# Injector status

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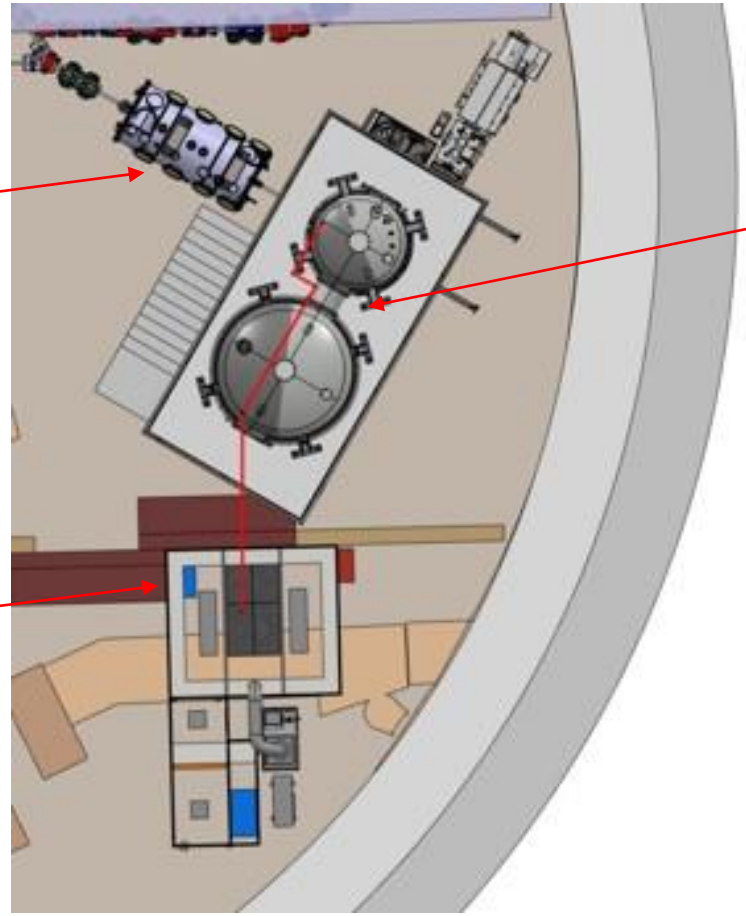
30/01/25

# Outline

1. Injector
    - Laser
    - Photogun
    - Buncher
    - The booster
2. The diagnostic beamline and the merger

# 1. Injector

Overview in the Igloo, building hosting PERLE

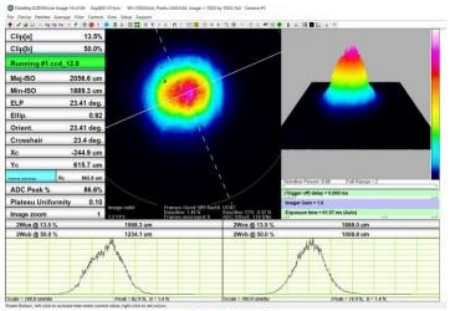


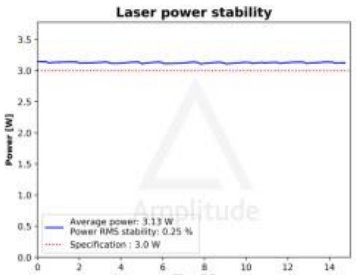
## The laser

- 1st phase (limited by purchase procedures) :
  - Purchased from Amplitude in December 2022, received in December 2023

Satsuma, fiber amplifier, LED pumping, 52 cm x 33 cm, 10 W in IR @10 MHz
Compressed, conversion to green and stretched to max 54 ps, FWHM

### Measurements at the delivery




dp = 0.2 %

Power at 40 MHz = 1.3 W
Energy = 32 nJ

*Laser transport*

16 nJ on photocathode

Q = 0.5 nC => QE = 6 %

The future: in 2026?

Upgrade of amplifier to 20 W

External trig. (90 k€)

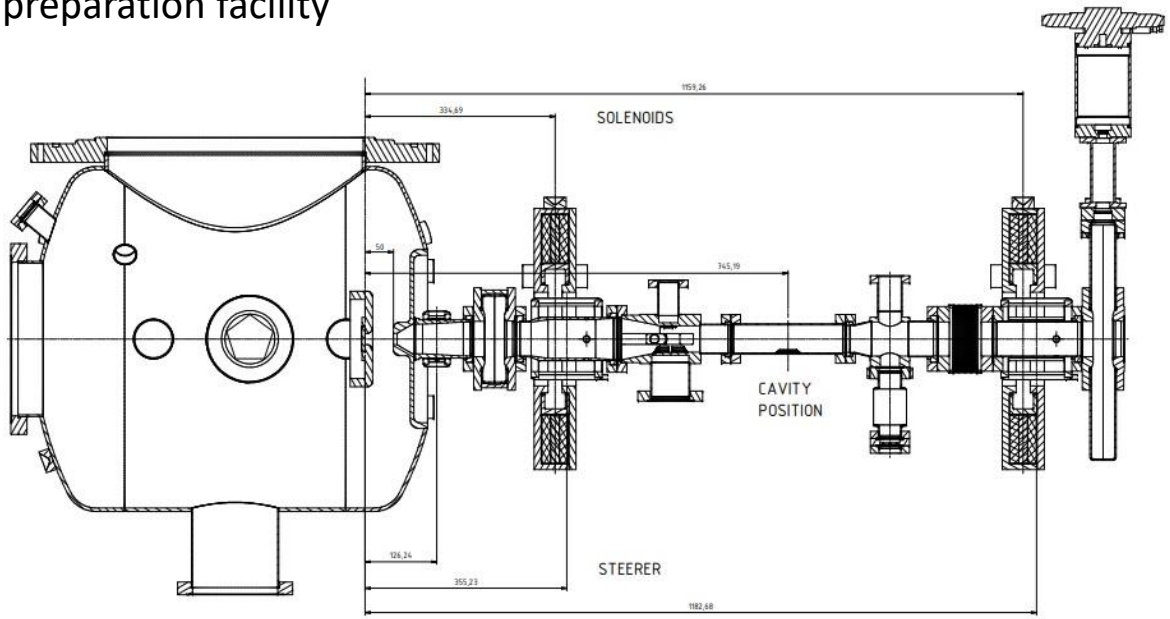
Reliability is concerning:

2 failures of amplifier in 6 months

## The gun

Since 2023, collaboration agreement between IJCLab (IN2P3) and Research Instruments (RI) for photoinjector R&D

- Hardware of Lighthouse project (terminated) transfered to IJCLab for PERLE
  - Photogun, HV system and photocathode preparation facility



# 1. Injector

## The gun

- PPF and transfer system installed, one broken welding fixed
- HV tanks installed
- Diagnostics ready, Faraday cup ordered in december => delivery  october 2025

  mechanical holder to do
- Remote control bought to RI (PLL and supervision programs), Siemens modules ordered

  to do:  control room, screen's camera, BPM and FC to acquire
- Electrical cabling, water and compressed air to do

## The bunching cavity

- Specifications from the injector with the ALICE gun:

  copper cavity at 801.58 MHz; 1,4 MV/m; minimized power, coupling vs beamloading

- RF design by Juanlu from ESS Bilbao begun in 2023:

  2 possible designs: pillbox with nosecone or spherical like C-ERL

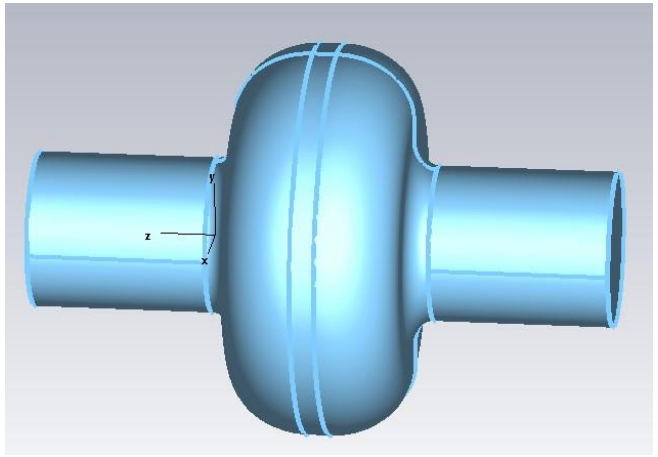
- Technical drawings by Samuel Marchal begun last year, spherical prefered and 3D printing considered
- End of last year, after discussion with Riga lab., decision to give up this option and to go with the pillbox as it is most probably easier to machine and less expensive

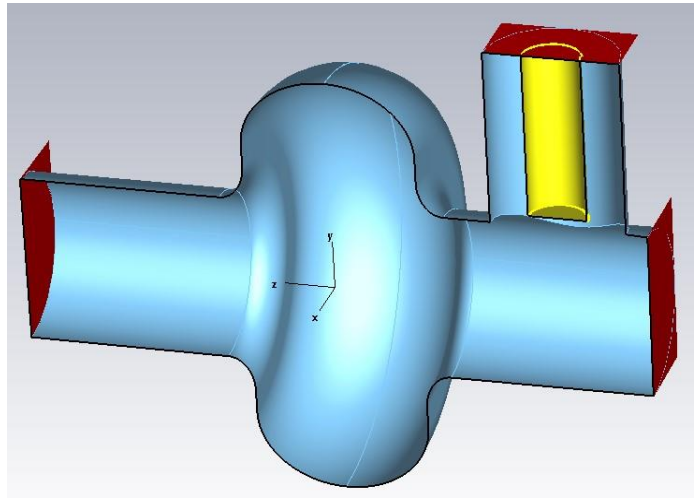
**Next steps:**

1. Finish RF design somewhere in spring
2. Detailed technical drawings by the end of summer
3. Call for tender in September, machining
4. Cavity ready to be installed in march 2026

## The booster

- Only 4 single cells, RF power is around 30 kW/cavity
- To save money for future fabrication: we keep same shape as end cell of the 5-cells PERLE's cavity
- Power coupler from the SPL design





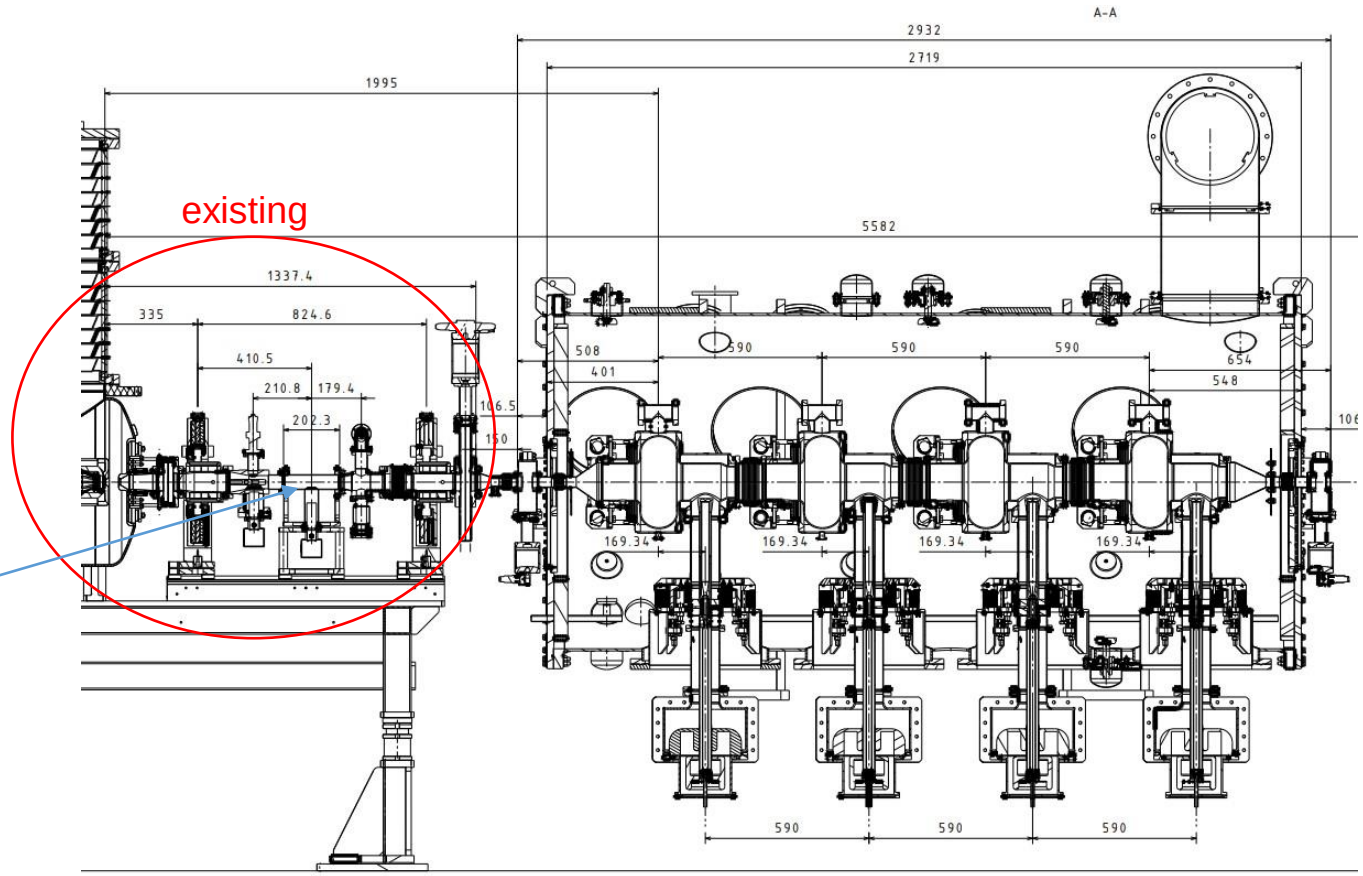
# 1. Injector

## The cryomodule of the booster

- Choice to use the same cryomodule as one developped for prototype elliptical cavities in ESS

- Design by S. Brault from IJCLab in September

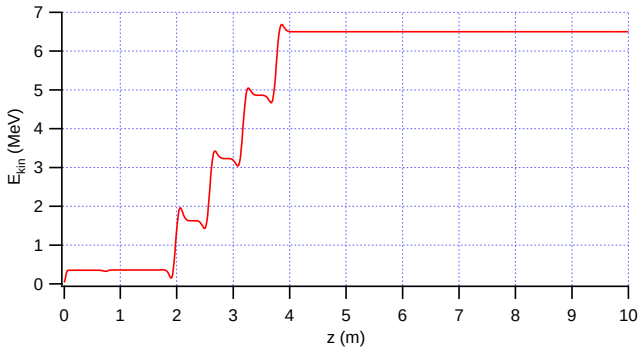
To be continued

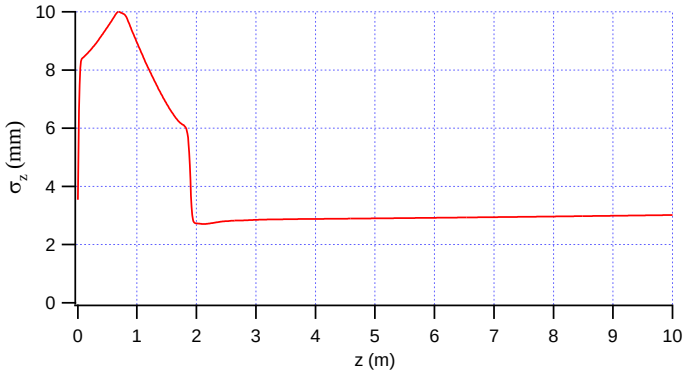


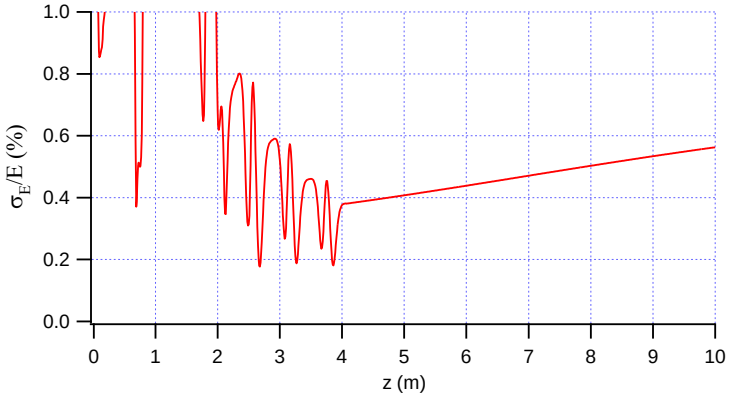

space
for bunching cavity

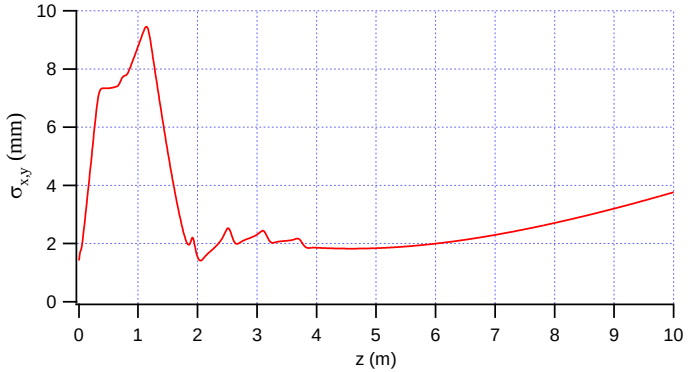
## Beam performances of the injector

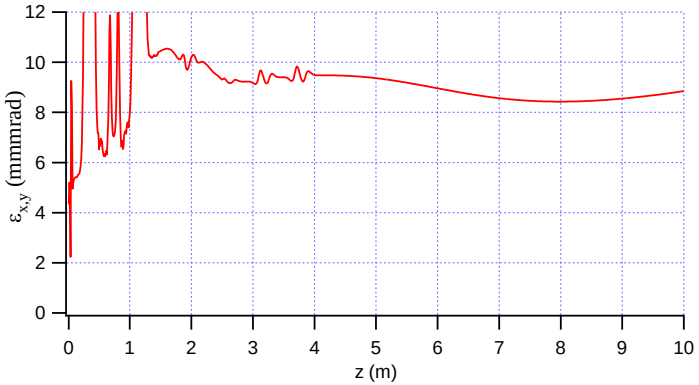
- ASTRA code, 500 pC, laser flat top only in transverse plane
- $E_{bc}$ = 0.82 MV/m; $E_b$ = 19.2 MV/m on crest




Maybe not the best but

Close to a realistic case

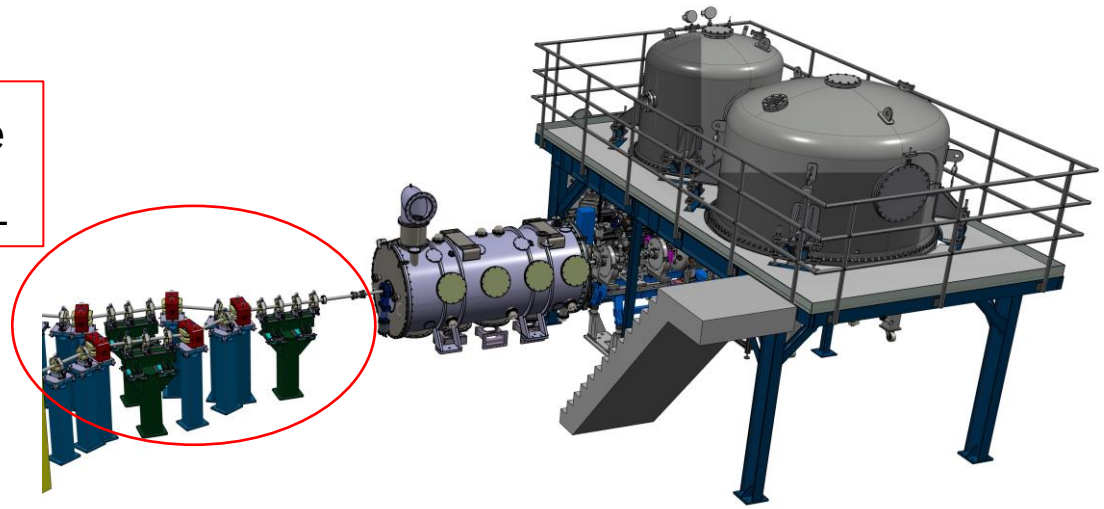
See C. Monaghan's talk

for the minimum emittance

# 2 Temporary beamline and merger

Merger: transfer beamline

Between injector and ERL



- **Before that**: temporay diagnostics beamline for commissioning phase

after the booster, ICT, steerers, deflecting cavity for bunch length

quad. doublet + screen for the beam sizes and emittances and a 45° dipole + screen for energy spread

# Planning

- Paramount milestone: the gun alone by the end of 2025-early 2026 to get funds from CNRS « Plan à risques »
- in 2026, continuation of previous task, then upgrade of the laser and installation of the buncher
- In 2027, installation of the booster and of the temporary beamline
- In 2028, commissioning of the injector