Stat. uncertainties on positron rate

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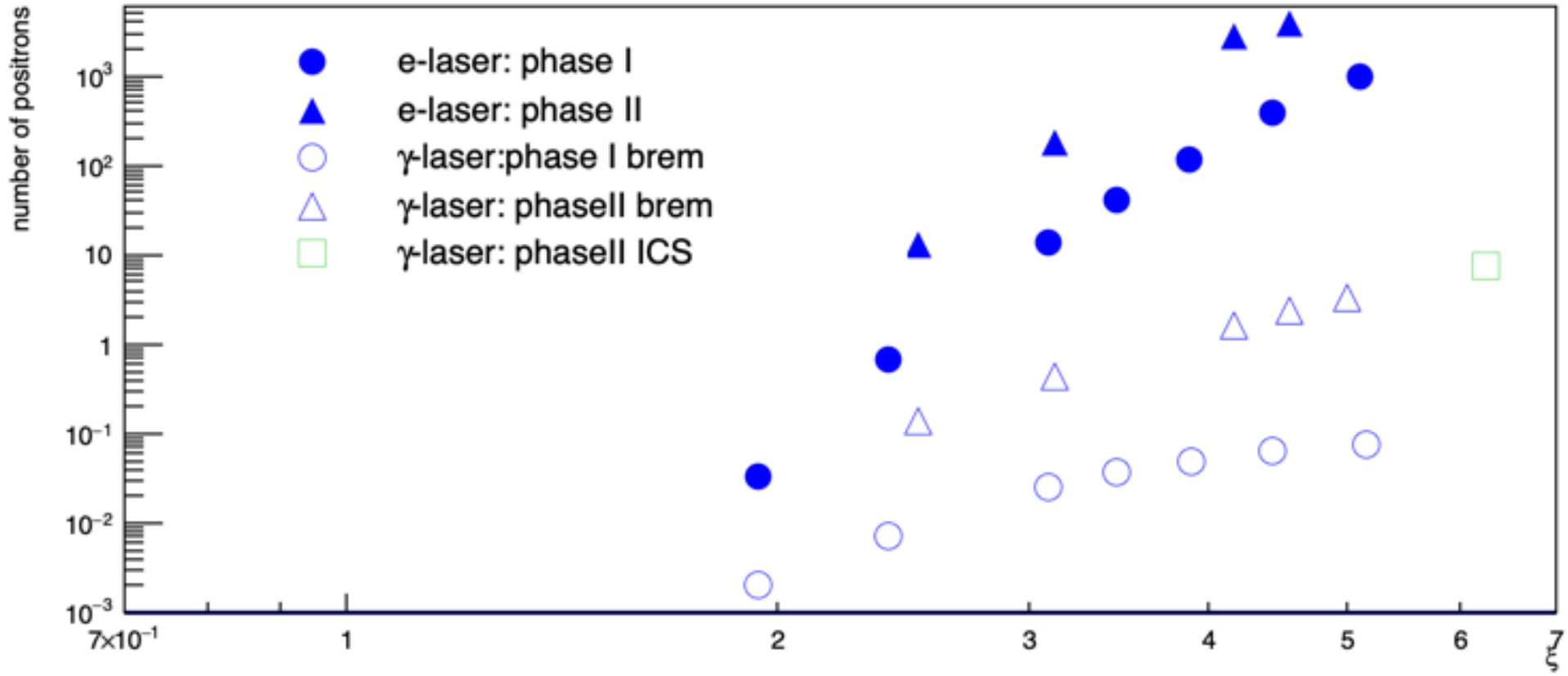
Statistics

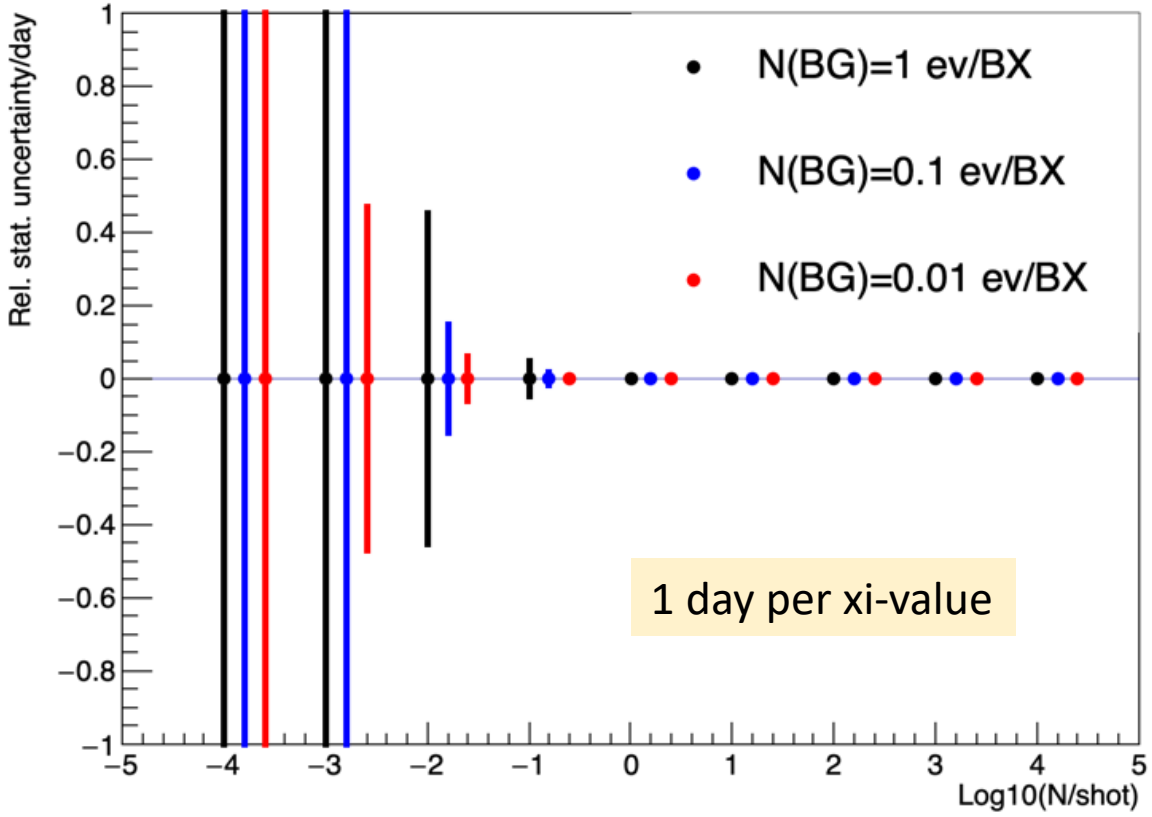
- Assume we take data for one day at a given xi value
  - 1 day=55000s (80% up-time and 80% efficiency and 24h)
  - Laser shot rate 1 Hz, BG rate: 9 Hz
- Calculate uncertainty assuming Ndata=Nsig+Nbg
  - Stat. uncertainty on Nbg based on 9 Hz of BG events
  - Stat. uncertainty on Ndata = sqrt(Ndata)
- Do calculation versus number of positrons per BX:
  - Assume signal rates between 10^-4 and 10^4
  - Assume backgrounds of 0.01, 0.1 and 1 per bunch crossing
- Assume signal efficiency is 100%
  - A bit optimistic ☺ but results will not change much with 90% => can plug in relevant number

Number of positrons / BC



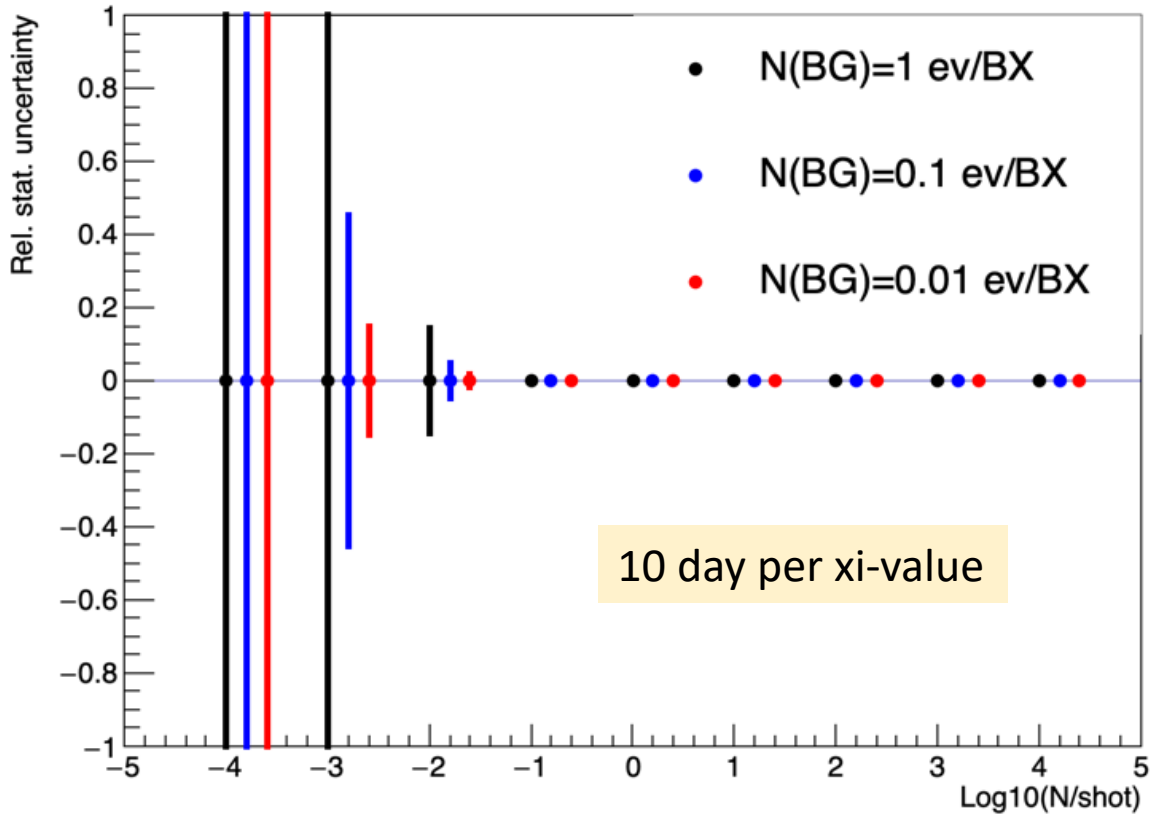
- With current statistics of MC: signal rates between 10^-3 and 5x10^3
- In my opinion we want to be sensitive for rates>10^-3

Uncertainties per day of data taking



- For N/shot=0.0001 unc.>100%
- For N/shot=0.001
  - N(BG)=0.01 => unc. =40%
  - Can increase N(day) to 10
    - N(BG)=0.1 => unc.=40%
    - N(BG)=0.01 => unc.=15%
- For N/shot>0: unc. <1% in all cases

Uncertainties per 10 days



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Conclusions

- We can achieve to measure rates of ~0.001 if we keep background <<0.1 events/BX
  - Otherwise we are limited by the background understanding
- This “background” is just the “beam only” background, i.e. not due to combinatorics in the signal.