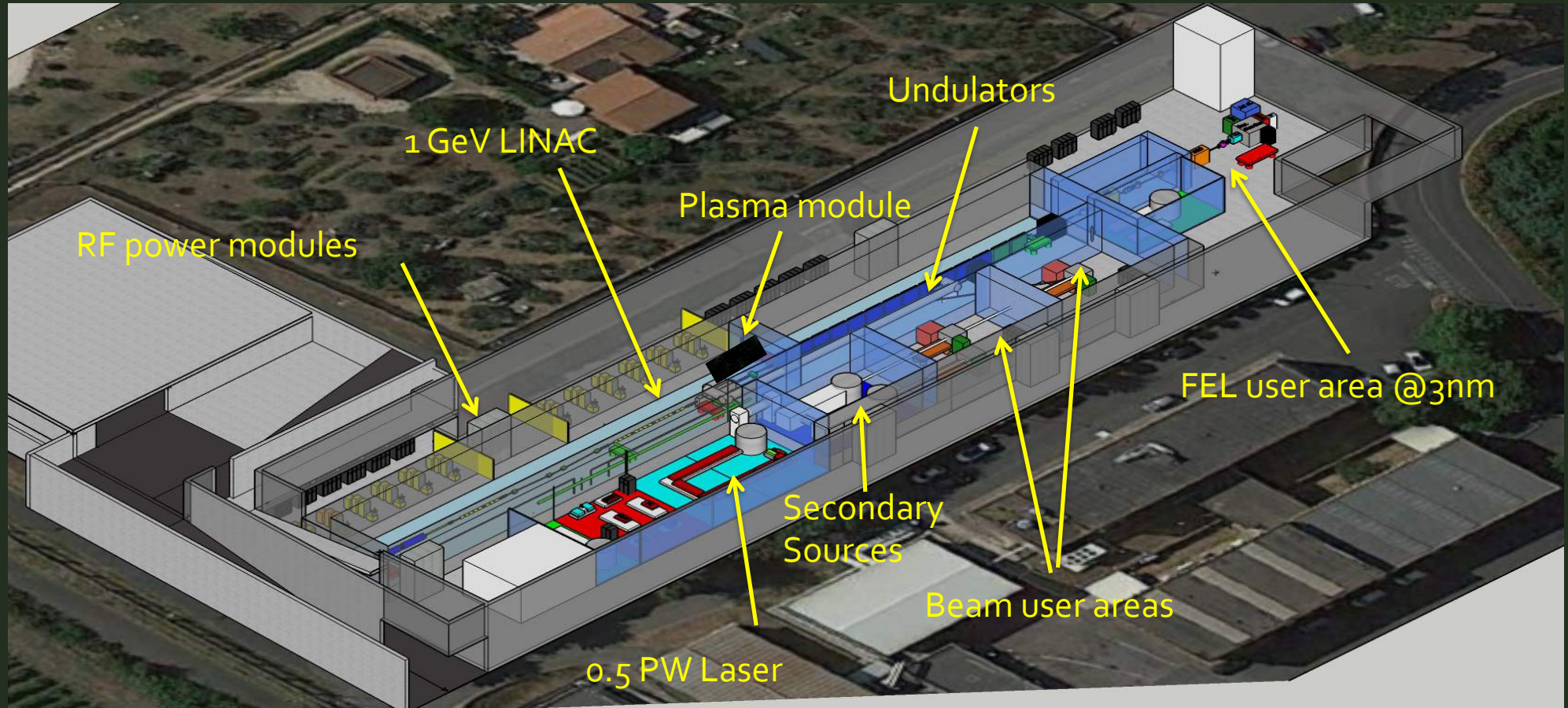


# EuPRAXIA & SPARC\_LAB



<http://www.lnf.infn.it/sis/preprint/pdf/getfile.php?filename=INFN-18-03-LNF.pdf>





/VOLUME/36/ANNO/2020/NUMERO/3-4/

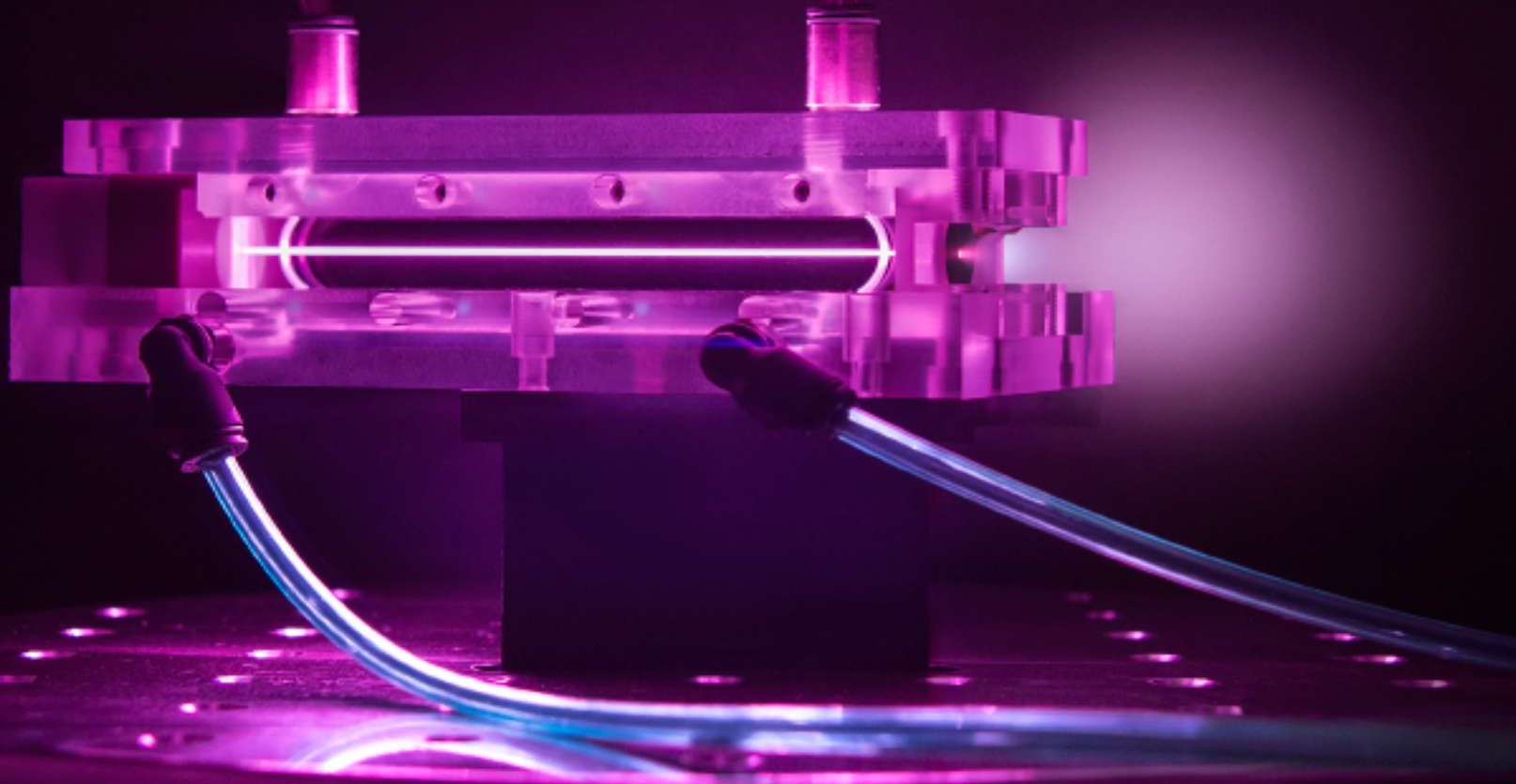
# IL NUOVO SAGGIATORE

BOLLETTINO DELLA SOCIETÀ ITALIANA DI FISICA

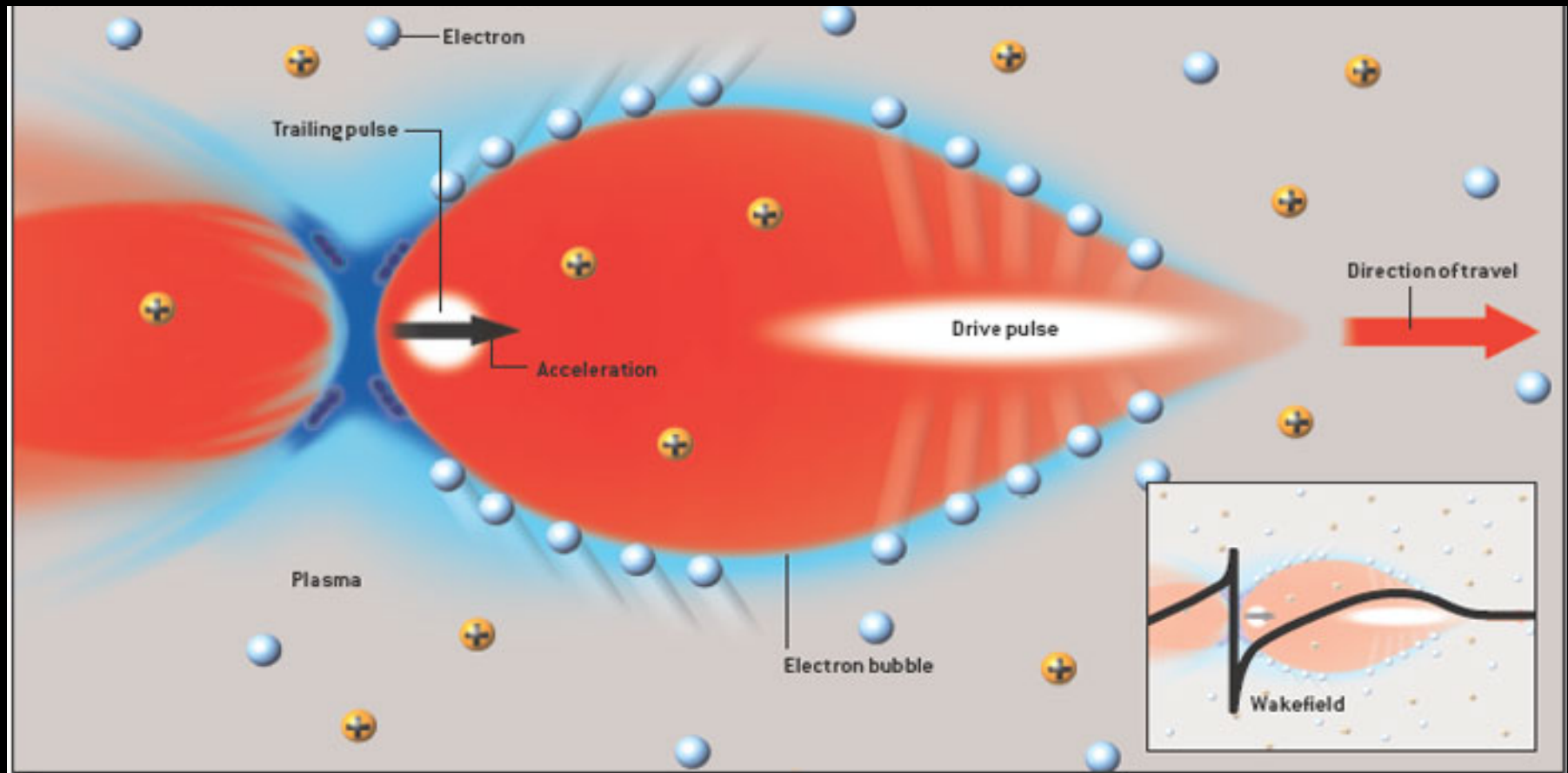


M. Ferrario, R. W. Assmann, "Accelerating the Future"  
<https://www.ilnuovosaggiatore.sif.it/download/62>

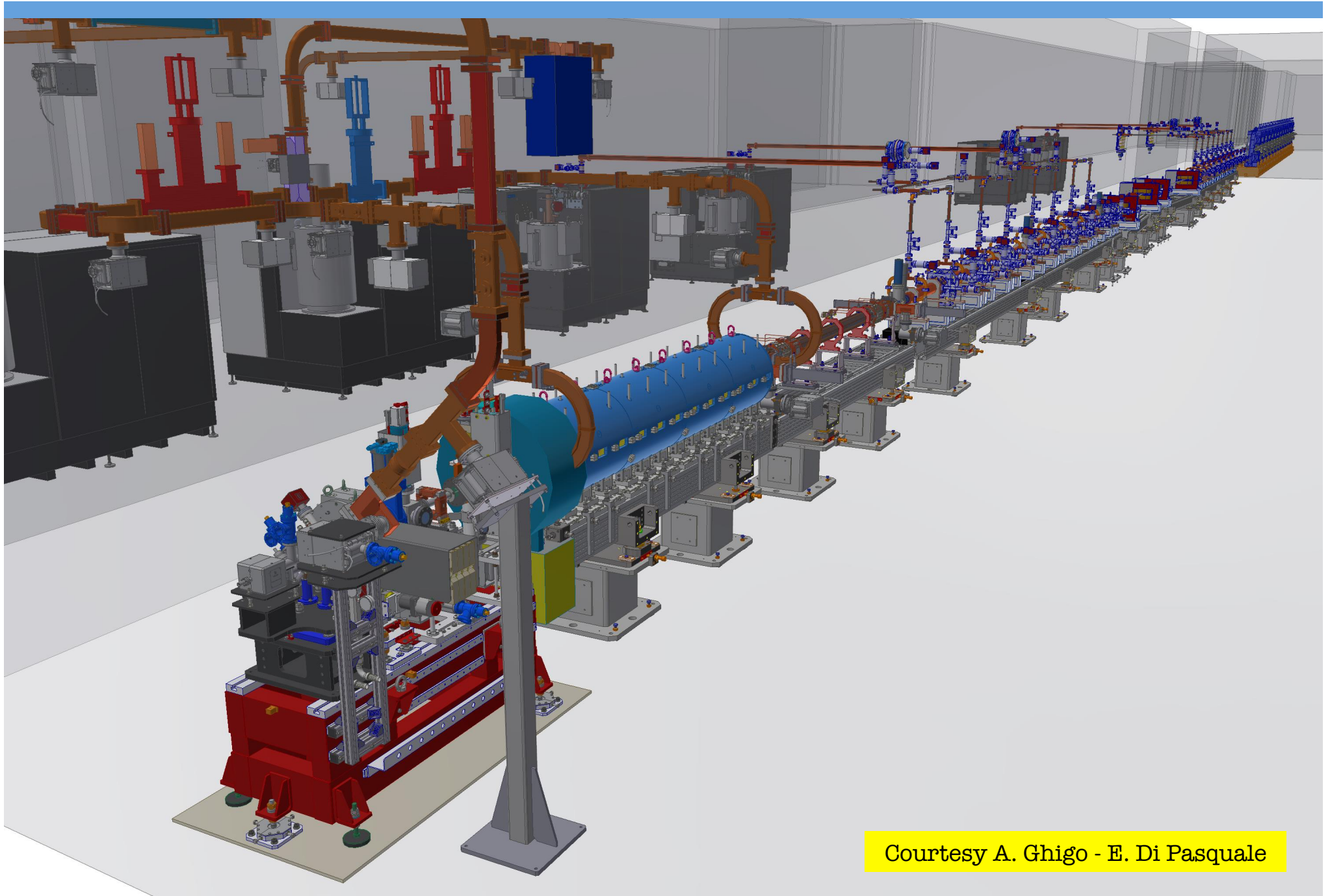
# Plasma Capillary Discharge





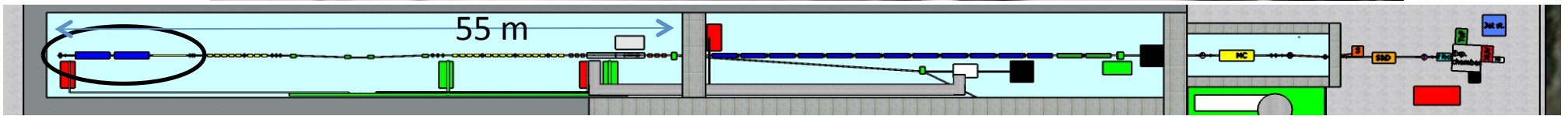
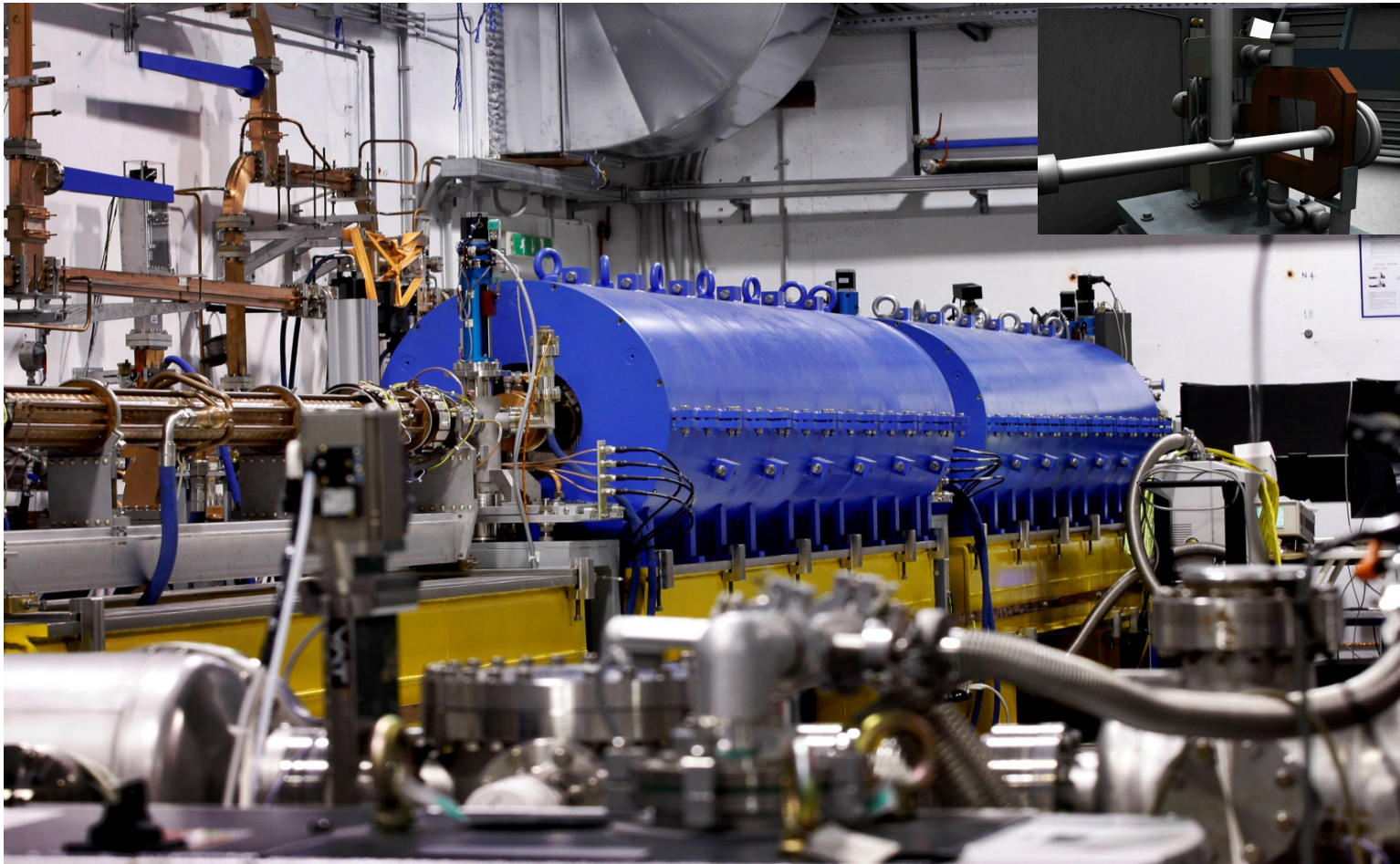




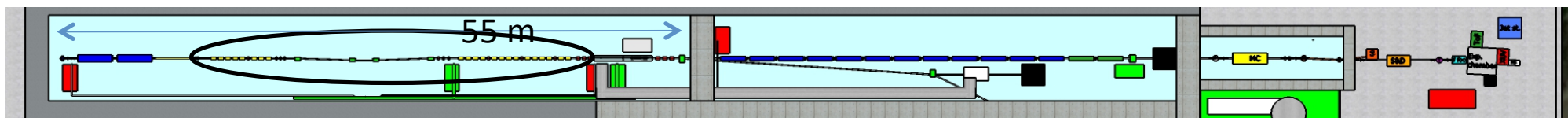
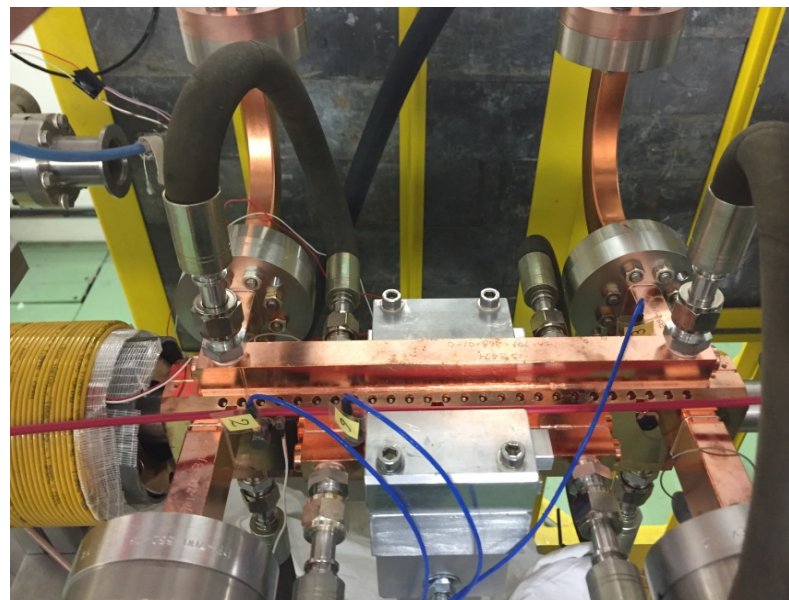


Courtesy A. Ghigo - E. Di Pasquale

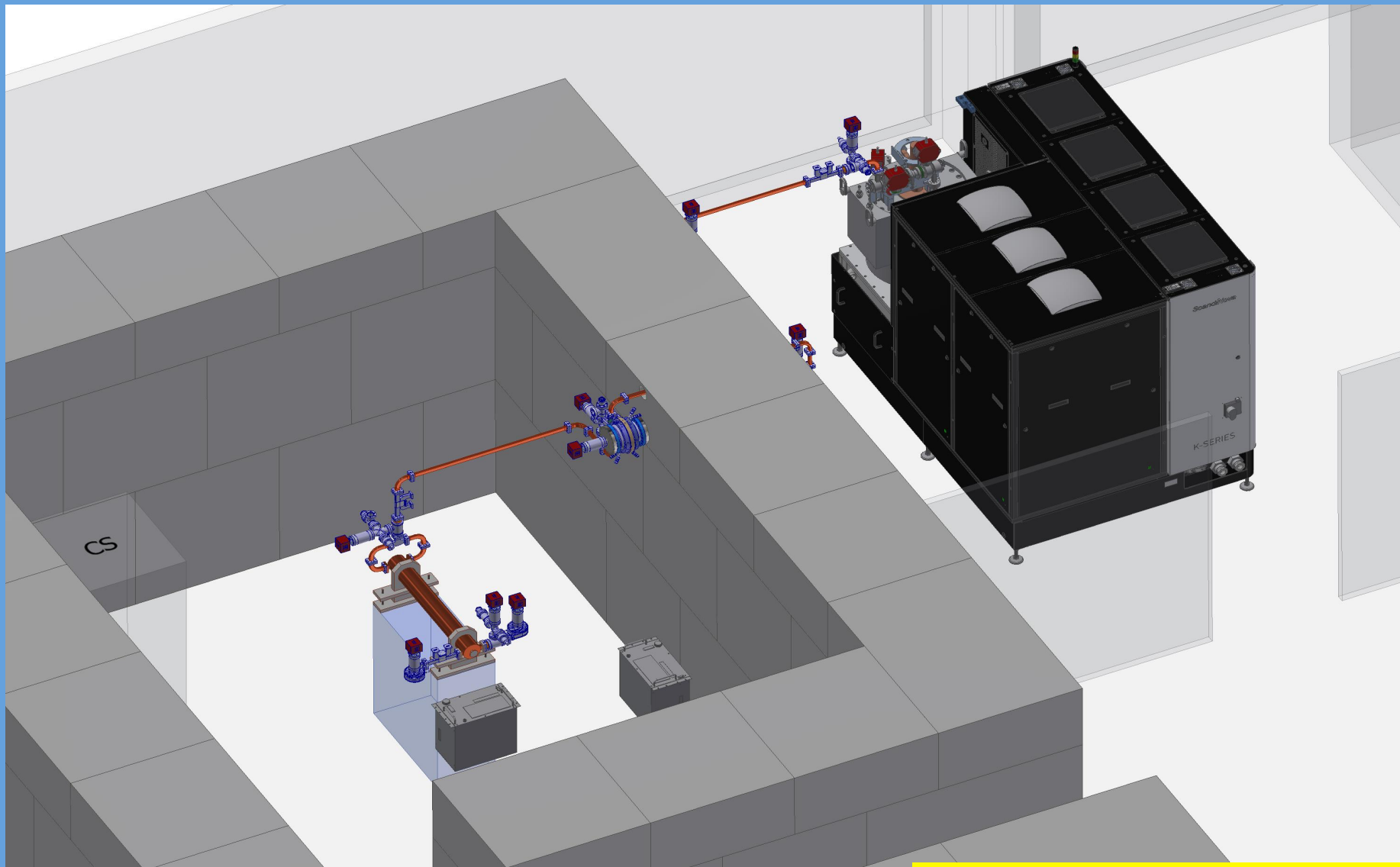
# SPARC\_LAB HB photo-injector







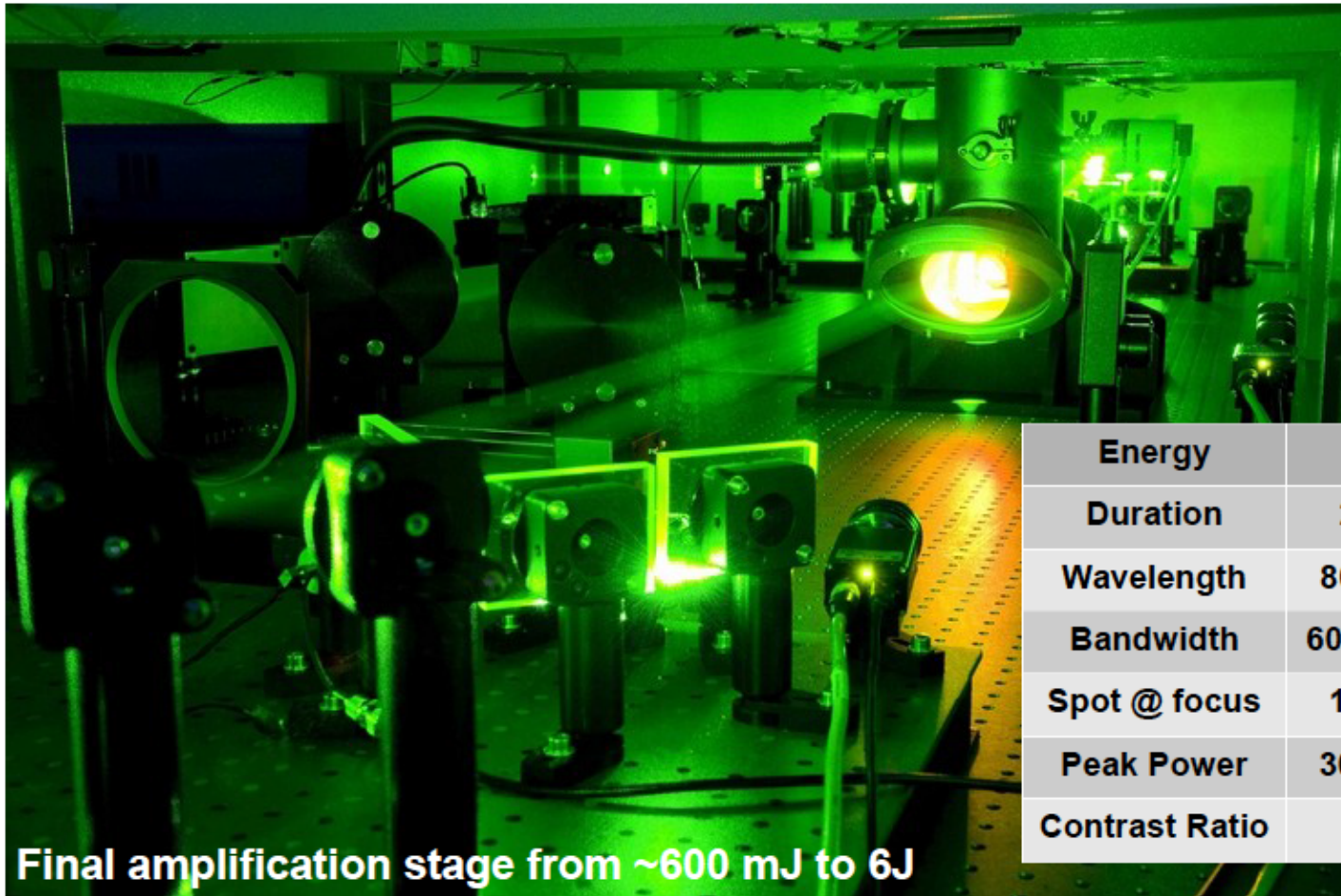
# X-BOX@LNF



Courtesy E. Di Pasquale



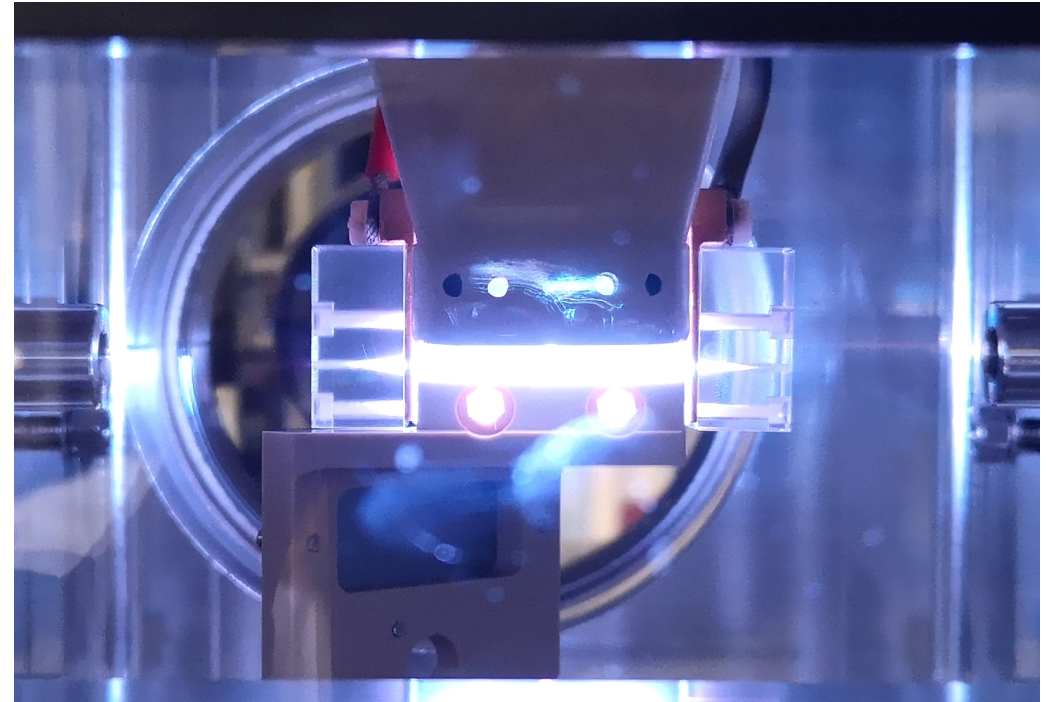
# Ti:Sa FLAME laser



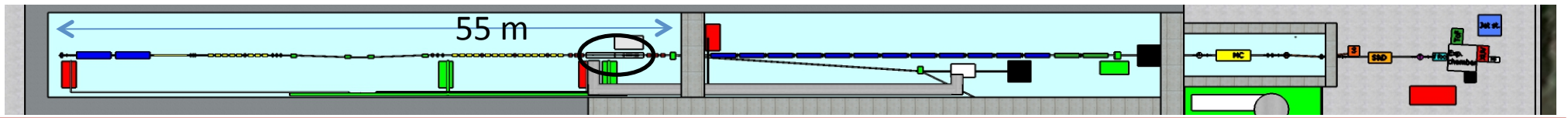
Energy	6 J
Duration	23 fs
Wavelength	800 nm
Bandwidth	60/80 nm
Spot @ focus	10 $\mu$ m
Peak Power	300 TW
Contrast Ratio	$10^{10}$

Final amplification stage from ~600 mJ to 6J

# Plasma WakeField Acceleration

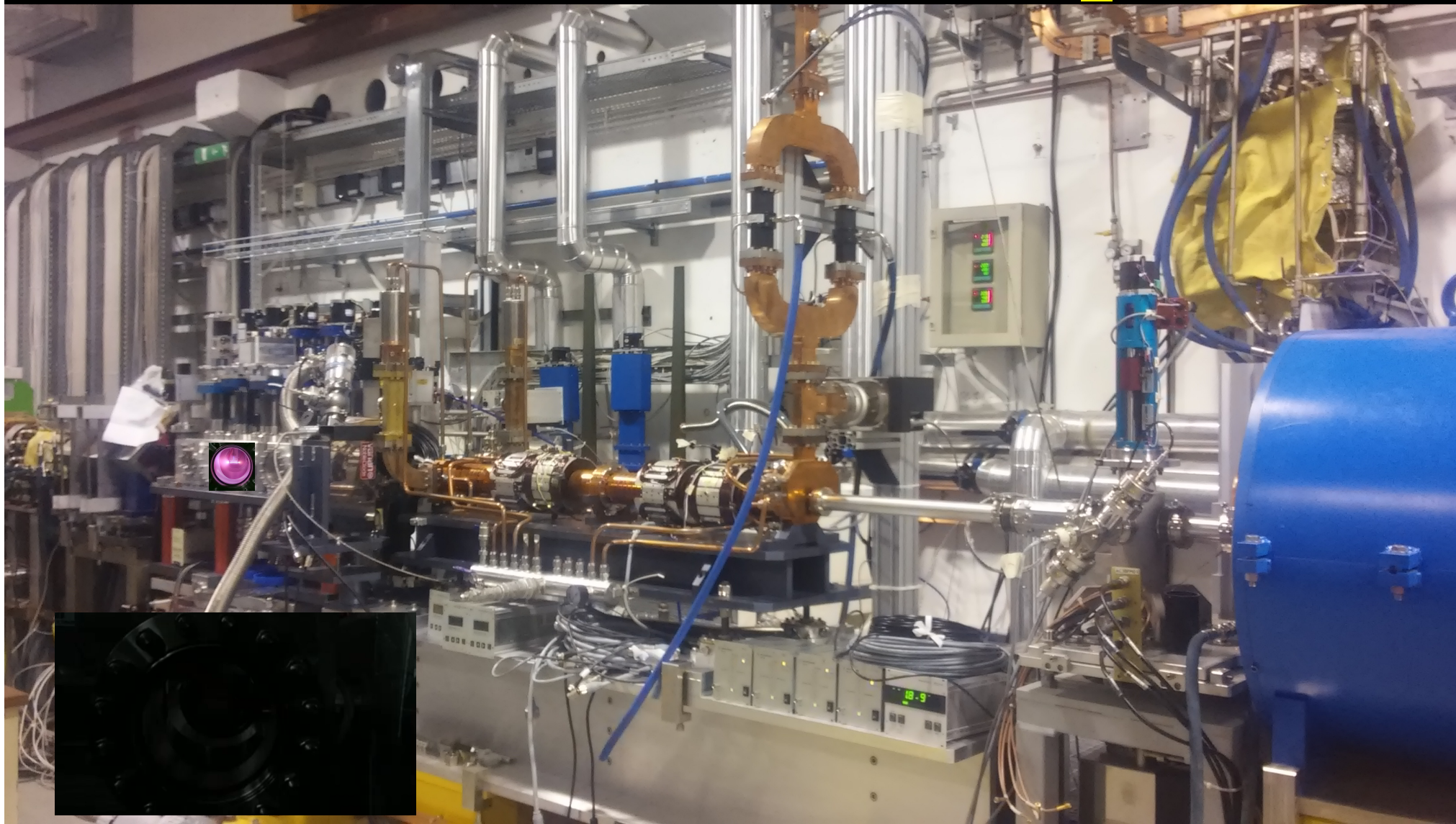


Capillary discharge at SPARC\_LAB

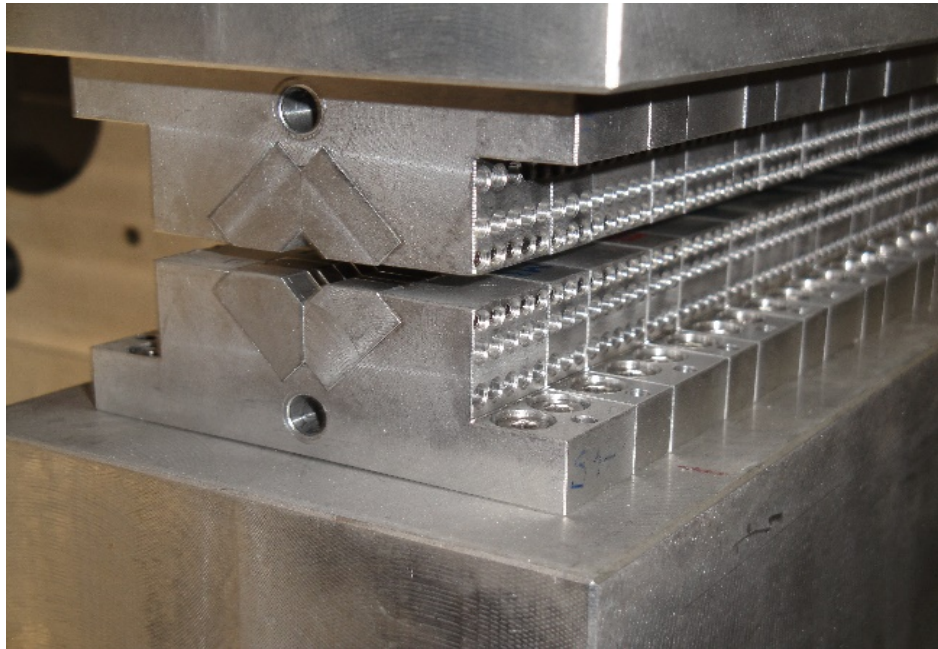




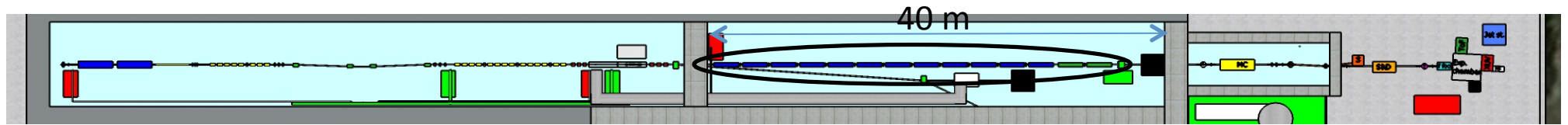
# PWFA vacuum chamber at SPARC\_LAB



# Undulators

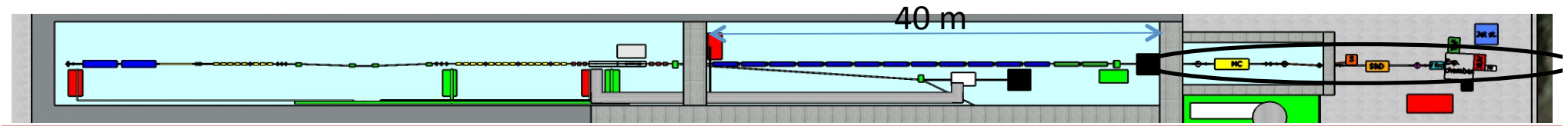
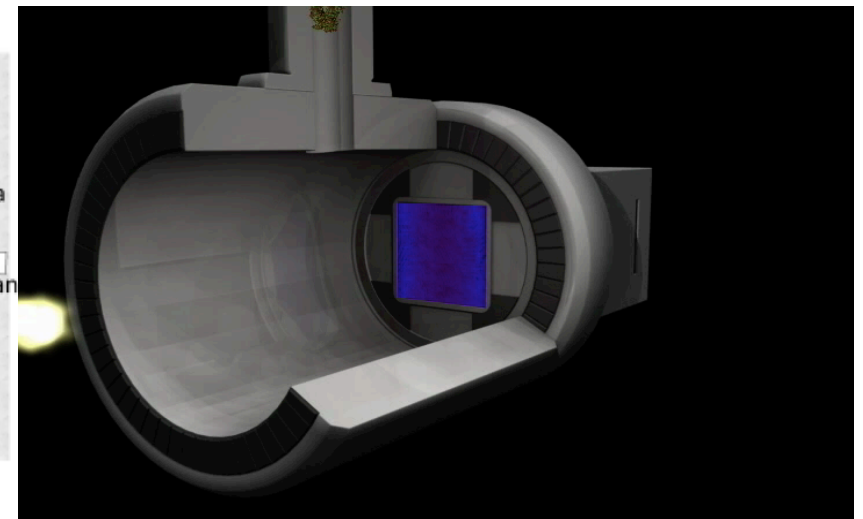
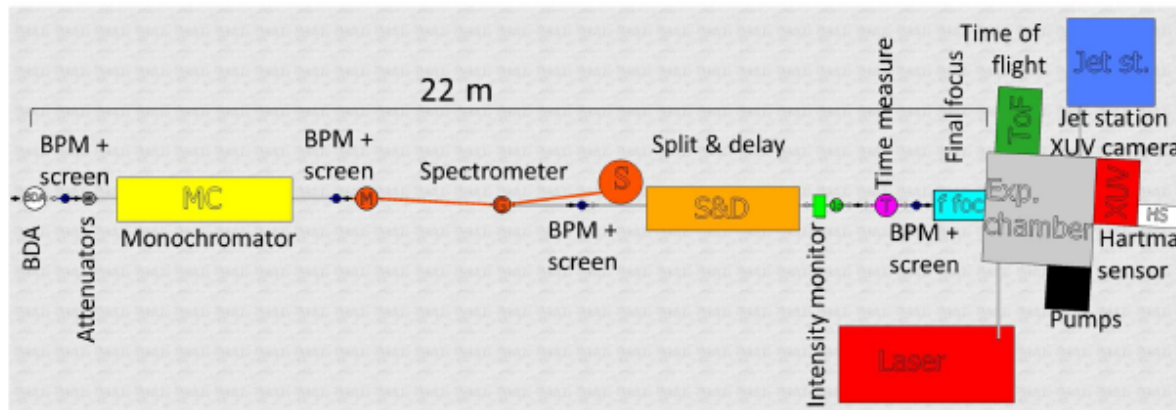


KYMA  $\Delta$  undulator at SPARC\_LAB:  $\lambda=1.4$  cm, K1





# Photon beam line





**List of possible PhD activities**



## Beam Dynamics

- Manipulation of high brightness - ultra short electron beams in a high gradient X-band RF linac to drive plasma-based accelerators
- Design of a compact transport line of high brightness electron beams accelerated in plasma modules for a free electron laser source
- Phase space optimisation of high brightness electron beams accelerated in plasma module for advanced radiation sources

## Timing and Synchronization

- Developments of new methods and devices for femtosecond synchronization in linear accelerators

## Plasma Module

- Numerical and phenomenological study of plasma de-chirper
- Implementation of quasi-static approximation in Architect code for PWFA
- Plasma density measurement in gas-filled discharge capillaries for plasma acceleration by means of interferometric techniques
- Theoretical study of plasma formation in plasma sources for plasma-based accelerators
- Theoretical and experimental characterization of plasma beam dumps for plasma-based accelerators
- Experimental and theoretical characterization of plasma sources for plasma-based accelerators by means of spectroscopic techniques

## **INJECTOR**

- Transverse and longitudinal shaping of laser pulses for high-brightness photo-injectors (R.P.)

## **RF LINAC**

- Design, Realization and High Power radiofrequency tests of X-band structures for the EuPRAXIA@SPARC\_LAB project (D.A.)
- Design, Realization and High power radiofrequency test of a C-band photo-gun for high brightness electron LINACs (D.A.)
- Active quasioptical Ka-band rf pulse compressor switched by a diffraction grating (B.S.)
- Beam dynamics of Ka-Band Klystron amplifier including RF drive cavities and output cavities design (B.S.)
- 36 GHz MW MAGNICON Ka-Band Device (B.S.)

## **DIAGNOSTICS**

- Extending electro-optical sampling based diagnostics to femtosecond resolution (R.P.)



## **PLASMA MODULE**

- Theoretical studies of plasma discharges in capillary discharge waveguides. (A.B.)
- Study of pinch effects and heat transfer in capillary-discharge wave-guides (R.P.)
- Optimization of active-plasma lens devices for ultra-high focusing gradients (R.P.)
- Deflection of particle beams with curved active-plasma lens geometries (R.P.)
- Plasma source study and design for particle acceleration

## **FEL**

- Studio e caratterizzazione di un canale di trasporto basato su dispositivi a plasma per l'iniezione nel FEL a EuPRAXIA@SPARC\_LAB (E.C.)
- Generation of short pulses in Free Electron Laser Amplifiers (L.G.)
- Free electron laser driven by a laser plasma accelerator.
- Design, construction and application of a innovative THz source for applications

## **FLAME**

- Femtosecond laser synchronization for external injection of electron bunches in a laser driven plasma wave. (A.G.)
- 
- “Study of a compact and high efficiency laser removal technique for EUPRAXIA@SPARC\_LAB” (M.P.A.)
- 
- Laser plasma acceleration for production of betatron radiation for multi-purpose applications in EuPRAXIA

Laser plasma acceleration for production of charged and neutral particles for EuPRAXIA.  
(positrons included)

## **BEAM DYNAMICS**

- Numerical PIC studies for plasma-based acceleration (A.D)
- Studies on beam dynamics of charged particles injected in plasma ramps

Analysis towards the preservation of plasma resonant regime in multi-bunch driving structure





**Thanks**