

Gun conditioning at PITZ.

PITZ gun

Conditioning procedure

Momentum and gradient of the Gun

History of the Gun 4.4 operation at PITZ

Interlock statistics

Dark current measurements

Cathodes

Summary

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DPG-Frühjahrstagung

Dresden, 03.04.2014

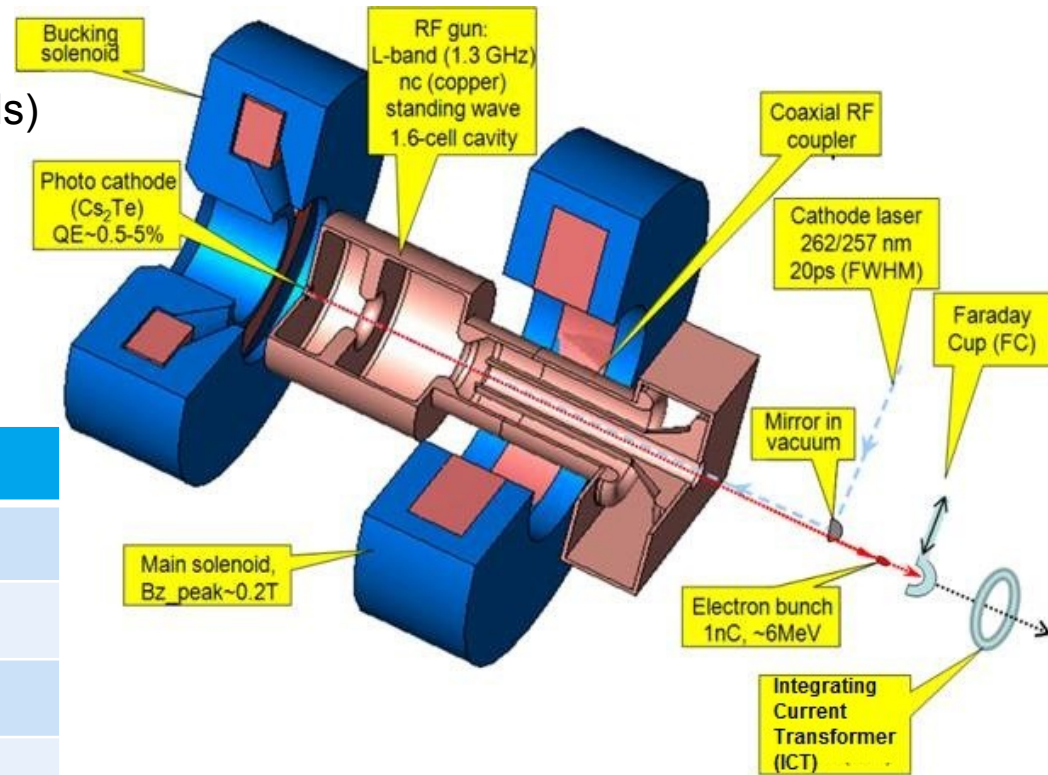
The RF photo gun operates with a standing wave regime in the π -mode with resonant frequency of 1.3 GHz

The gun consists of:

- normal-conducting cavity (1.6 copper cells)
- exchangeable molybdenum cathode with CuBe contact spring
- pair of solenoids

Main parameters

Accelerating gradient at the cathode, MV/m	60
Beam energy after gun, MeV	~6.5
Full RF power, MW	6.5
Number of bunches	1..600
RF pulse, μ s	≤ 650
Repetition rate, Hz	10



Conditioning steps:

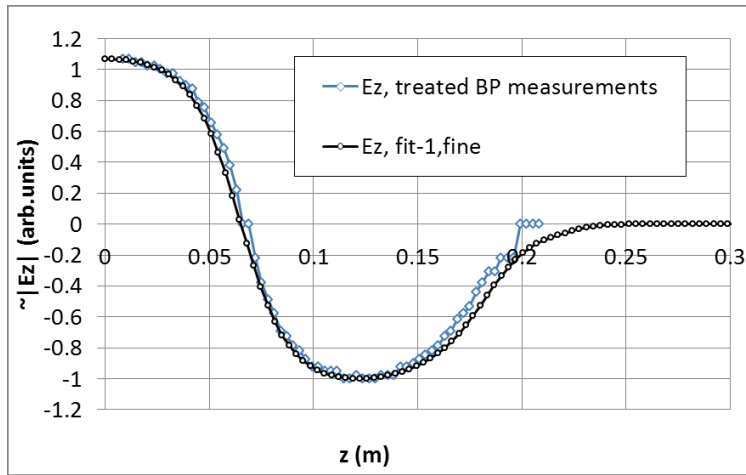
1. Rep. Rate. **5 Hz**, RF pulse length 10 μs , RF power from 0 to Max
2. Rep. Rate. 5 Hz, RF pulse length **20 μs** , RF power from 0 to Max
3. Rep. Rate. 5 Hz, RF pulse length **50 μs** , RF power from 0 to Max
4. Rep. Rate. 5 Hz, RF pulse length **100 μs** , RF power from 0 to Max
5. A) Rep. Rate. **10 Hz**, RF pulse length 10 μs , RF power from 0 to Max
B) Rep. Rate. 10 Hz, RF pulse length **50 μs** , RF power from 0 to Max
6. Rep. Rate. 10 Hz, RF pulse length **100 μs** , RF power from 0 to Max
7. Rep. Rate. 10 Hz, RF pulse length **200 μs** , RF power from 0 to Max
8. Rep. Rate. 10 Hz, RF pulse length **400 μs** , RF power from 0 to Max
9. Rep. Rate. 10 Hz, RF pulse length **650 μs** , RF power from 0 to Max

Ramp-up procedure:

- RF power increase by steps of max 0.2 MW every 15 min. for new RF pulse length
- vacuum pressure $< 10^{-7}$ mbar (Thales requirement).
- In case of significant vacuum or other trips:
 - re-ramp RF power from 0 with short pulses (10 μs)
 - restart with step 1 or step 5 respectively
 - increase the pulse length in reasonable steps
- Initially, the rf gun solenoid is off (than sweep).
- Only FF, no FB.

Momentum and gradient of the Gun 4.4

Field profile fit



$$P_{gun} [MW] = 0.0018 \times \left(E_{cat_h} \left[\frac{MV}{m} \right] \right)^2$$

$$60 \frac{MV}{m} \rightarrow 6.5 MW$$

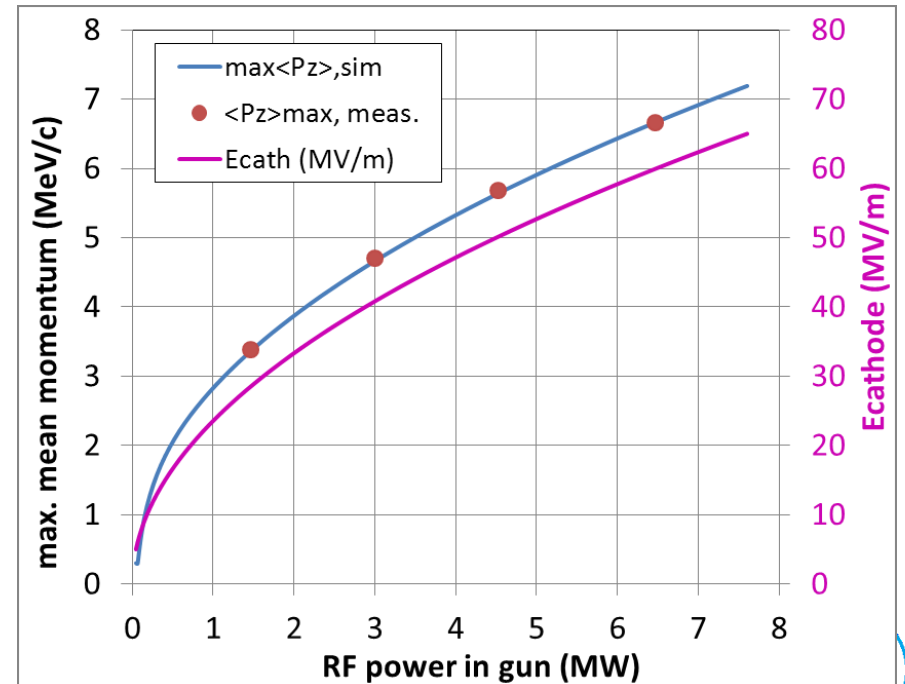
Conditioning Goal:

10Hz x 650us x **6.5MW**
with solenoid

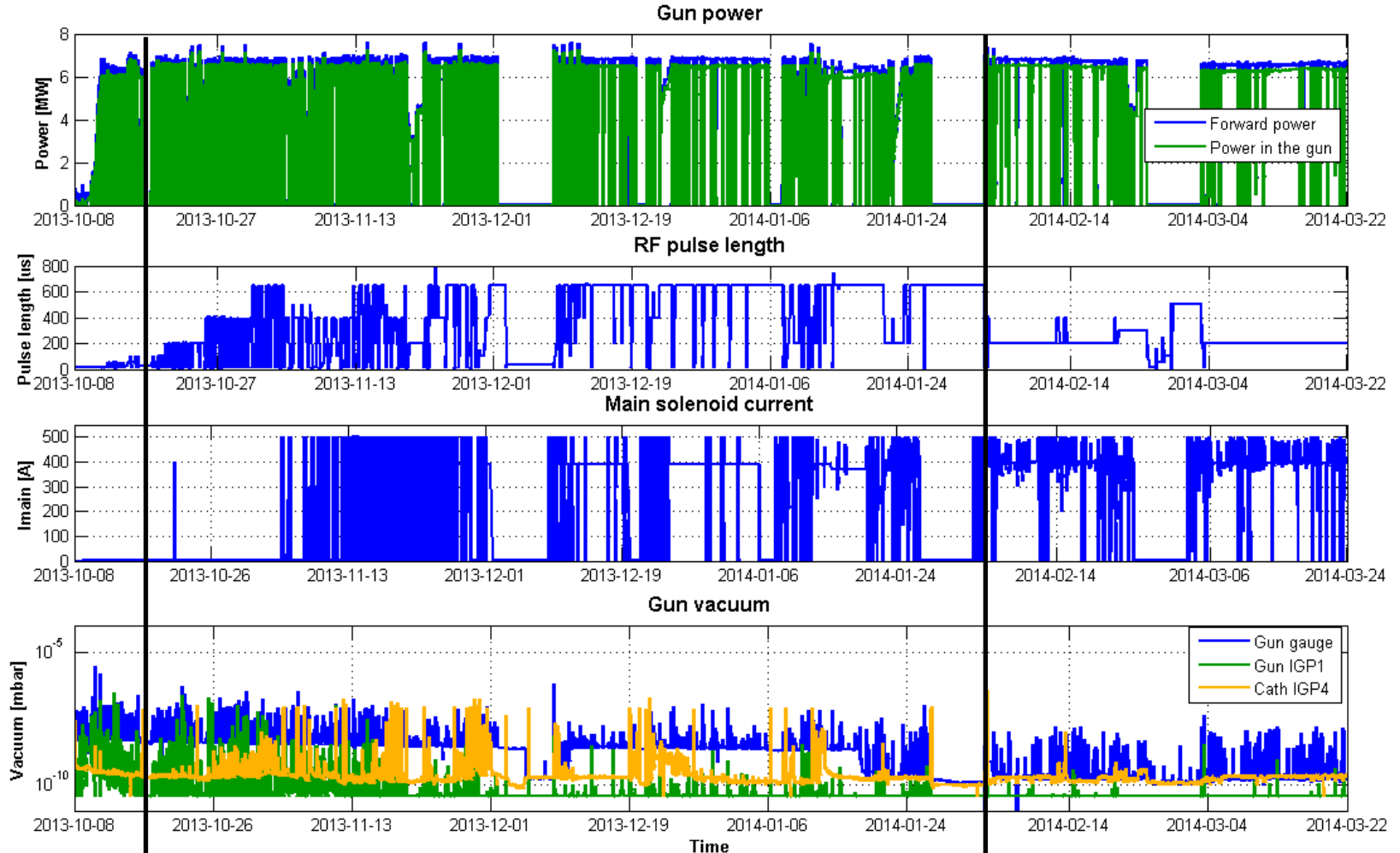
Conditioning Milestone:

24h unperturbed run at Goal + I_{main}=390A

Power in the gun, MW (5MW coupler)	Beam momentum, MeV/c
1.46	3.390
3.00	4.704
4.53	5.678
6.47	6.657



Gun 4.4 run history from 08.10.2013 until 23.03.2014

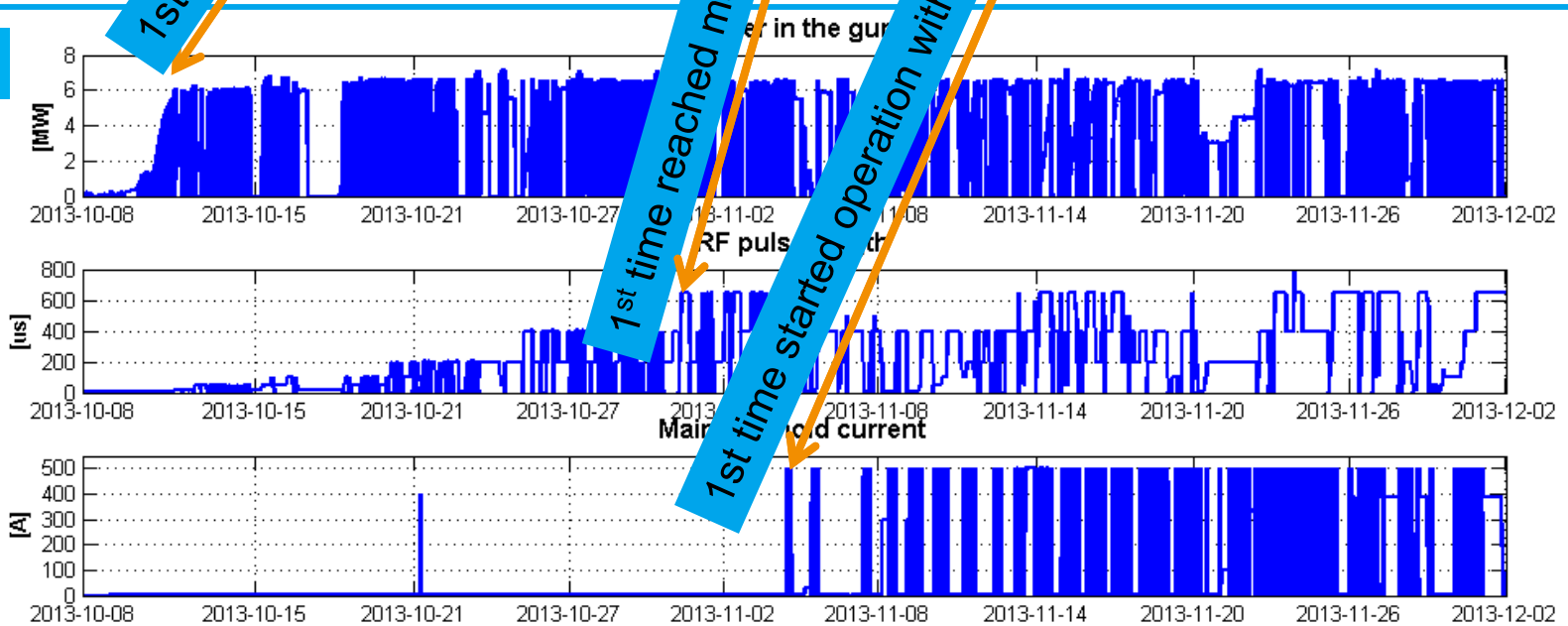
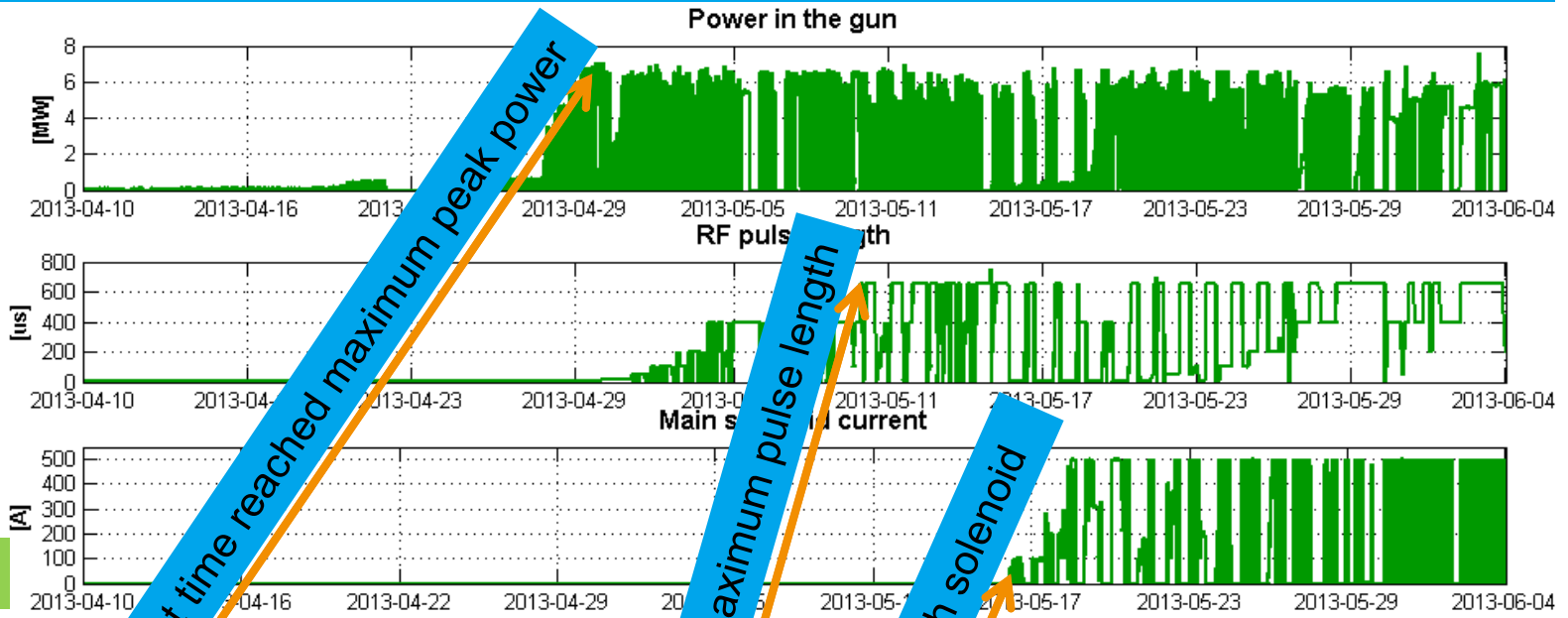


Repetition rate was changed from 5Hz to 10Hz

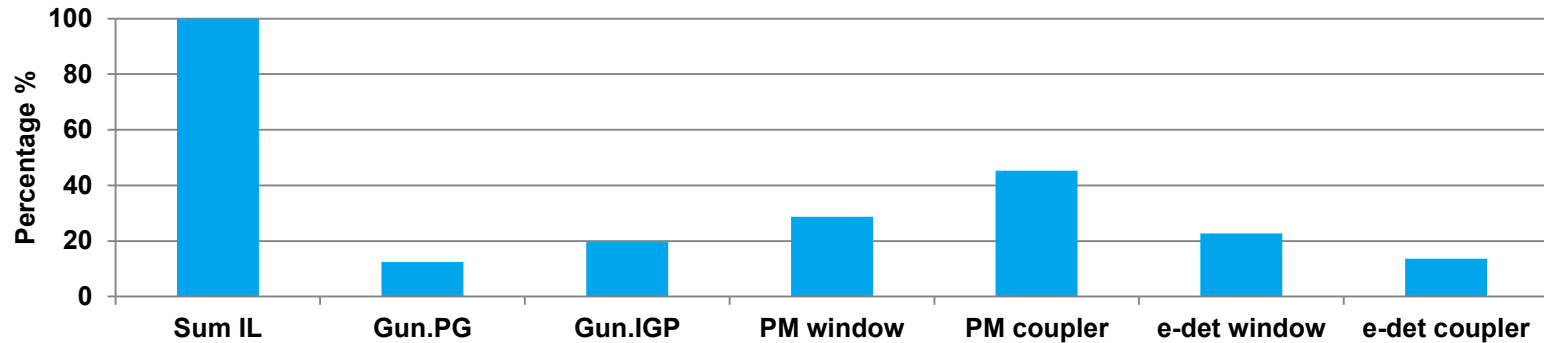
End of the conditioning and beginning of gun tests



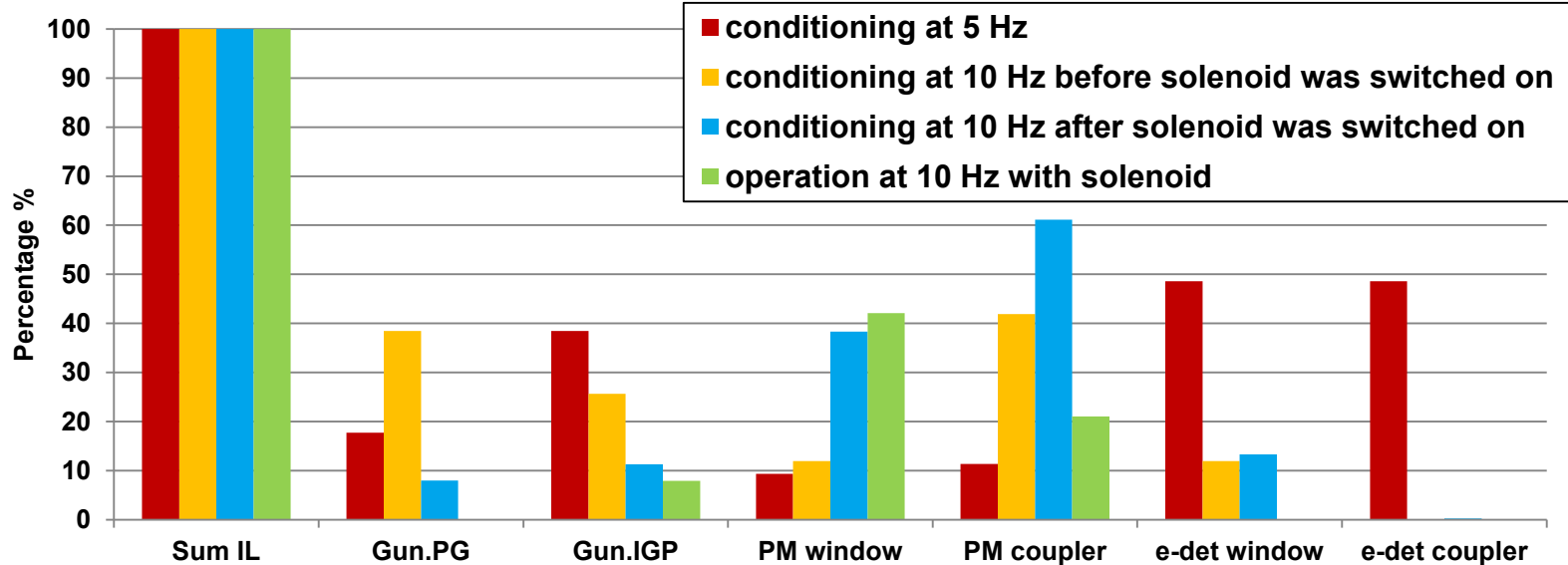
Guns 4.3 and 4.4 conditioning history



Statistics for all run time

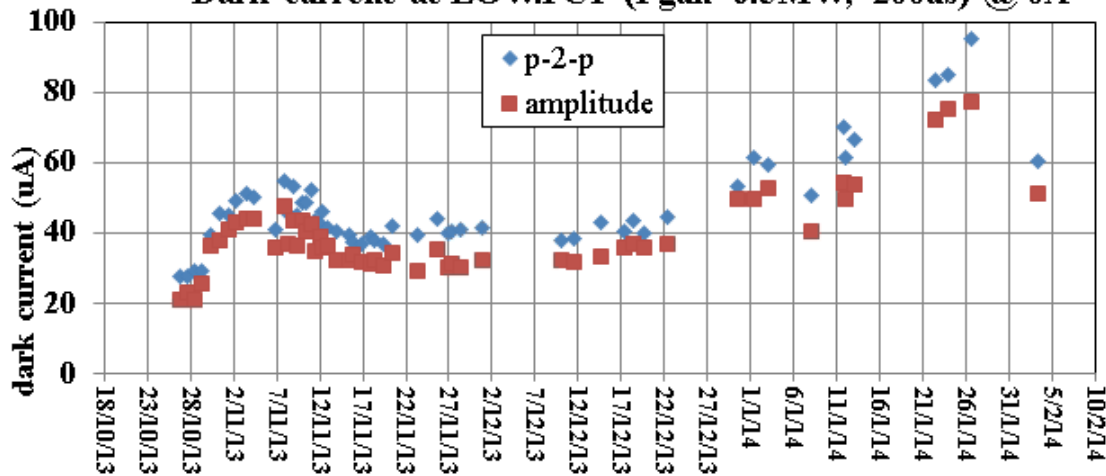


Statistics for different run periods

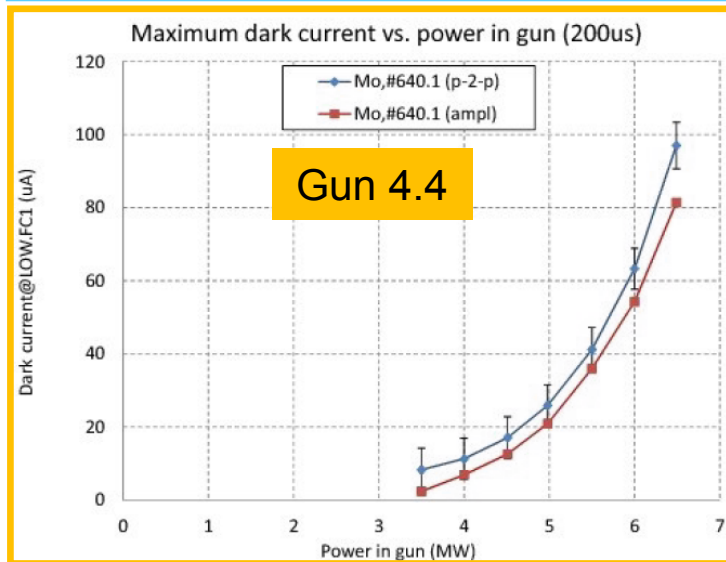
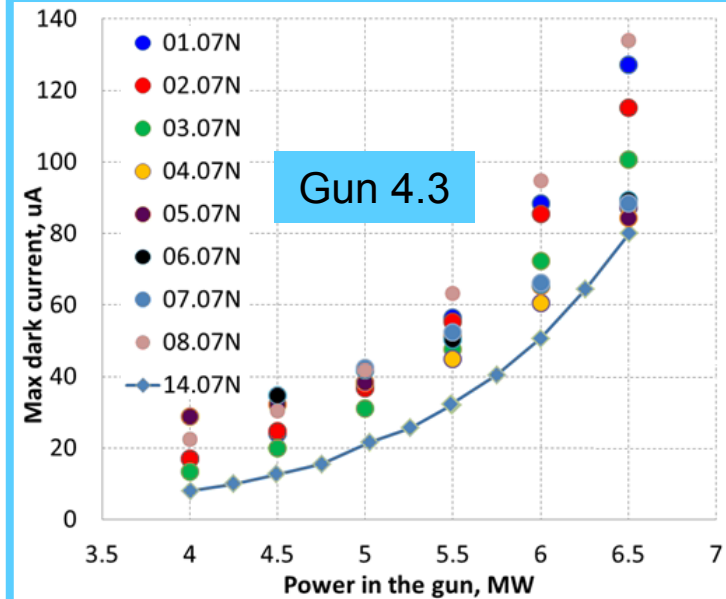
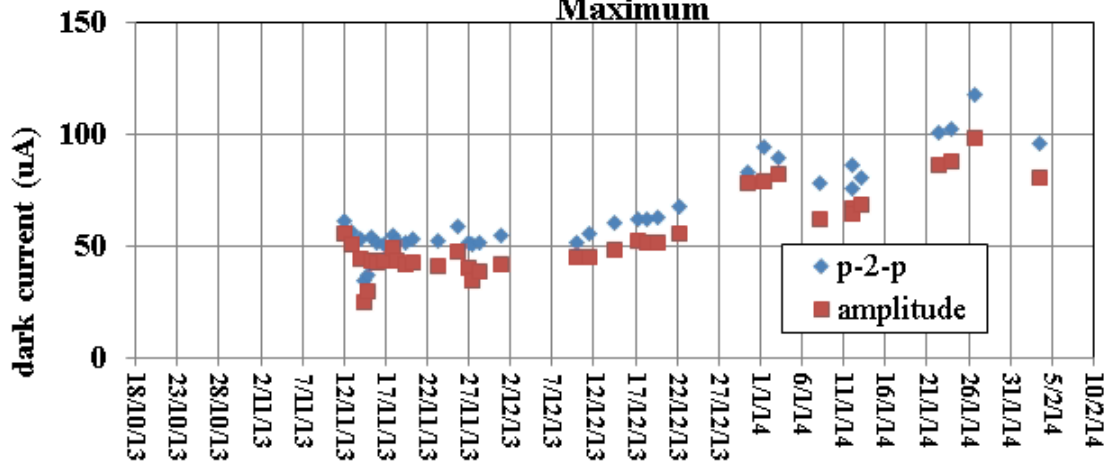


Dark current measurements

Dark current at LOW.FC1 ($P_{\text{gun}}=6.5\text{MW}$, 200us) @ 0A

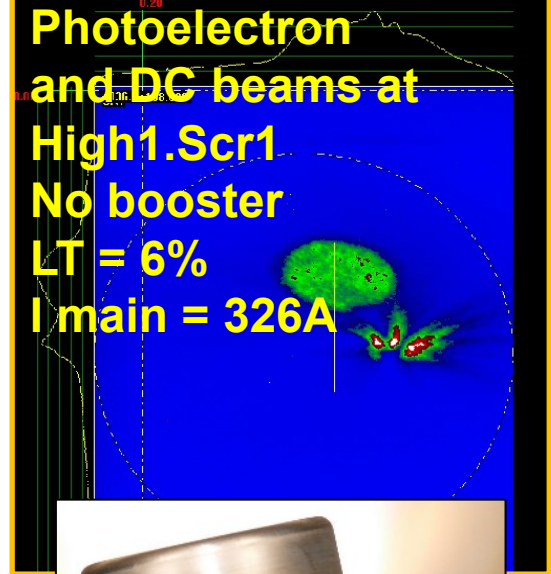
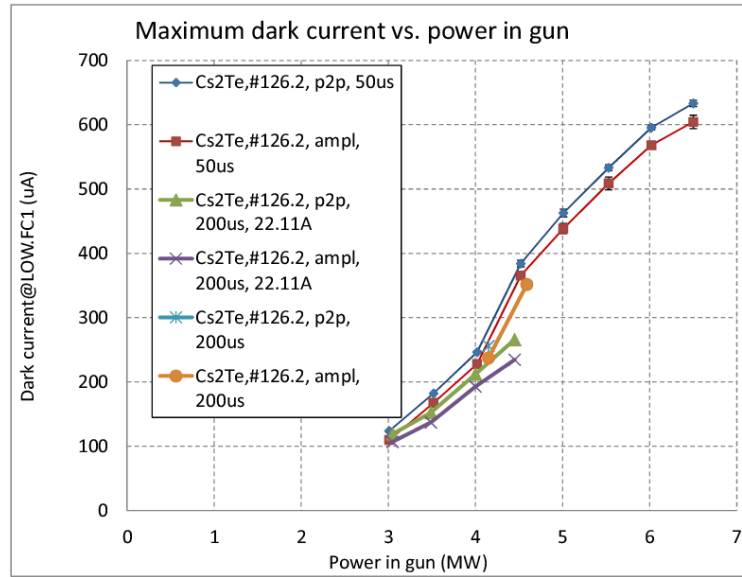
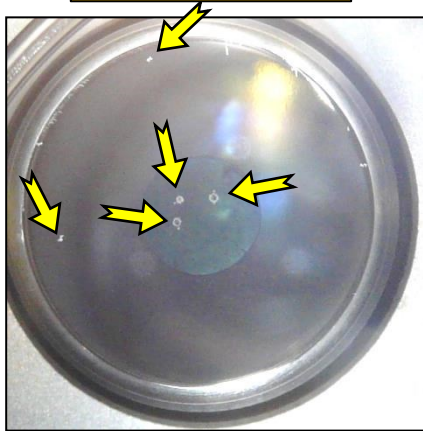


Dark current at LOW.FC1 ($P_{\text{gun}}=6.5\text{MW}$, 200us) @
Maximum



Cathodes

126.2 Cs₂Te



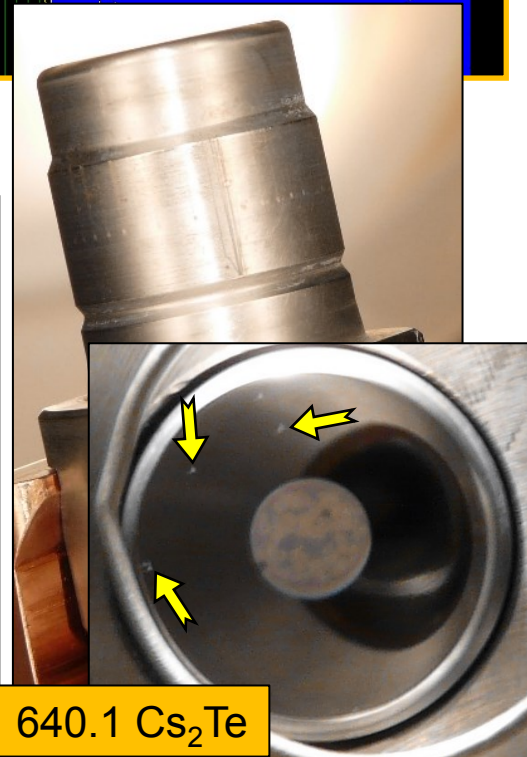
636.1 Mo



633.1 Mo



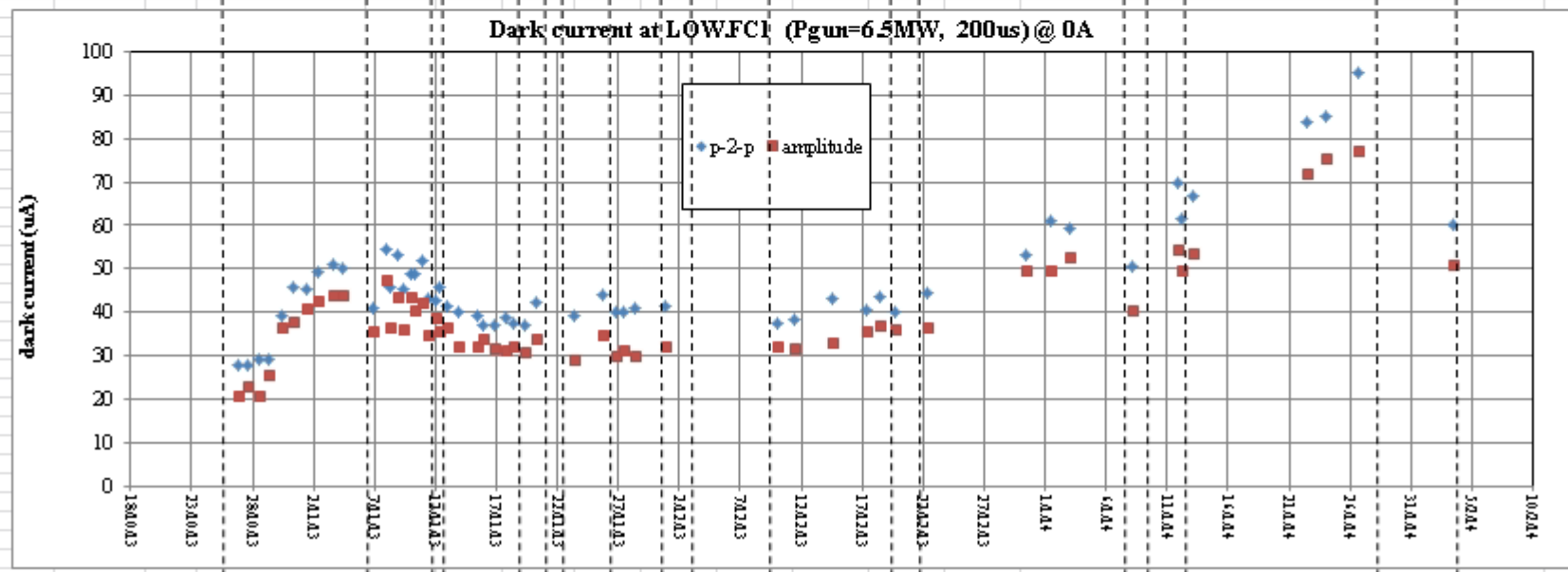
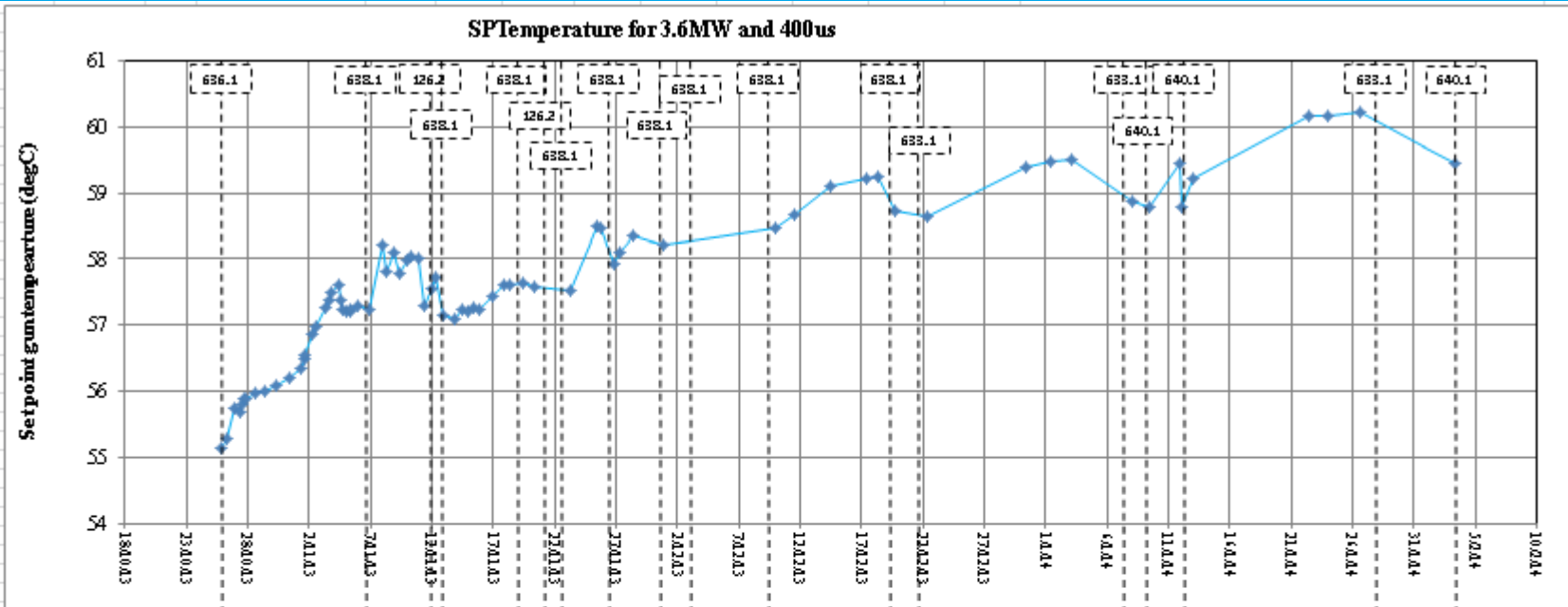
638.1 Mo

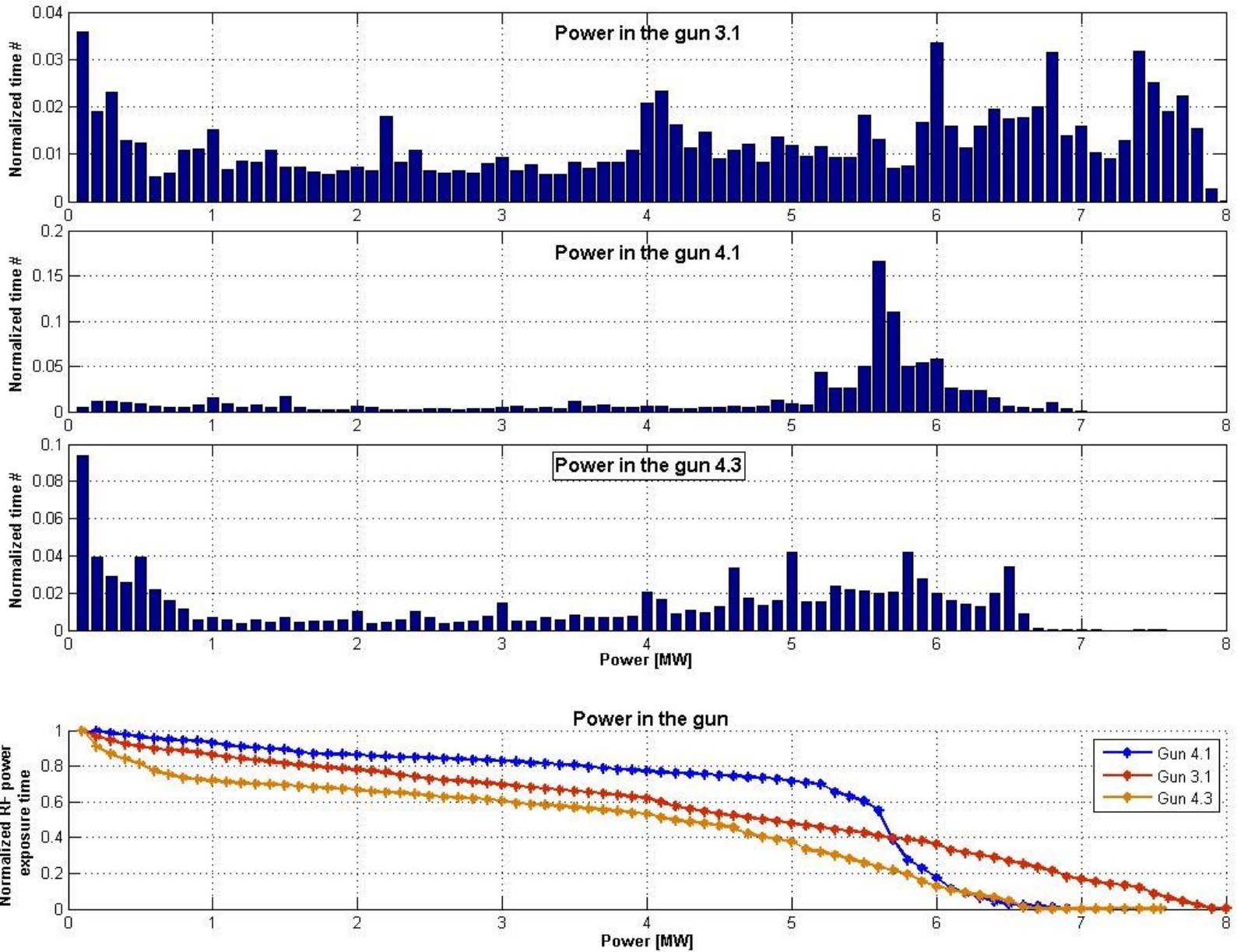


640.1 Cs₂Te

- ❖ Gun 4.4 was conditioned and could be operated
- ❖ Gun 4.4 showed good progress in the conditioning process
- ❖ Dark current values are the same as for the gun 4.3
- ❖ Cathode damages were observed during operation of the gun

Thank you for your attention.





Mo cathodes observation

- Extracted cathode (636.1) was in upright (azimuthally) position
- There are a lot of marks on the side surfaces
- No damages/spots observed at the front surface

Mo, #636.1



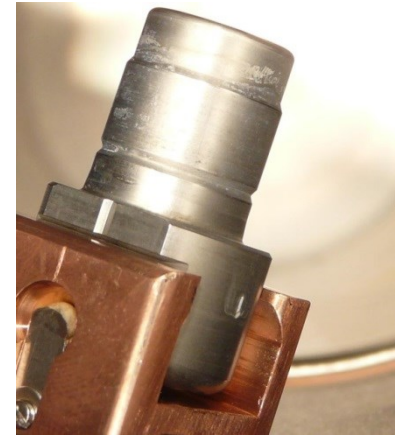
Mo, #637.1



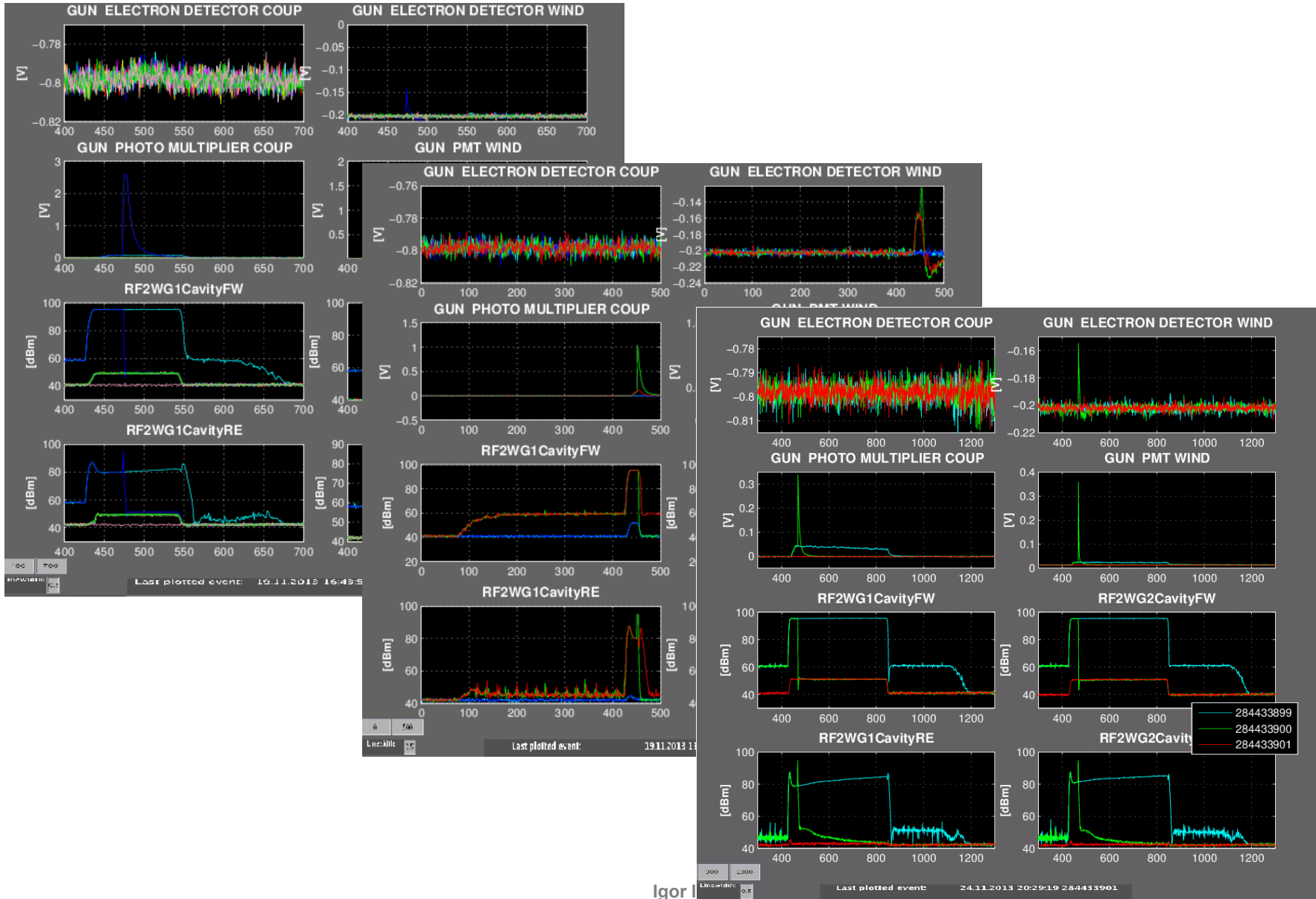
Mo, #638.1

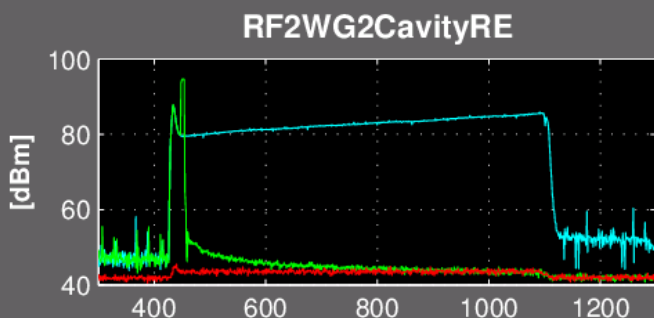
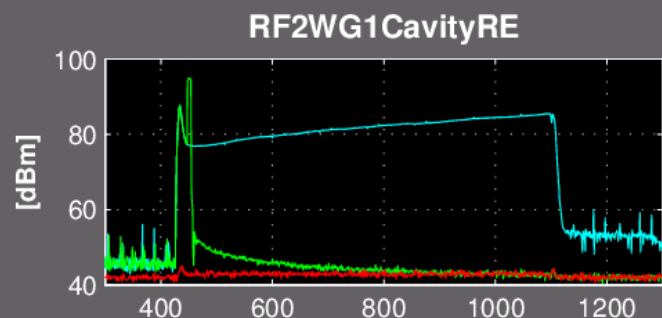
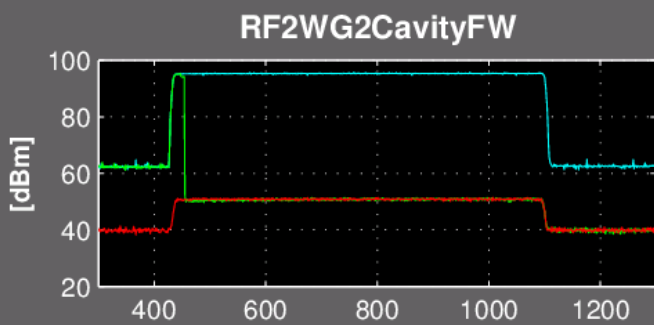
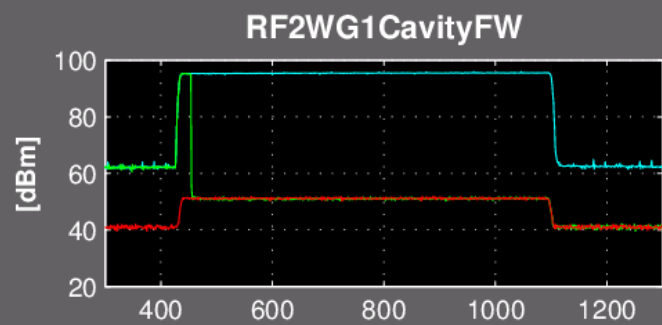
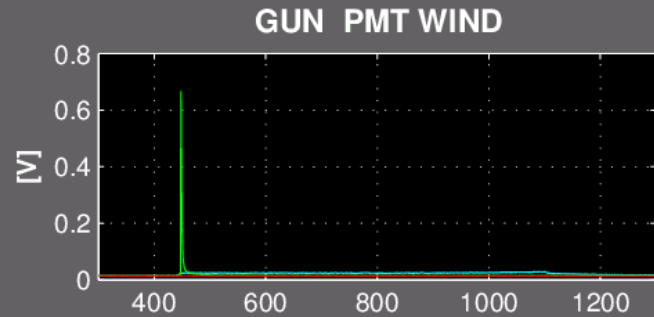
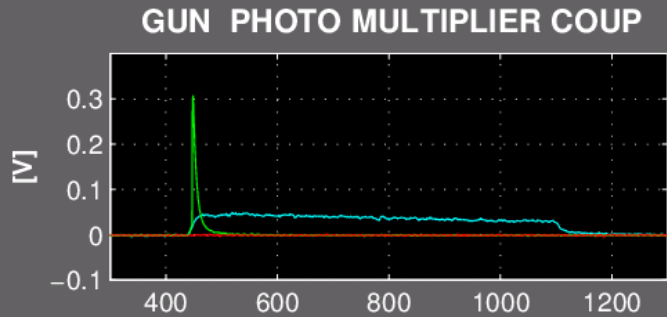
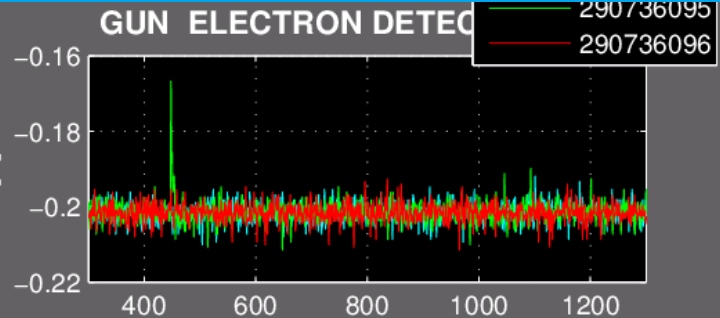
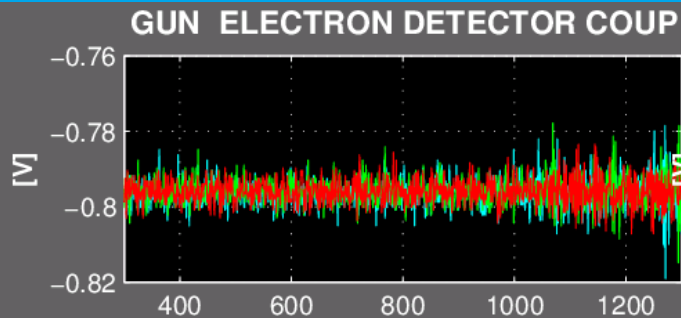


Mo, #639.1



Examples of the Gun IL events





∞:00 1:00

Linewidth: 0.5

Last plotted event: 02.12.2013 3:33:09 290736096



1st event - normal run

2nd event - spike on the refl. power in both waveguides at the middle of the pulse + PMT and e-detector activity

3rd event - normal run

4th event - shortening of the pulse and IIs

5th event - preamplifier off

