LUXE

LOI status and some news

Beate Heinemann (DESY and University of Freiburg)

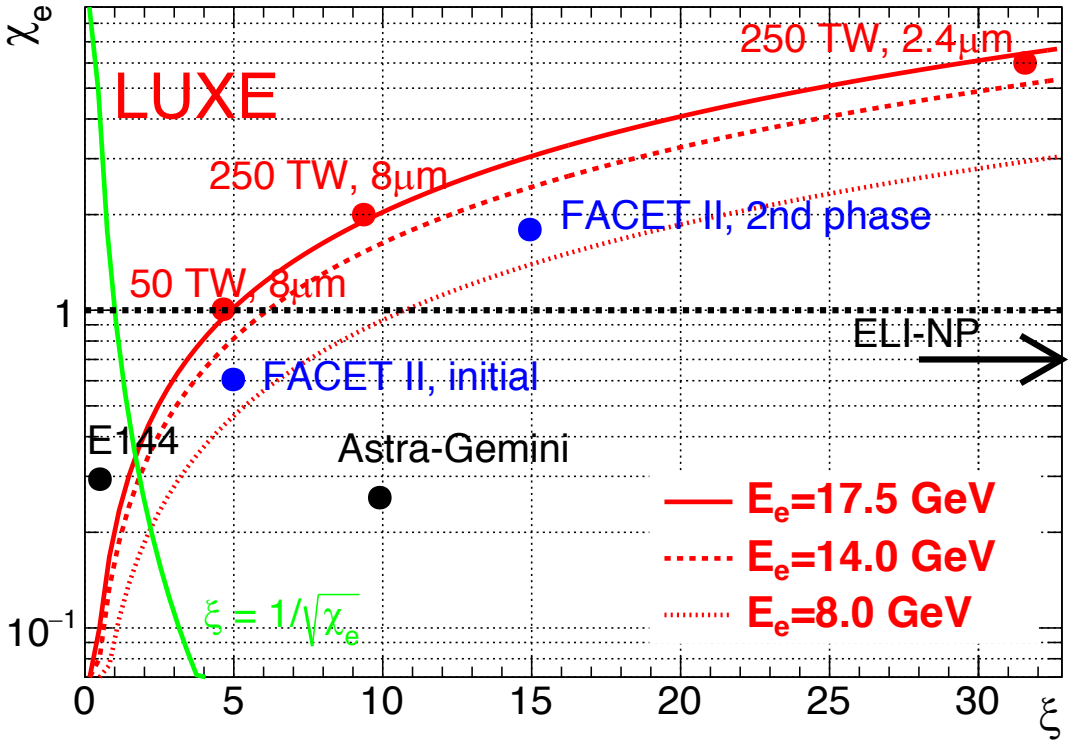
June 18th 2019

COMMENTS

- **Received “major” comments**
  - Primarily on Science Case. Andreas will work through in the next days (consider all of them and sharpen the text and make sure it is correct)
    - Will adapt Executive Summary accordingly afterwards
  - Otherwise no major comments on the main body
  - Note: Appendices will *not* be part of LOI. They are just for our own information.
- **Several updates since the distribution of LOI**
  - See next slides

SCIENCE CASE

- **Made new version of plot**
  - Added point for 50 TW laser
  - Added line to indicate $\xi \geq \frac{1}{\sqrt{\chi_e}}$ to indicate where approximation is valid



if one assumes complete screening.[6] This results, at high laser intensities, $\xi \gtrsim 1/\sqrt{\chi_e} \gg 1$, in the non-perturbative, $e^{-8/(3\chi_e)}$ dependence of the laser-assisted BPPP rate,

$$\Gamma_{\mathrm{BPPP}} \to \frac{\alpha\, m_e^2}{E_e}\, \frac{9}{128}\sqrt{\frac{3}{2}}\, \chi_e^2\, e^{-\frac{8}{3\chi_e}\left(1-\frac{1}{15\xi^2}\right)}\, \frac{X}{X_0}\,, \quad (14)$$

ressembling the behavior of the laser-assisted OPPP rate, Eqs. (4) and (9), if one replaces in the latter expression χ_γ by χ_e. Therefore, the Schwinger critical field can be inferred from the asymptotic behavior of laser-assisted BPPP for high laser intensities,

$$\Gamma_{\mathrm{BPPP}} \to \frac{9}{128}\sqrt{\frac{3}{2}}\, \alpha\, E_e\, (1+\cos\theta)^2 \left(\frac{|\mathbf{E}|}{\mathrm{E}_c}\right)^2 \exp\left[-\frac{8}{3}\frac{1}{1+\cos\theta}\frac{m_e}{E_e}\frac{\mathrm{E}_c}{|\mathbf{E}|}\right]\frac{X}{X_0}$$

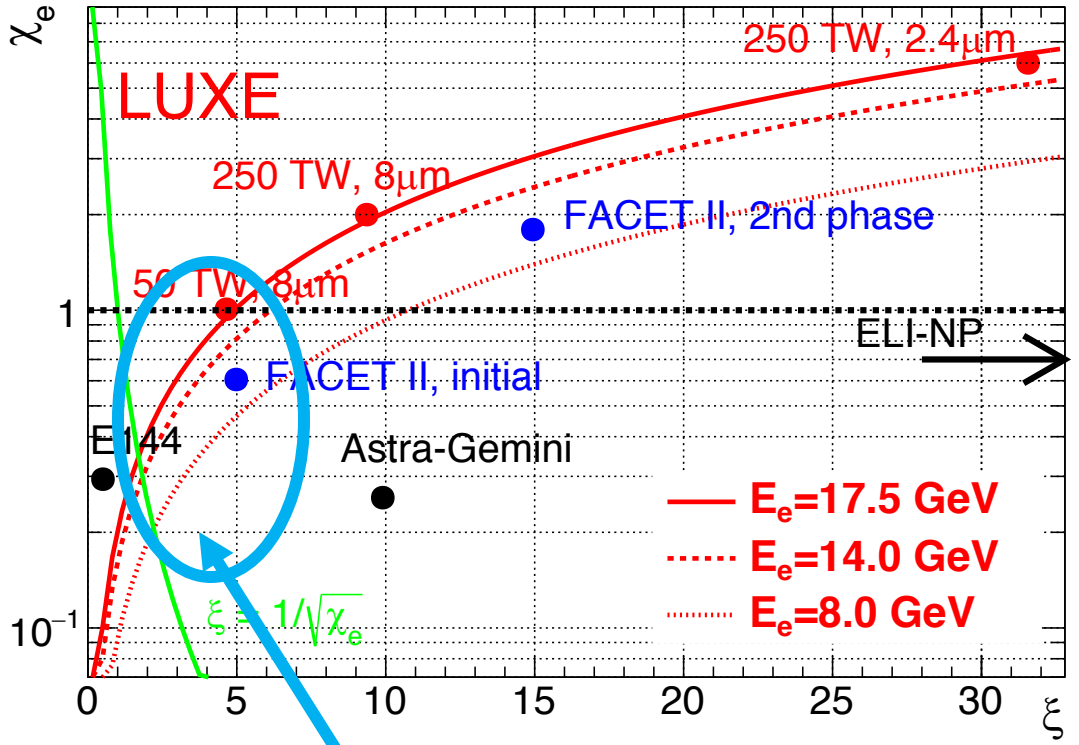
SCIENCE CASE

- **Made new version of plot**
  - Added point for 50 TW laser
  - Added line to indicate $\xi \geq \frac{1}{\sqrt{\chi_e}}$ to indicate where approximation is valid

if one assumes complete screening.[6] This results, at high laser intensities, $\xi \gtrsim 1/\sqrt{\chi_e} \gg 1$, in the non-perturbative, $e^{-8/(3\chi_e)}$ dependence of the laser-assisted BPPP rate,

$$\Gamma_{\mathrm{BPPP}} \to \frac{\alpha\, m_e^2}{E_e}\, \frac{9}{128}\sqrt{\frac{3}{2}}\, \chi_e^2\, e^{-\frac{8}{3\chi_e}\left(1-\frac{1}{15\xi^2}\right)}\, \frac{X}{X_0}\,, \quad (14)$$

ressembling the behavior of the laser-assisted OPPP rate, Eqs. (4) and (9), if one replaces in the latter expression χ_γ by χ_e. Therefore, the Schwinger critical field can be inferred from the asymptotic behavior of laser-assisted BPPP for high laser intensities,



Most relevant region for this aspect

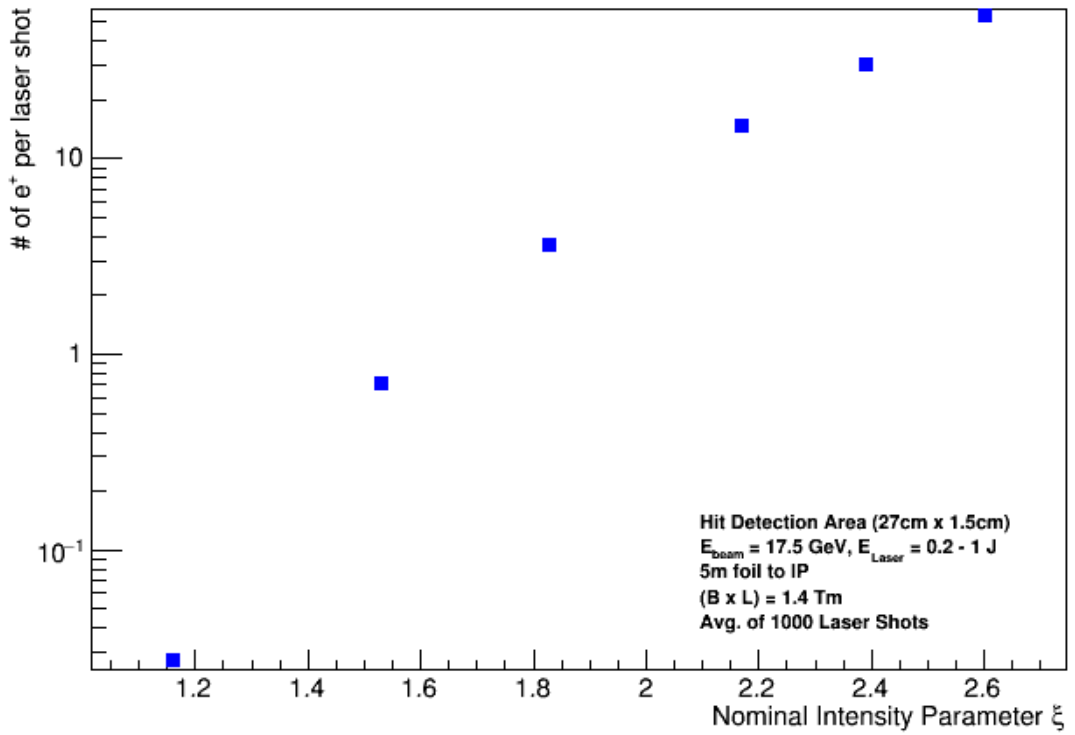
$$\Gamma_{\mathrm{BPPP}} \to \frac{9}{128}\sqrt{\frac{3}{2}}\, \alpha\, E_e\, (1+\cos\theta)^2 \left(\frac{|\mathbf{E}|}{\mathrm{E}_c}\right)^2 \exp\left[-\frac{8}{3}\frac{1}{1+\cos\theta}\frac{m_e}{E_e}\frac{\mathrm{E}_c}{|\mathbf{E}|}\right] \frac{X}{X_0}$$

BACKGROUNDS

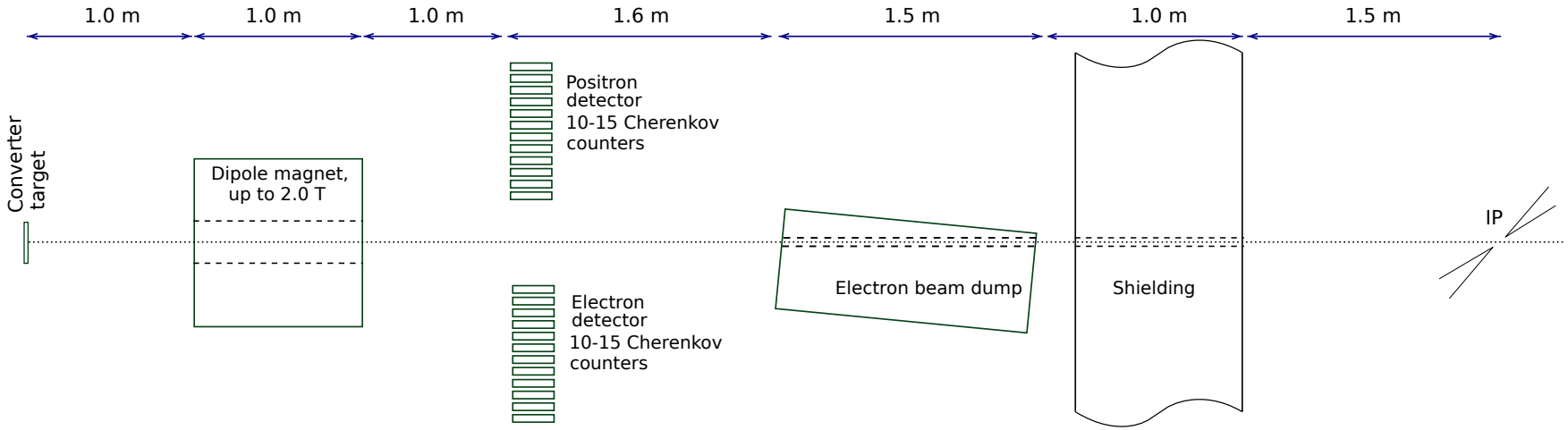
Significant progress in design of experimental setup to minimize backgrounds

- See talks by Gianluca and Sasha later
- Simulation size not sufficient yet to claim sensitivity at 0.1-particle level but in progress
  - I think this should be our goal

0.1 particle



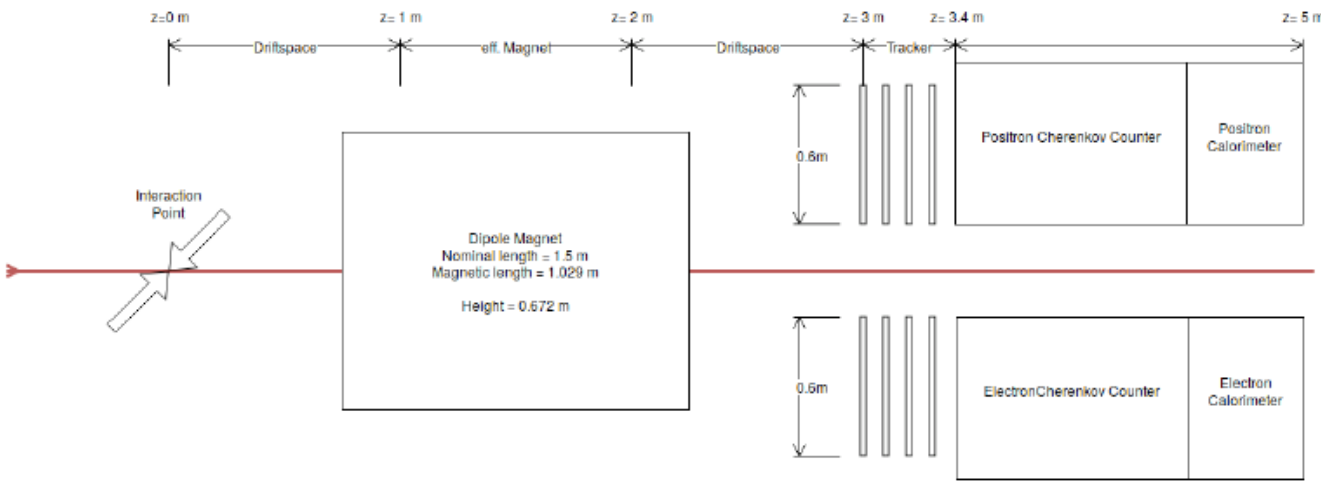
CHERENKOV DETECTORS

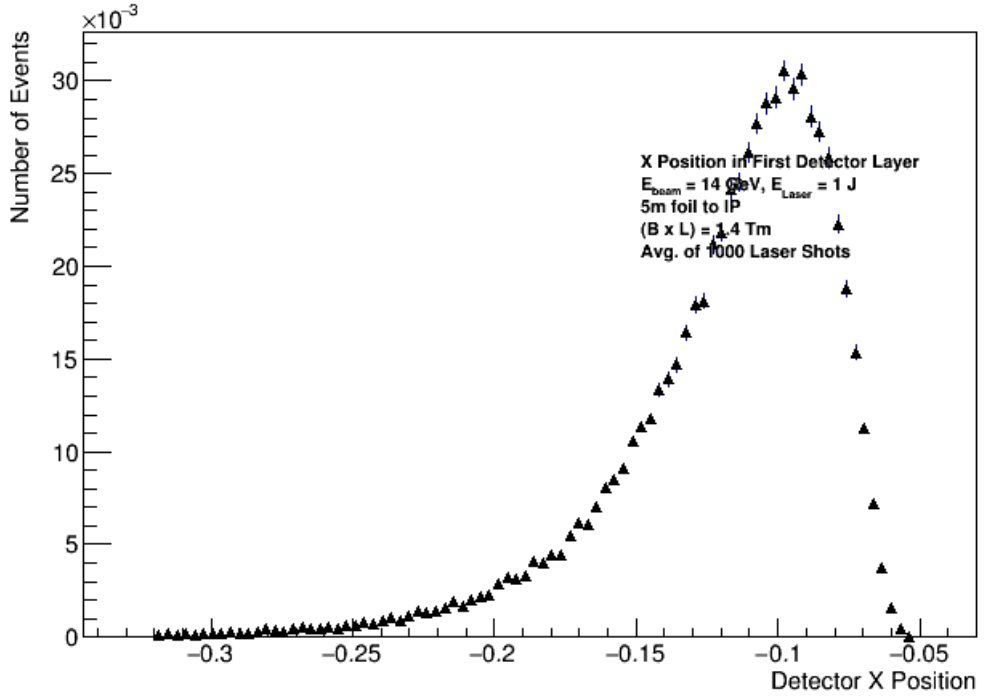


From J. List

- **Cerenkov detectors for monitoring photon flux (based on e+ and e-)**
- **Prototype developed for polarimeters for ILC**
  - Linear response over dynamic range of ~1000
  - Size: 1x1 cm2 (can be adapted but seems reasonable, see talk by Matthias Saimpert later)
  - Cost per channel ~4k€ +10 k€ per detector
- **One detectors with 20 counters per side costs ~90k € total**
  - Could also consider them as part of photon detection system where fluxes are also high

DETECTORS BEHIND IP (FOR PHOTON BEAM)



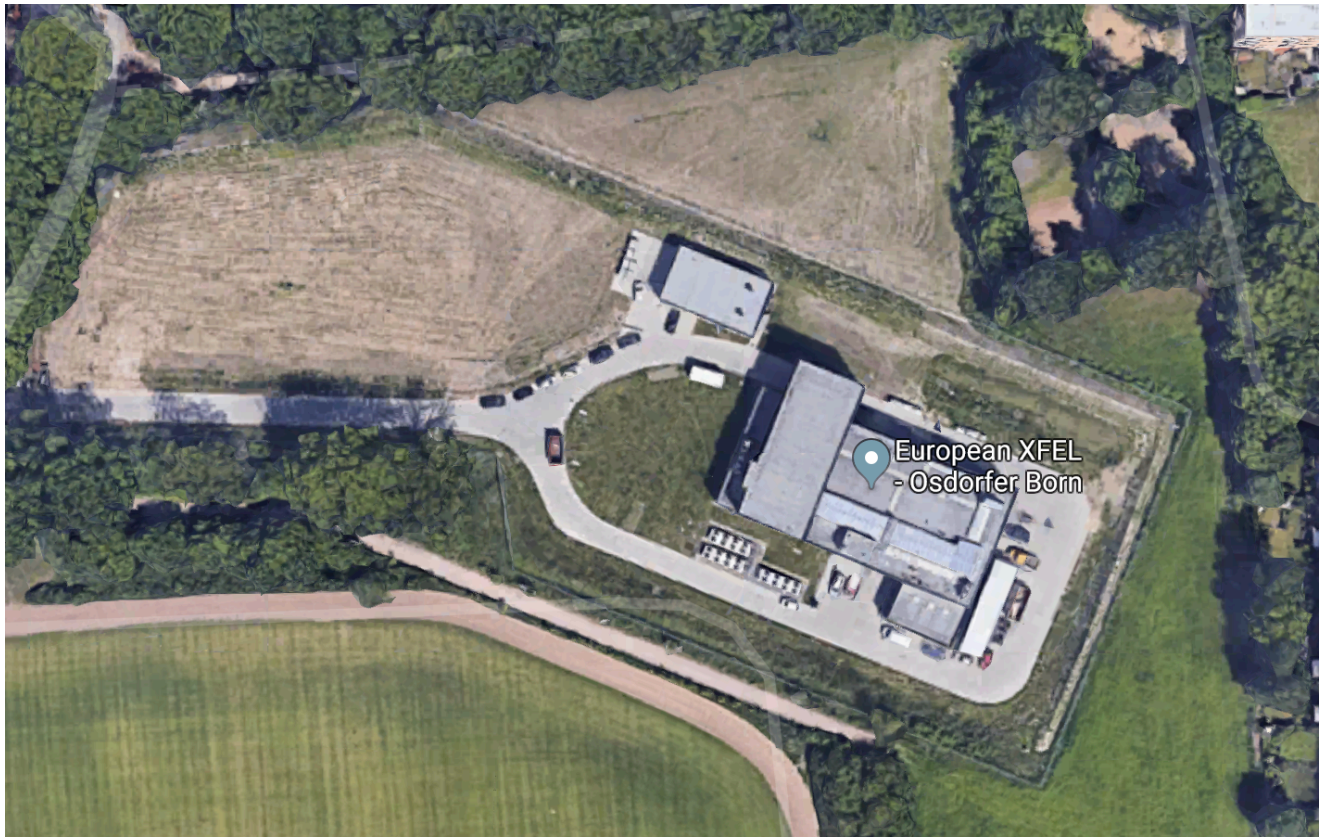


- **Size of detectors ~30 cm seems sufficient**
  - With 27 cm length we only loose 0.9% of all electrons/positrons (Marius) and can in principle adjust magnetic field to catch them
    - But would loose low-energy ones which are also most contaminated by background…
  - Setup different for electron beam setup

CIVIL CONSTRUCTION

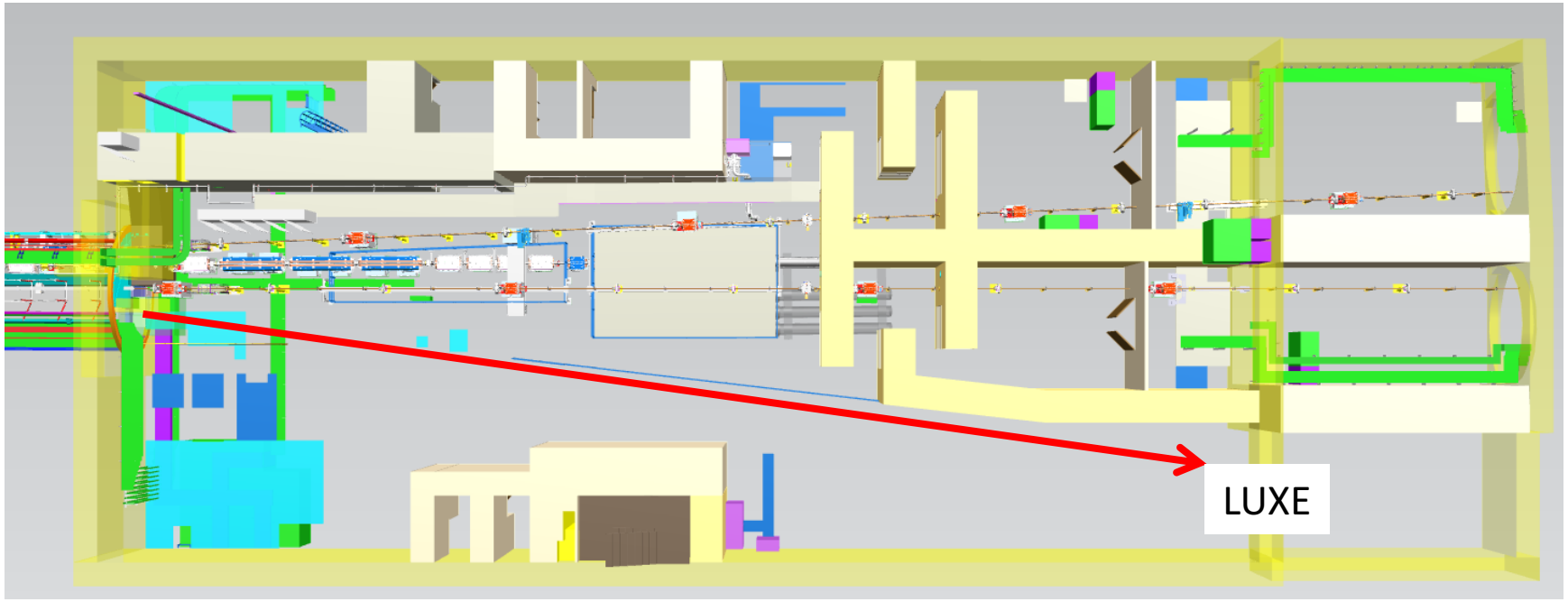
- **Need to understand civil construction aspects, i.e. size of area needed for laser, control room and diagnostics.**
  - Florian and Winnie identified too smallish rooms which are available but they are likely not sufficient
  - Laser requirements for 200 TW: >40 sqm (+ “at least 300 sqm for diagnostic” where?)
  - And, need control room and room for racks for DAQ etc.
- **Unfortunately have not had time to work on solving this**
  - Will try to find time asap.

LOCATION: OSDORFER BORN



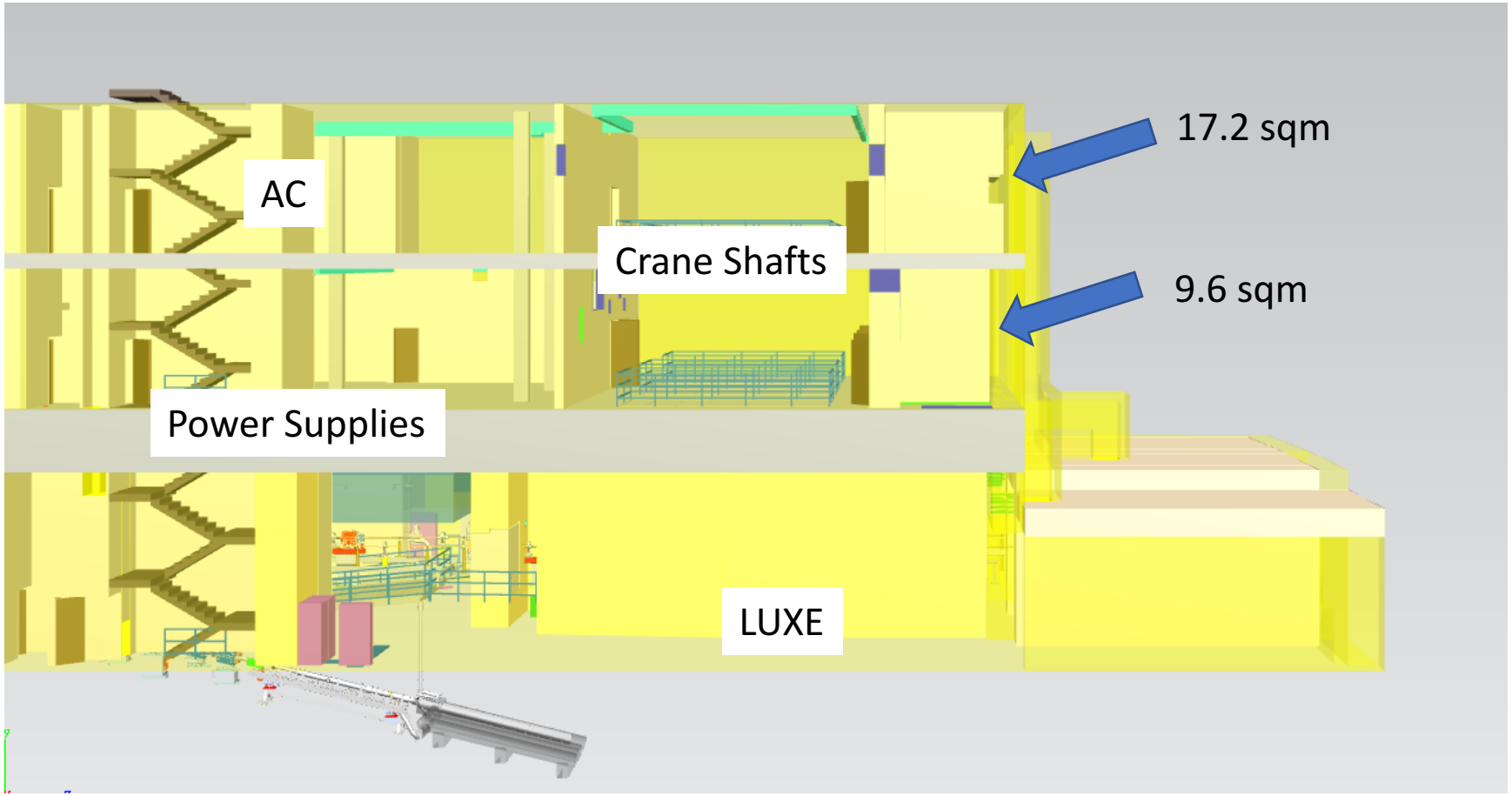
TOP VIEW LEVEL -3

From F. Burkart



SIDE VIEW -3 / -2 / -1

From F. Burkart



COSTS

Item	Cost (k€))	Comment
Laser System	2500-3000	
Cerenkov Detectors (x4)	360	Assumes using 4 detectors (2 for brem photon flux, 2 for PDS)
Silicon Detectors (x4)	1000	Used after IP and in PDS (cost lower if length 27 cm)
Calorimeter	540	Two calorimeters behind IP
Calorimeter	640	Two calorimeters + backscattering calorimeter in PDS
Scintillator	100	For e- detection after IP in e+laser setup
DAQ system	100	
Magnets/beam extraction	1200	
Infrastructure	?	Cooling, etc. (???)
Civil Engineering	?	Possibly new room/building (??)

Total Cost: about 6.5-7M € + costs for infrastructure and engineering

NEXT STEPS: PROPOSAL

- Converge on laser setup today (?)
- Collect comments until Friday this week
- Produce *final* draft by August 16th
- One more week for reading/comments
- Submit by Aug. 30th