

ALEGRO 2023

22-24 MARCH

Location: DESY Hamburg, Germany
Organisation: Brigitte Cros, Richard D'Arcy, Patric Muggli, Jens Osterhoff
Administration: Daniela Koch

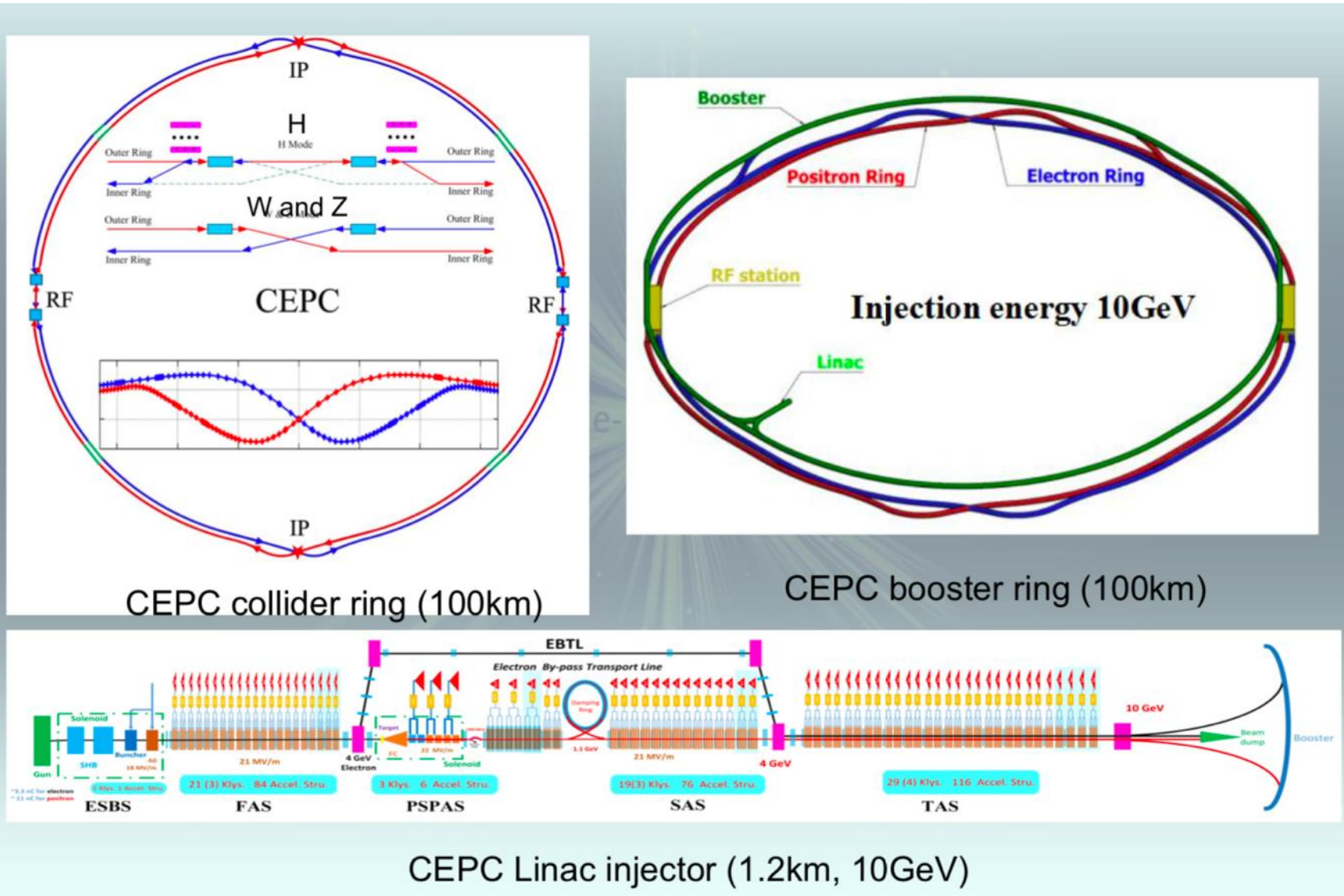
ALEGRO 2023



“Early” Particle Physics Applications and Test Facilities

Brian Foster, Maria Vranic, Matt Zepf, Stuart
Mangles

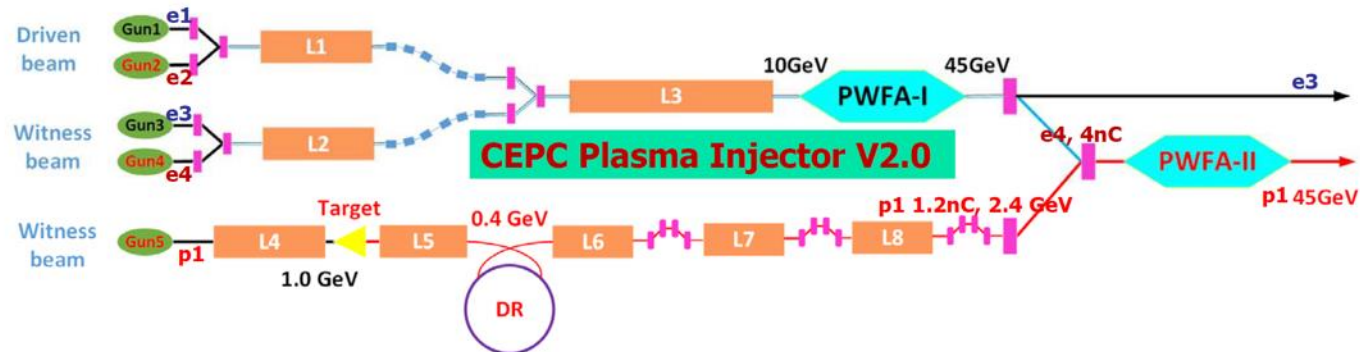
CEPC Accelerator



CEPC PWFA Linac

Booster Requirement	
Energy (GeV)	45.5 (0.2%)
Bunch Charge (nC)	0.78
Bunch length(um)	<3000
Energy Spread(%)	0.2
$\epsilon_N(\mu\text{m}\cdot\text{rad})$	<800
Bunch Size(um)	<2000

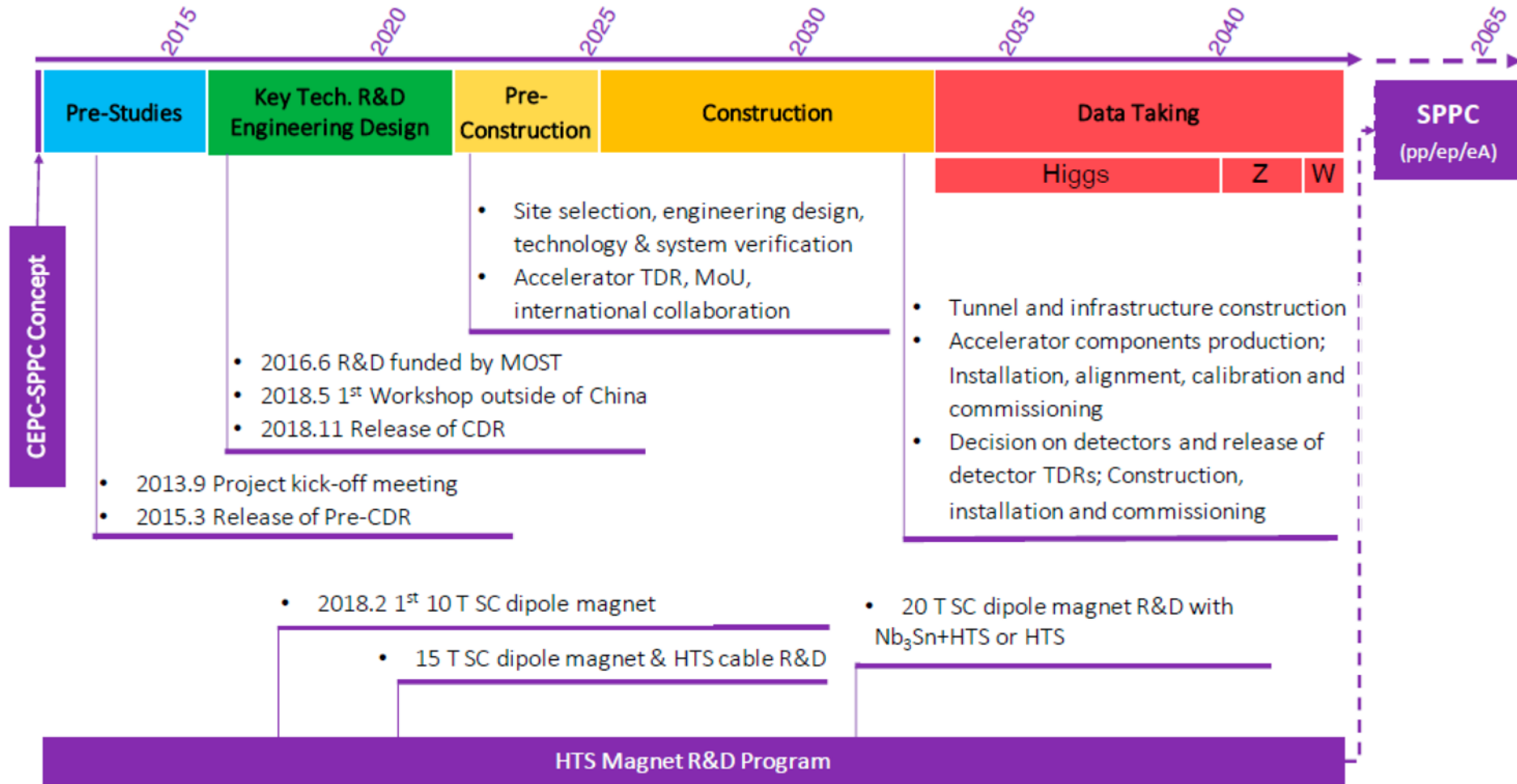
- Electron Acceleration → HTR
- Positron Acceleration → Stable mode
- Conventional Accelerator optimization
- Beam manipulations



- e^- run at low Transformer ratio 1 – 1.5 – some concern that beams unstable to small offsets and enhanced hosing instability – under study.
- Uniquely useful for green-field site – FCCee? No.
- But e^+ ? Linear wakes can symmetrise e^+/e^- but only with low efficiency, high emittance, low gradient. Non-linear?

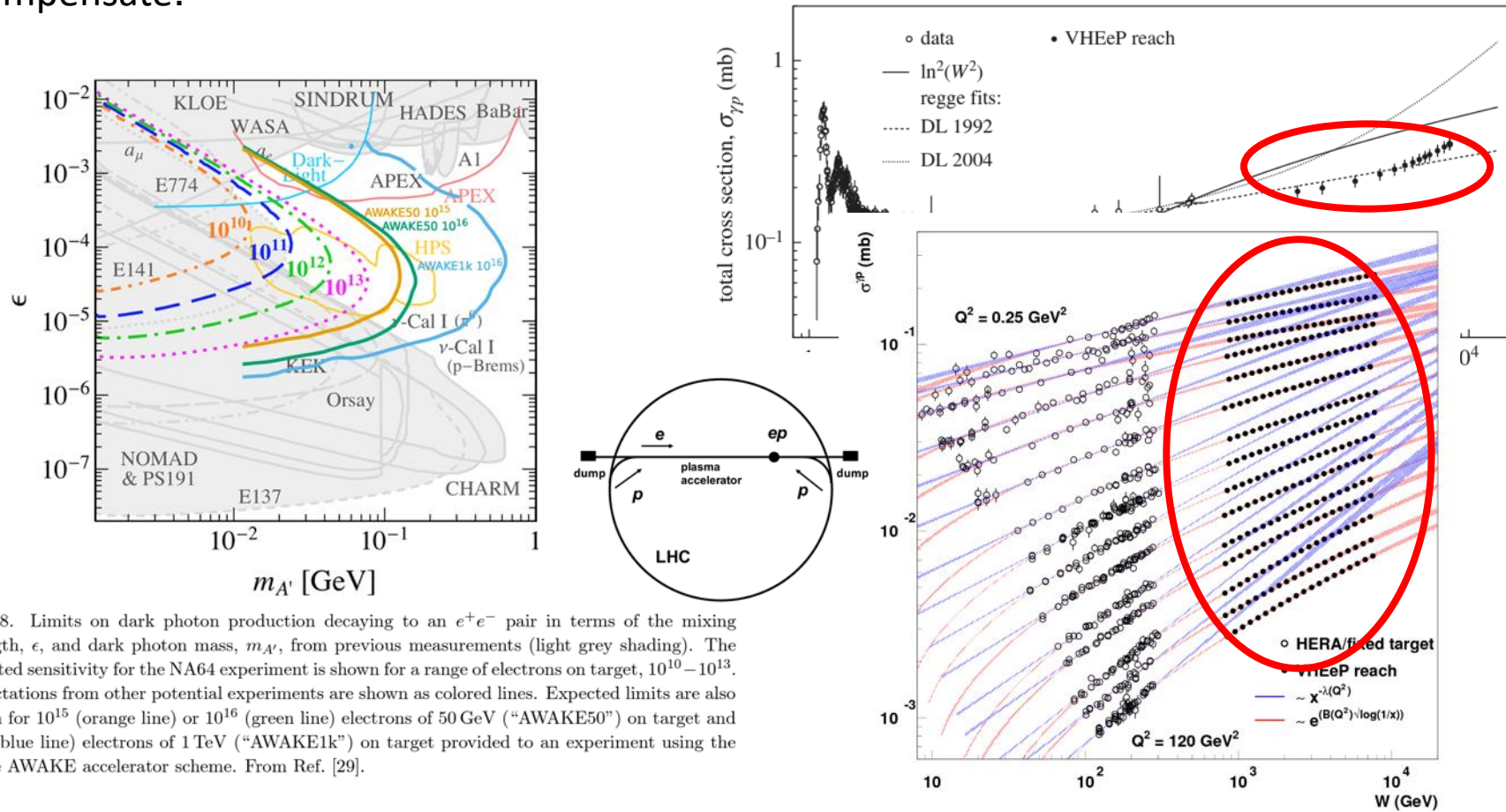
CEPC Timeline

CEPC Project Timeline



AWAKE Physics

- \mathcal{L} Limited by p accelerator repetition rate – look for high-cross-section processes to compensate.



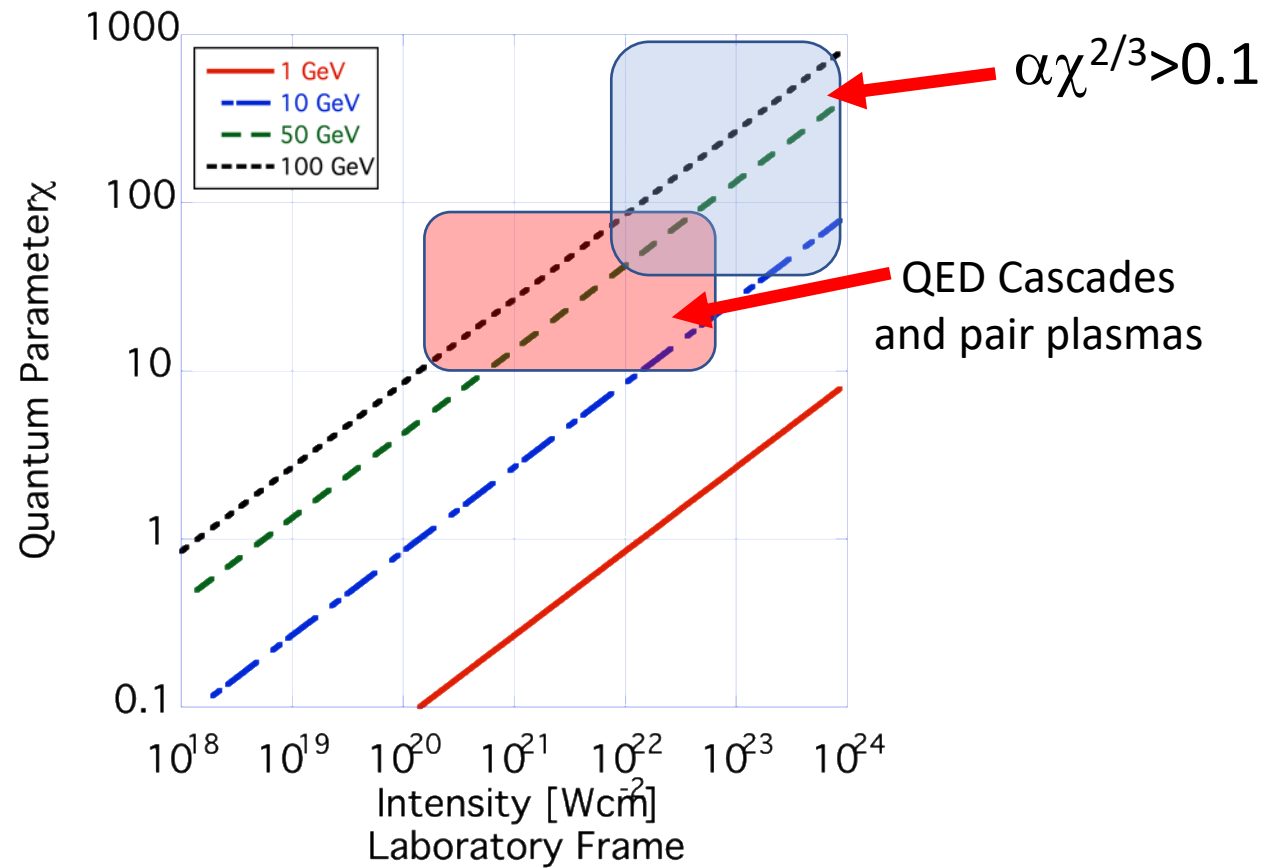
Non-linear QED

- See Matt's talk yesterday & after I finish.
- Critical requirement is high-energy ($< \sim 100$ GeV) e^- beam which is a crucial "early" deliverable of any sort of L/PWFA facility.
- Also highly useful for pp test beam purposes.

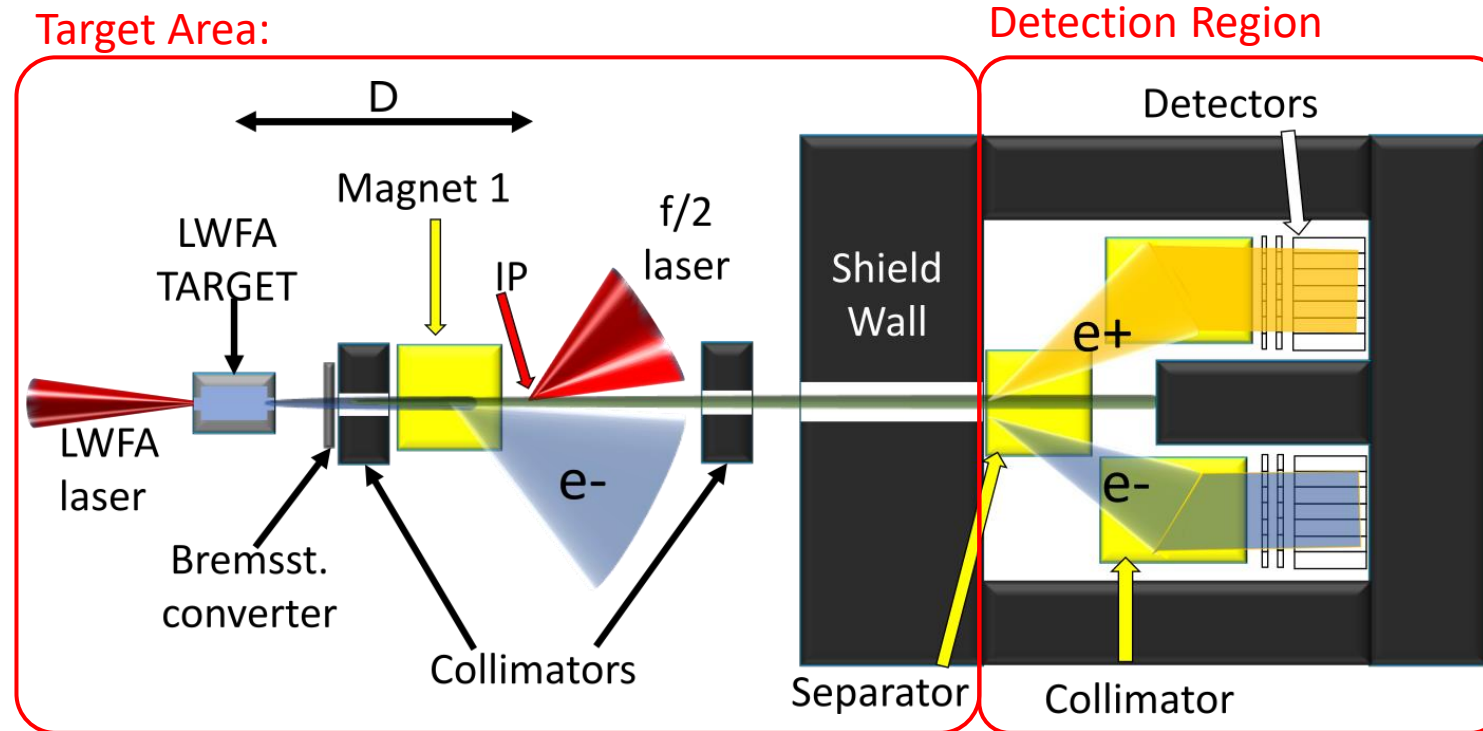
Resources

- As far as I can see, this is mainly a data/opinion-gathering exercise.
- We are not going to design any experiments or test beam.
- Needs to be very close collaboration with the collider WG – which Carl L. & I have already agreed

Plasma wakes can reach new regimes



Detailed Planning Exists



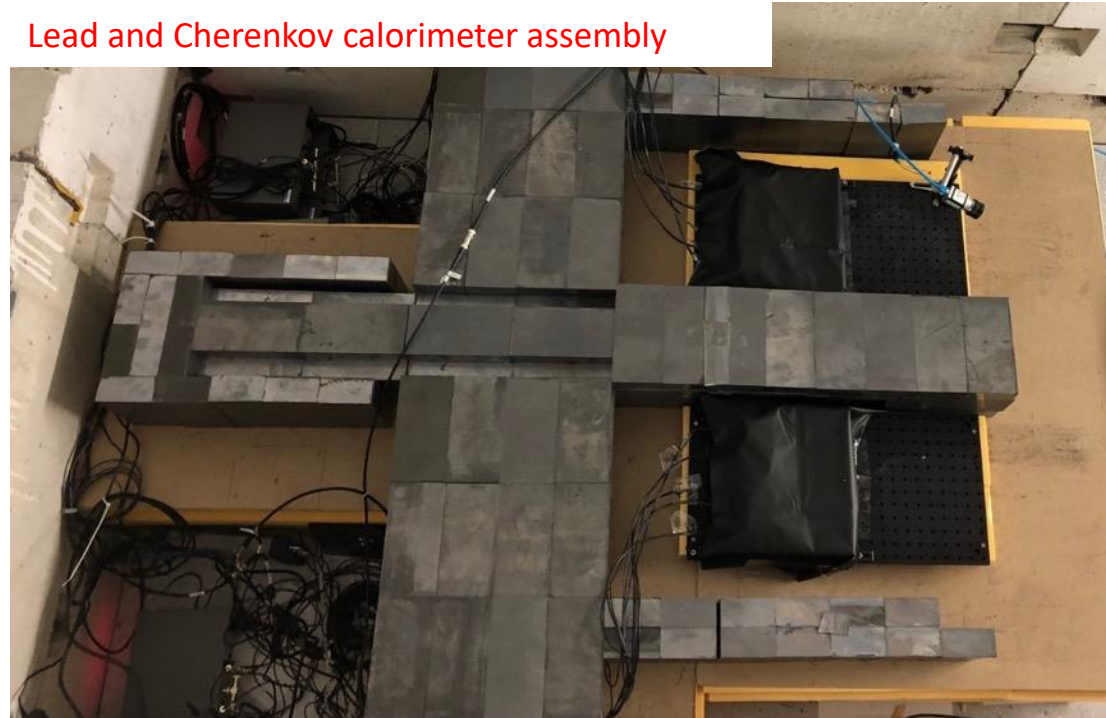
- $> \text{GeV}$ LWFA generated γ -ray beam colliding with ultraintense laser
- 45J, 28cm dia
 - Split to f/60 LWFA laser (30J) and f/2 interaction laser
- Detector Area separated by shield wall
- Based on our Gemini proposal ([arXiv:2103.06059v1](https://arxiv.org/abs/2103.06059v1))

Experiment is becoming a reality

Detection region construction at CALA



Lead and Cherenkov calorimeter assembly



Current Projects

- DFG Research Group
 - Experiment part built
- LUXE Collaboration
 - Detector tests
 - Experiment design
- E320
 - Experiment with ,first light' on detectors
- CLF – UK
 - Test experiments performed

Steps for future facility

- Exciting science to be done
 - Parameter regime far beyond current data and theory
- Expertise from current experiments
 - Requires large collaboration to develop full experiment and science case

LUXE

Conceptual Design Report for the LUXE Experiment

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E320

DFG- Group ,Quntumvacuum‘

Bild C, Doyle L, Eckey A, Gies H, Golub A, Grafenstein, K, Karbstein F, Karsch S, Khademi P, Klar L, Lindner A, Müller C, Oelmez B, Paulus GG, Oude-Weernink R, Ruhl H, Salgado F, Seidel A, Schmitt A, Schreiber J, Schulze K-S, Song Y, Sundqvist C, Zepf M

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Initial Resources

- Theory and Experimental team to work detail science case
- Depends on the real parameters
- Decide on a demonstrator facility
- Outline Science Case high energy extension of current programmes – very exciting
 - QED $\chi \gg 1$
 - BSM searches (beam dump experiments)
- Similar to Alan's talk yesterday