EUROPEAN PLASMA RESEARCH ACCELERATOR WITH EXCELLENCE IN APPLICATIONS

WP 13: Alternative Radiation Generation

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Tasks and progresses

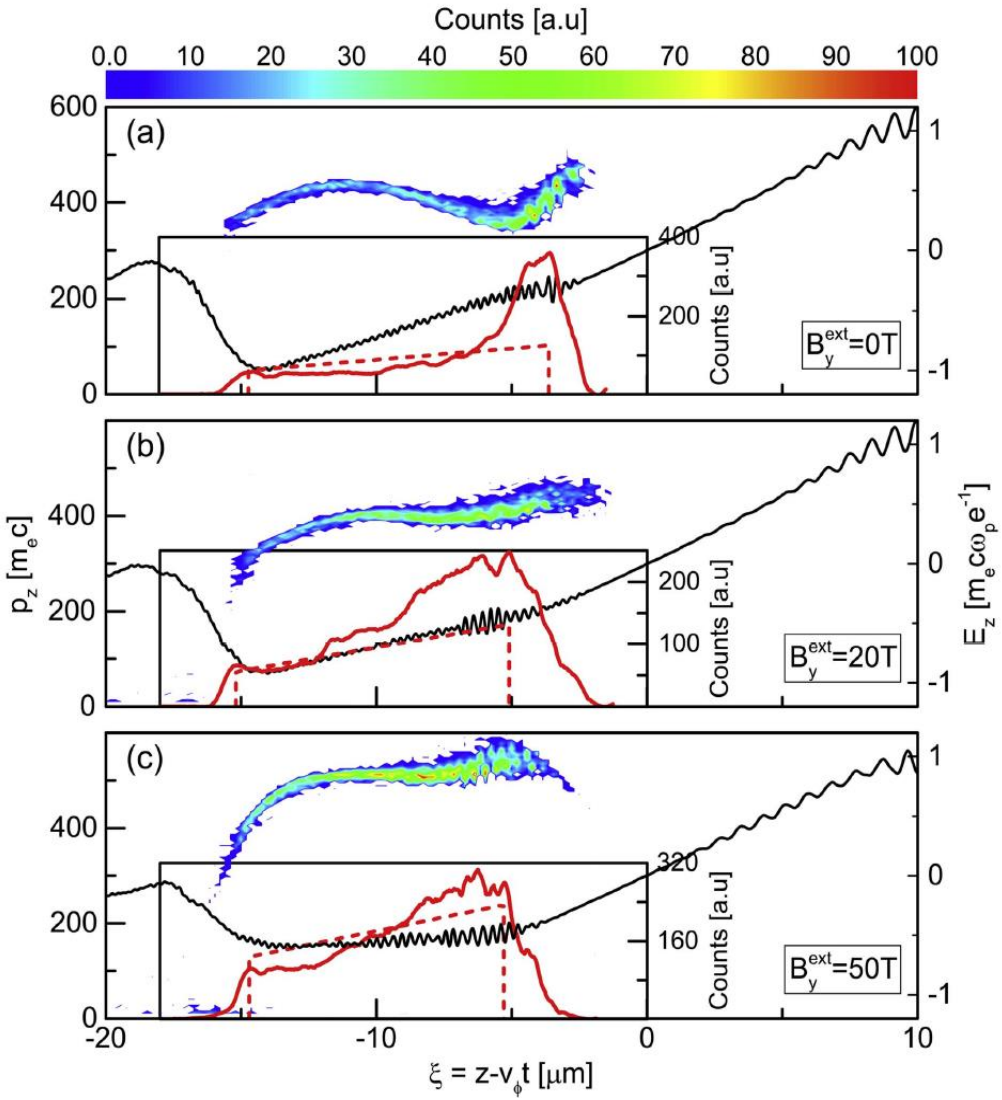
- **Task 13.1: Investigations of injection schemes for high quality electron bunches**

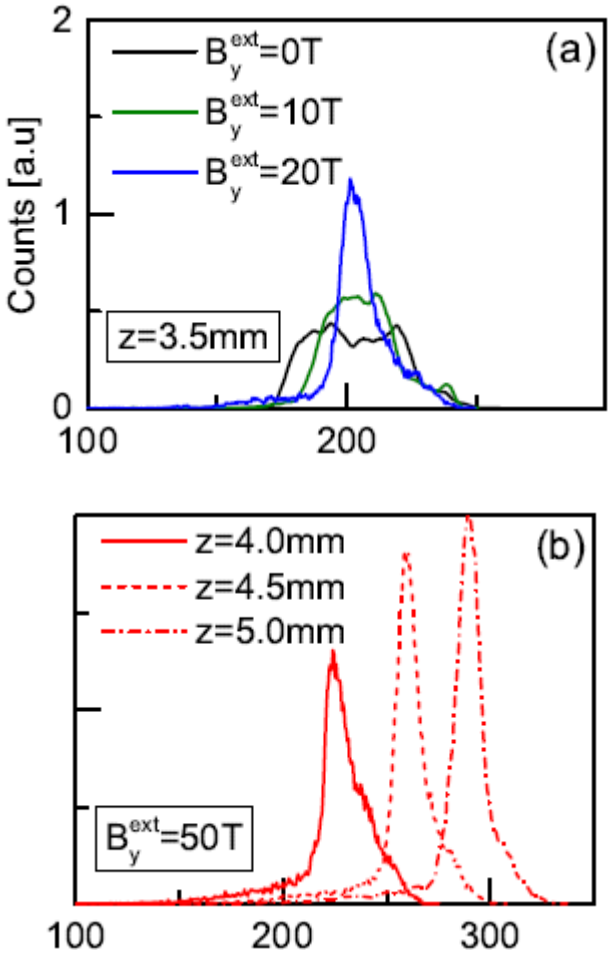
Challenges: robust control of electron injection for beams with > 1 GeV, > 50 pC, < 1% energy spread with a commercial ~200 TW laser system. (Options: Ionization injection, density gradient injection)

Deliverable: Report in 36 months (due 11/2018).

Work carried out so far: M. Zeng et al. PoP (2016); M. Weikum et al., NIMPRA (2016); X. Yang et al., Sci. Rep. (2017); L.X. Hu et al., Sci. Rep. (2018); M. Tooley et al., PRL 2017; G.G. Manahan et al., Nature Comm. 8, 15705 (2017); Q. Zhao, NJP 2018, J. Luo et al., PRL 2018

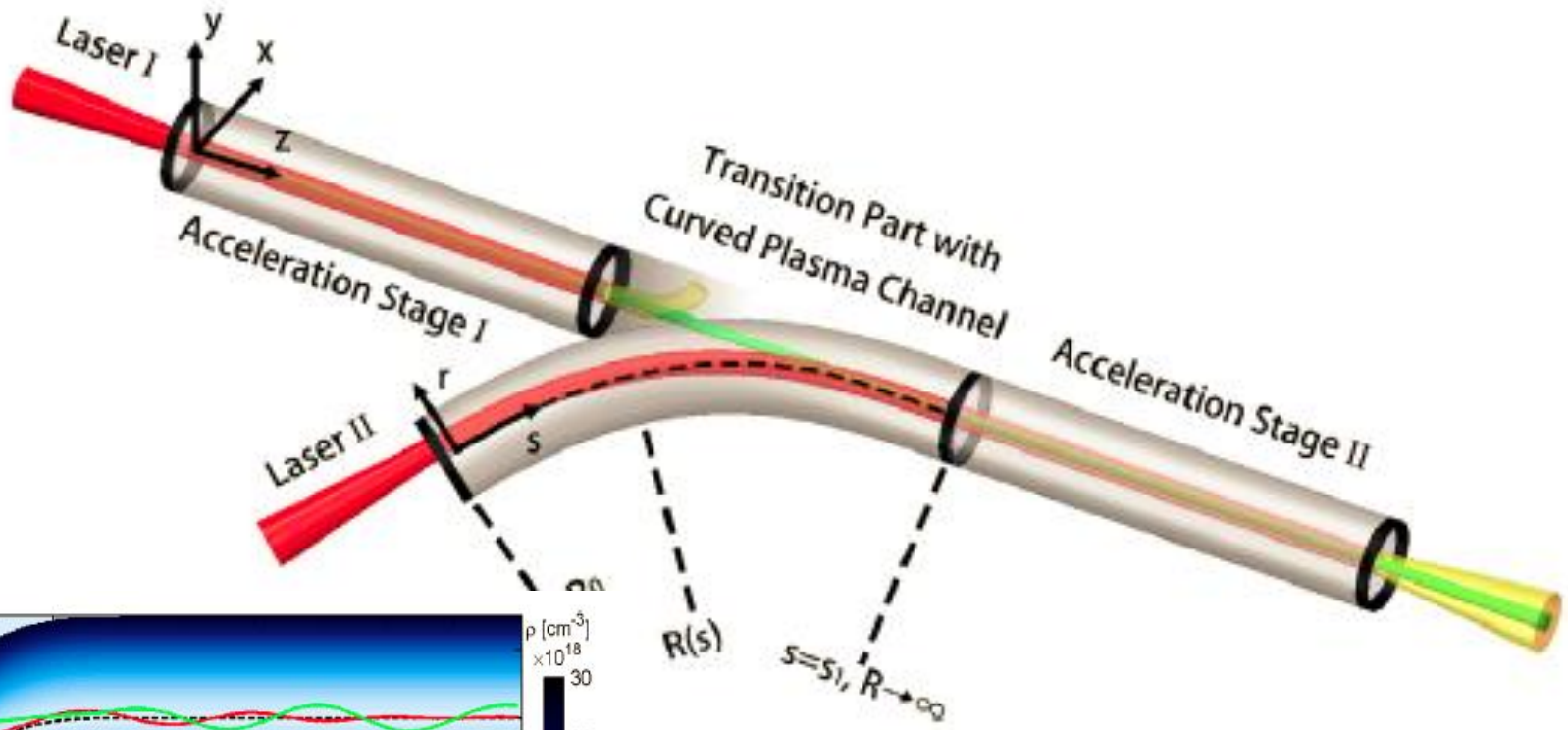
Ionisation injection controlled by external DC magnetic fields

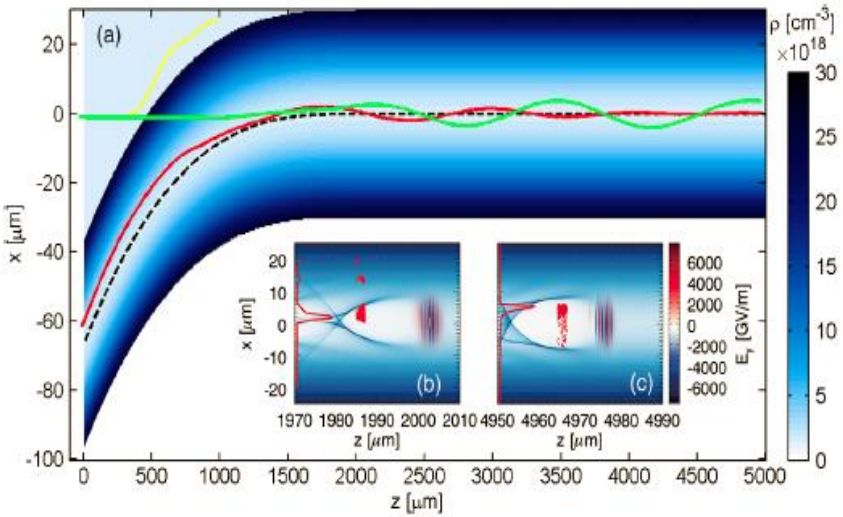




Q. Zhao et al., NJP 2018

Multistage Coupling of Laser-Wakefield Accelerators with Curved Plasma Channels





J. Luo et al., Phys. Rev. Lett. 120, 154801 (2018)

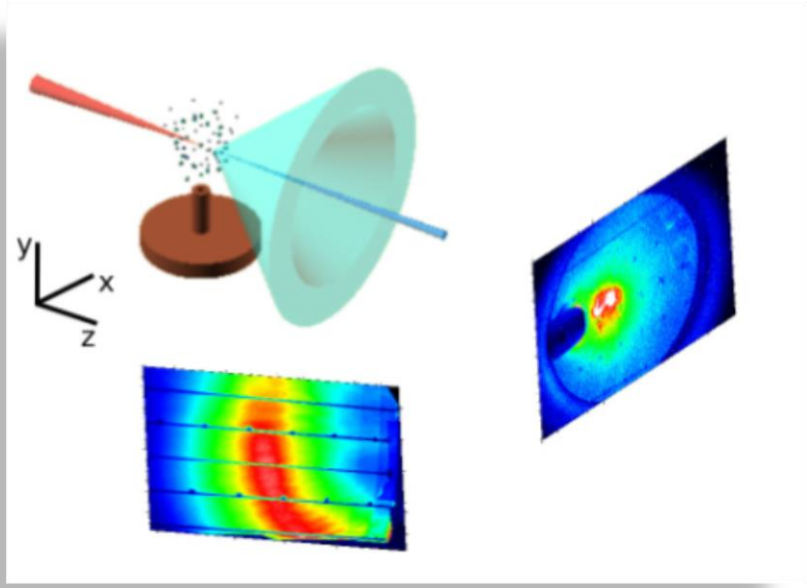
Tasks and progresses

- **Task 13.2: Extension of spectral range of plasma-based radiation sources to gamma-rays and the far infra-red**
- **Task 13.3: Investigations of coherence development in plasma-based radiation sources**

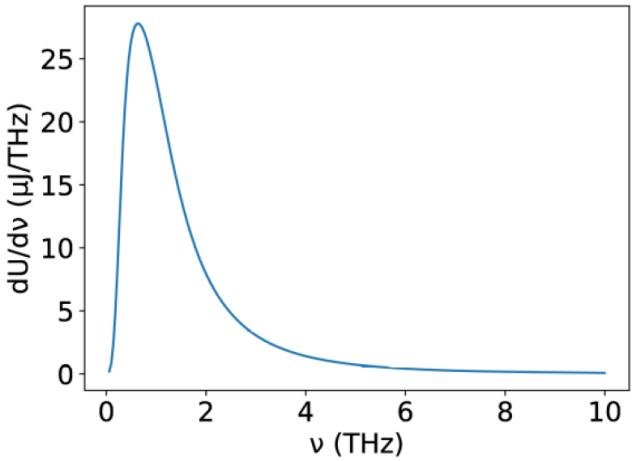
Deliverable: Report in 48 months (due 11/2019).

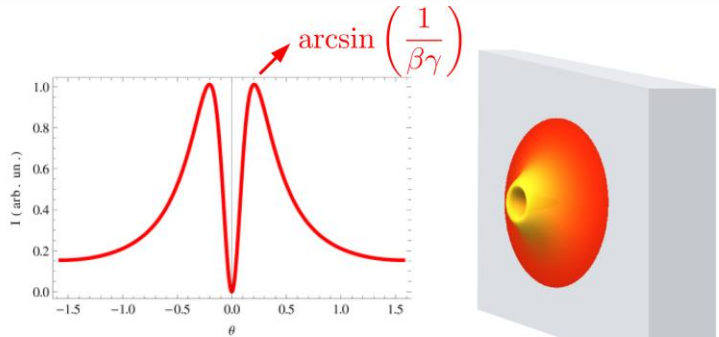
Work carried out so far: W.J. Ding & Sheng, PRE (2016); J. Luo et al., Sci. Rep. (2016); K. Huang et al., Sci. Rep. 6, 27633 (2016); L. L. Yu et al., Nat. Comm. (2016); T. Wilson et al., PPCF (2017); J. Vieira et al., arXiv 1601.04422 (2016); X. Yang et al., NJP 2018; W.M. Wang et al., arXiv 1710.11356 (2018).

Strong THz radiation by nC side electron emission from LWFA



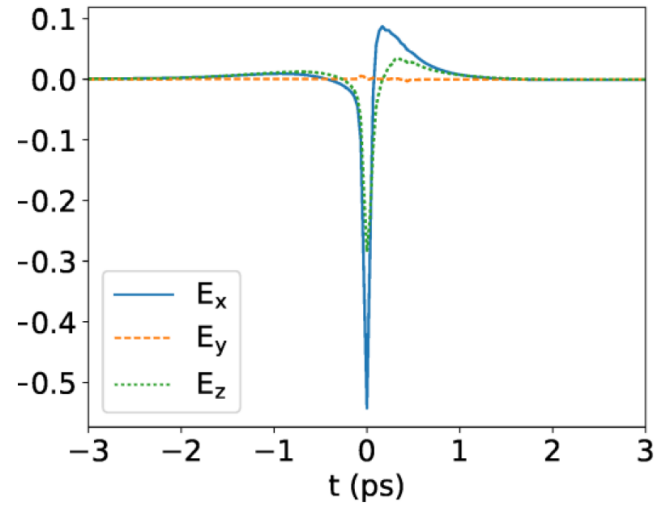
X. Yang et al., NJP 2018





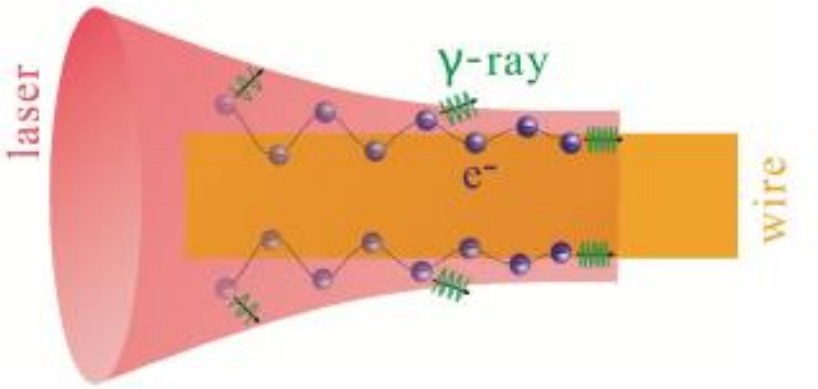
$$\frac{d^2U}{d\omega d\Omega} = \frac{e^2}{4\pi^3\epsilon_0 c}\frac{\beta^2\sin^2\theta}{(1-\beta^2\cos^2\theta)^2}$$

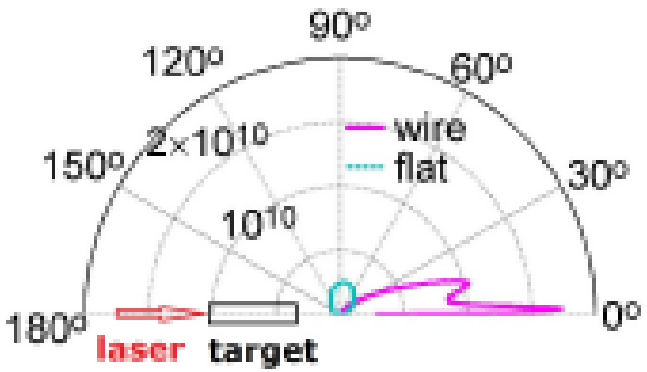
Ginzburg-Frank formula

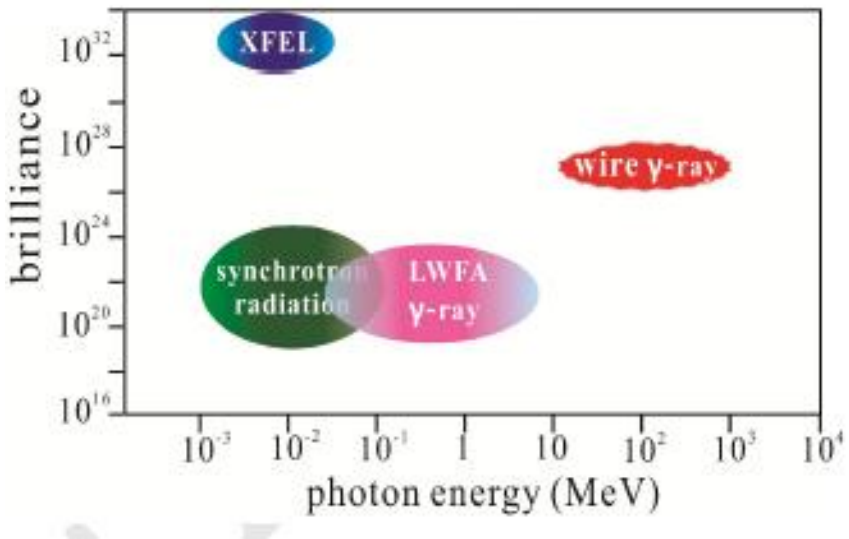


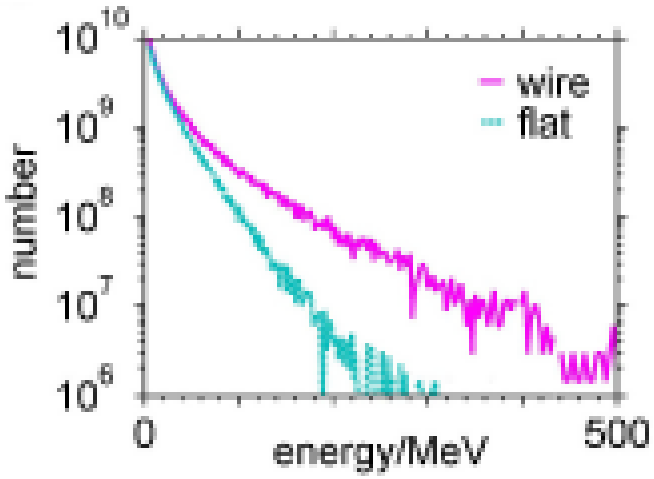
5 μJ for 1 nC

Multi-PW (2-5PW) laser driven QED wire wiggler for sub-GeV γ-rays









W.M. Wang et al., arXiv 1710.11356 (2018).

Tasks and progresses

- **Task 13.4: Development of diagnostic systems for investigating plasma-based radiation sources**

Challenges: diagnostic of beam transport, radiation coherence measurements, measurement of the correlation between the beam and radiation, advanced on-line diagnostic of electron beams and radiation.

Deliverable: Report in 36 months (due 11/2018).

Move to our new laboratory in the past year.

SCAPA is not fully operational, both target areas and diagnostic systems are under development.