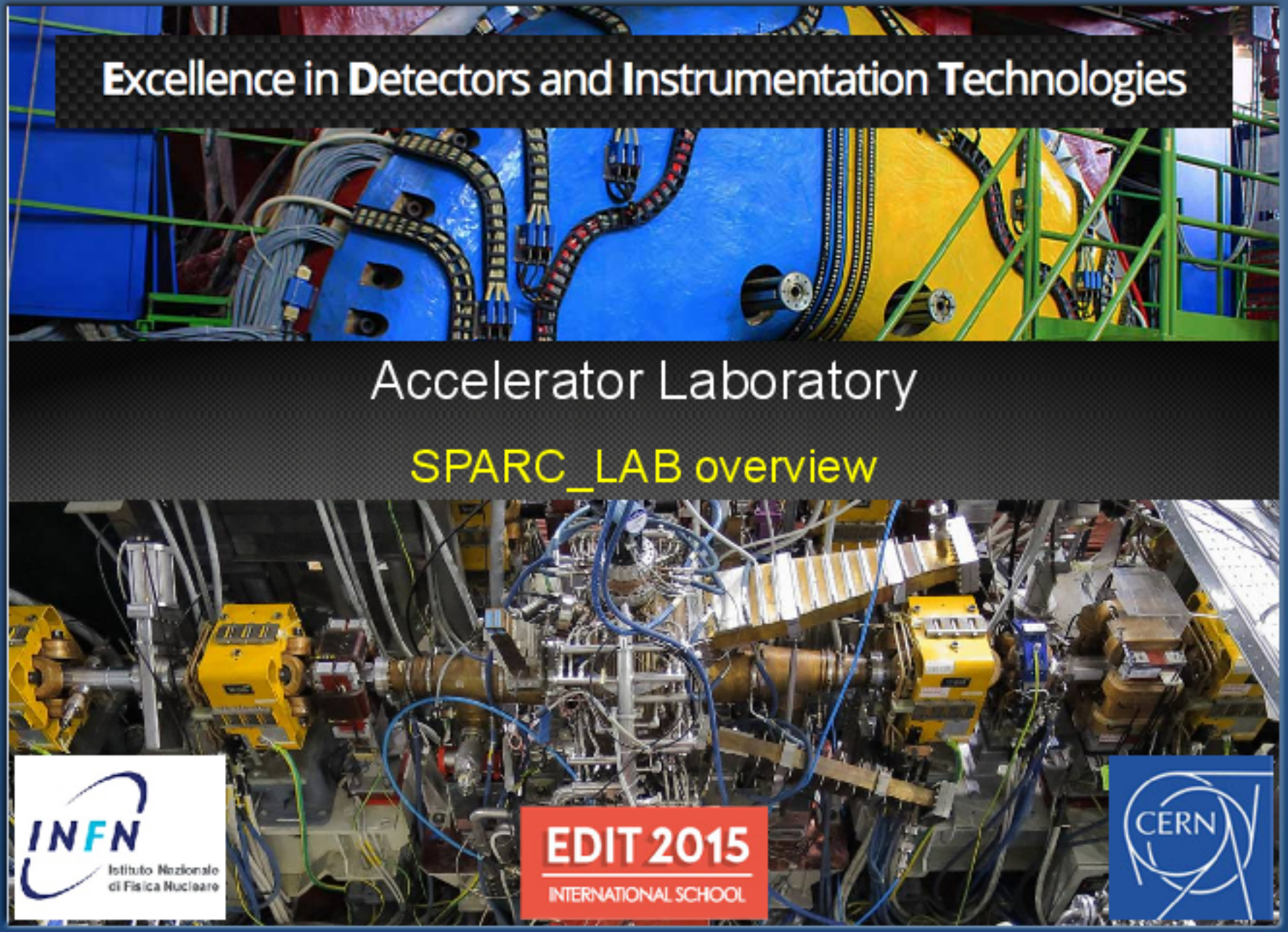
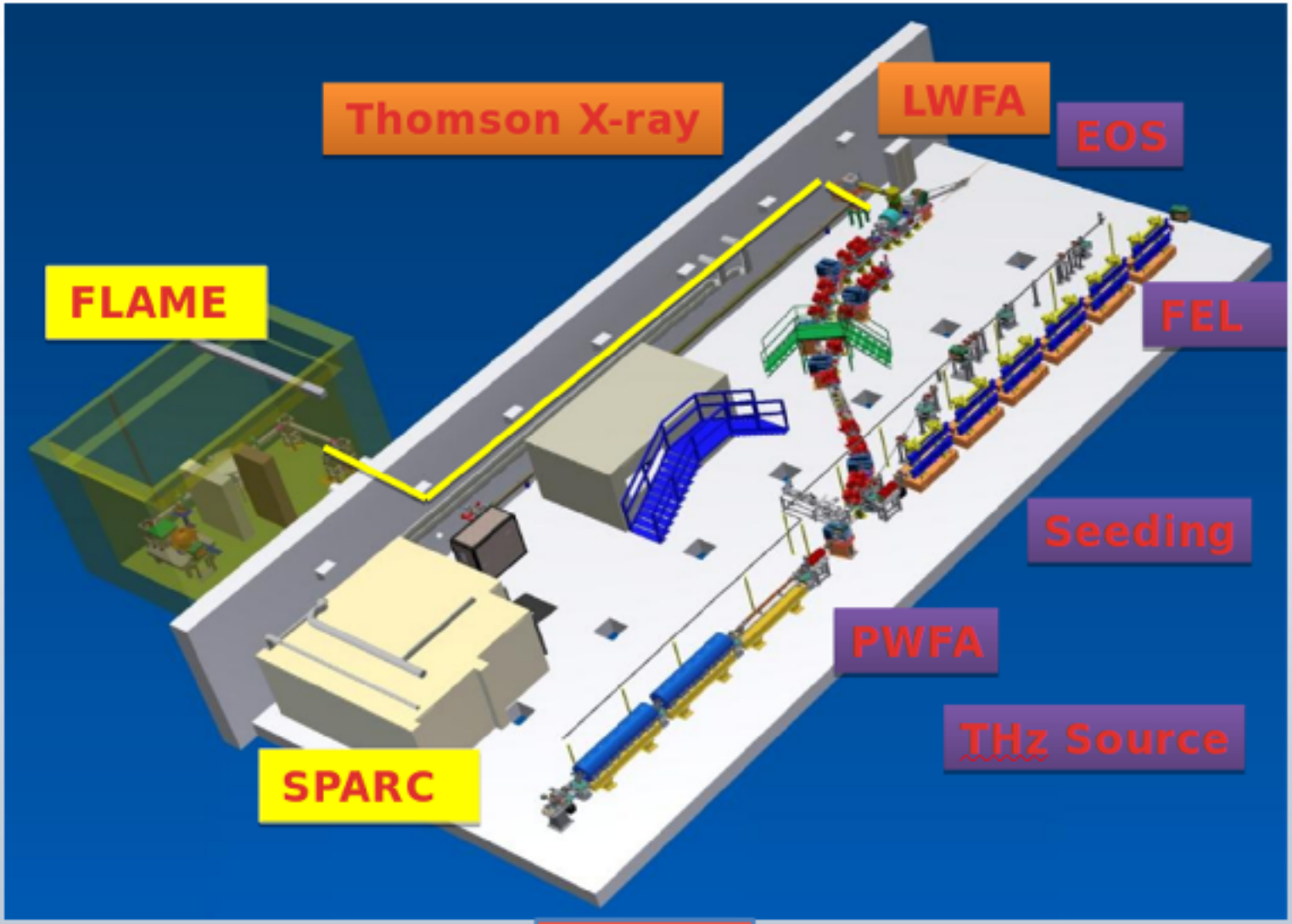

Excellence in Detectors and Instrumentation Technologies
Accelerator Laboratory
SPARC_LAB overview
INFN
Istituto Nazionale di Fisica Nucleare
EDIT 2015
INTERNATIONAL SCHOOL
CERN

SPARC_LAB layout and experimental lines



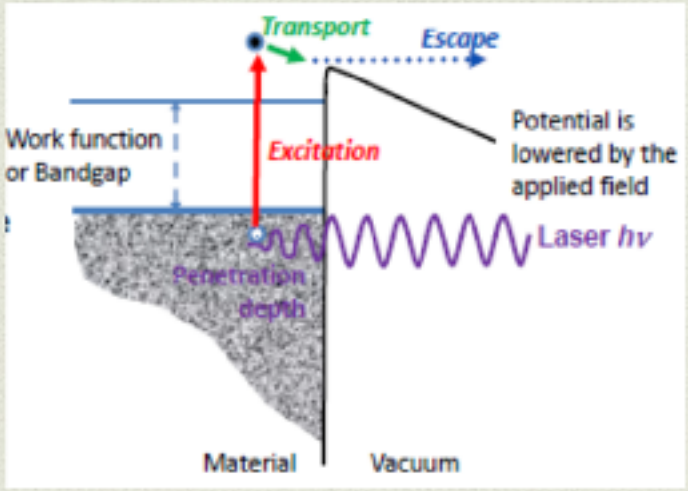
RF Photo-injectors

- **Radio-Frequency (RF) Gun**
  - RF guns are able to provide high peak current (ultra-short pulse length, i.e. ps down to few fs) and low emittance beams (down to < 1 mm mrad)
  - high brightness beams
- **Electrons are generated by photo-electric effect** from a metal or semiconductor material when illuminated by a laser pulse with proper wavelength (UV for a Cu cathode)
- Both transverse and longitudinal beam characteristics can be manipulated by properly **shaping the laser pulse**
- **High power RF fields** (~120MV/m gradient) are used to accelerate the beam just after the extraction from the cathode and to preserve the initial beam quality

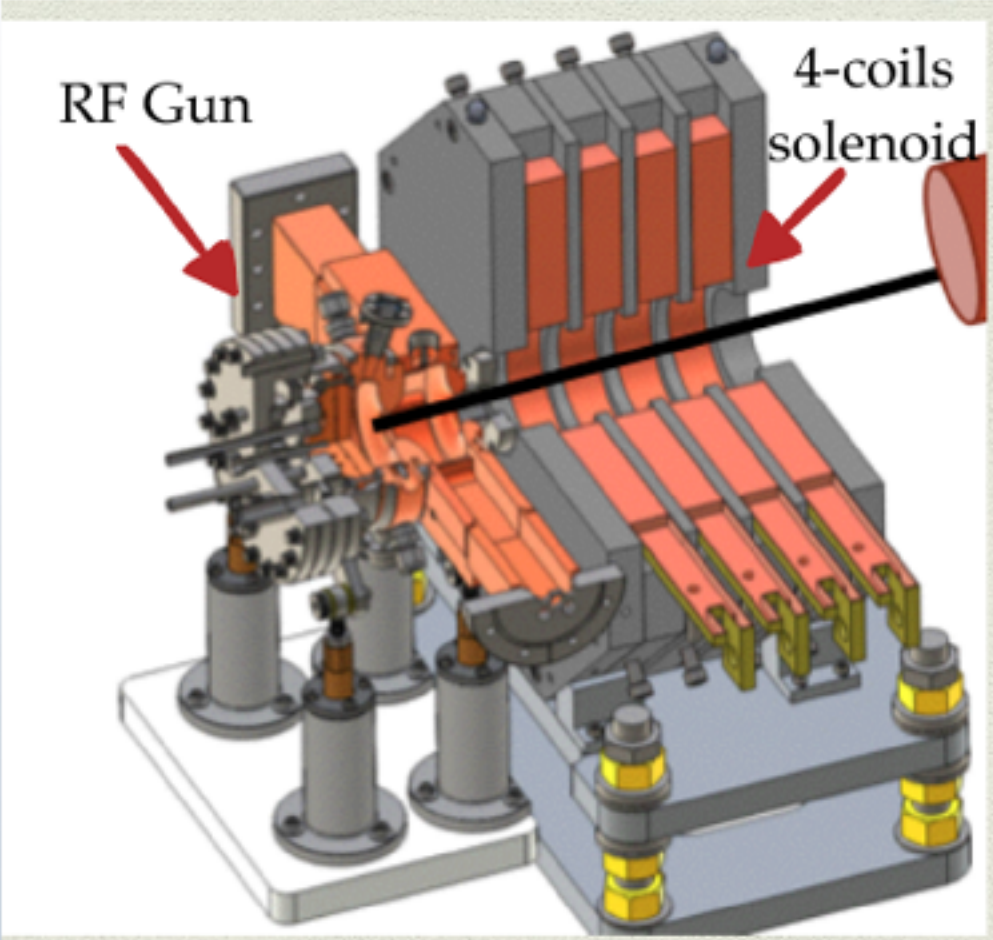
Photo-injector components

A RF photo-injector consists of a **laser generated electron source** followed by an electron beam optics system which preserves and matches the beam into a high-energy accelerator

- **Emission and initial acceleration**
  - **Drive laser**
    - to gate the emission of electrons from the cathode
  - **Photocathode**
    - to produce ps down to fs electron bunches when illuminated by laser pulses
  - **Electron gun**
    - to accelerate electrons from their rest energy up to few MeV
- **Beam focalization**
  - **Solenoid** for emittance optimization
- **Acceleration**
  - **Linac cavities**
    - to mitigate the space charge emittance growth, therefore preserving the beam quality



RF Photo-injectors



The beam wants to diverge for two reasons

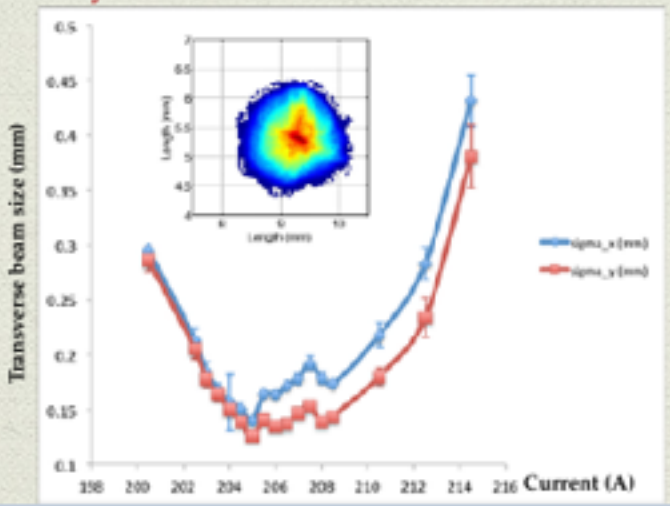
- **Space charge**

The electron bunch coming off the cathode is very dense and wants to expand violently due to the electrostatic force

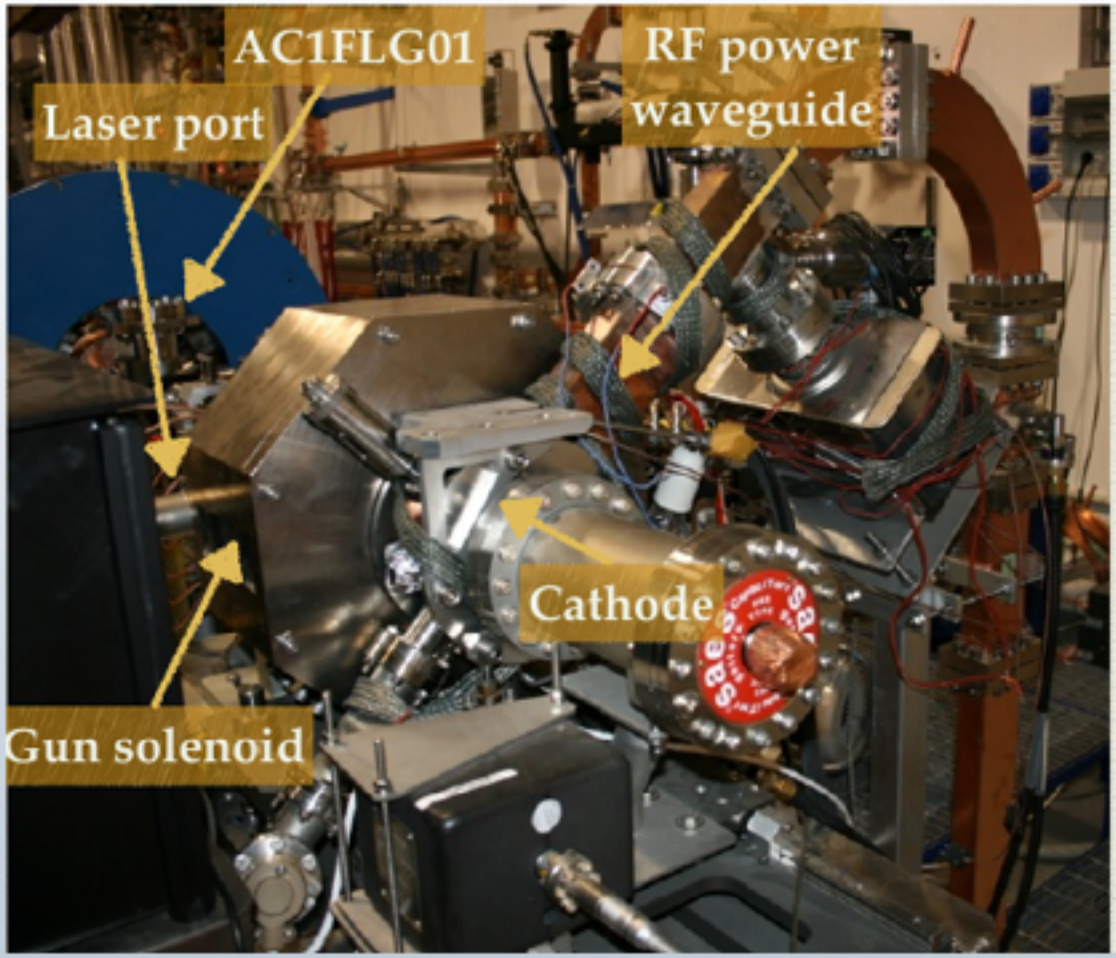
- **Divergent RF Fields within the RF gun**

Anytime the electric field varies longitudinally there is a radial field

The solenoid focuses the low energy beam radially



SPARC_LAB RF GUN area

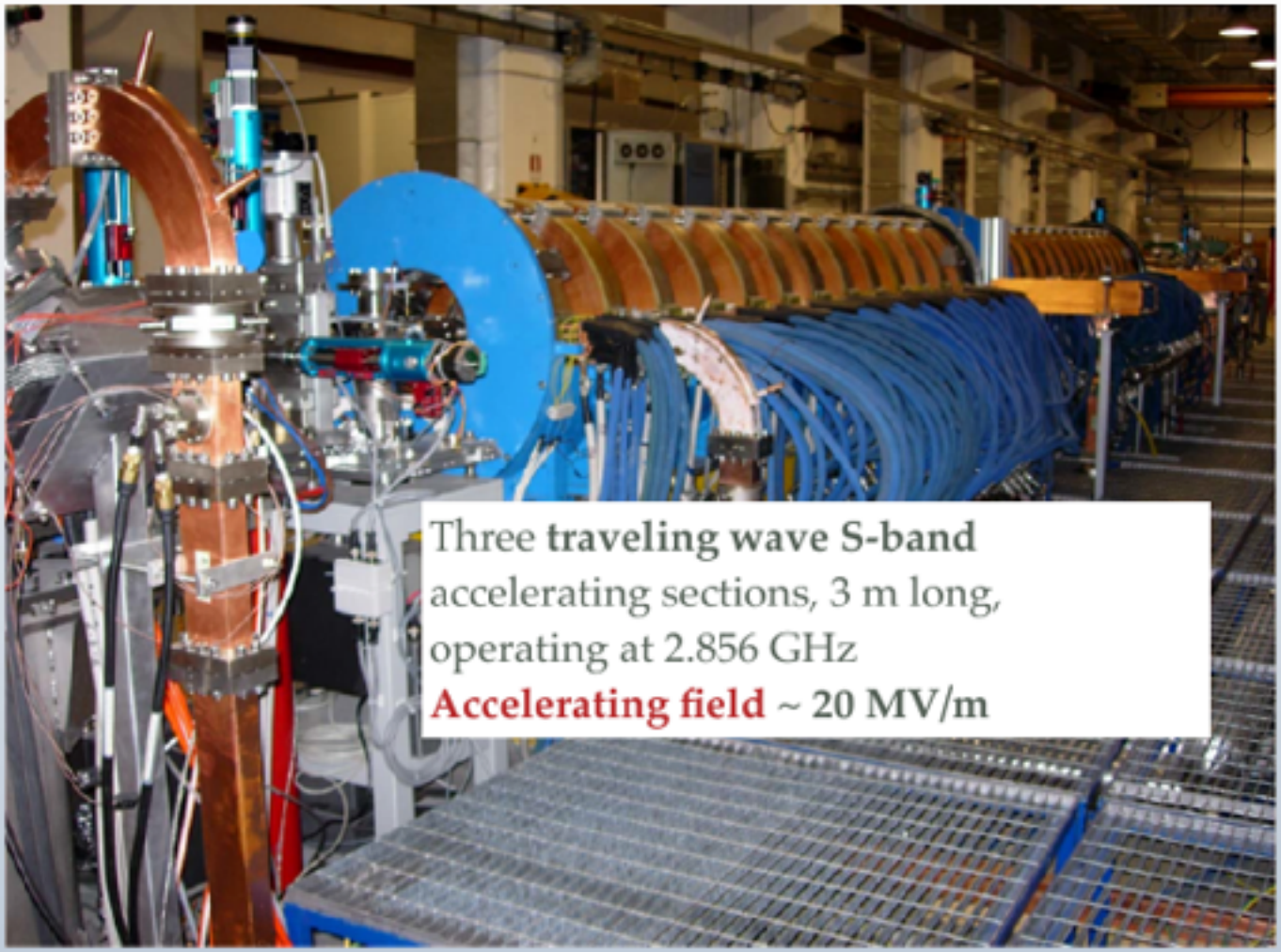


Measurements to be performed (once RF is turned ON)

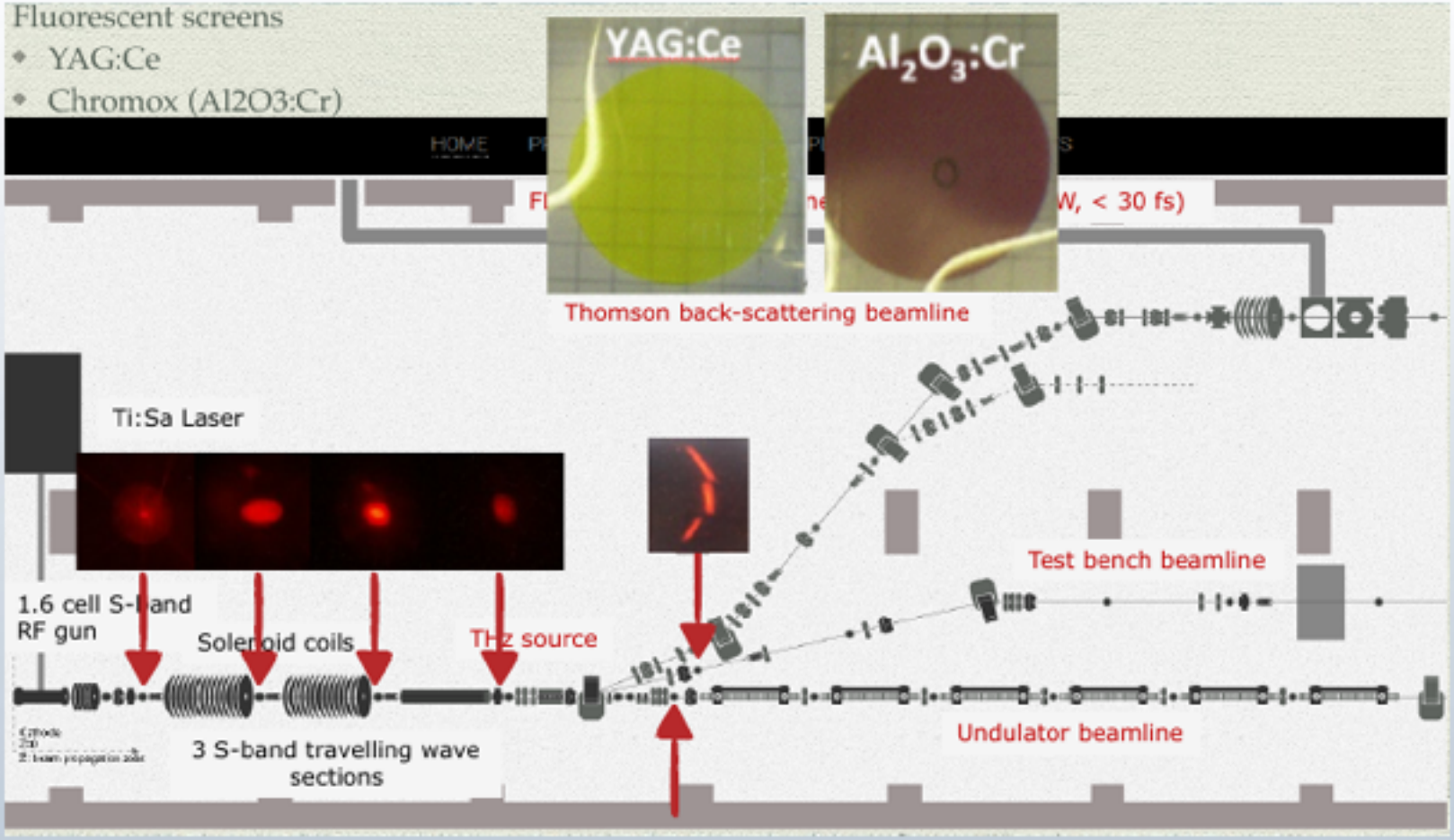
Scintillating screen (AC1FLG01) inserted

- Phase scan
  - Charge VS RF gun launch phase
- Charge
  - Beam Current Monitor named as AC1BCM
- Energy measurement
  - Vertical beam centroid VS steering current

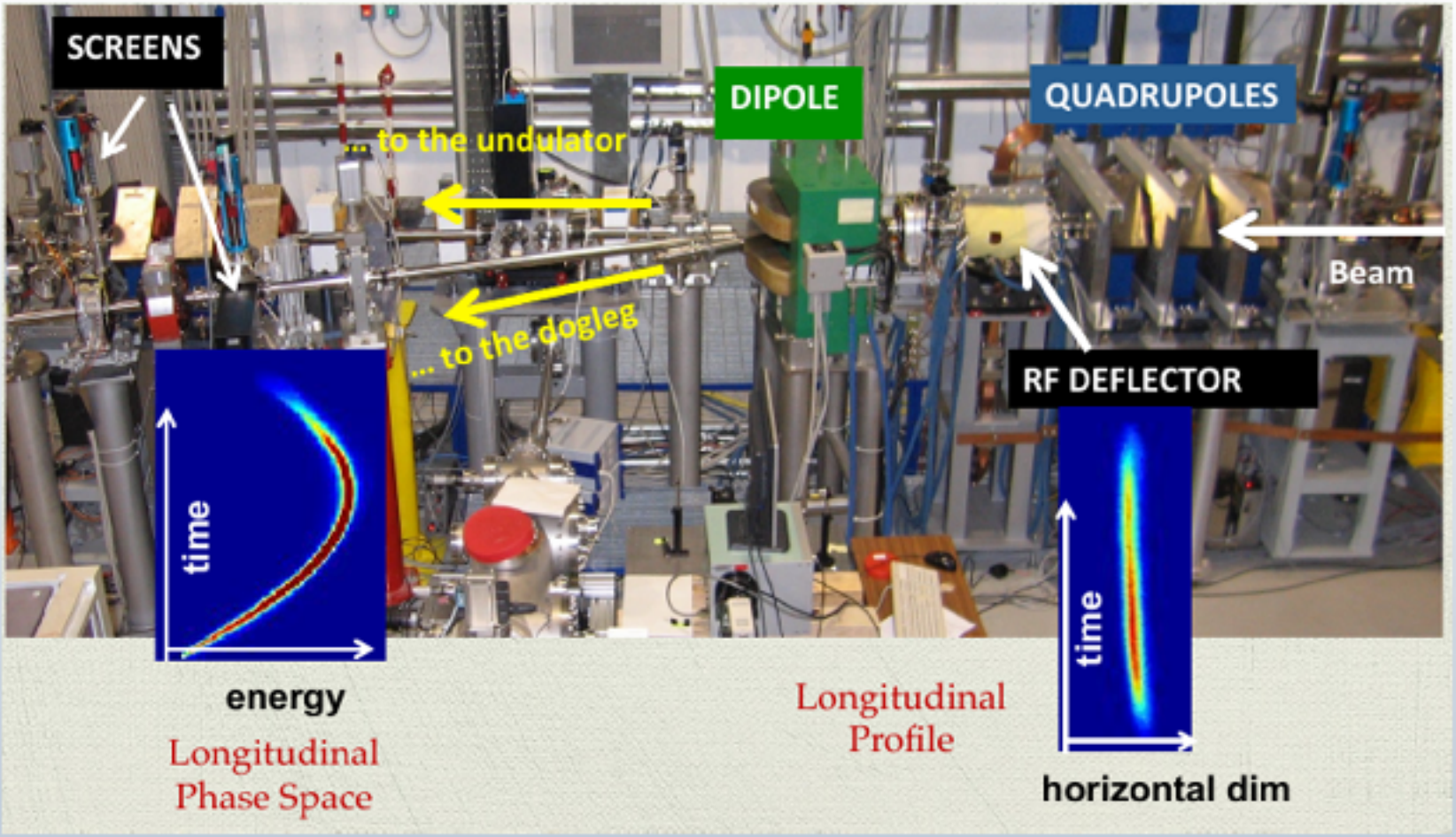
SPARC_LAB accelerating sections



SPARC_LAB electron diagnostics



SPARC_LAB diagnostic sections



Seminar will continue with a visit to the SPARC_LAB accelerator.

Then we will move in control room where startup operations and measurements will be presented and virtually performed.