



The LUXE experiment

Strong-field QED physics
LUXE experiment and opportunities
Current status

Strong-field QED

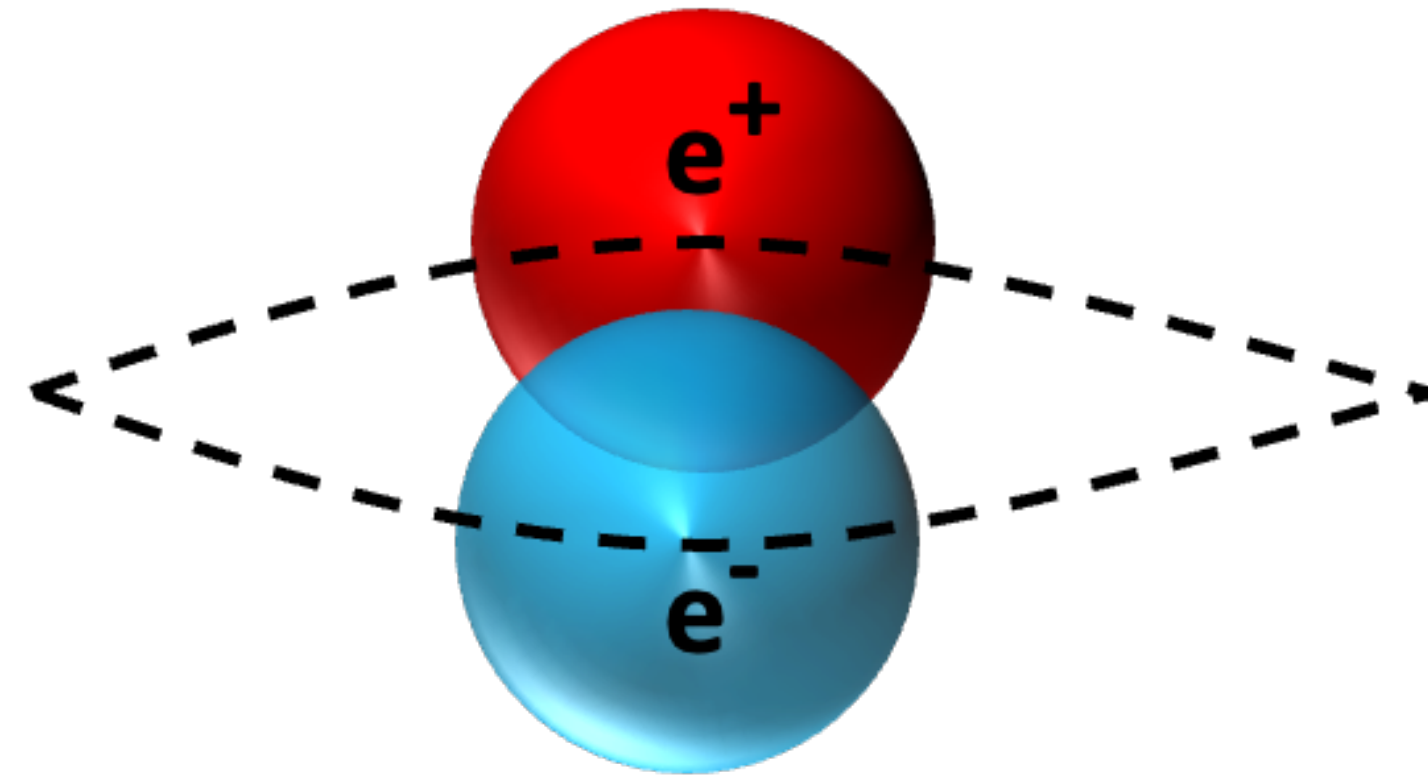
How strong is strong ?

Critical field or Schwinger limit:

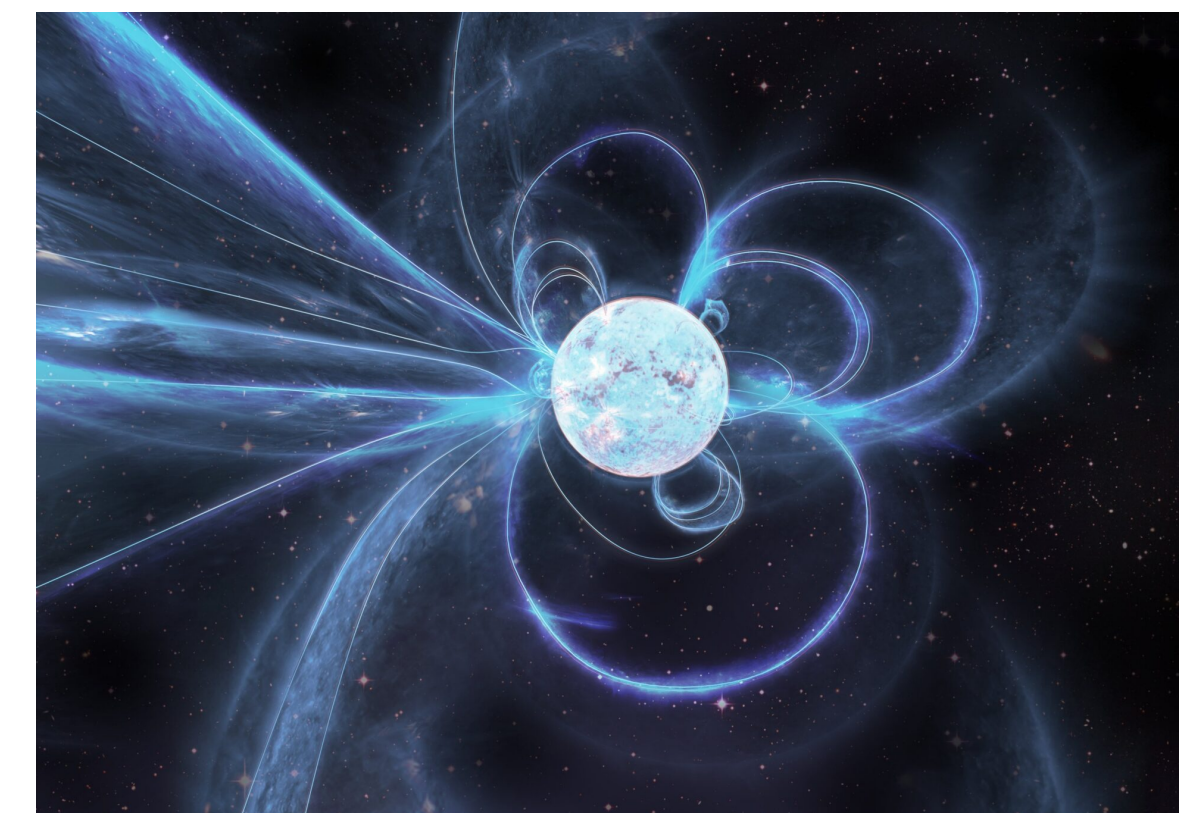
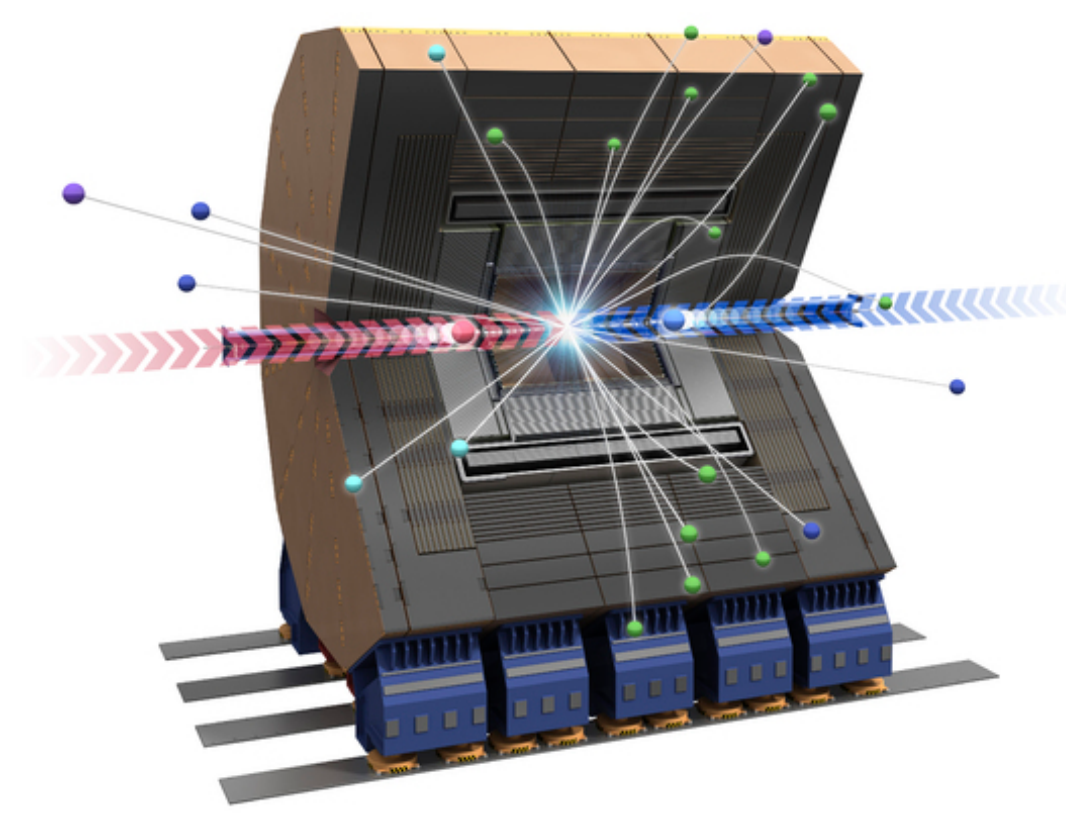
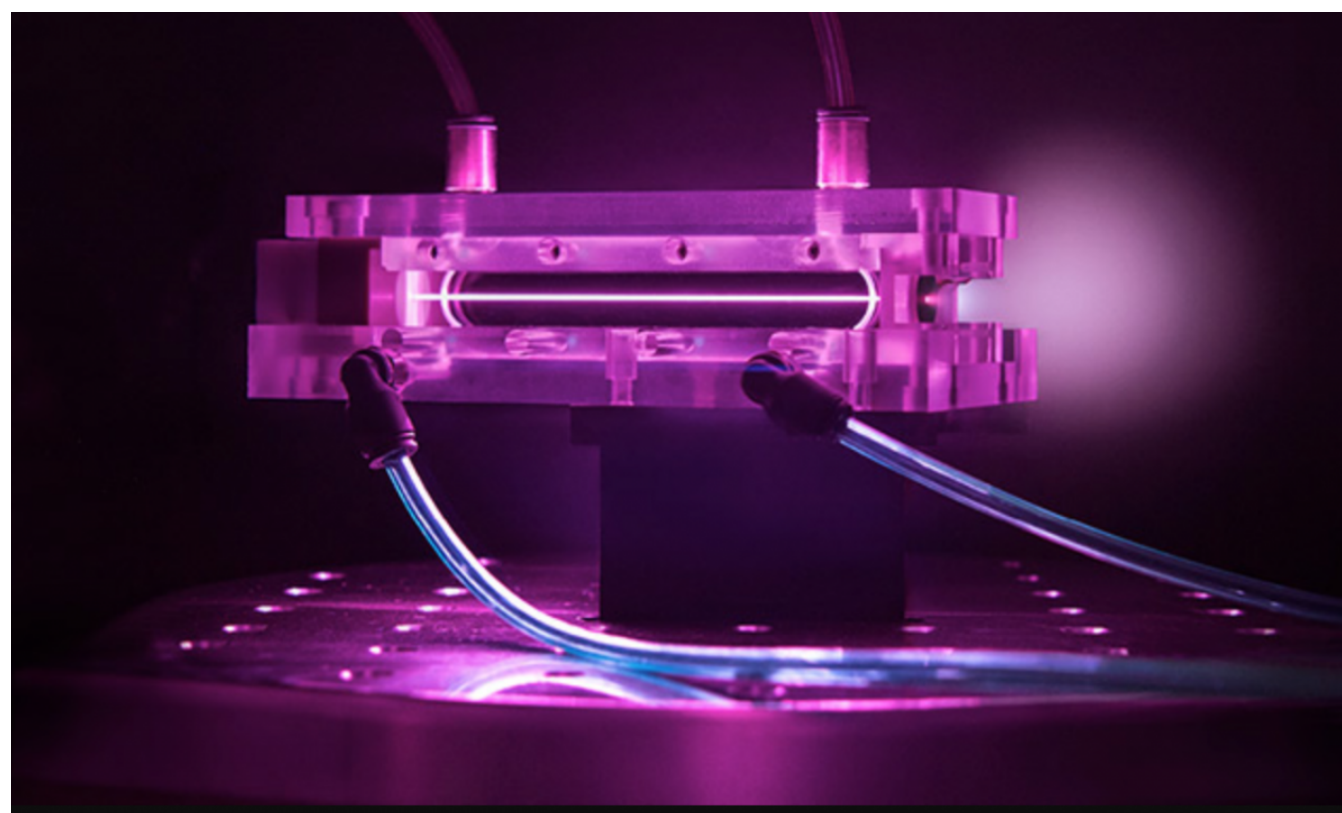
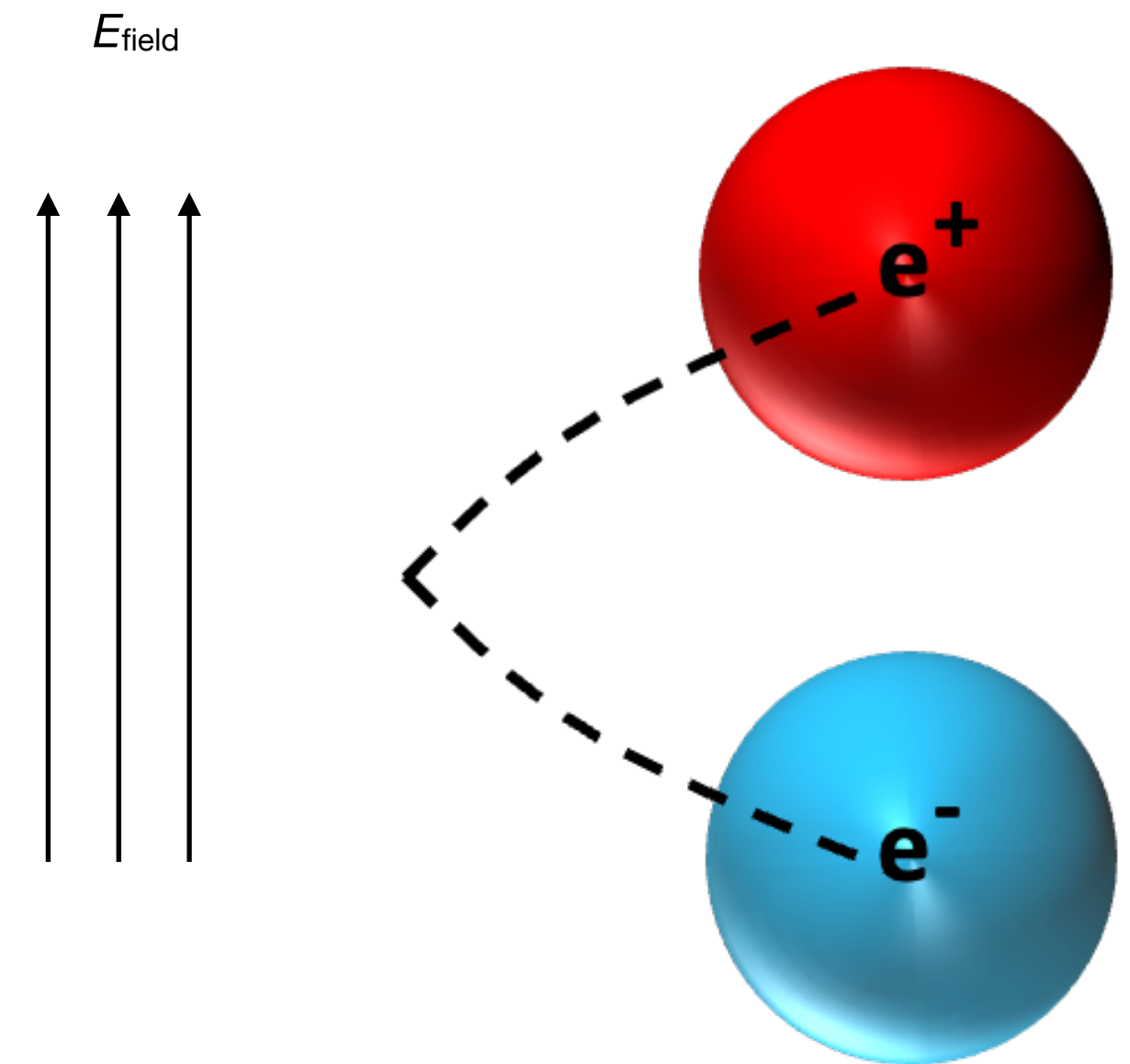
$$E_{\text{crit}} = \frac{mc^2}{e\hbar} = \frac{m^2 c^3}{e\hbar} = 1.3 \times 10^{16} \text{ V/cm}$$

Never achieved to date !
10,000× greater than
world's largest lasers.

Weak field
 $E_{\text{field}} < E_{\text{crit}}$



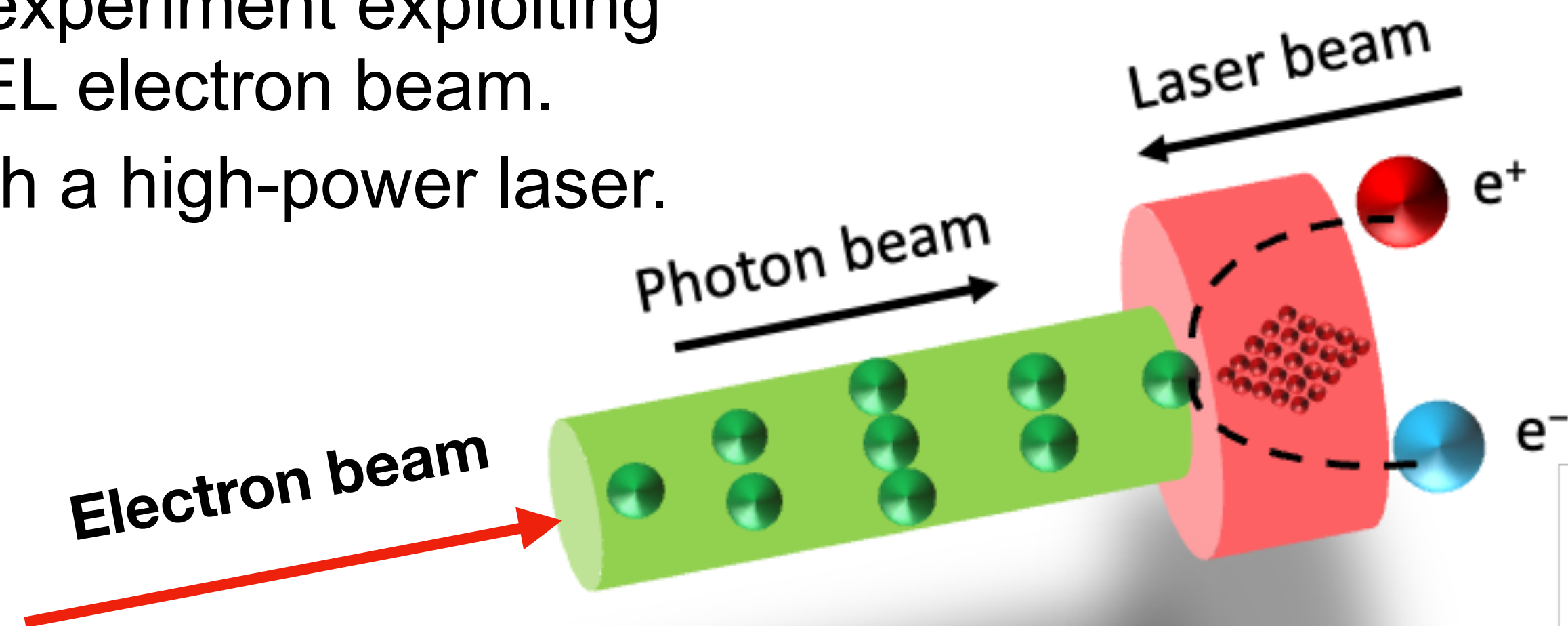
Strong field
 $E_{\text{field}} > E_{\text{crit}}$



Strong-field QED

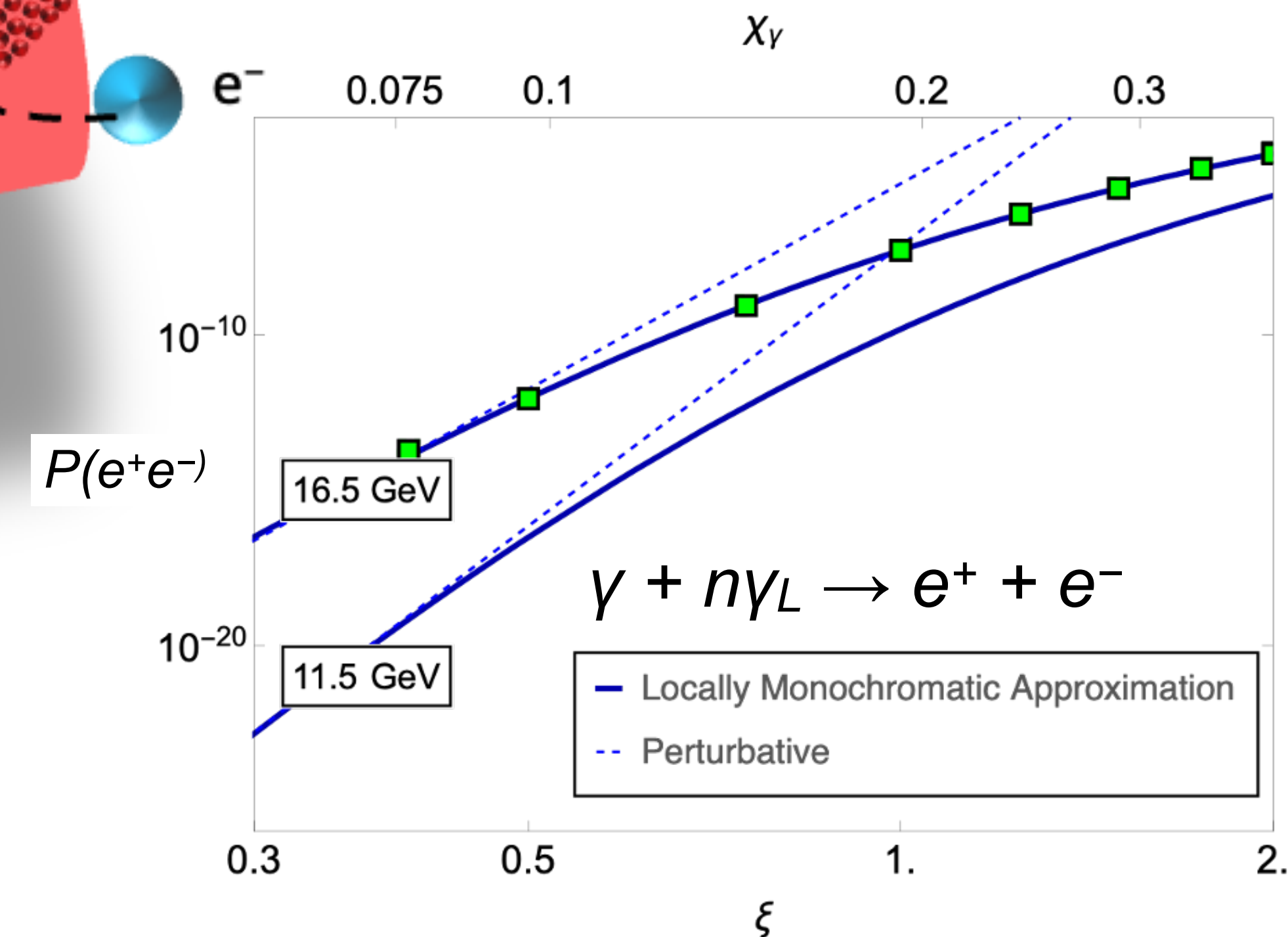
What we want to measure

- LUXE: Laser Und XFEL Experiment
 - A proposed new experiment exploiting the European XFEL electron beam.
 - In conjunction with a high-power laser.
- Investigate QED in new parameter space
 - E.g. transition to non-linear QED →
 - With high precision and control.



Boosted frame

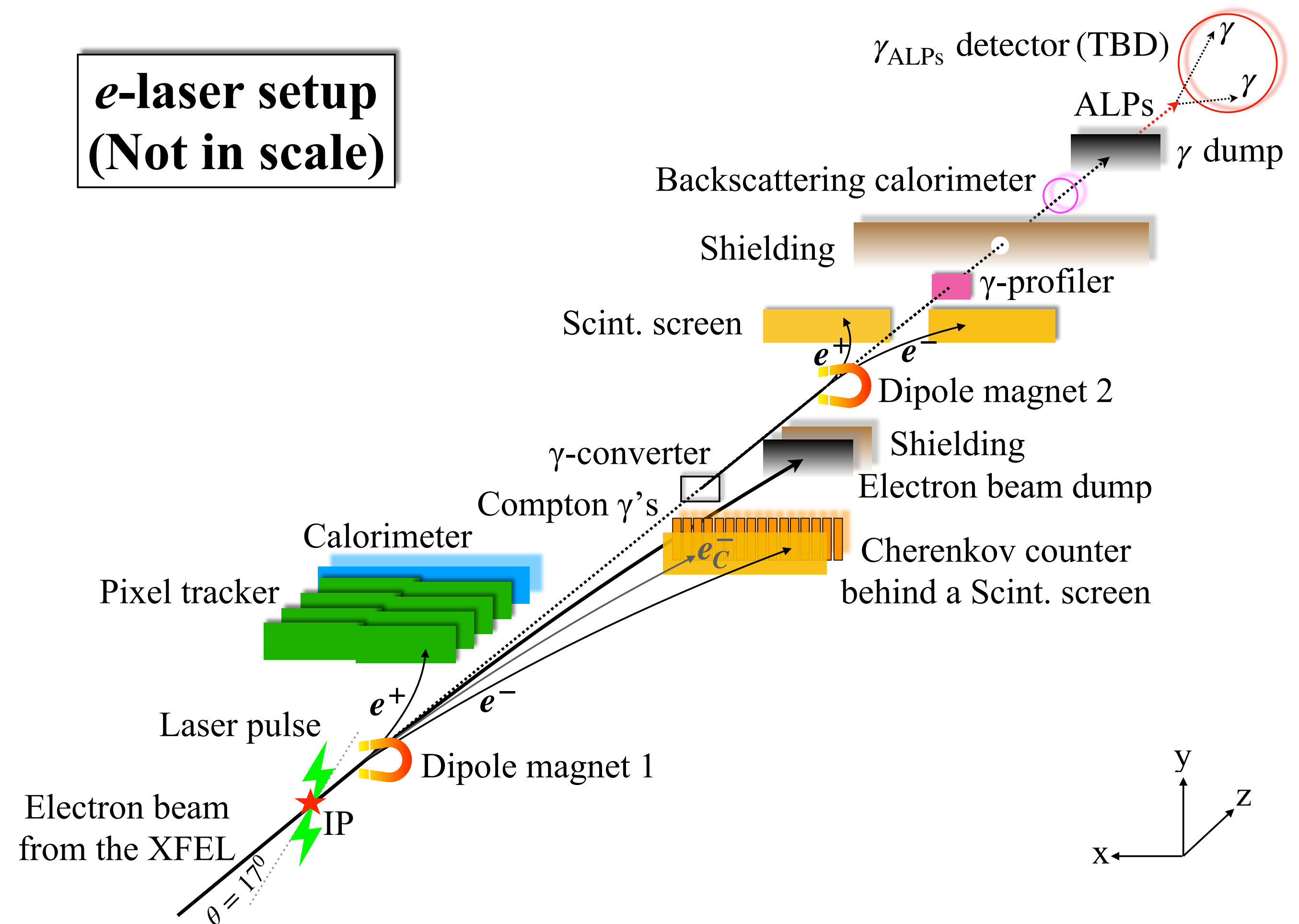
- Critical field can be reached with relativistic length contraction.



Experimental layout and possibilities

Key features

- Also γ -laser mode.
- Note ALPs physics programme
 - From high photon flux.
- As host, DESY's role significant.
- Also many opportunities...

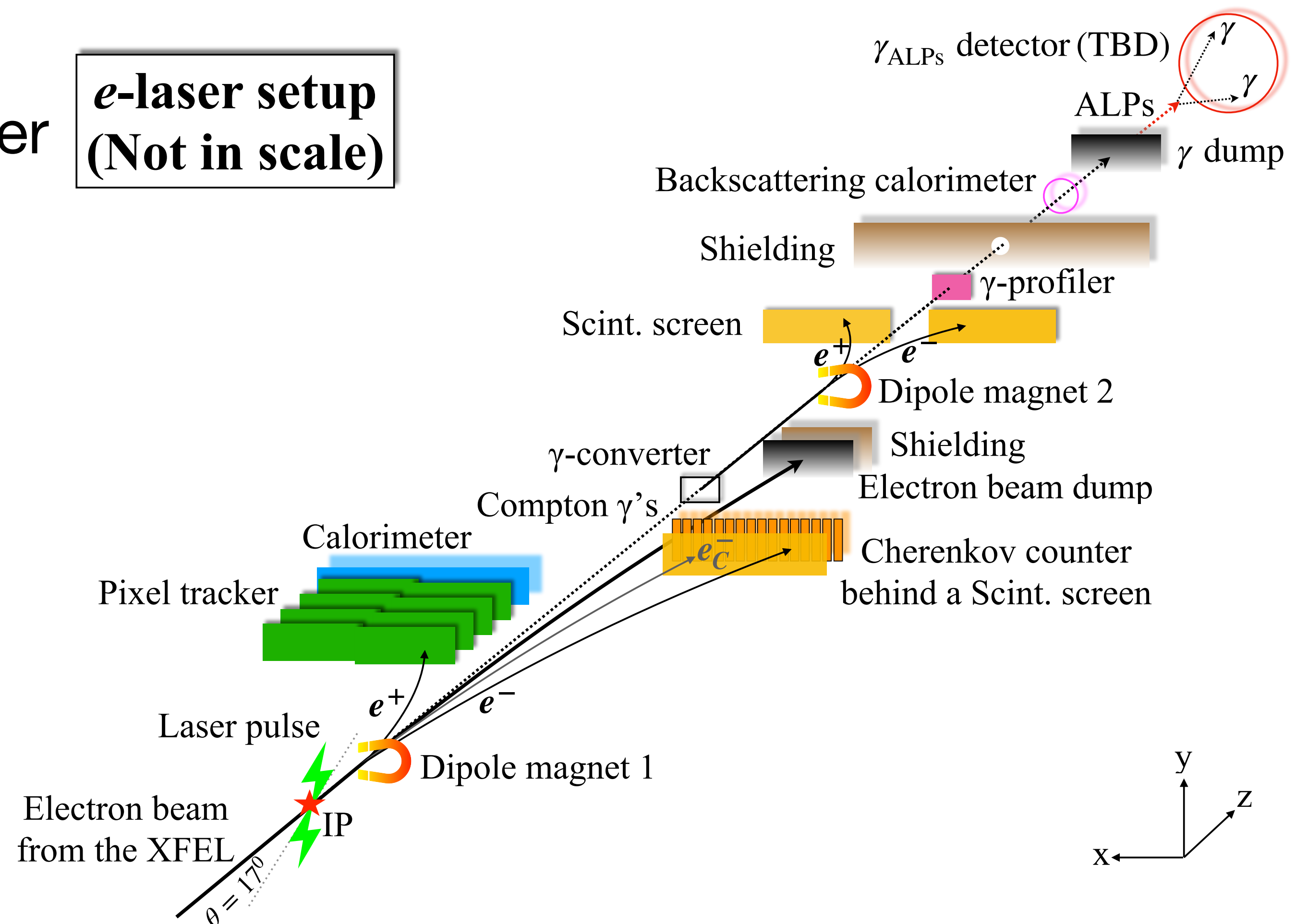


Experimental opportunities

where DESY could be/is involved

- Laser and collaboration with M.
- Pixel tracker upgrade: timing, higher occupancy, diSiPMs.
- Cherenkov detector development.
- Backscattering calorimeter.
- ALPs detector.
- Computing and software.
- ...

e-laser setup
(Not in scale)



Current status

- ELBEX has given project a real boost: possible commissioning in 2029 and LUXE data 2030 onwards.
- Possible (PW) laser as part of EuXFEL fusion programme; JETI40 laser (10+ TW) from Jena in Hall West. Also big boost to the project.
- The PoF V funding period fits in very well with LUXE development and exploitation.
 - **Plenty of opportunities for strong DESY FH contributions that are novel.**
 - **Data taking encompassing a significant fraction of the funding period.**