Optical link prospects for Phase II Pixels

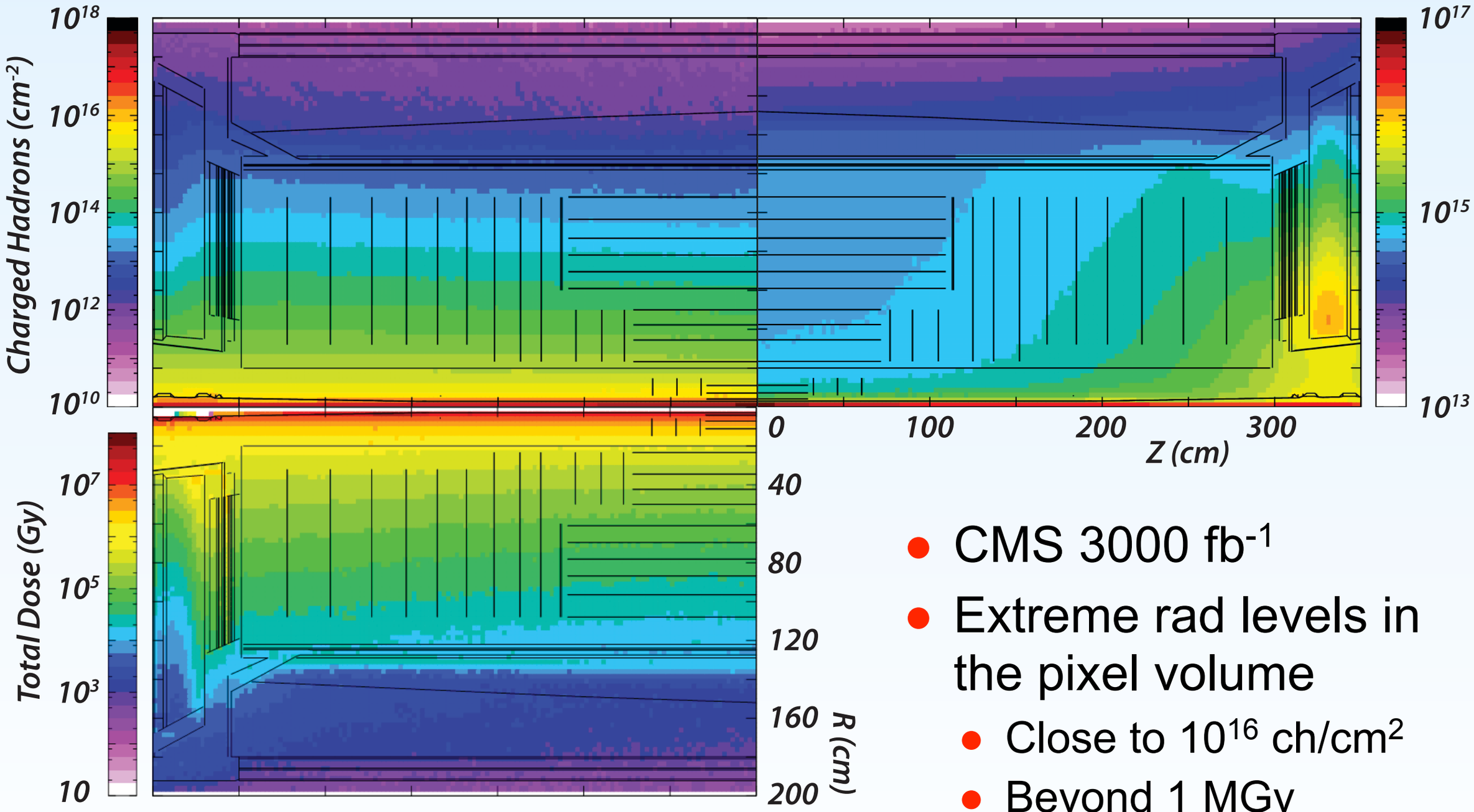
- Some remarks on the possibilities of using Optical Links in the innermost regions of CMS after LS3

- Radiation effects

- Power dissipation

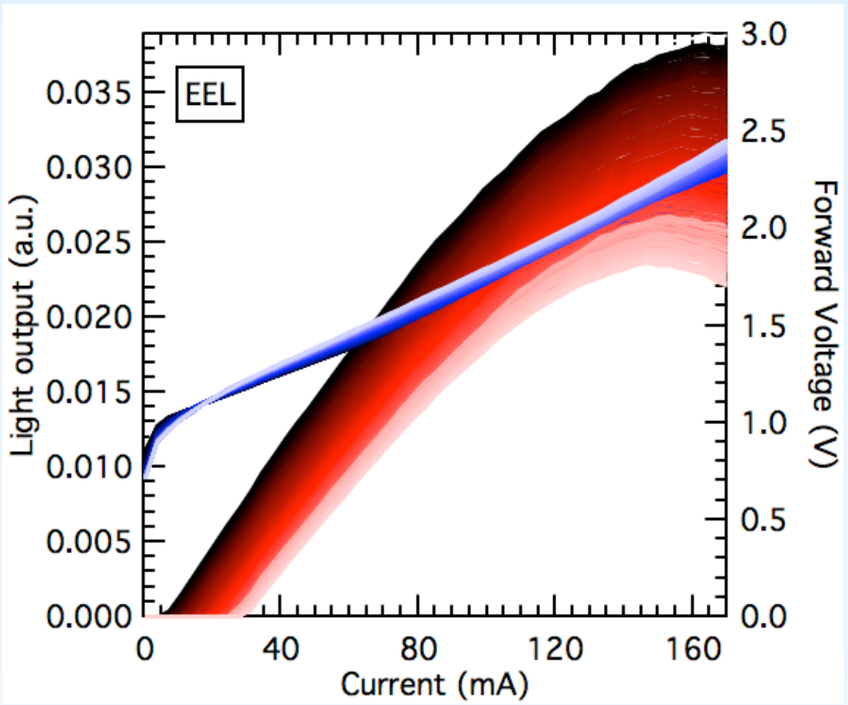
- Size

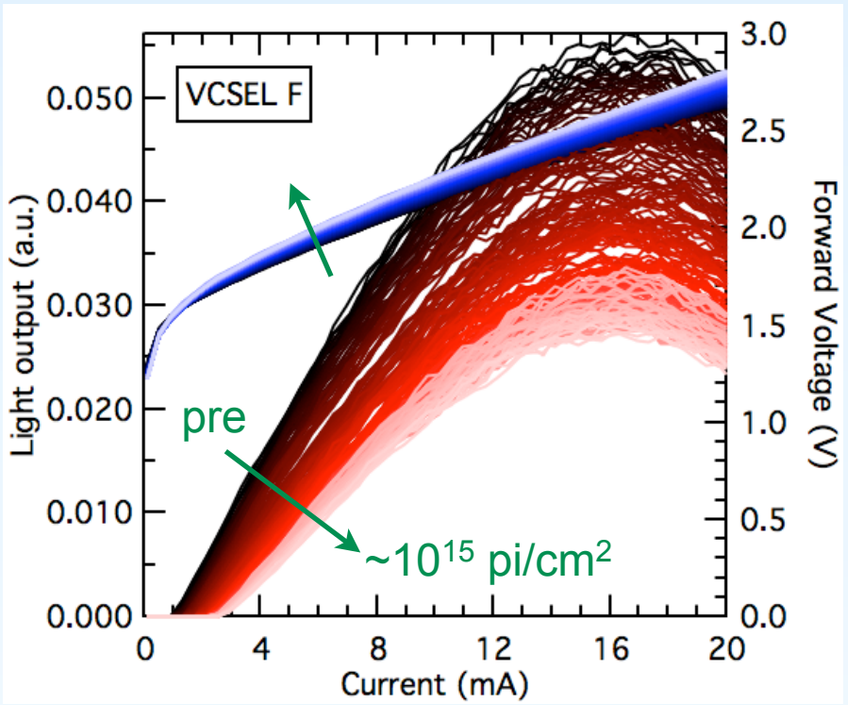
Radiation levels

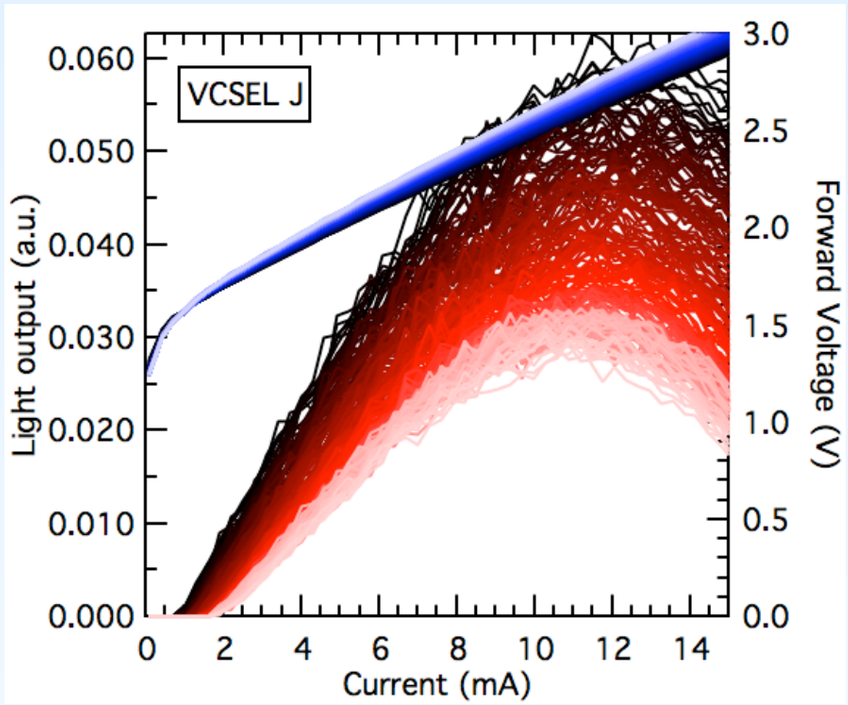


- CMS 3000 fb^{-1}
- Extreme rad levels in the pixel volume
  - Close to 10^{16} ch/cm^2
  - Beyond 1 MGy
  - Several 10^{15} n/cm^2

Lasers

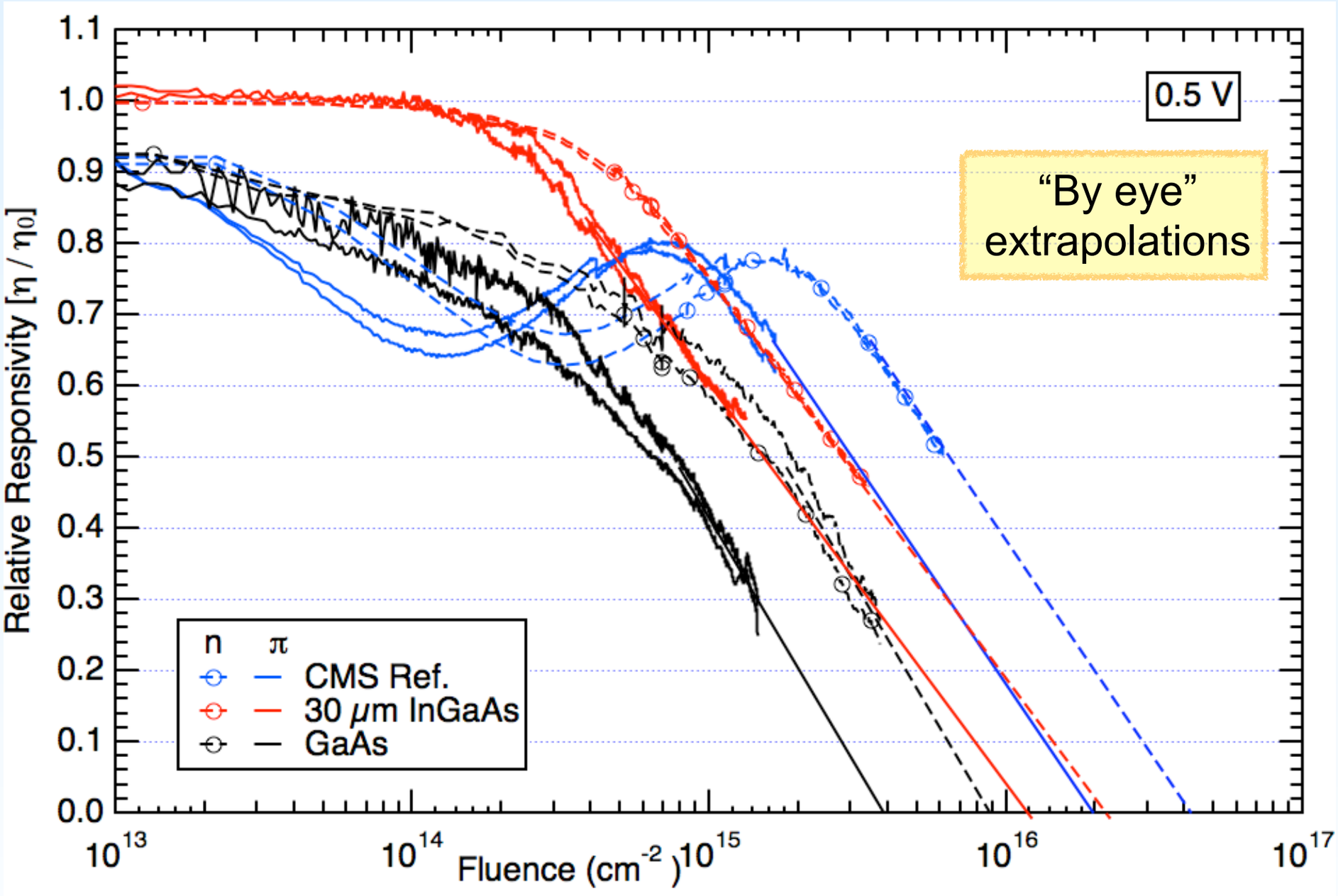






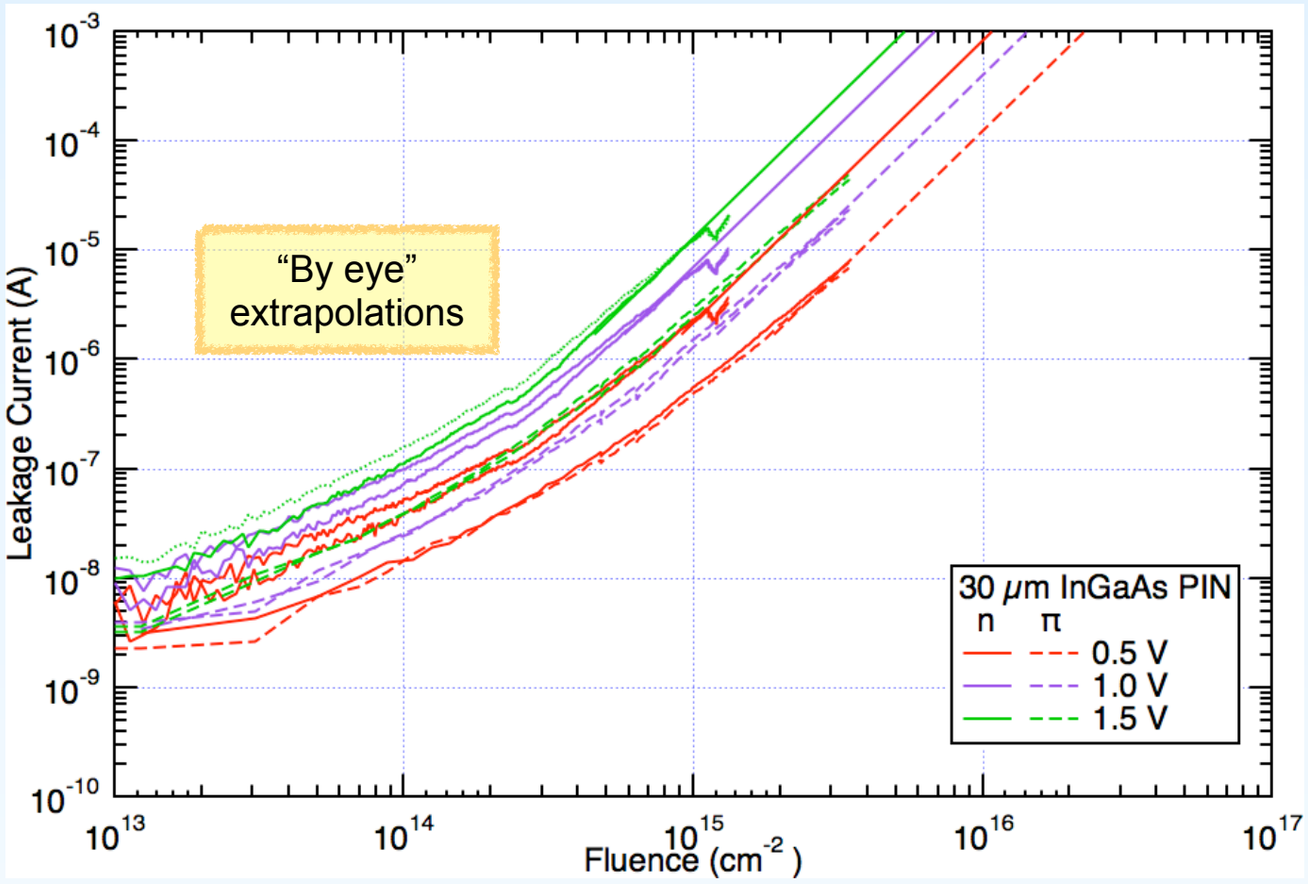
- By eye, might assume lasers could survive “a few” 10^{15} /cm^2
  - Need to be able to track threshold changes
  - Deal with output amplitude degradation in link budget
- Annealing helps a bit
  - Gain a factor of two in reduction of damage at SLHC fluxes

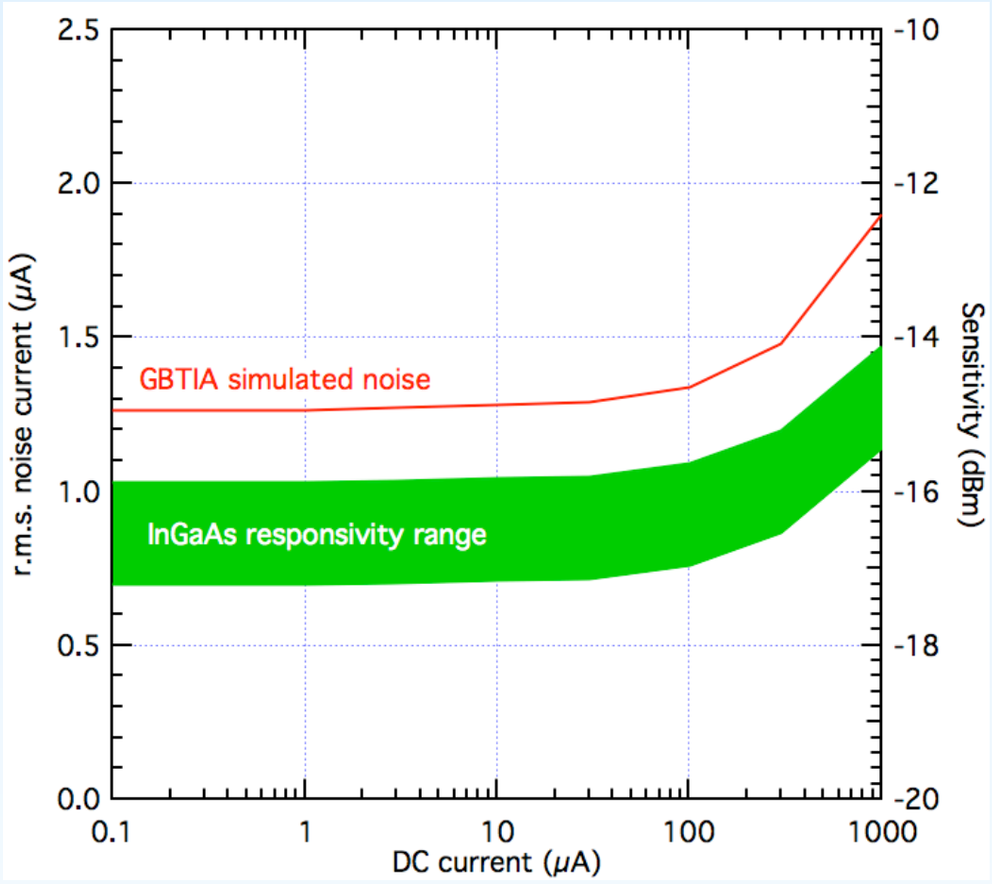
Impact of PD Responsivity loss



- GaAs non-functional after around 4×10^{15} pi/cm^2
- InGaAs non-functional after around 10^{16} pi/cm^2
- No annealing

Impact of PD Leakage Current





Reminder: no leakage in GaAs devices

- 1 mA leakage current adds 1.7 dB sensitivity penalty
- Not clear that removal of DC-current is possible beyond this?

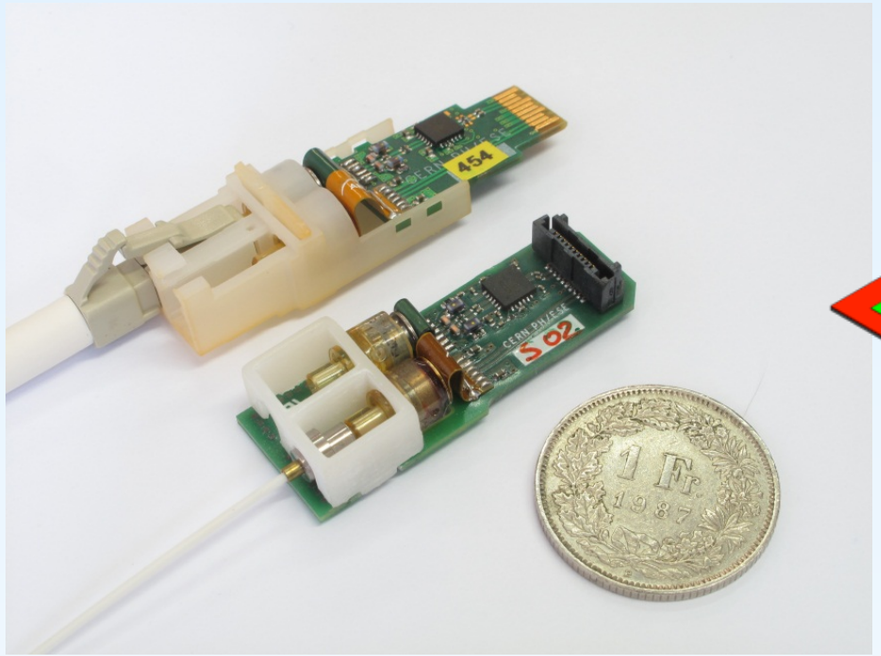
Power Dissipation

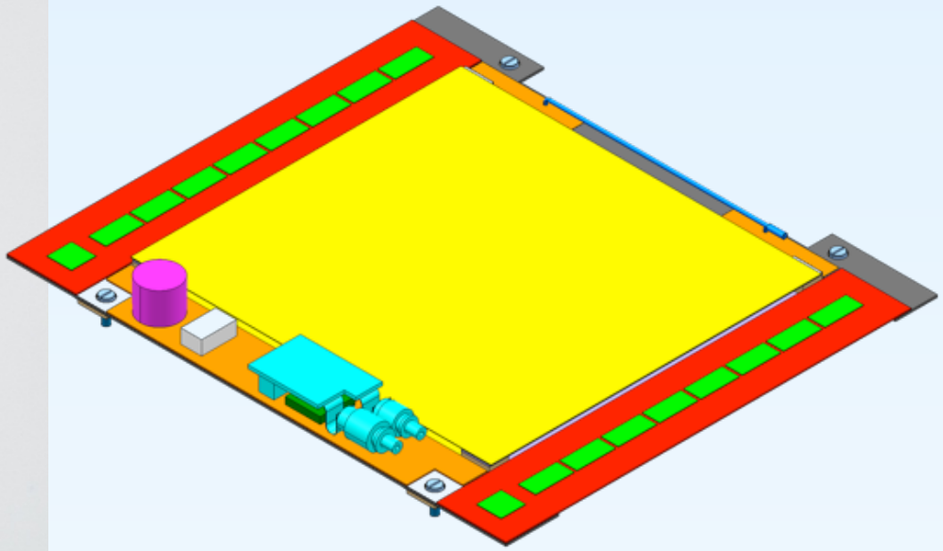
- Current Versatile Link modules (5 Gb/s)
  - Tx draws approx. 100 mA from 2.5 V
  - Rx draws approx. 50 mA from 2.5 V

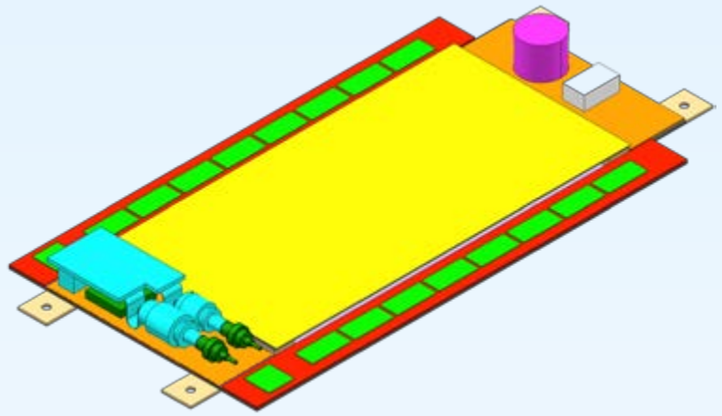
Call it 400 mW per TRx

- Prospect of reducing this by factor of 2 seems do-able
  - Need to work much harder on ASIC and finding a lower-power component to find further factors of reduction
  - To be checked with further iterations of laser driver ASICs

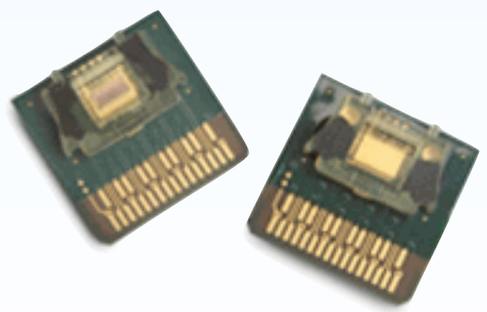
Size







- Could perhaps fit components packaged in industry std. size packages for Tracker 2S (and PS) modules
- Further size reduction requires custom packaging effort
  - To be pursued within VL+ follow-up project
- Only cost-effective with volume



Discussion

- Are there new technologies out there that promise to be significantly more rad hard, smaller and lower power?

- Do we have to push the opto-electronics out of the innermost regions?

- Other mitigation strategies?