

EUROPEAN

PLASMA RESEARCH

ACCELERATOR WITH

EXCELLENCE IN

APPLICATIONS



WP13: Diagnostics

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This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement

- Tasks
 - Define a diagnostics suite for EuPRAXIA
 - Assess the suitability of existing designs for a plasma wakefield accelerator

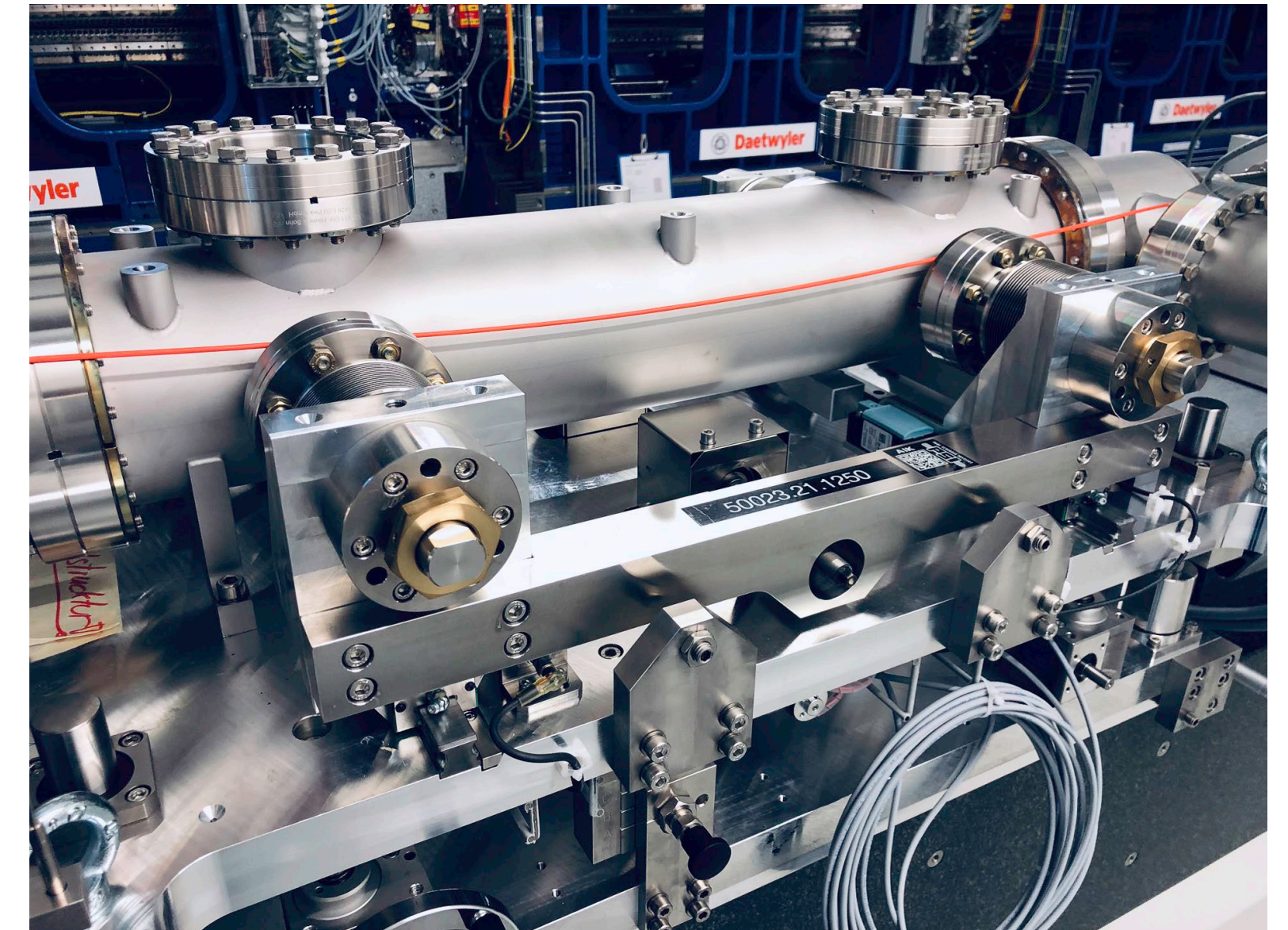
- A compact accelerator needs compact diagnostics
- Conventional solution can be used even if:
 - Small beam size at plasma entrance (μm scale) sets a problem for transverse diagnostics
 - Short bunch length (fs scale)
 - Since transporting the beam after the plasma cell is the first priority, the design of the diagnostics needs to accommodate the optics of the machine

Beam diagnostics

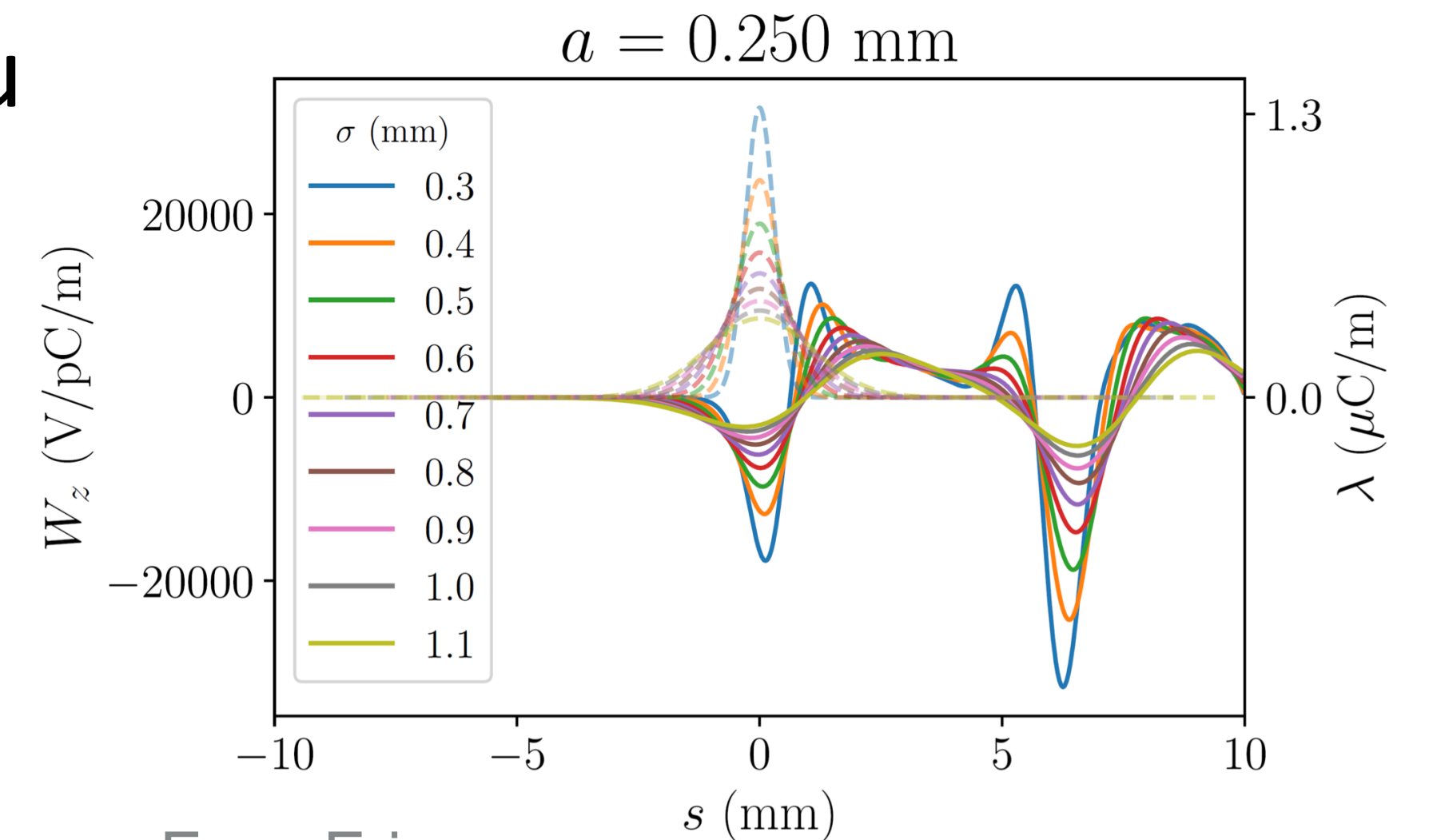
- PWFA & LWFA have similar problems:
 - Driver removal
 - Difficulties in capture optics
 - High divergence
 - Shot to shot instability

Photon diagnostics

- Less critical because we can use most of the usual FEL solution.
- Once the beam is lasing the tools for X rays diagnostics are state of the art....

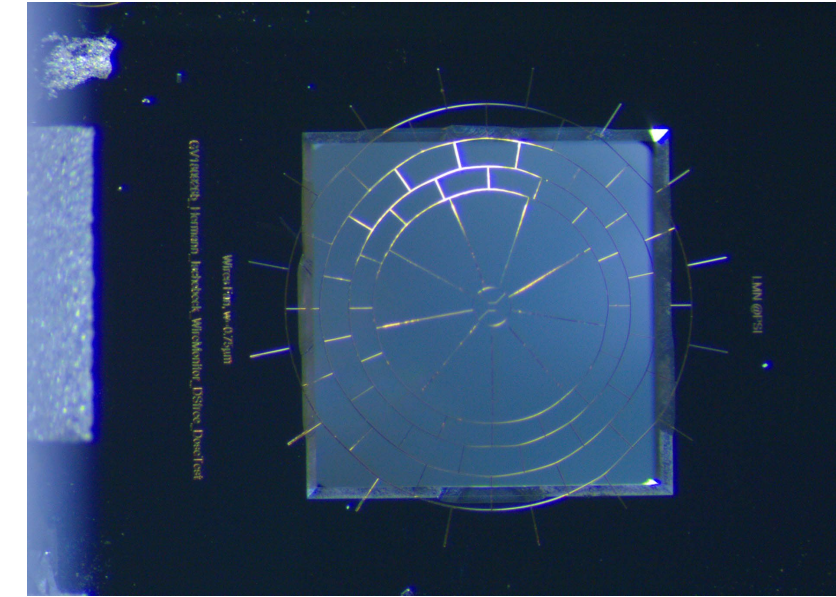


- Challenge: control the longitudinal phase space distribution
- Many FELs have adjustable wake field structures
- Modeling of these structures
 - Different length scales make modeling difficult
 - Exact material properties unknown
 - Cross-check with other systems
- Alternative to RF deflecting structures

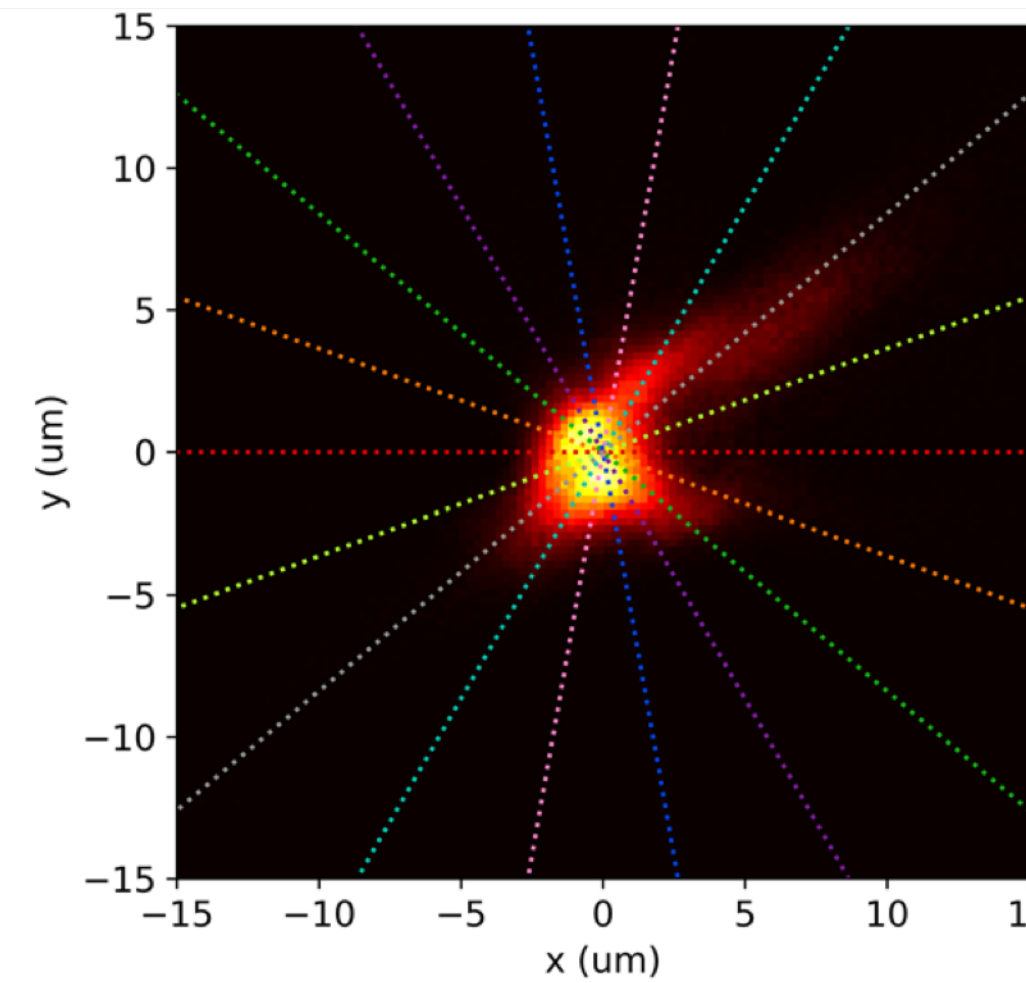
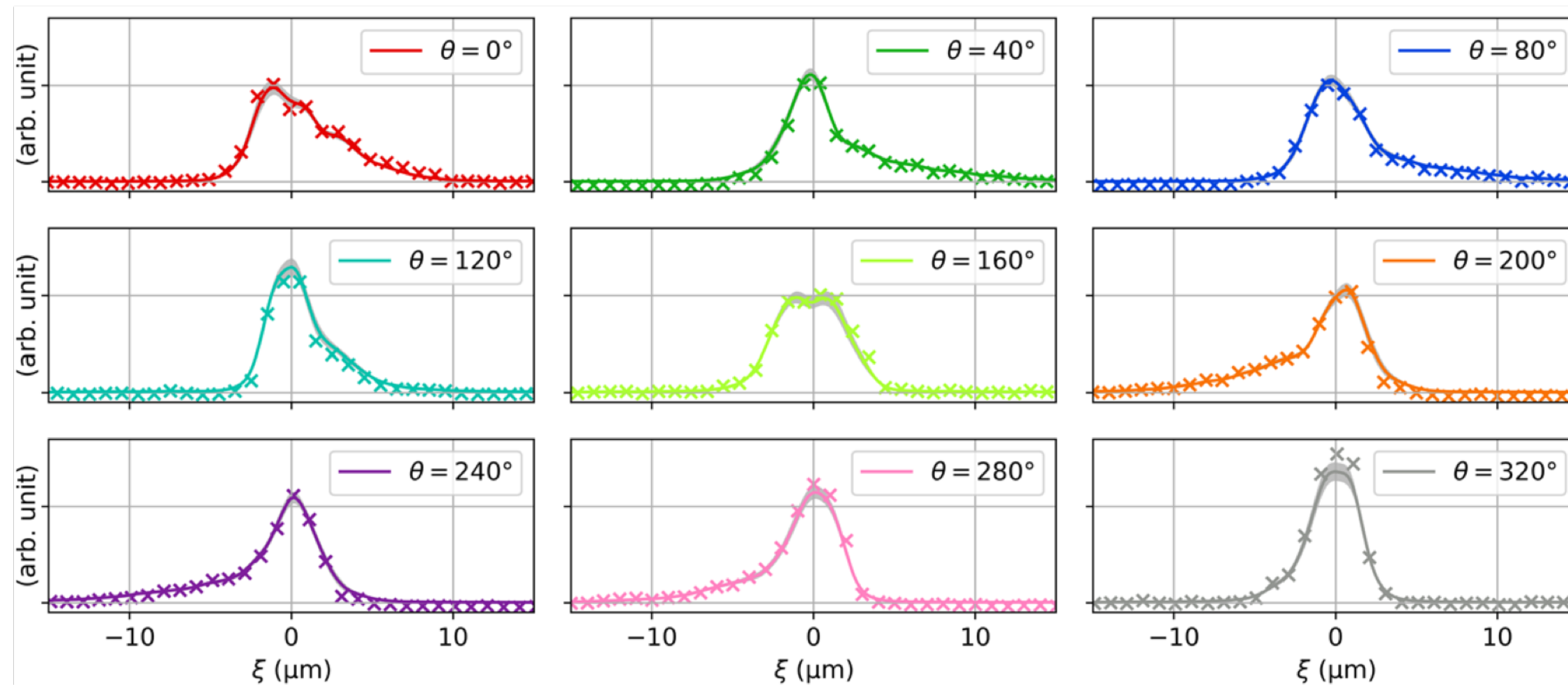


Evan Ericson

- ← Spider web wire scanner, made from gold using electron beam lithography
- ← Movement by in-vacuum piezo actuators
- Manufacturing of silicon nitride structures
- Made by low-pressure chemical vapor deposition, and photolithography, using direct laser writing of the photoresist
- Melting point: 2170K
- ↓ Tomography is used to reconstruct the 2-dimensional image



- ▶ Challenge: integration into the plasma chamber
- ▶ Detection of scattered particles over the background
- ▶ Possible synergy with PACRI

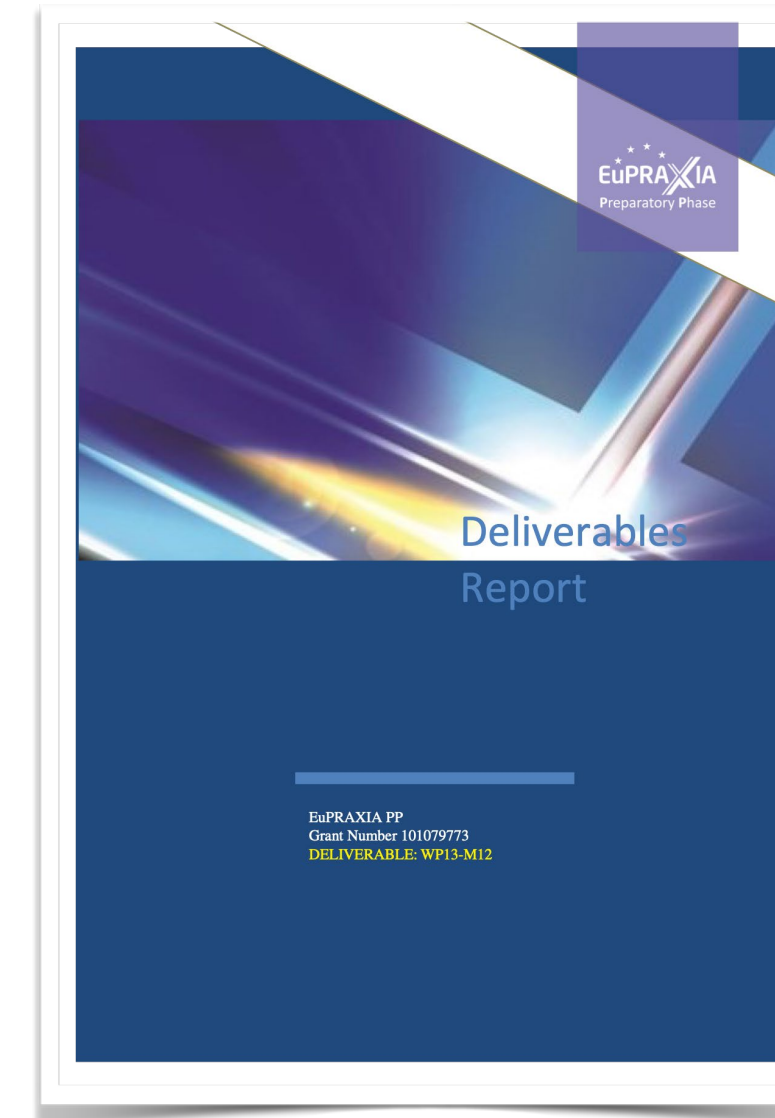


Simona Borrelli, Benedikt Hermann, Francesca Addesa, Alessandro Cianchi, Rasmus Ischebeck

- Workshop on EuPRAXIA Electron and Photon Diagnostics
- June 12–13, 2023
- <https://agenda.infn.it/event/35247/>



- Report on state of the art and structures to be funded
 - Delivered: October 2023
- Report on technical results achieved
 - To be delivered: October 2024
- Report on the technical readiness level and maturity of diagnostics
 - To be delivered: April 2026



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- EuPRAXIA@SPARC_LAB will be the first FEL for users driven by plasma acceleration
- All the EuPRAXIA developments can be tested and used at EuPRAXIA@SPARC_LAB.
- Diagnostics integration in the machine layout, especially in the plasma chamber will be the most difficult challenges

- This second deliverable is mainly the status of the diagnostics in EuPRAXIA@SPARC_LAB TDR
- We did not address all the problems, but we wrote the solutions for the ones we solved.

Report on technical results achieved in the field of diagnostics
October 10, 2024

EuPRAXIA Report: WP13 Deliverable 13.2

Abstract

Photons and electron diagnostics are fundamental in commissioning and operating EuPRAXIA. In this deliverable we report the progress made in the definition, implementation and prototyping of devices for EuPRAXIA. In particular, being EuPRAXIA@SPARCLAB, i.e. the so called beam driven scheme for plasma acceleration, the first pillar to implement in the strategy, the report is focused mainly on this scheme, while some solutions that are found here can in any case be translated also in the laser driven scheme.

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Workshop

Open Positions

The image shows three overlapping screenshots of web pages. The leftmost screenshot is the PSI website's 'Job Opportunities' page, featuring the PSI logo and navigation menu. The middle screenshot is a zoomed-in view of the 'Job Opportunities' page, showing the text: 'The Paul Scherrer Institute PSI is the largest research institute for natural science within Switzerland. We perform cutting-edge research in the fields of fundamental physics, health innovation and fundamentals of nature. By performing research, we work on sustainable solutions for major challenges facing society and economy. PSI is committed to the training of future generations. Therefore, our staff are post-docs, post-graduates or apprentices. Altogether, PSI employs over 10,000 people.' Below this, it mentions 'The Electron Beam Instrumentation Group at the Center for Accelerator Science and Engineering' and 'develops, installs and maintains beam instrumentation and diagnostics for the SLS at PSI. We are presently upgrading the Swiss Light Source to a diffraction-limited storage ring, SLS 2.0. In this context, we are looking for a'. The rightmost screenshot is the SiROP application portal, showing a 'REGISTER NOW' button and a job listing for 'Postdoc in Chirped Pulse Amplification Laser'. The SiROP page includes a 'HOME' section, a 'MENU' with links for Login, Register, Search Opportunity, Search Organization, and Create project alert, and an 'INFORMATION' section with links for About SIROP, Team, Network, Partners, Imprint, and Terms & conditions. The job listing includes a 'Description' and 'Key Responsibilities'.

Trainee (Research on Large Language Models)

PhD Student for Synchrotron Diagnostics



- Scope:
 - Electron beam instrumentation
 - X-ray instrumentation
 - Controls, data acquisition
 - Virtual diagnostics

- Proposal: locate at PSI











Develop



Design



Deliver