



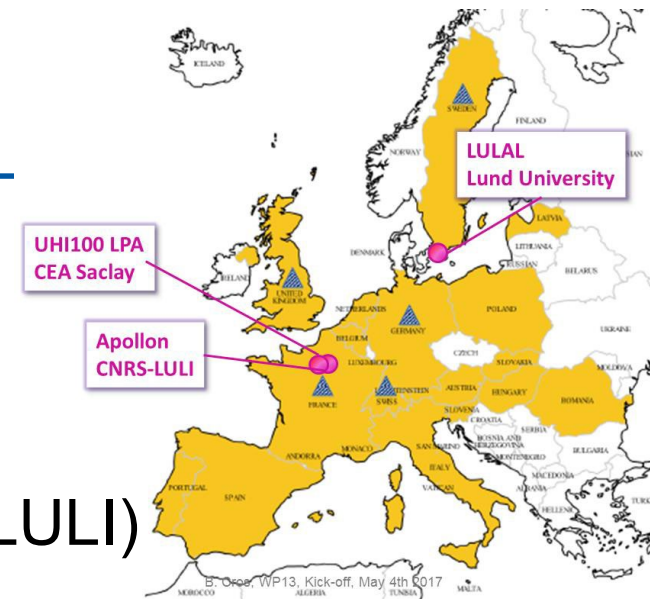
WP13: Access to Plasma Beam testing facilities

CERN / May 2nd, 2022/ Final meeting

Brigitte CROS / CNRS - LPGP

Overview

- 3 facilities offering TA in WP13:
 - LULAL (Lund University)
 - UHI100 LPA (CEA LIDYL)
 - APOLLON MUST-LPA (CNRS LULI)



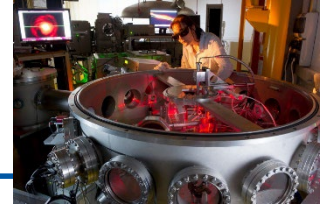
- Access provided: 1146 hours, 47 users
 - 2 projects at UHI100 LPA
 - 4 projects at LULAL
 - 1 project at APOLLON

SCIENTIFIC
REPORTS
nature research

OPEN Laser wakefield accelerated
electron beams and betatron
radiation from multijet gas targets

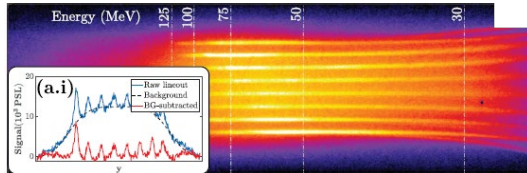
Vidmantas Tomkus^{1,2}, Valdas Girdauskas^{2,3}, Juozas Dudutis¹, Paulius Gečys¹,
Valdemar Stankevič², Gediminas Račiukaitis², Isabel Gallardo González², Diego Guénot¹,
Jonas Biörklund Svensson⁴, Anders Persson⁵ & Olie Lundh¹

Access to UHI100-LPA (CEA Saclay)



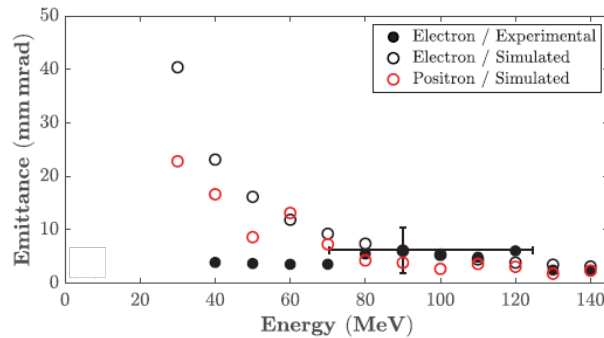
S. Dobosz Dufrénoy- Facility coordinator

Secondary electron signal through pepper-pot W mask and dipole



Campaign n°1: *ARIES-CEA-LIDyL-2017-01* (Janv-Fev 2018 /152 Units)

Emittance characterisation of laser-driven positron beams for injection in conventional accelerators



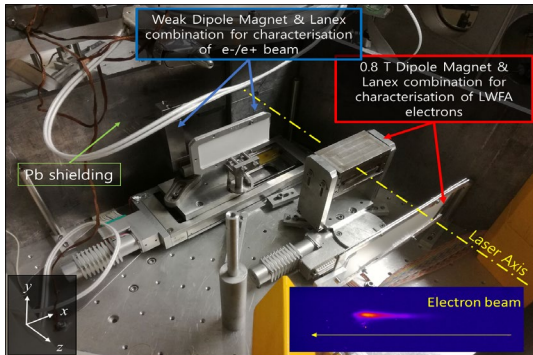
OPEN ACCESS
IOP Publishing
Plasma Phys. Control. Fusion 0 (2020) xxxxxx (7pp)
<https://doi.org/10.1088/1361-6587/ab7e81>
Plasma Physics and Controlled Fusion

Non-invasive characterisation of a laser-driven positron beam

A Alejo¹, G M Samarin¹, R Warwick¹, C McCluskey¹, G Cantono², T Ceccotti², S Dobosz Dufrénoy², P Monot² and G Sarri¹

¹ Centre for Plasma Physics, School of Mathematics and Physics, Queen's University Belfast, BT7 1NN United Kingdom
² LIDYL, CEA, CNRS, University Paris Saclay, 91191 Gif Sur Yvette cedex France

published, 2020



Campaign n°2: *ARIES-CEA-LIDyL-2018-01* (Feb-March 2019 /176 Units)

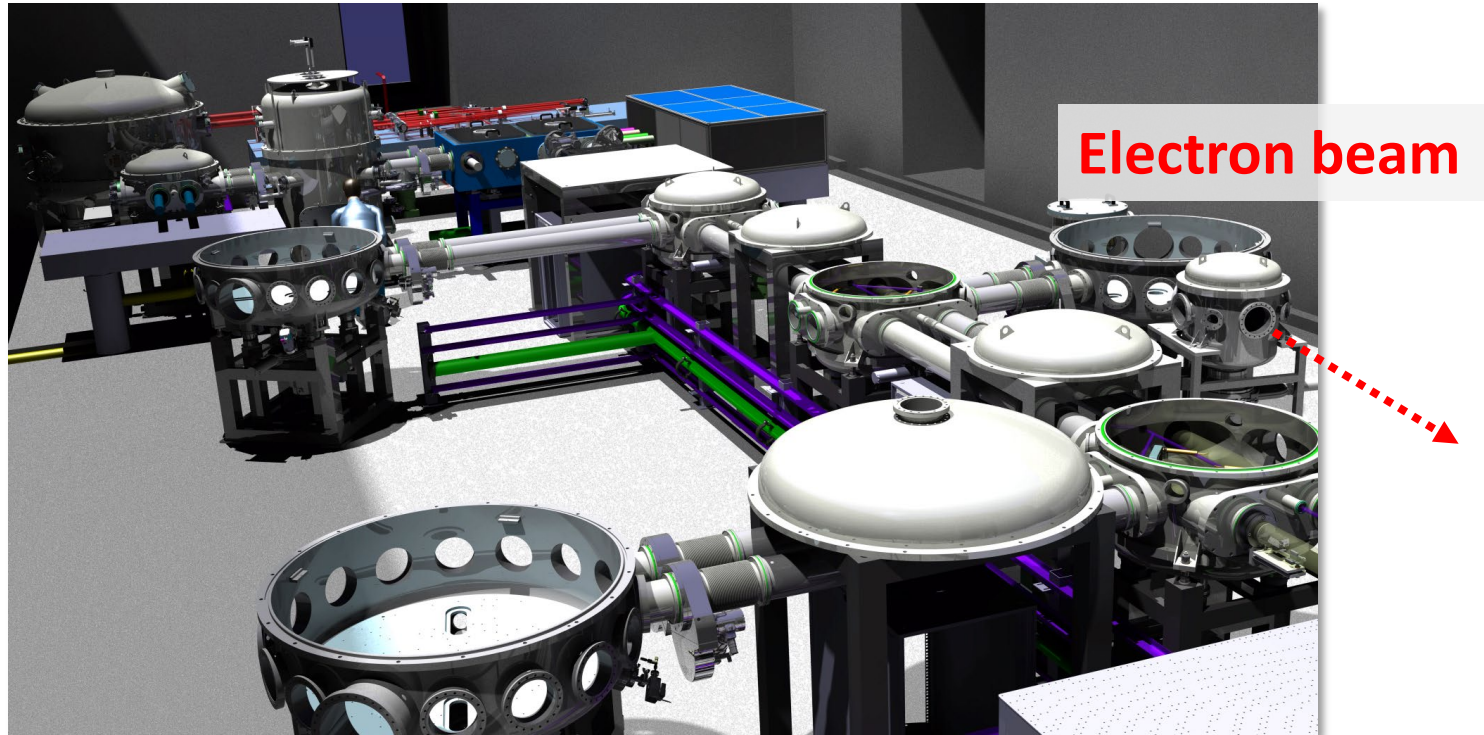
Laser-driven low-energy positrons for high-resolution non-disruptive inspection of materials – G. Sarri and coll. (Queen's University – Belfast)



Upgraded facility implemented at CEA

Orme des Merisiers

New redesigned experimental facility in a completely refurbished area
(few km away from CEA-Saclay)



New laser beam diagnostics, two laser beams available, **40% more energy on one beam in « single beam configuration »**

Increase of electron beam energy and charge are expected



Upgraded facility implemented at CEA

Orme des Merisiers

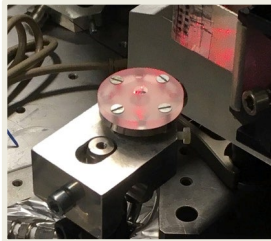
New redesigned experimental facility in a completely refurbished area (implementation now completed after long delays due to covid restrictions and lockdowns)



Commissioning of experimental area in Progress:
Waiting for permission to operate from ASN

Access to LULAL

4 experiment campaigns completed
(30 users, 788 units)



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REPORTS
nature research
Check for updates

OPEN Laser wakefield accelerated electron beams and betatron radiation from multijet gas targets

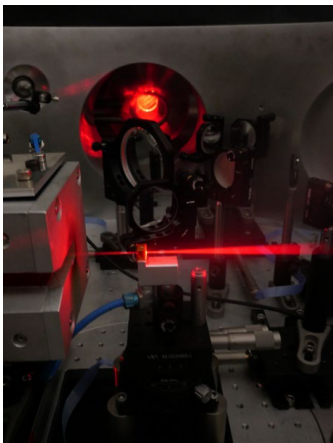
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Olle Lundh, olle.lundh@fysik.lth.se

- Multistage Laser and Beam Driven Plasma Accelerator,
PI : G. Raciukaitis (FTMC), Vilnius, Lithuania
- Spray imaging with laser driven X-ray
PI: Lars Zigan (FAU), Erlangen-Nürnberg, Germany

Understanding the breakup and atomization of fuel sprays is essential for improving e.g. engine efficiencies.

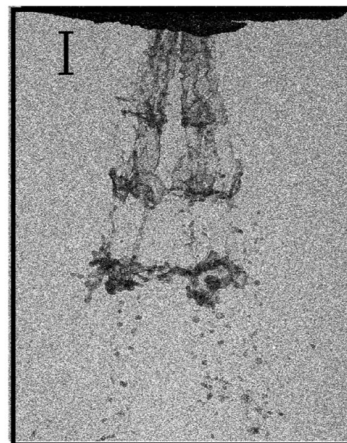
LWFA X-ray source



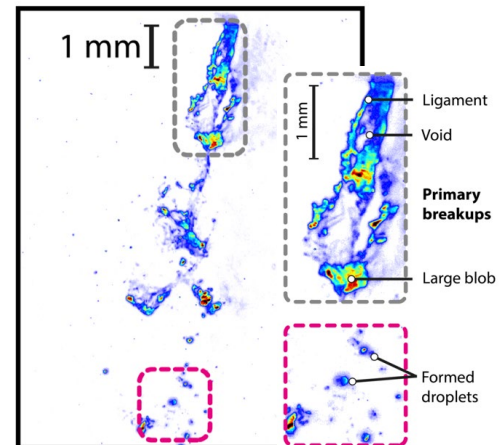
Fuel injection spray



LWFA X-ray image



Laser-induced fluorescence

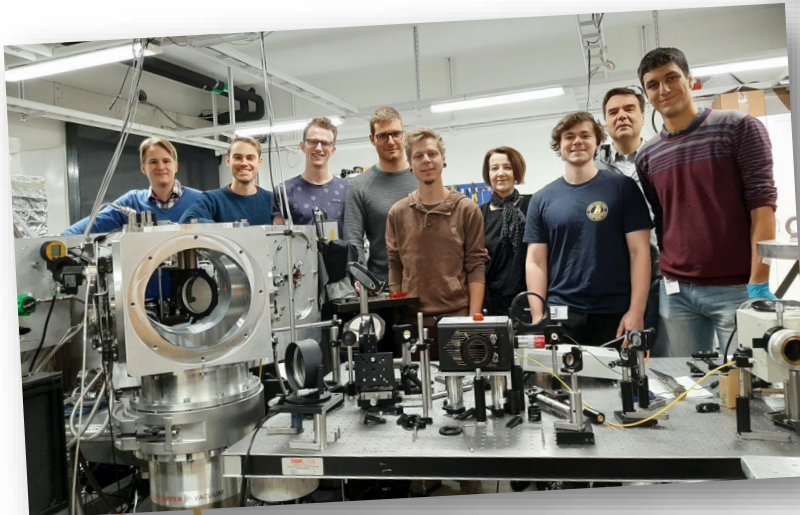
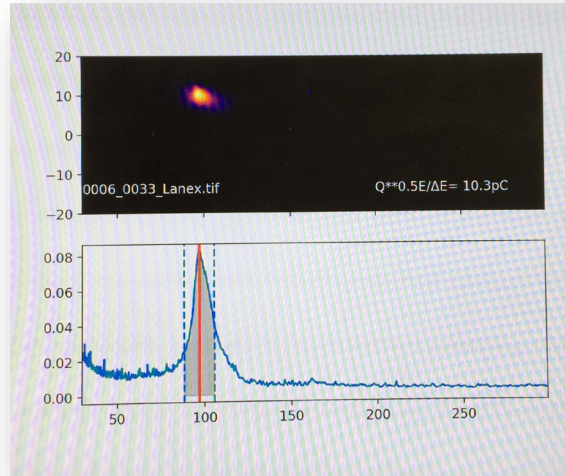


Access to LULAL

Testing plasma accelerator source for EuPRAXIA 1 & 2

Quantitative detailed study of the impact of laser properties on electron beam properties.

Automated online optimization of the electron beam



2 TNA projects (Nov-Dec 2019 and 2021)

4+4 weeks access,

20 visiting users,

10 participating institutes, 5 countries

Imperial College (UK), University of York (UK), Oxford University (UK), CLF (UK), CNRS (FR), U Paris-Saclay (FR), CEA-Saclay (FR), ENEA (IT), IST (PT), Lund University (SE)

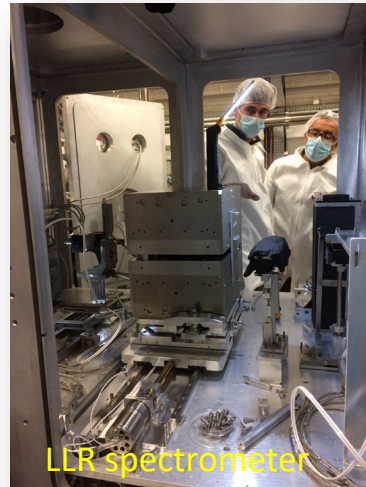


EuPRAXIA

ARIES



Commissioning experiments at

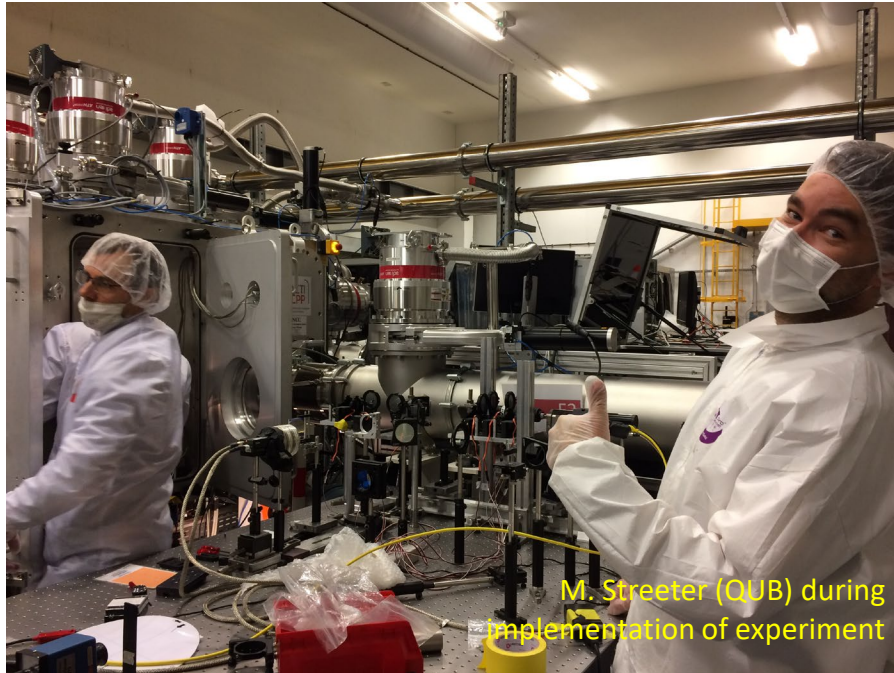


- PI B. Cros (CNRS LPGP) with teams from CEA LIDYL (S.Doboz), CNRS LLR (A. Specka) and CNRS IJCLAB (N. Delerue), supported by Apollon technical teams
- April 2021
- Apollon F2 beam focussed by a 3m focal lens optic, in a gas cell, electron spectrometer and on axis diagnostics
- H₂+1%N₂ plasma, 2 to 20mm long were explored,
- 4.5 J laser energy at cc
- Electron spectra observed in the detection window: 200 MeV – 1.6 GeV (lanex + yag detectors)
- Results in agreement with PIC simulations

Access to Apollon

Generation of laser-driven GeV-scale high-quality positron beams

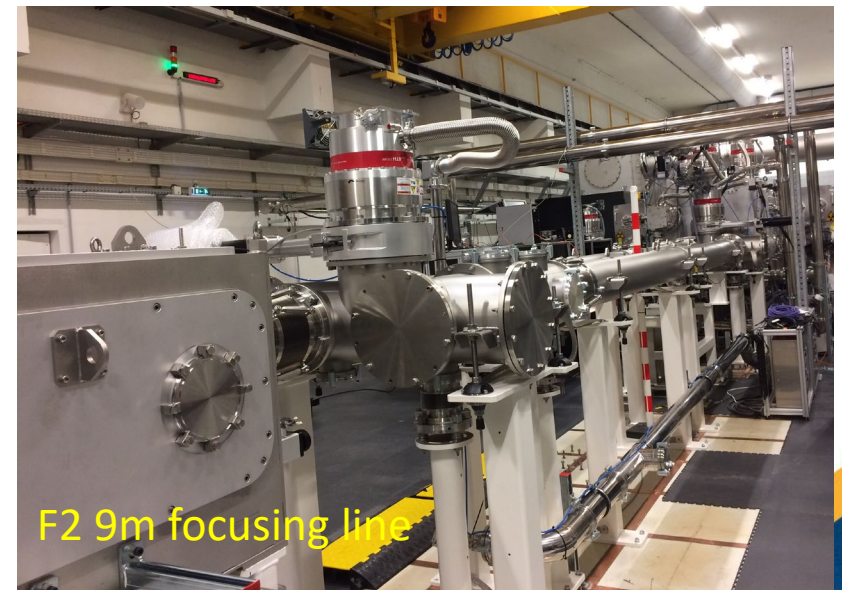
TNA March 14 to April 8 2022



M. Streeter (QUB) during implementation of experiment

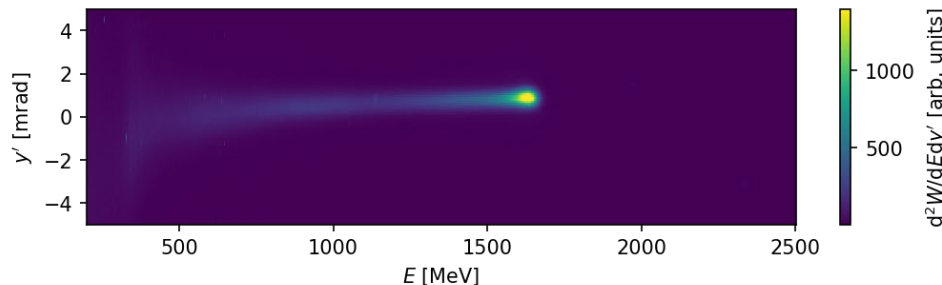
Project selected by the Apollon program committee following the 2021 call for proposals, and by the WP13 User Selection Panel

- PI G. Sarri
- Queen's University Belfast
- Supported by the commissioning team: B. Cros (CNRS LPGP), S. Dobož-Dufrénoy (CEA LIDYL) A. Specka (CNRS LLR) and Apollon technical teams



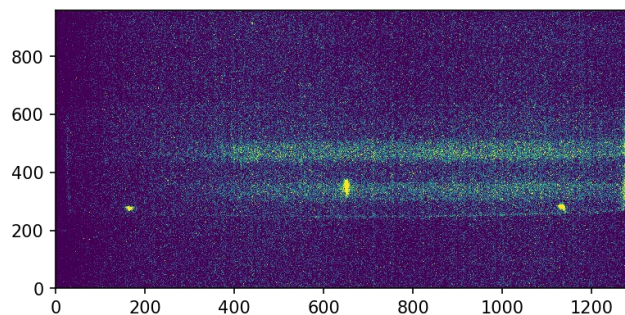
F2 9m focusing line

- Generation of > 1 GeV electron beams from laser-wakefield generation



Max. energy: 1.7 - 1.9 GeV
 Overall charge: 0.3 - 0.6 nC
 Divergence: 0.9 mrad

- Production of GeV-scale positron beams of high spatial quality



Max. energy: ~ 1 GeV
 Overall charge: ~ 3 pC
 emittance and source size
 measured (*to be analysed*)

- Testing of a gamma-ray spectrometer for high-flux and ~ 1 GeV gamma-ray beams
 gamma-ray spectrometer successfully tested and showing expected $\sim 10\%$ level energy resolution.
 Results currently being analysed.
- Detection of muons from a laser-driven configuration
detectors currently being etched for analysis...

Summary

- Access to electron bunches driven by laser in plasma was provided at **UHI100 LPA** and **LULAL** and **APOLLON** facilities for various applications:
 - physics of plasma accelerators,
 - generation of secondary particles or radiation,
 - use of secondary radiation for imaging.
- Promising results for future use of plasma accelerators:
 - Large range of parameters can be delivered,
 - Flexibility of set-ups and environments for users
 - Reliability and stability can be improved through the development of dedicated facilities and specific beamlines



LUNDS
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This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 730871.



Thank for your attention