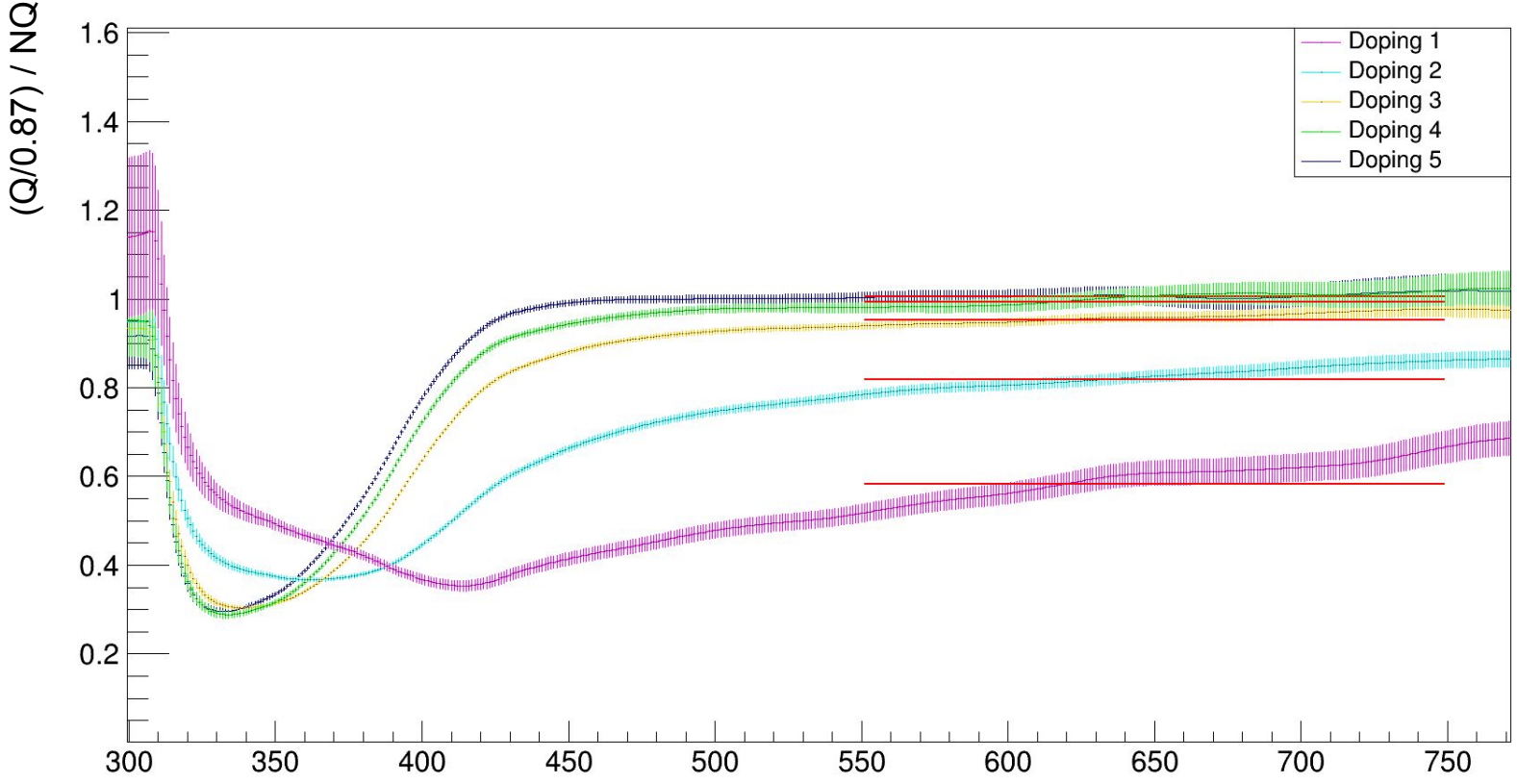
- cross-check: with Dope5 data, compute <wfm> for both xArapuca modules
- for each tick, compute:
  R= $\text{Integral}_{<wfm>Q}(i,1800)$ / $\text{Integral}_{<wfm>NQ}(i,1800)$
- if the signal ratio is ~constant from tick 450 (approx. 100 ticks after trigger) onwards, R should also be ~constant in that range.
- R is relatively stable (at 0.86-0.87) in the 450-550 range
- R eventually gets below that value, but not above

Q/NQ ratio vs doping



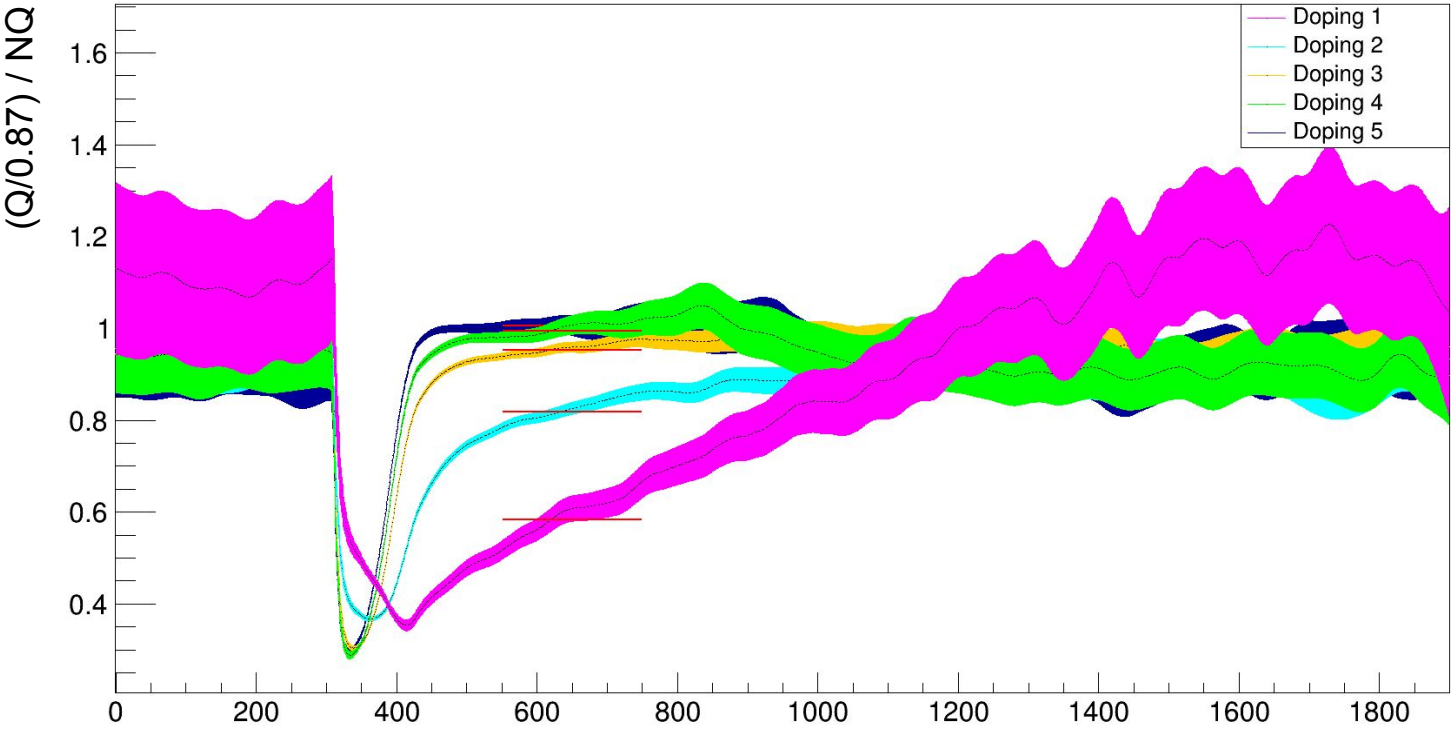
- ratios are adjusted with an intercalibration factor of 0.87

Q/NQ ratio vs doping



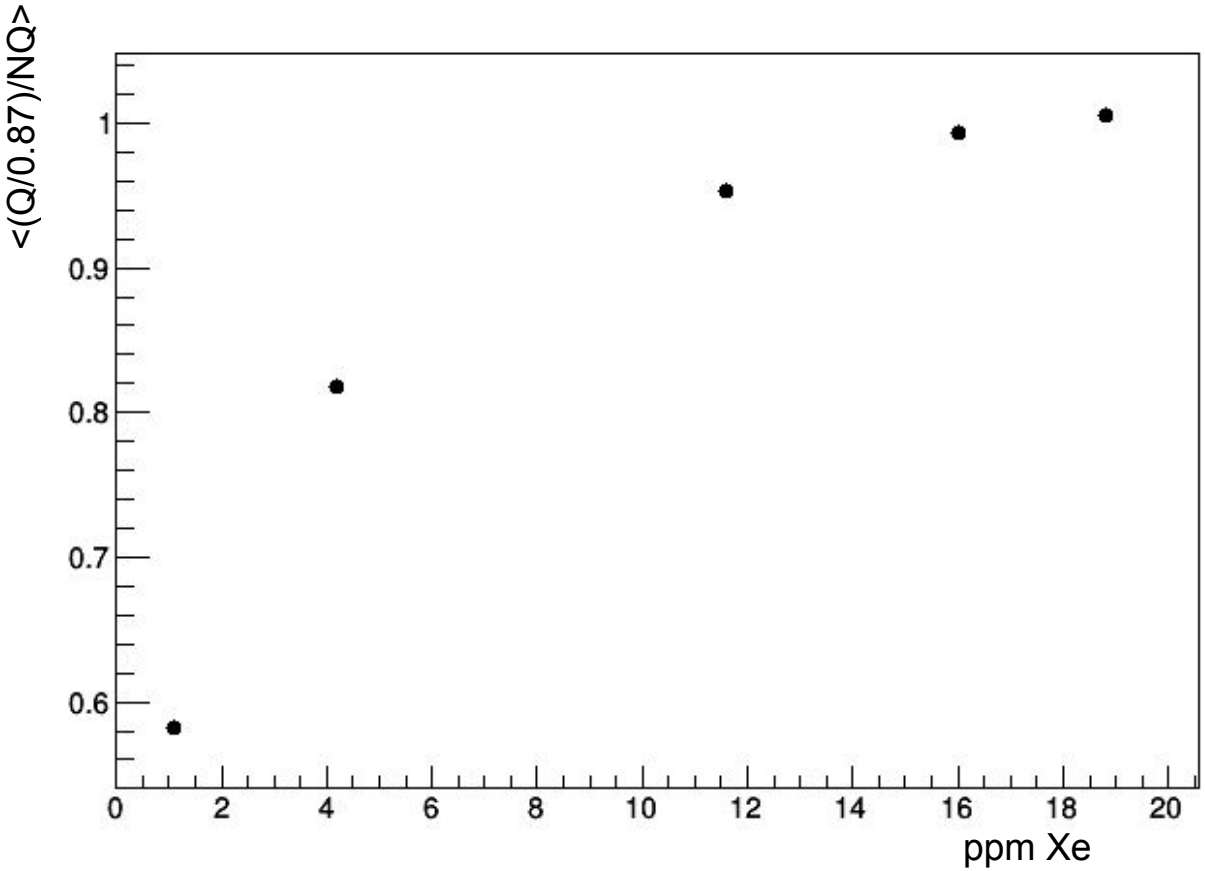
- smoothing (3 x 21-bin-wide moving average filters) is applied

Q/NQ ratio vs doping

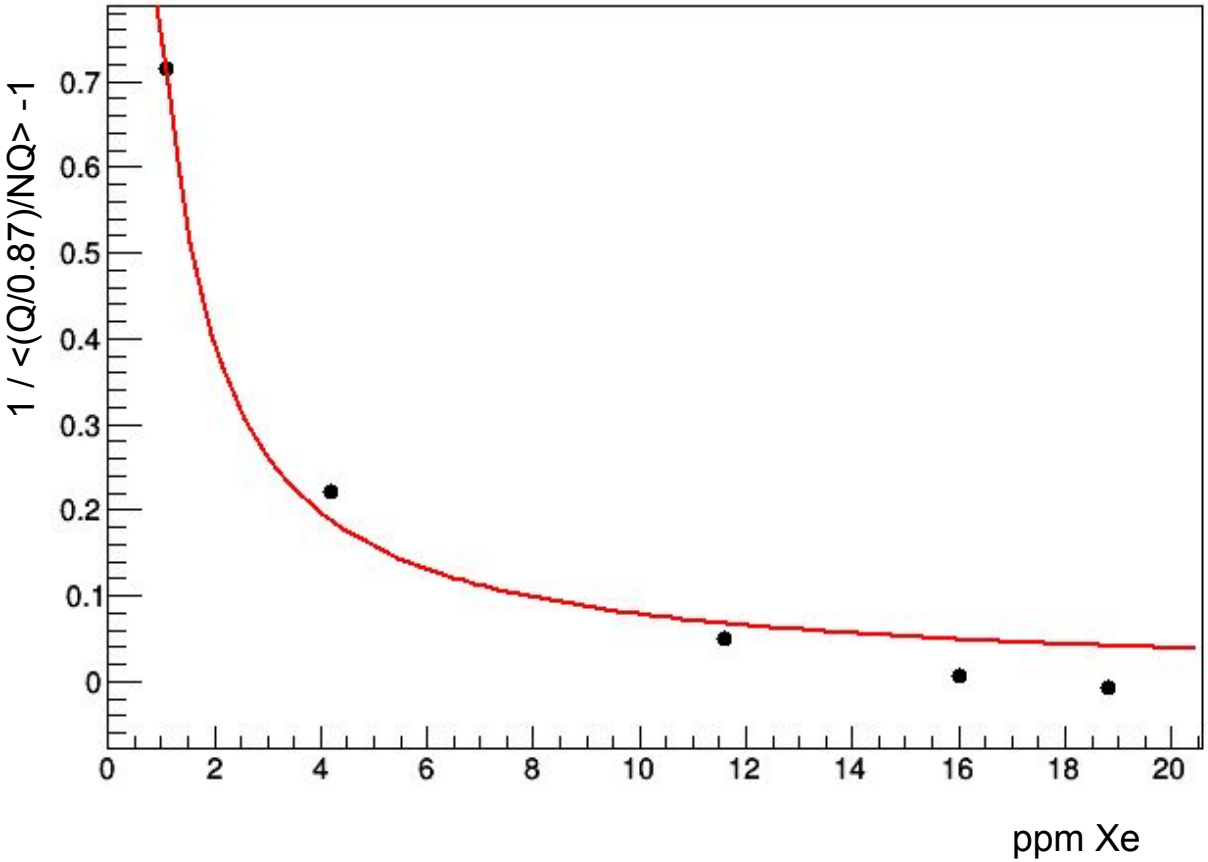


- In earlier doping periods, the ratio is far from constant!
- choice of range for the fit (550,750) is somewhat arbitrary

Q/NQ ratio vs Xe concentration



Q/NQ ratio vs doping



- the ratio should be approximately $\tau_{150}/(\tau_{XX}+\tau_{150})$

→ 1 / <(Q/0.87)/NQ> -1 ~ τ_{XX}/τ_{150}

- rough fit as A/[ppm] yields
  A = 0.79 ± 0.04
  → taking τ_{150}=5120 ns*

  τ_{XX} ~= 4045 / [ppm] ns

*(M. Hofmann et al.: Ion-Beam Excitation of Liquid Argon)

Conclusions

- fixed bug in the saturation cut, re-computed Ar τ_{slow} values
- checked undershoot problem in the <wfm> subtraction
  - results are consistent with ic=0.87
- rough analysis of the NQ/Q ratio evolution with doping yields τ_{XX} ~= 4045/[ppm] ns