SOME QUESTIONS OF GUN CONDITIONING

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OVERVIEW

- GUN 4.1
- Conditioning optimization
- Conditioning goal
- RF Window
- Trip rate monitor
- IL system
- IL signal thresholds
- Summary

GUN 4.1

Operation at FLASH started 26.06.2012

27.06.2012

Full power of 4 MW reached at 630 us

2.07.2012 - 9.07.2012

Continuous gun operation at full power of 4 MW 630 us

Most probable reason for such a different behavior at PITZ and at FLASH is the RF windows.

The gun was conditioned very well, the only question is when did it happen.

The conditionig and the trip rate measurements done in May were dominated by the windows.

WIndow Teststand in Zeuthen (WITZ)

CONDITIONING OPTIMIZATION

- **An assumption:**

There is a "golden" algorithm for conditioning of an RF cavity

Criteria:

- **The fastest conditioning progress**
  kW of average power per day at a certain trip rate
- **Working and reliable gun**

CONDITIONING GOAL

- **Achieve a stable and reliable operation mode by eliminating the causes of the operation interruption and/or performance degradation**

Surface contamination responsible for bad vacuum

Field emitters responsible for electrical breakdowns

...

Weak binding to the main element surface.
Evaporation rate depends on the surface temperature.
Causing "slow" vacuum event with massive outgasing.

part of the main element's material
causing "short" vacuum spikes

avoid:

bringing the pumps in saturation

long RF pulses

Effectively elimitated via:

controlled discharge
(surface plasma)

controlled electrical
breakdowns

RF WINDOWS

Al2O3 ceramics, transparent for UV

The windows are not afraid of high temperatures, but the temp gradients.

Planar RF window with TiN film on the vacuum side.
A dipole electric field mode parallel to the window plane

The current SC module couplers have cylindrical windows

Designed for RF couplers of SC modules for 1 MW,
and operated at 0.3 MW

The current FLASH window is operated at FLASH since 6 years

Latest pieces produced in HH can not achieve
the former quality and therefore the performance.

GUN TRIP RATE MONITOR

gunTRM

log all IL events
with all relevant information

plot auxilary data

online calculation
of the trip rate value

In development (low priority)

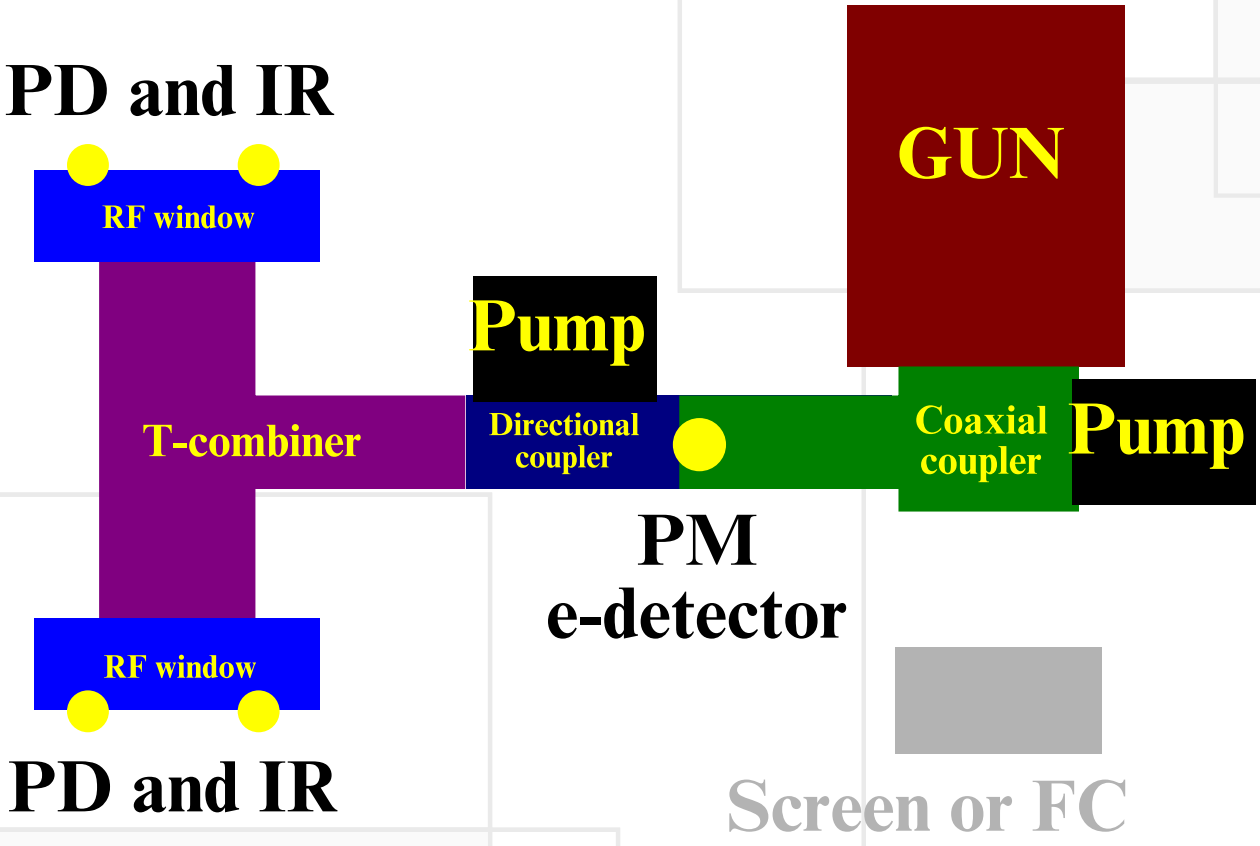
How to distinguish the gun and window ILs ?

INTERLOCK SYSTEM OF THE GUN

Arcs and breakdowns	PM at the vacuum side photodiodes at the SF6 side electron detector
Bad vacuum	based on IGP current readout
Overheating and temperature gradients at the RF window	PT1000 and an IR detector.

In HH the photo sensor signals are calibrated to 10 V/lux. Lux is a lot of light. The calibration is checked periodically to make sure that a threshold of X Volts always corresponds to the same amount of light.

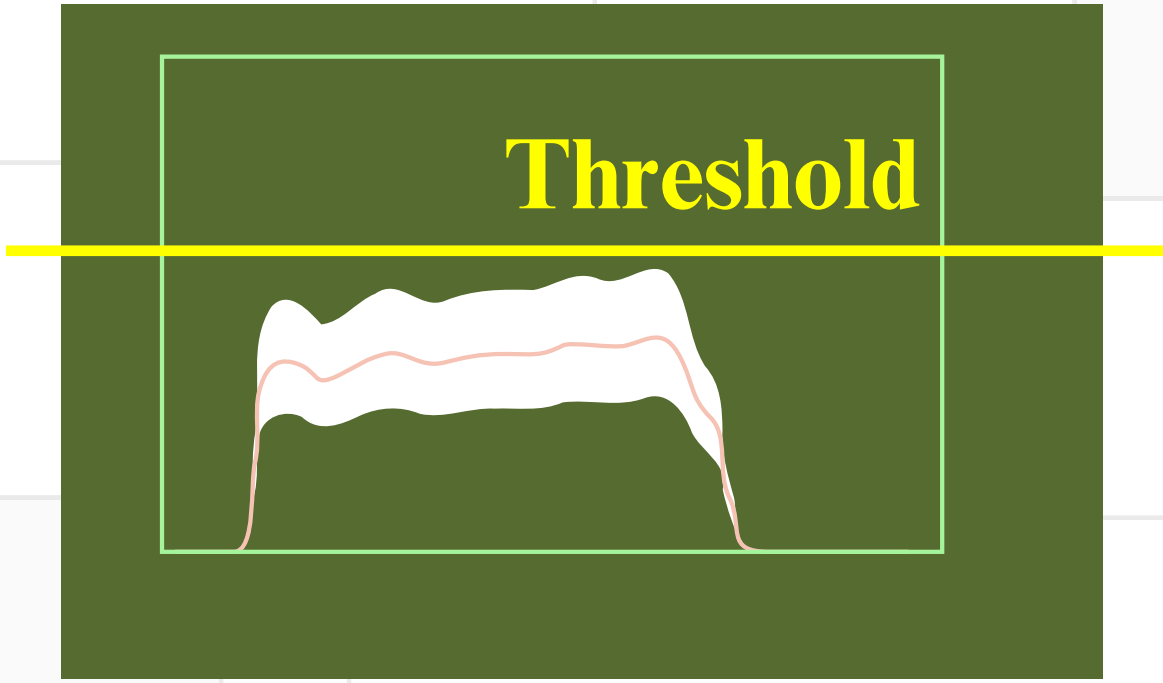
INTERLOCK SYSTEM OF THE GUN



IL SIGNAL THRESHOLDS

- **HH approach:**

Any signal higher than the noise envelope of a "usual" baseline has to be detected as an IL



SUMMARY

From the Gun 4.1 smooth setting in operation at FLASH it follows that the gun was ell conditioned for 4MW and 630 us. It should also mean that at PITZ main ILs are coming from the other RF component (RF windows , ...)

In order to optimize the conditioning process of the gun one needs to distinguish between ILs happening at different locations (elements) of the system.The current IL detector arrangement does not allow this. There can be a simple upgrade using the screen or a FC downstream the gun.

Once the procedure for IL signal calibration and definening a threshold is settled it would be nice to have a software tool that logs all IL events and calculates the trip rate online.