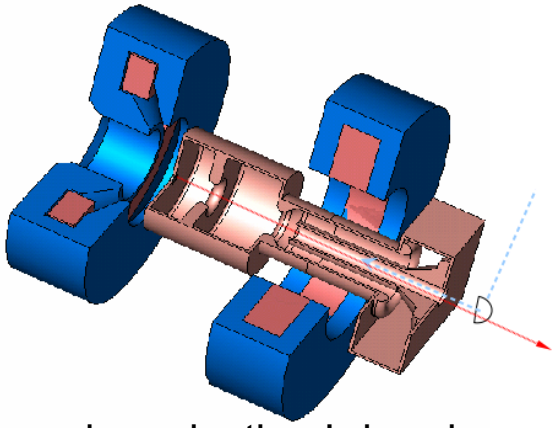
LATEST NEWS ON HIGH AVERAGE RF POWER OPERATION AT PITZ.

Y. Renier (on behalf of the PITZ team)

Contents:

- Gun-4.6 Setup.
- Commissioning/Operation history.
- Electron beam characterization.



Normal conducting L-band gun

Motivation:

- PITZ develops, test and characterize high brightness electron sources for FLASH/ European XFEL.
- Long bunch trains (SC linac) and high field at the cathode (small emittance) needed.
- The gun must have stable and reliable operation at high average power (e.g. 6.5 MW peak power, 650 us RF pulse length, 10Hz repetition rate for the European XFEL).
  42.25 kW average power !!!

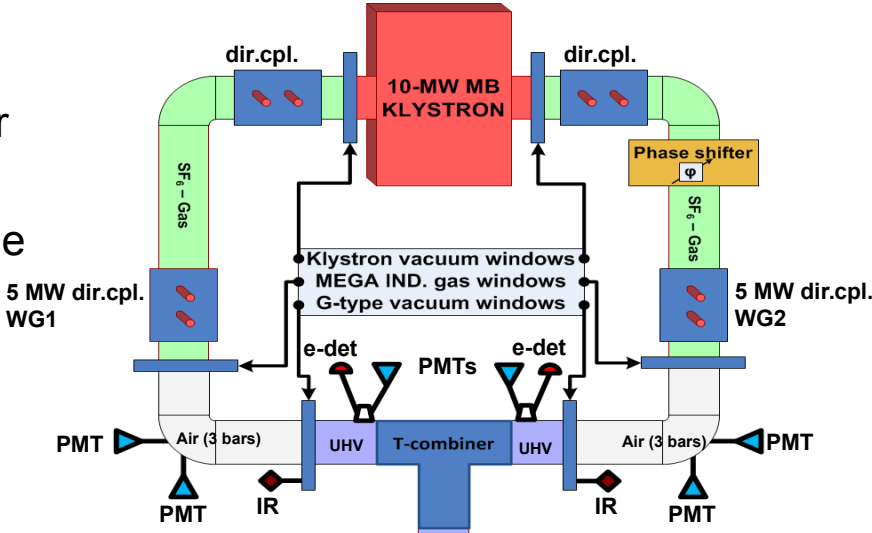
HELMHOLTZ ASSOCIATION

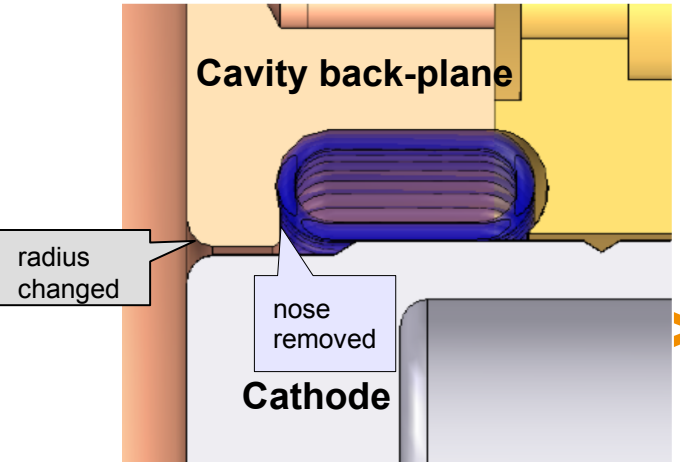
PITZ Photo Injector Test Facility Zeuthen

DESY

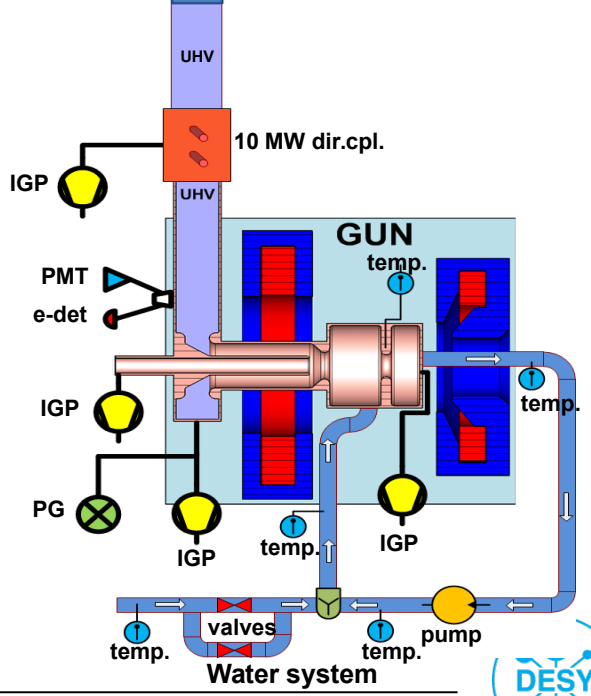
New Gun 4.6 Setup

- Features of the gun 4.6 setup
  - gun 4.6 with new type of cathode spring holder design (watchband-reloaded).
  - two pre-conditioned DESY-type windows for the 2-window setup.
  - T-Combiner with optimized RF design for best vacuum window position.
  - Very sensitive ILs for the conditioning phase.



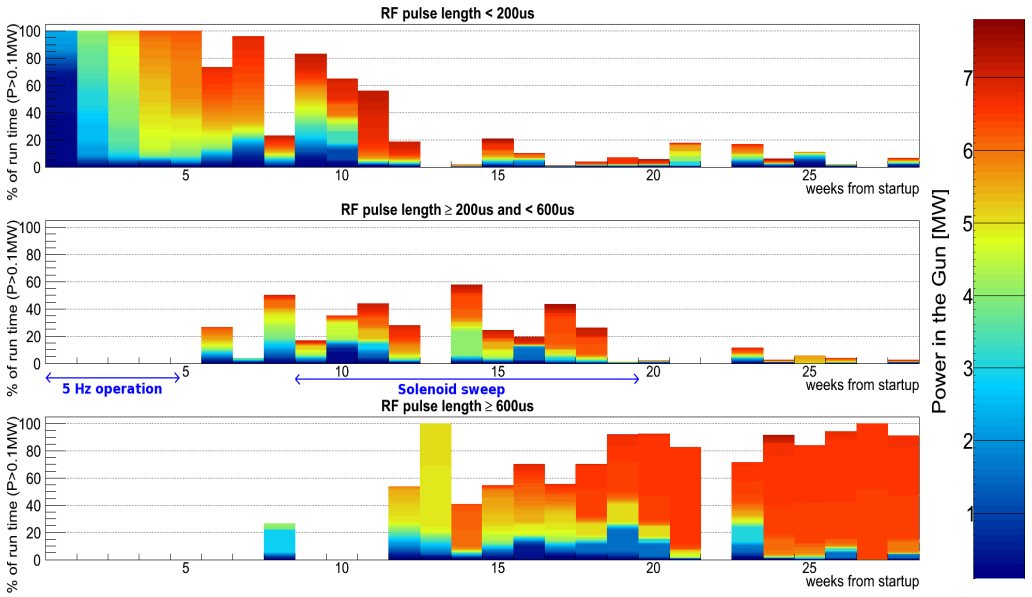


- Fast IL system (few us):
  - Photomultipliers (PMTs).
  - Electron detectors.
  - Reflected power (measured by dir. coupl.).
- Slow IL system :
  - Vacuum (measured by PGs and IGPs).



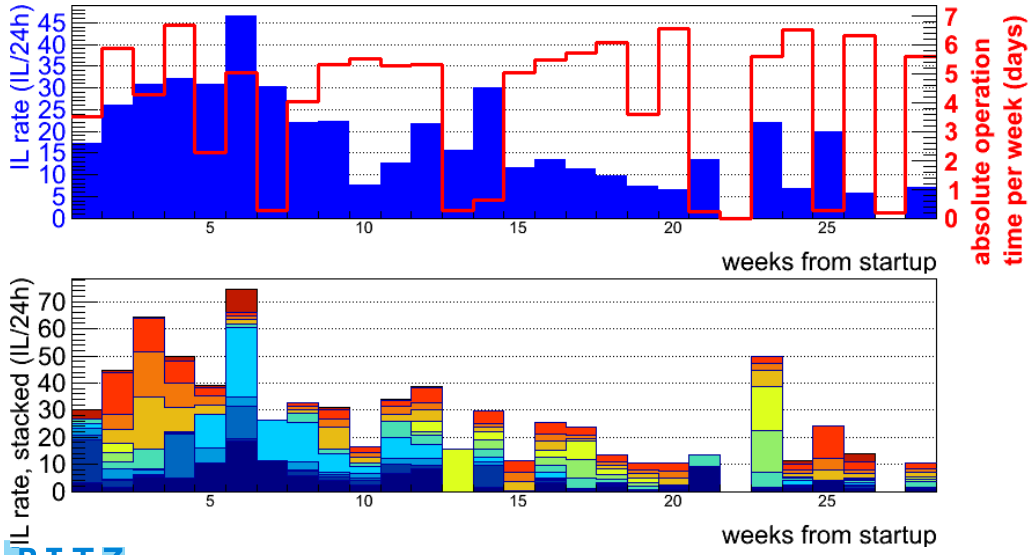
Power, pulse length and ILs history

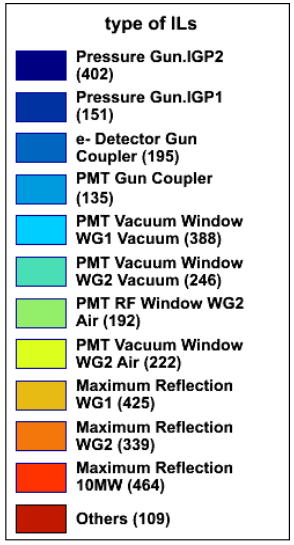
(all data with >0.1MW peak power in the gun are taken into account)



- Conditioning started on 7.3.2016.
- No signature of cathode springs failure. watchband reloaded design works.
- 16 weeks to reach 6.5 MW @ 650 us (XFEL nominal parameters).
- More than 80% of operation above 6 MW and above 600 us in the last month (goal >99%), still increasing.

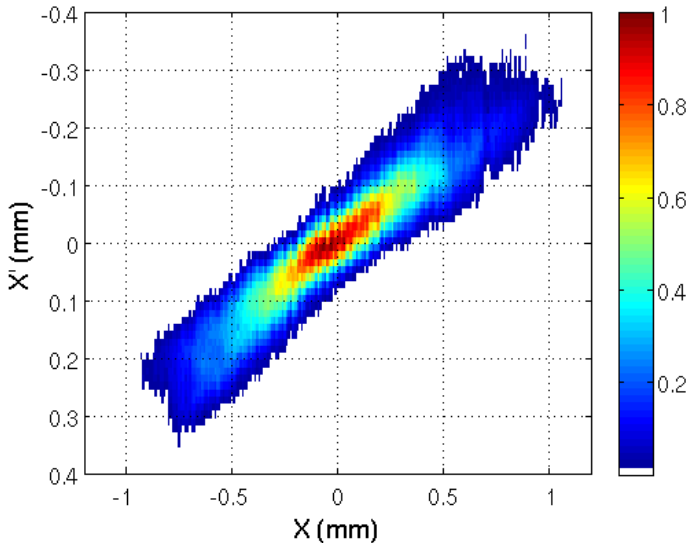
Poster MOPRC002, today 16h - 16h30

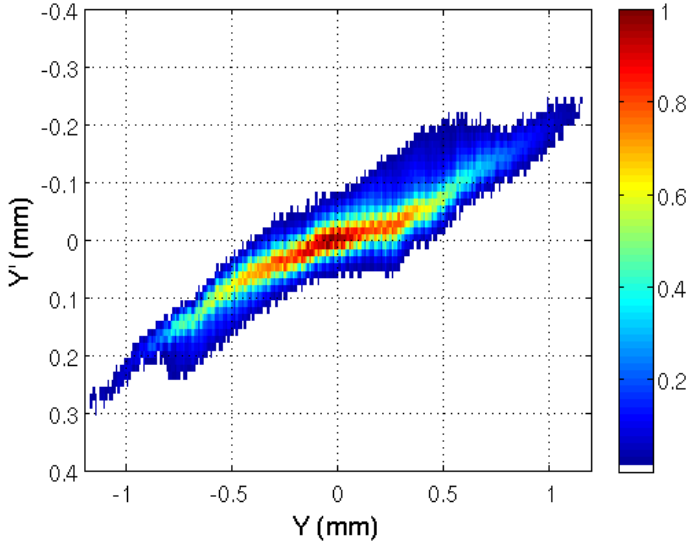


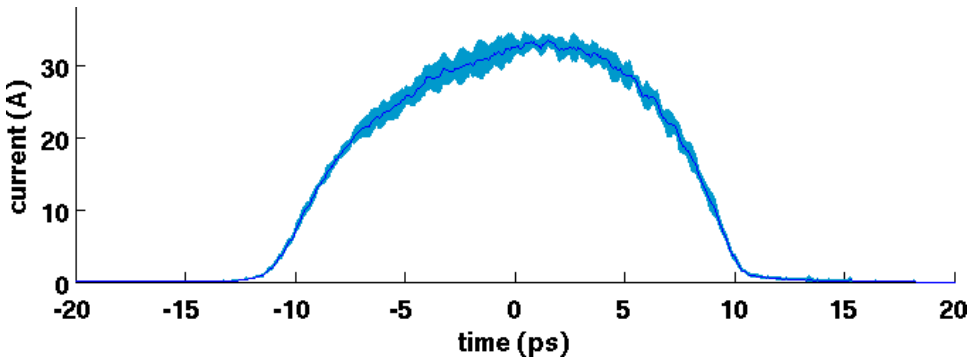


- The IL rate decreases.
- Different type of ILs, changing with time.
- Significant amount of ILs are due to the RF transmission line.

Electron Beam Characterization (0.5 nC charge, 11 ps Gaussian)







- After optimization (solenoid, laser spot size):
  - Projected transverse emittance: 0.80±0.04 mm.mrad
  - Bunch length: 16.3±0.4 ps FWHM (32 A peak current)
  - Brightness ($\frac{2I_{peak}}{\varepsilon_x \varepsilon_y}$): 100 A.mm^{-2}.mrad^{-2}
- Better than specifications for the European XFEL initial phase.
- With improved laser shaping, we will go far beyond nominal specifications.

About electron beam imperfection studies: Poster MOPLR013, today 16h30 - 17h