Luminosity scan

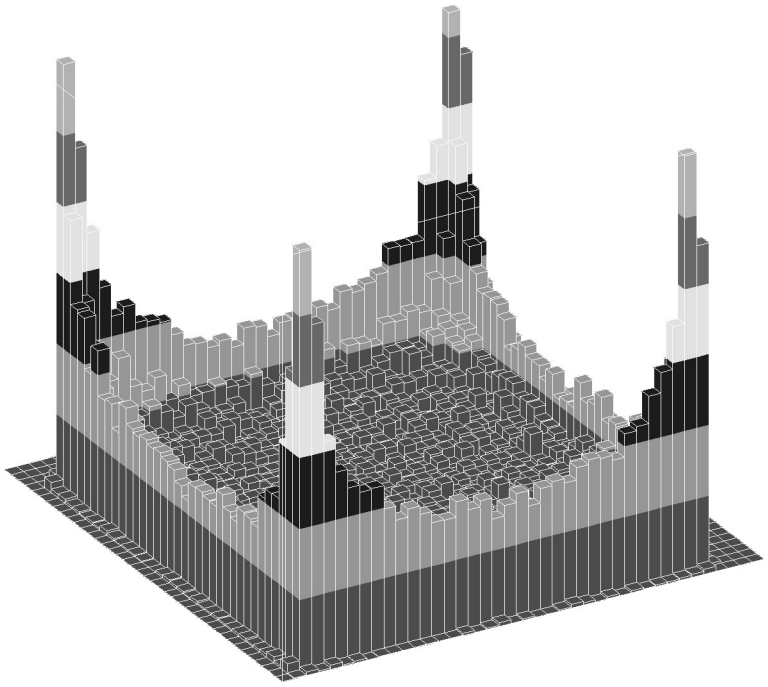
Why?

- Localized boiling can cause uncertainties in cryogenic target density
- Cryogenic targets
  - H_2 *(0.07283 g/cm^3 @ 19.0 K)*
  - D_2 *(0.16743 g/cm^3 @ 22.0 K)*
  - ^{3}*He and* ^{4}*He (0.00393 g/cm^3 @ 6.1 K)*

Luminosity scan

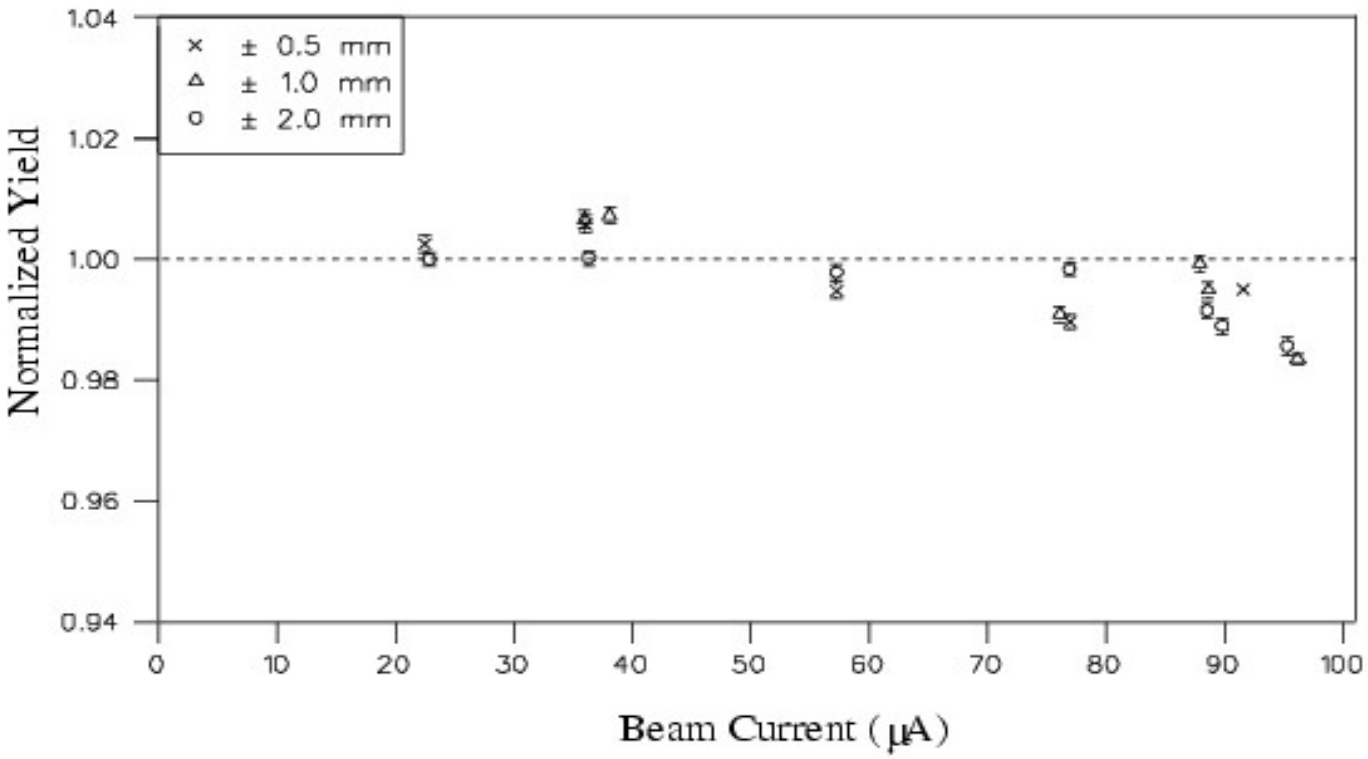
Possible dependences

- Beam current
  - *A range from 10 – 90 μA was used*
  - *The higher the current, the higher the risk of boiling*
- Raster size
  - *2 x 2 mm*
  - *Depending on the spot size of the beam and due to the sinusoidal raster motion in x and y, boiling effects are higher in the edges*
  - *The smaller the raster, the higher the*



How to test

- Plotting the normalized yield (events per charge) versus the beam current



(from thesis of J. Arrington,1998)

- The fall off of the yield at higher beam current indicates localized boiling of the target
- No dependence on raster size within *~0.013%/mm/μA*

Where to get the yield

- Yield = events per charge (normalized to one)

$$YIELD = \frac{\#events \cdot ps1}{(1-dt_c)\cdot(1-dt_e)\cdot e(trig)\cdot e(3/4)\cdot e(track)\cdot e(cer)} \cdot \frac{1}{Q}$$

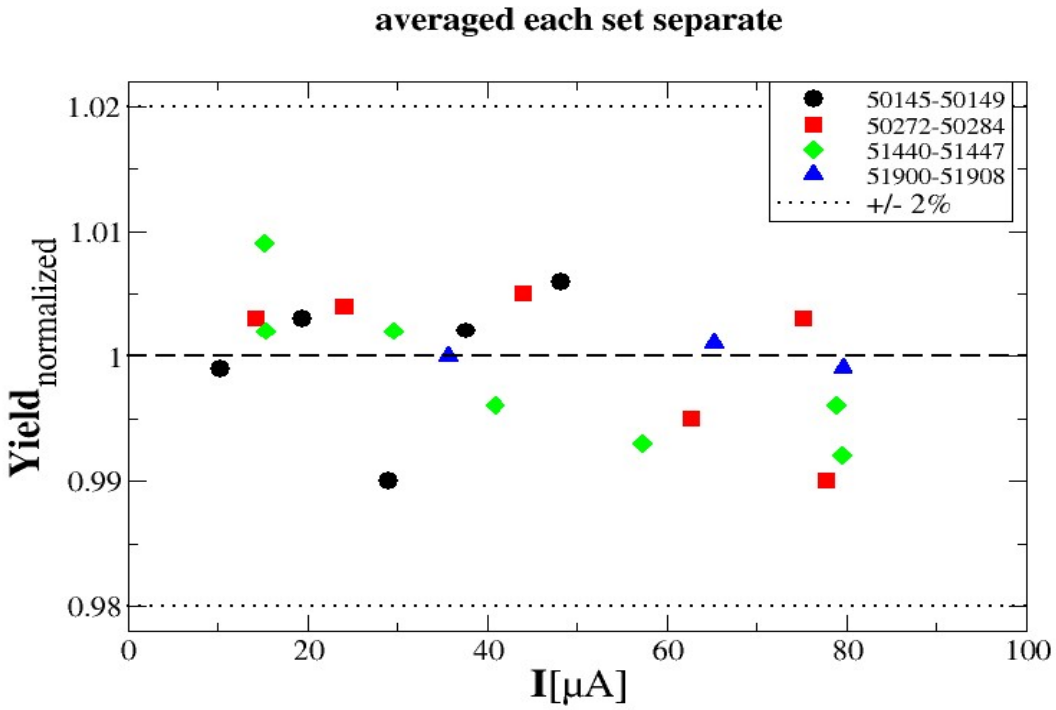
#events number of good events (determined by applying cuts)

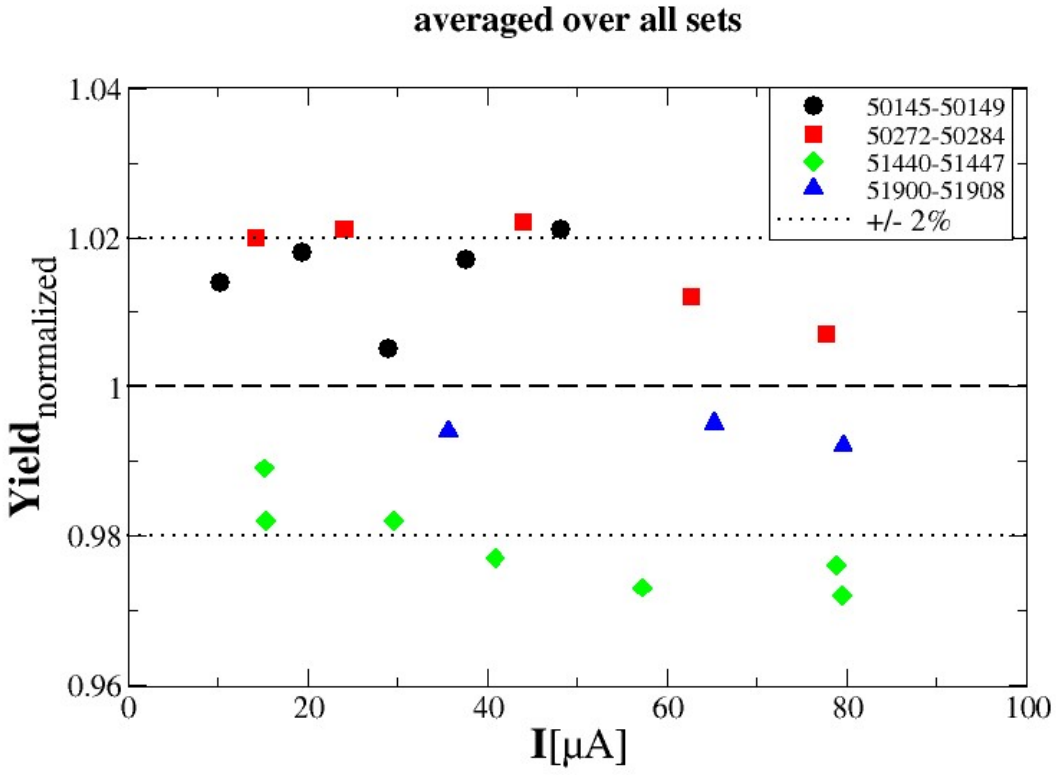
hcer_npe>2 *ev_type==1*
abs(hsdelta)<12 *abs(hsshtrk-1)<0.15*
abs(hsxptar)<0.07 *abs(hsyptar)<0.03*

ps1 Prescale factor
dt(c), dt(e) Computer and electronic dead time
e(trig) Trigger efficiency
e(track) Tracking efficieny
e(3/4) ¾ efficiency
e(cer) Cerenkov efficiency
Q_{charge} Charge

Carbon test data

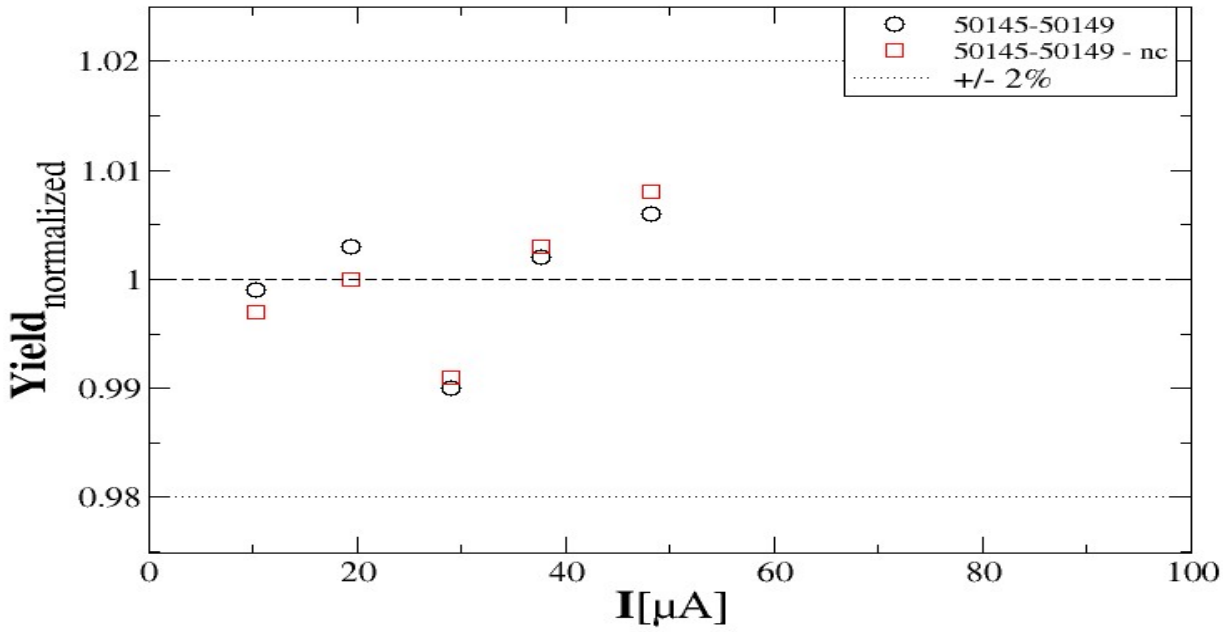
- Carbon as solid target is supposed to have a stable yield even at high beam currents

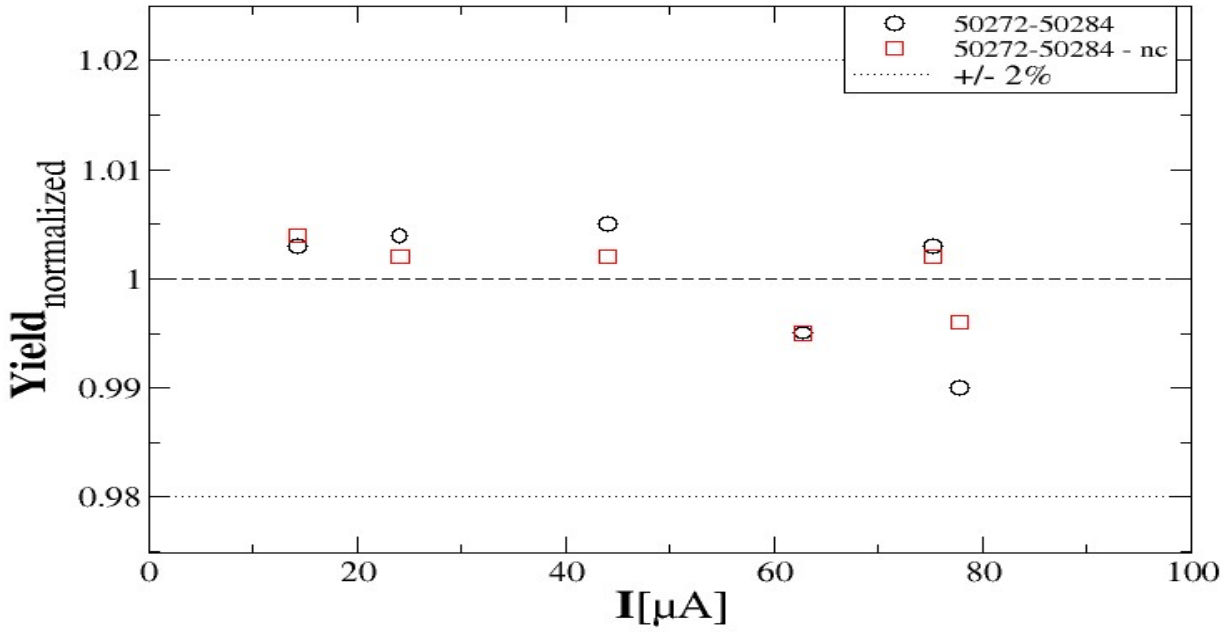




Carbon test data

- Checking effects of cuts

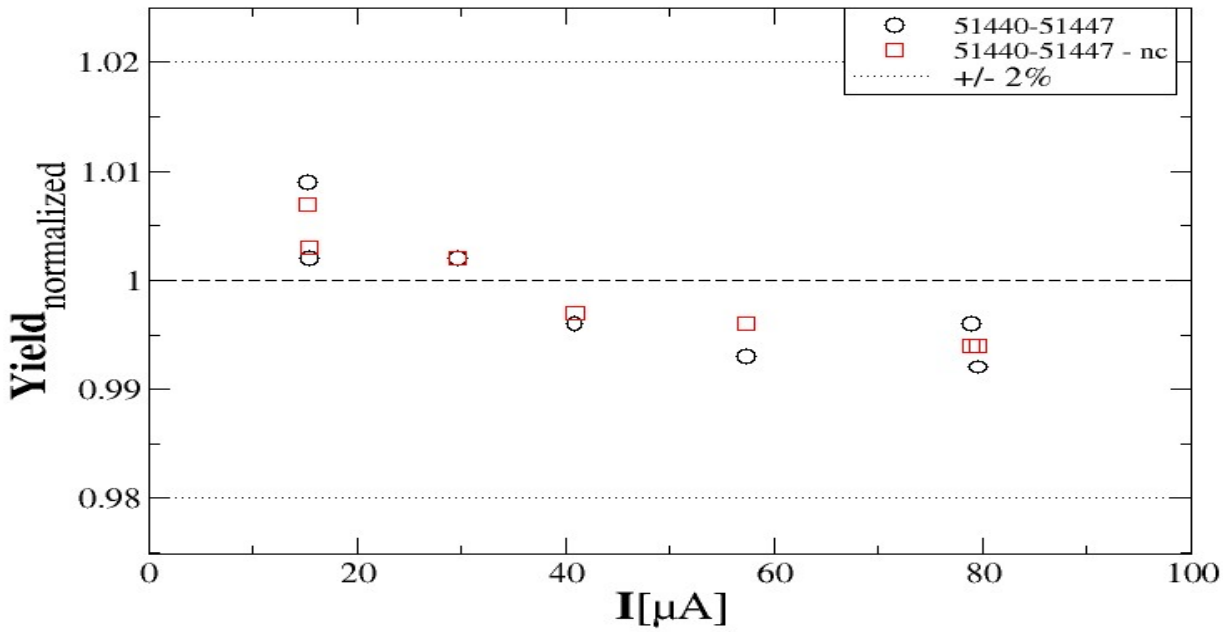


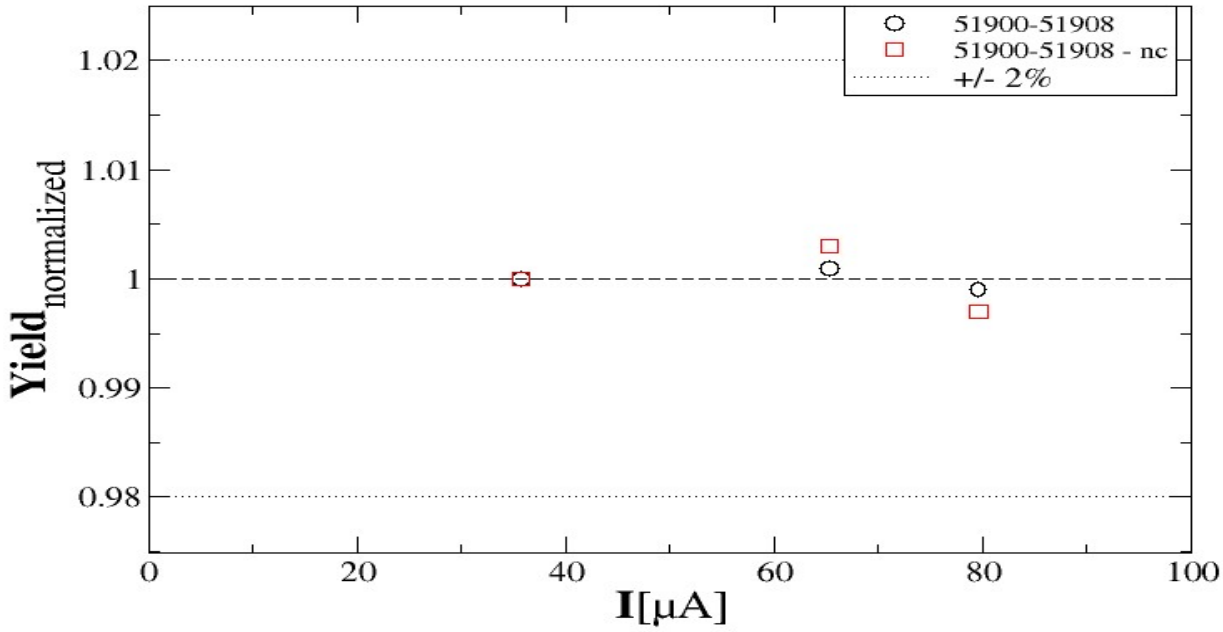


The two plots represent two different luminosity scan sets

Carbon test data

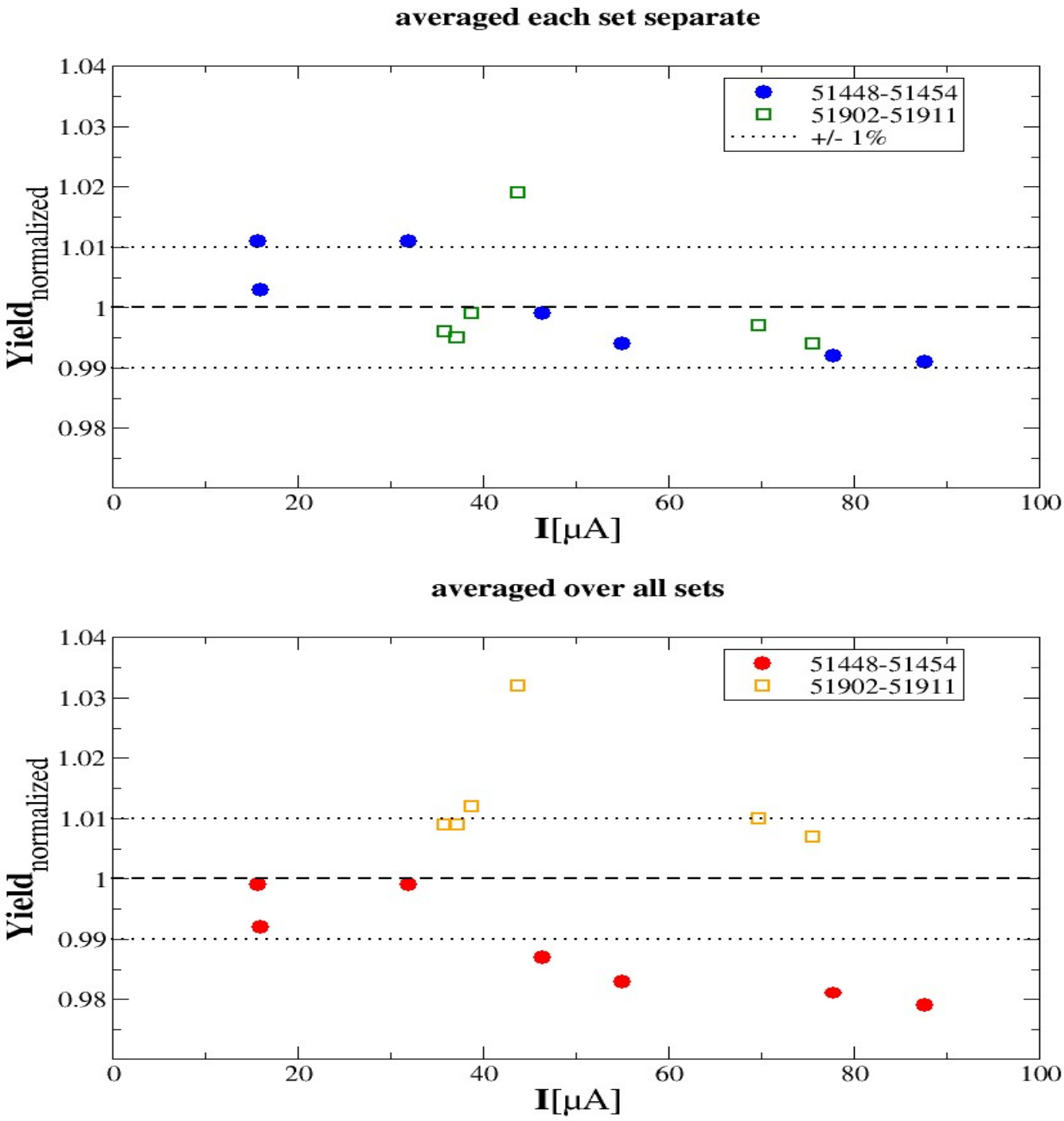
- Checking effects of cuts





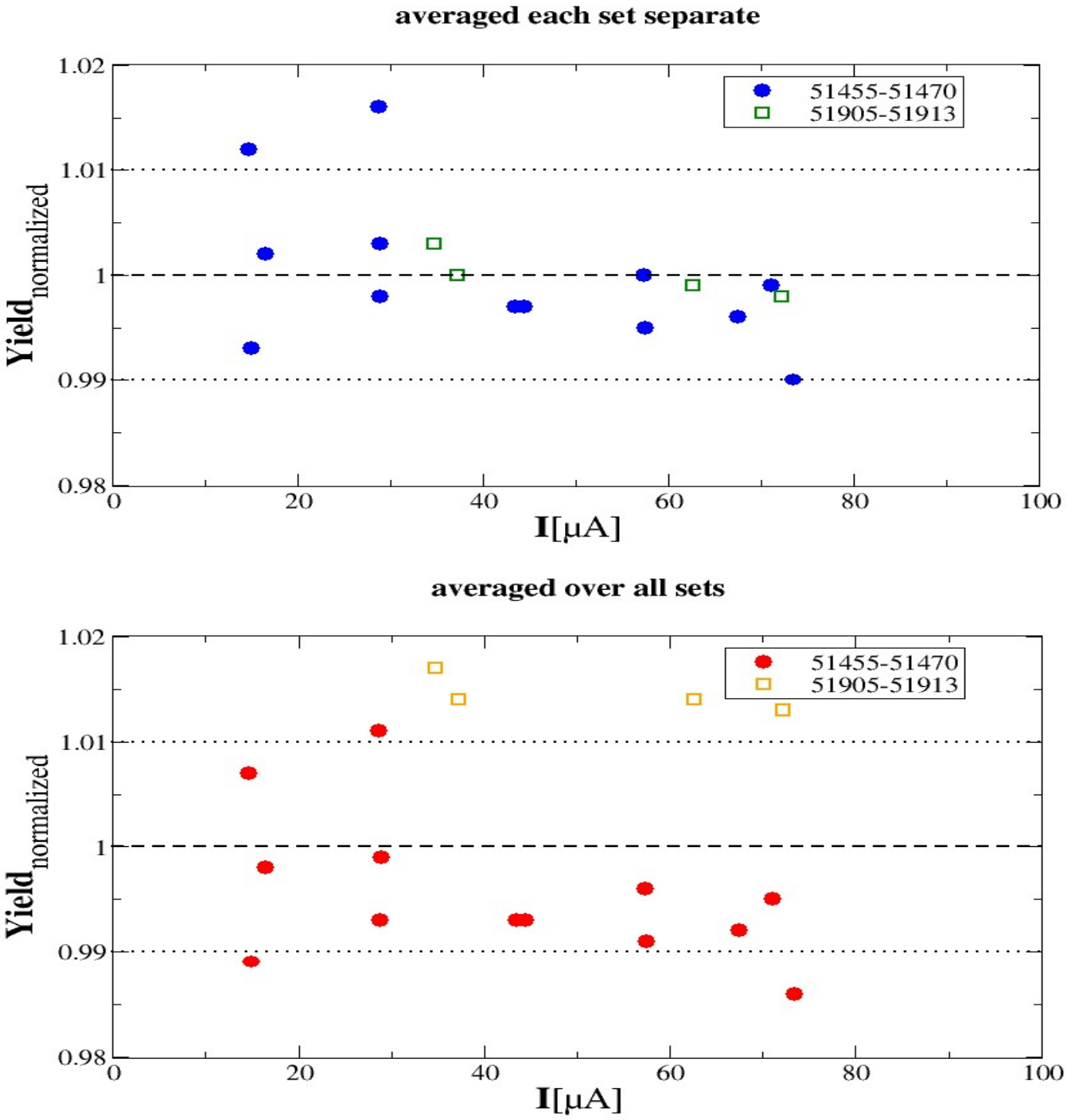
The two plots represent two different luminosity scan sets

Hydrogen



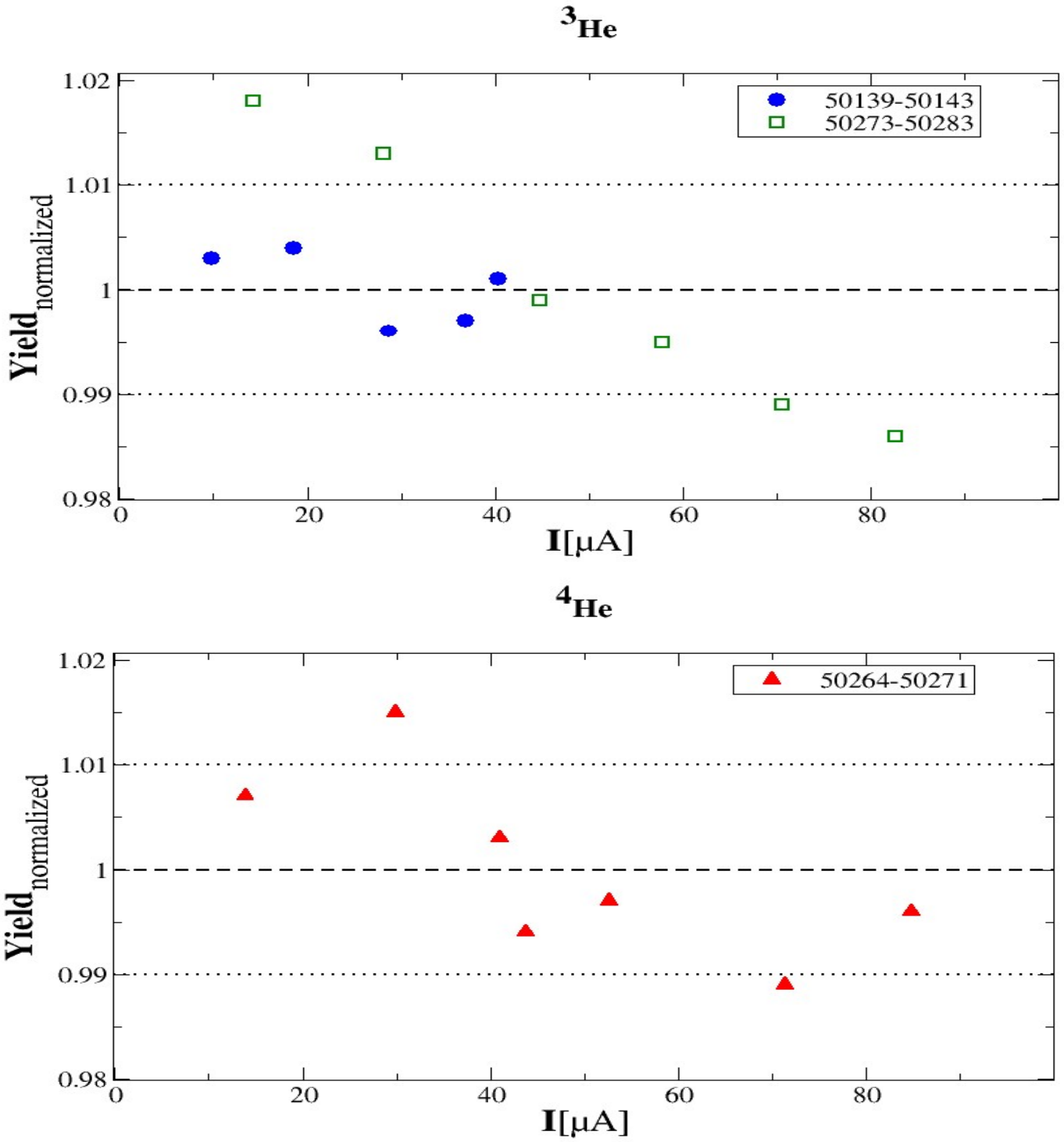
- The point at appr. 45 μA is ~3% off
- The black set drops off slightly

Deuterium



- Similar behavior like hydrogen
- 514.. runs have 2% less yield than 519.. runs

Helium



- ^{3}He and ^{4}He current dependencies similar to carbon test data
- 502.. runs with slope of ~ 4% / 100 μA

Conclusion

- The yield is in a range of $\sim 0.8\%$ when normalized to each set separate, else $\sim 1.5\%$
- Overall slope of about - 2% / $100\ \mu A$
- Not yet understood is the behavior of the yield for the carbon test data
  - Same effect for H, D and He
    - *No boiling effect seen (but cannot be excluded)*

Next steps

- Check efficiency dependence
- Use pions instead of electrons
- Where available compare HMS to SOS data
- Check current calibration (deviation from linear behavior)