PITZ Run coordination meeting.

Holger Huck
09.07.2015

HELMHOLTZ GEMEINSCHAFT

DESY

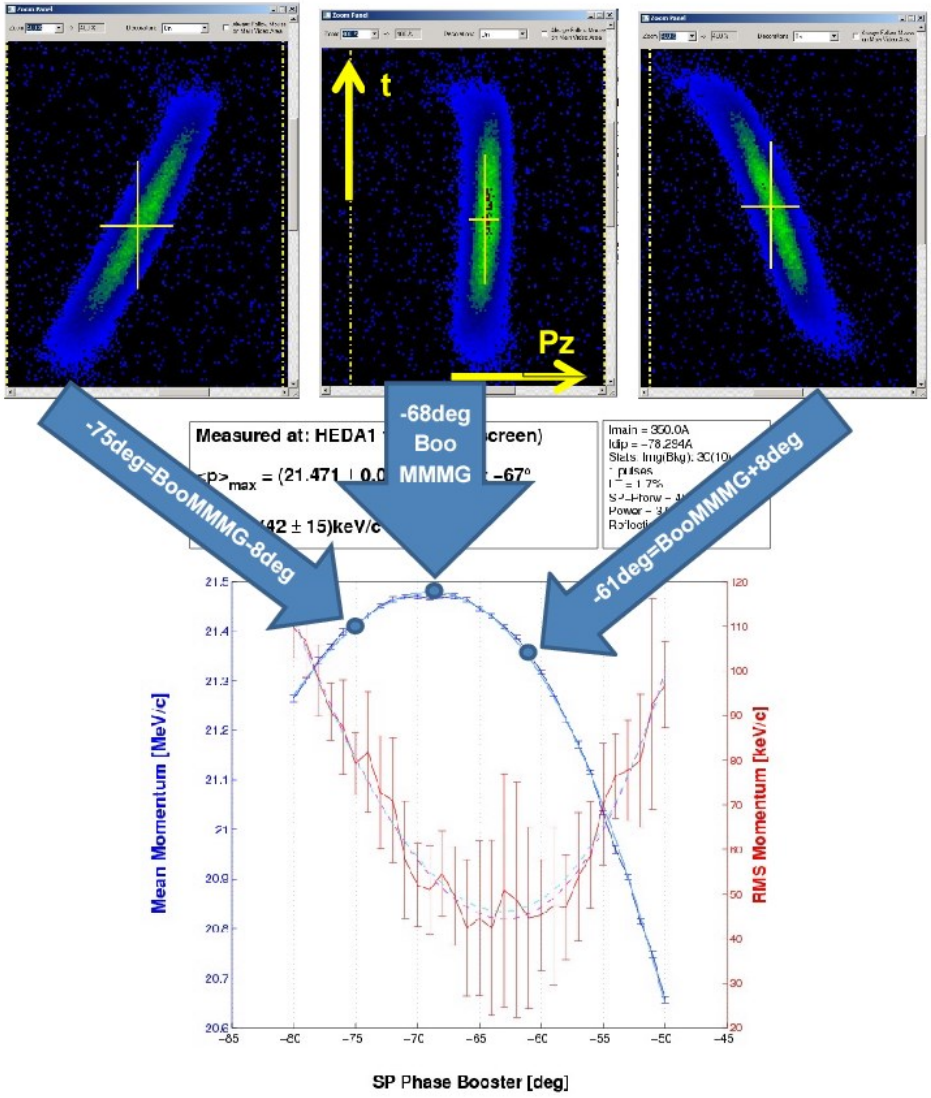
Overview (7.7.2015)

- TDS commissioning started!
  - First RF in structure (during weekend RF leak, ~1% power).
  - Up to now conditioned until ~200 kW in structure.
  - Commisioning of new jddd and matlab tools.
  - Preliminary measurements taken:
    - Calibration of couplers vs. E-beam deflection.
    - Temperature dependencies.
    - Bunch length vs. charge and booster phase.

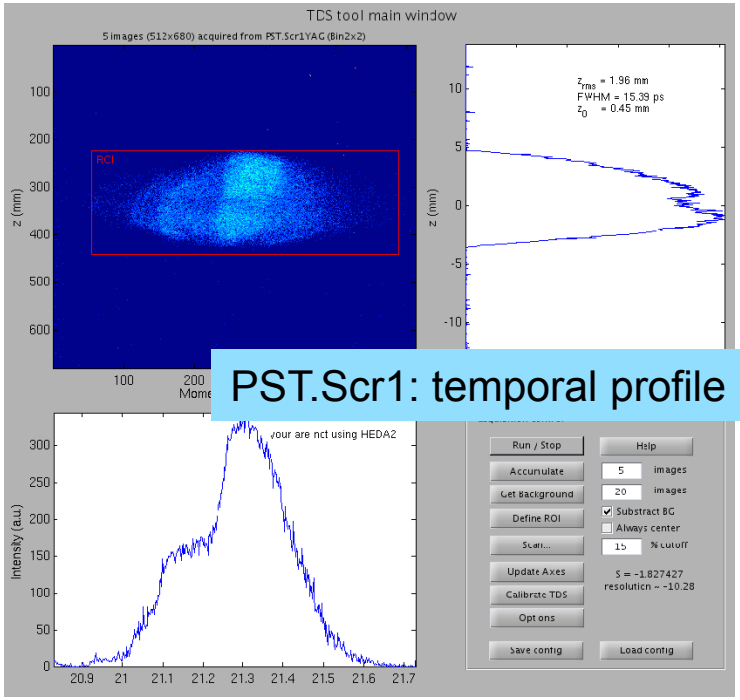
- „first“ HEDA2 measurements, fine calibration needs to be checked.
- BPMs around TDS calibrated, accuracy not satisfying (~1 mm).
- Some unusual instabilities during the weekend, probably due to climate conditions (phase jitter, laser drift, horizontal beam jitter).

First e-beam deflection with TDS

HEDA2: full longitudinal phase space

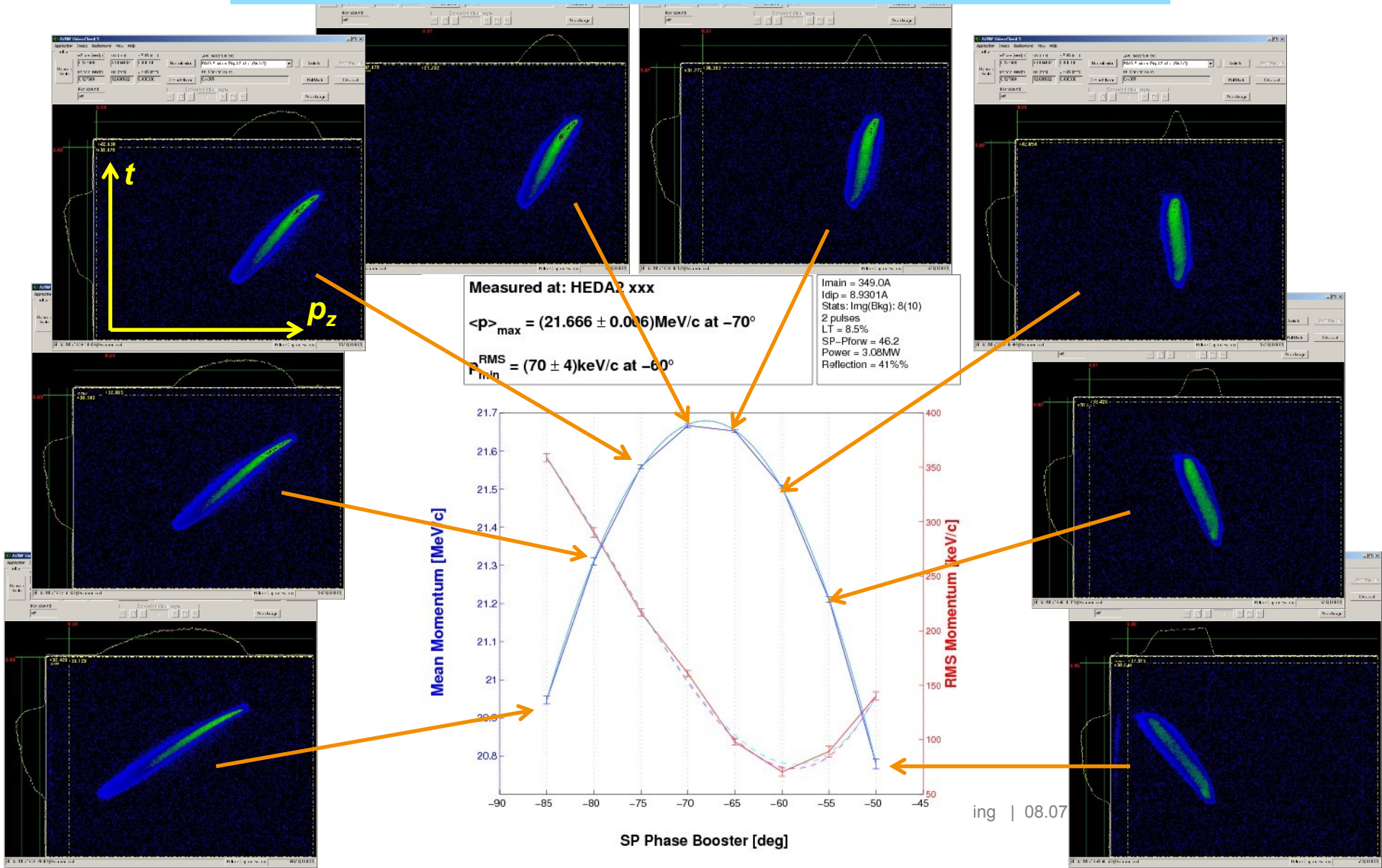


- Resolution limited by low (~10% of nominal) deflecting voltage (~25 kW in structure)



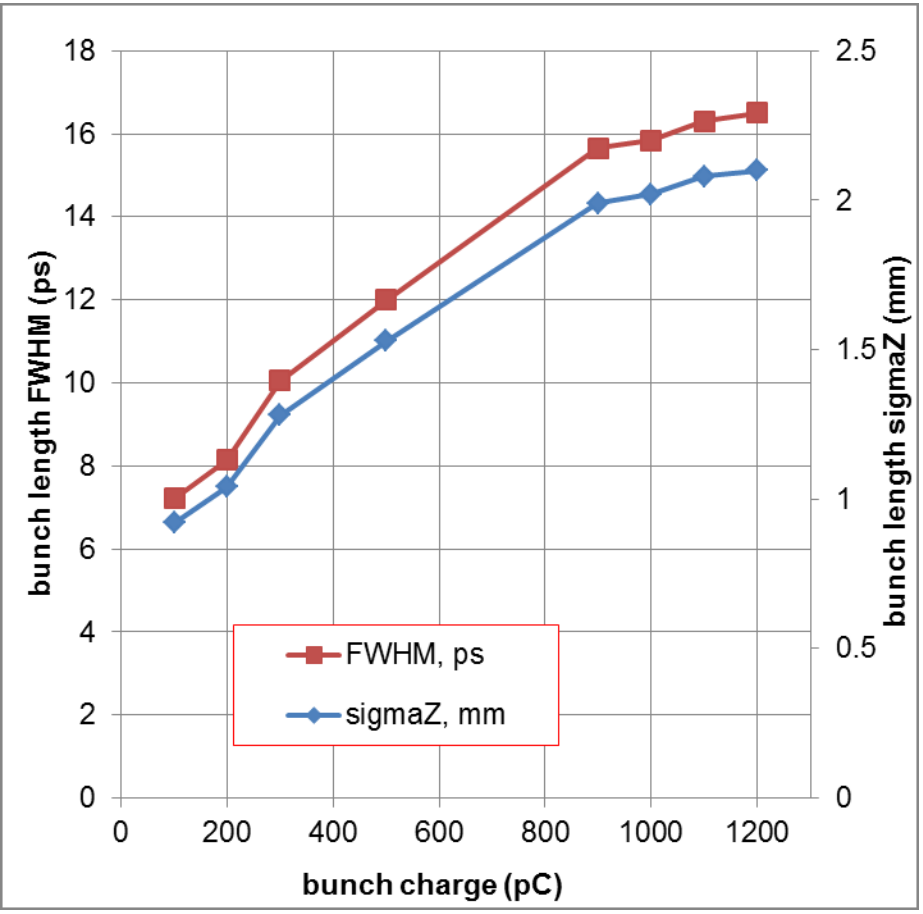
First e-beam deflection with TDS

HEDA2: full longitudinal phase space vs. Booster phase, Q=500pC



First e-beam deflection with TDS

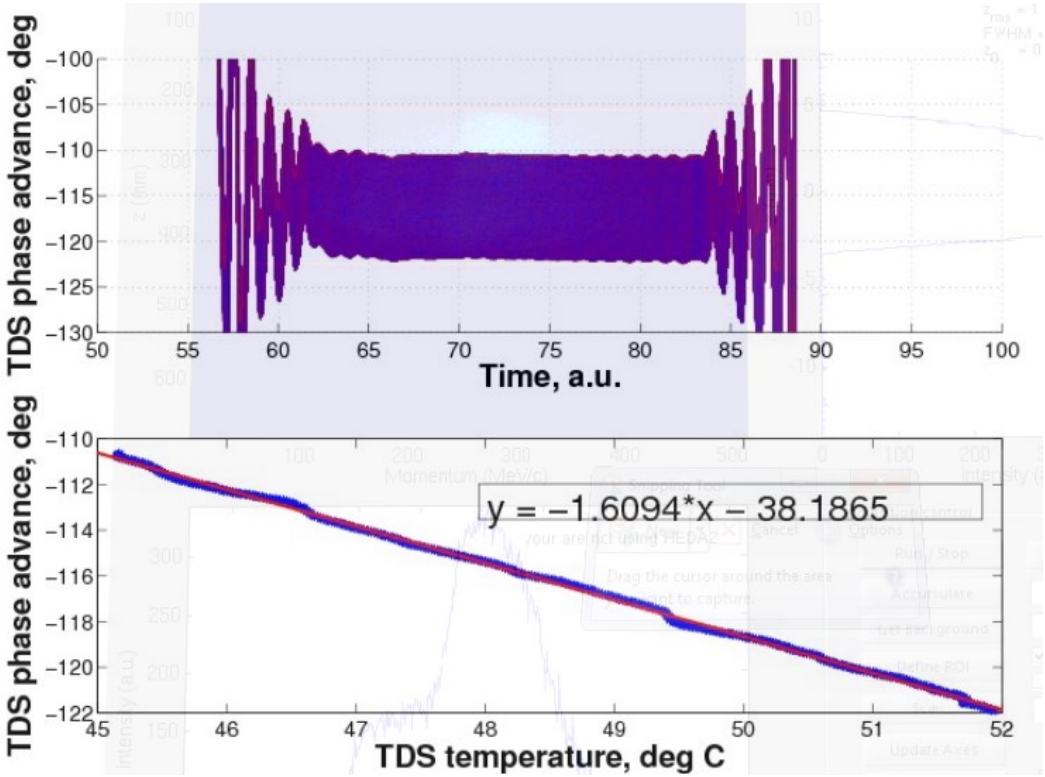
Bunch length vs. Bunch charge (BSA=1.5mm)



LT, %	Q, pC	sigmaZ, mm	FWHM, ps	Imain, A	H1.Q10, A	TDS_Phi0
2	100	0.92	7.22	345	1.1	68.37
3.5	200	1.04	8.14	354	1.09	68.72
4.8	300	1.28	10.06	344	1	73.72
8.5	500	1.53	12	360	1.08	70.31
20	900	1.99	15.66	360	0.99	72.05
25	1000	2.02	15.84	359	0.97	72.23
45	1100	2.08	16.3	360	0.98	72.11
80	1200	2.1	16.5	360	0.98	72.17

Temperature dependencies

- Phase advance between 14 cells shows 1.6 deg shift per Kelvin
- Corresponds to 0.8 deg/K shift of zero-crossing phase
- Resonance temperature 51 deg C instead of 45 (?)

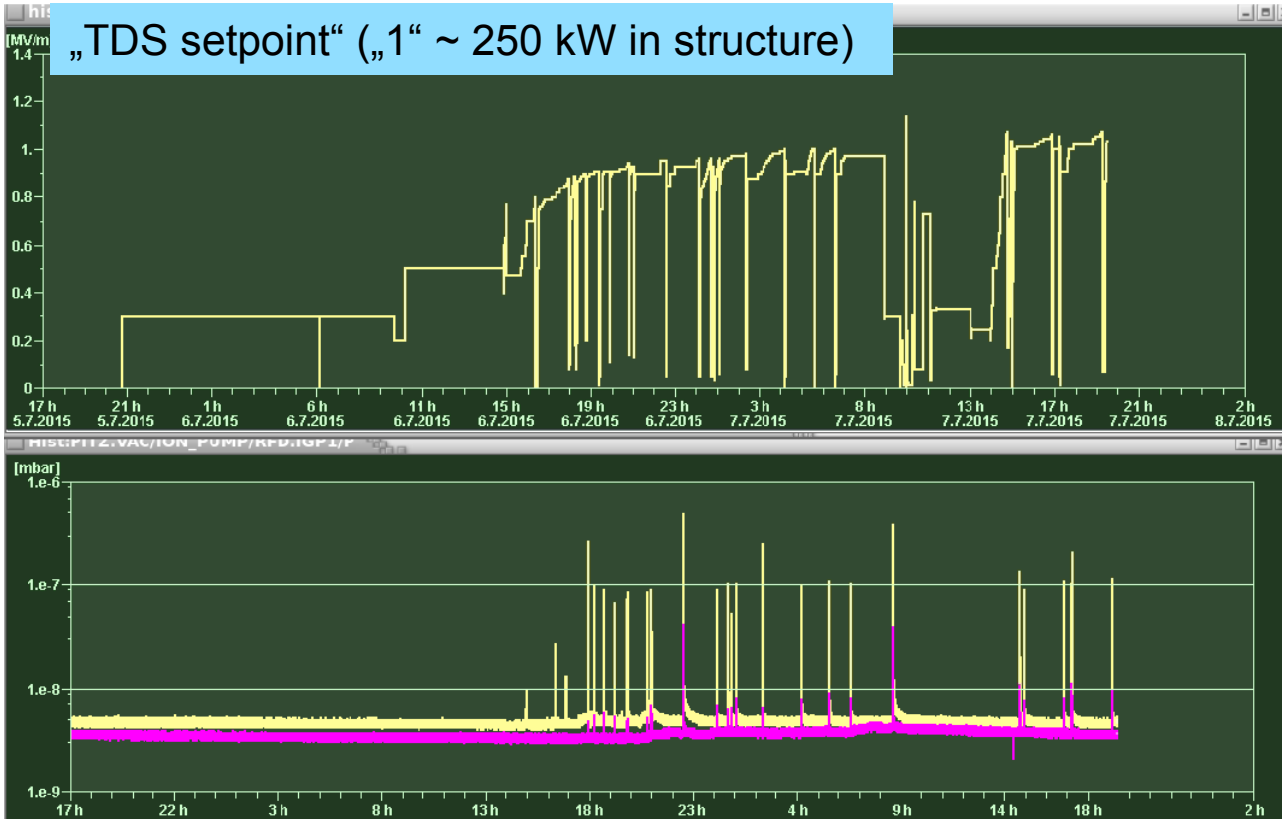


No measurable dependence of reflected power vs. temperature (resonance very broad)!

Virtually no RF heating (average power <50 W)

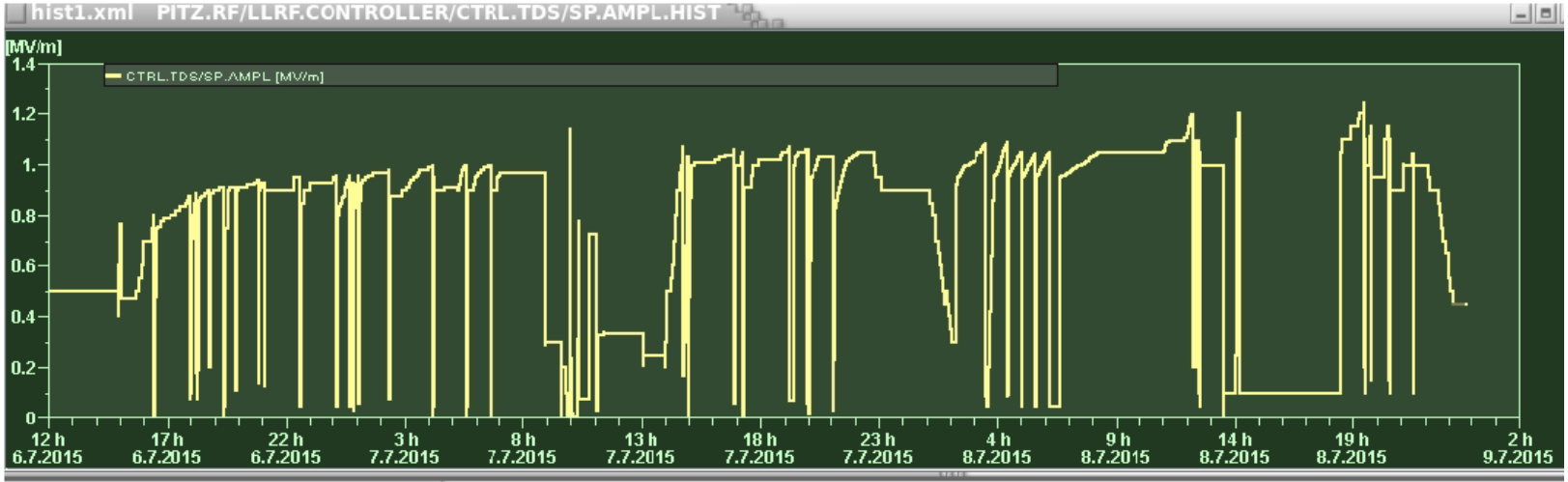
Conditioning progress (beginning)

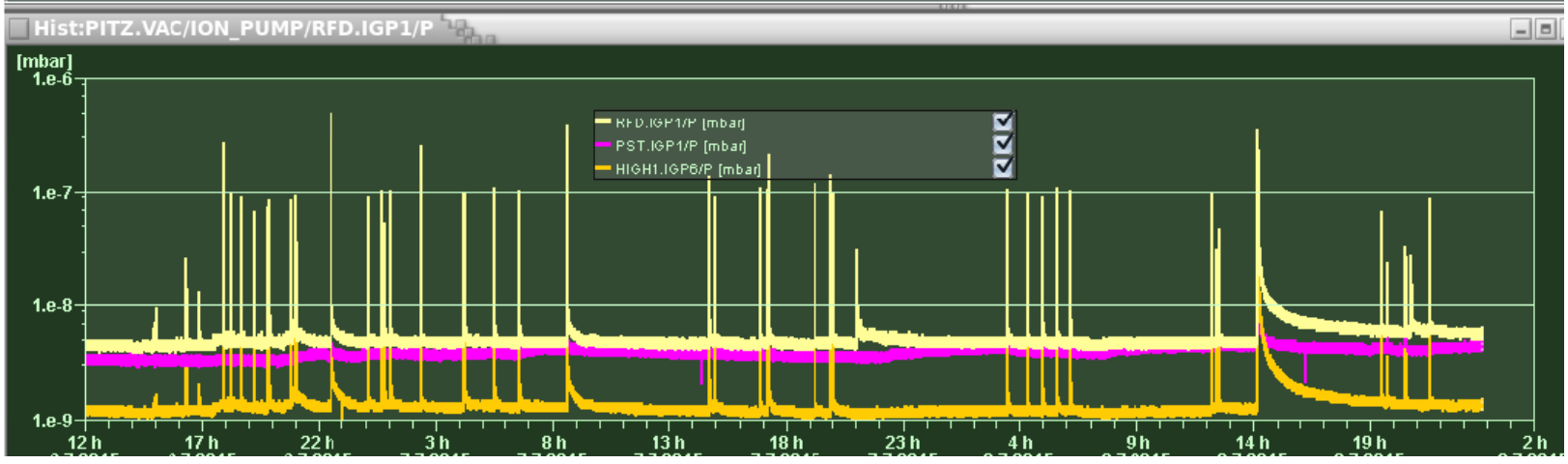
- Last weekend: 25 kW due to RF leakage in waveguide system.
- Then fast progress for one shift until ~250 kW in structure.
- Slow progress afterwards…
- couplers & phase probes calibrated Tuesday morning.



Conditioning status

- Wednesday several hours at 0.5-0.5-0.5 us
- reaching twice to SP 1.2…
- …but no proress in late shift, then switching back to 0.5-2.5-0.5
- one huge vacuum event because IL logic was temporarily disabled





Calibration

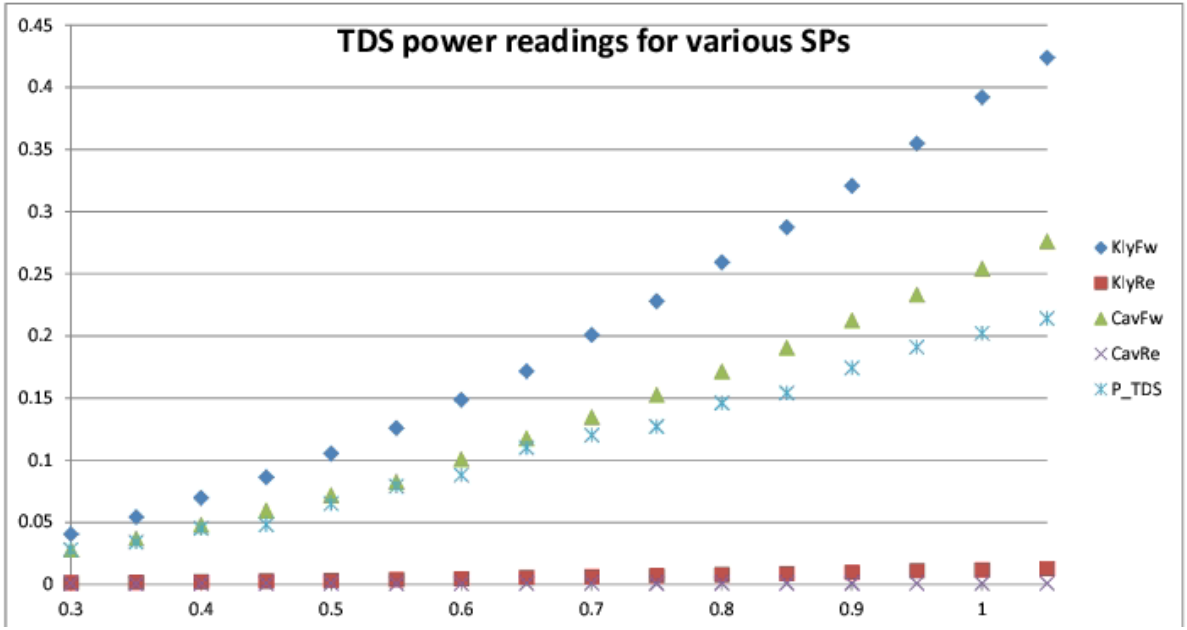
Preliminary results at current maximum setpoint:

- 480 kW forward power from klystron
- 10 kW reflection at klystron coupler

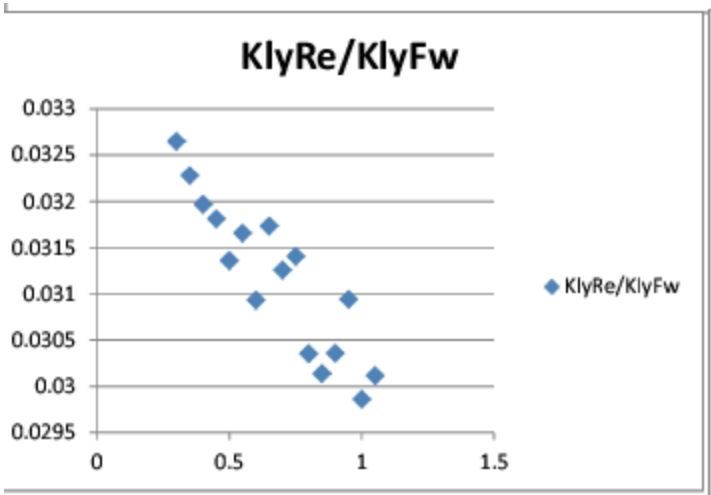
- 280 kW forward power at TDS coupler
- 230 kW estimated from e-beam deflection

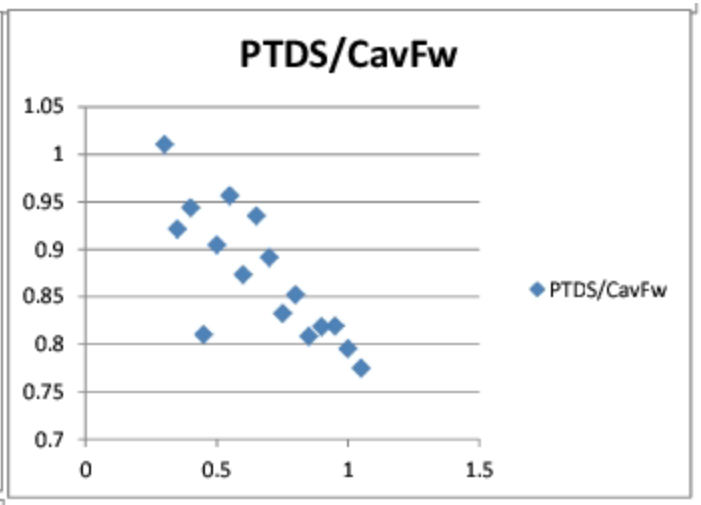
- 1 kW reflection at TDS coupler

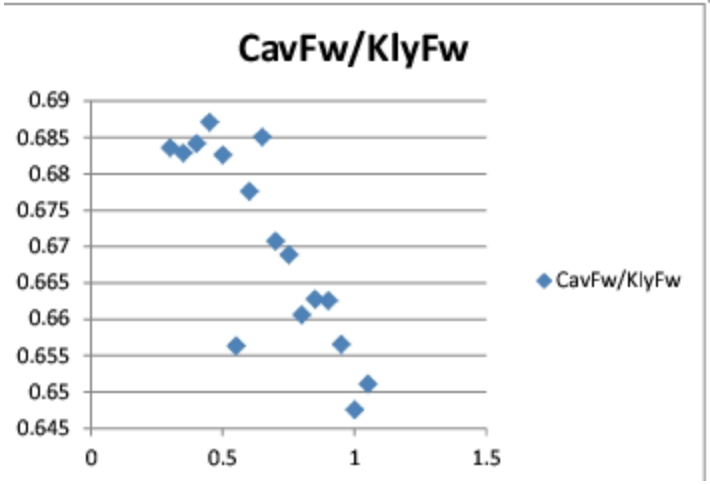
- …Wednesday new version of TDS tool, now reliable results that fit very well to coupler data!



Calibration

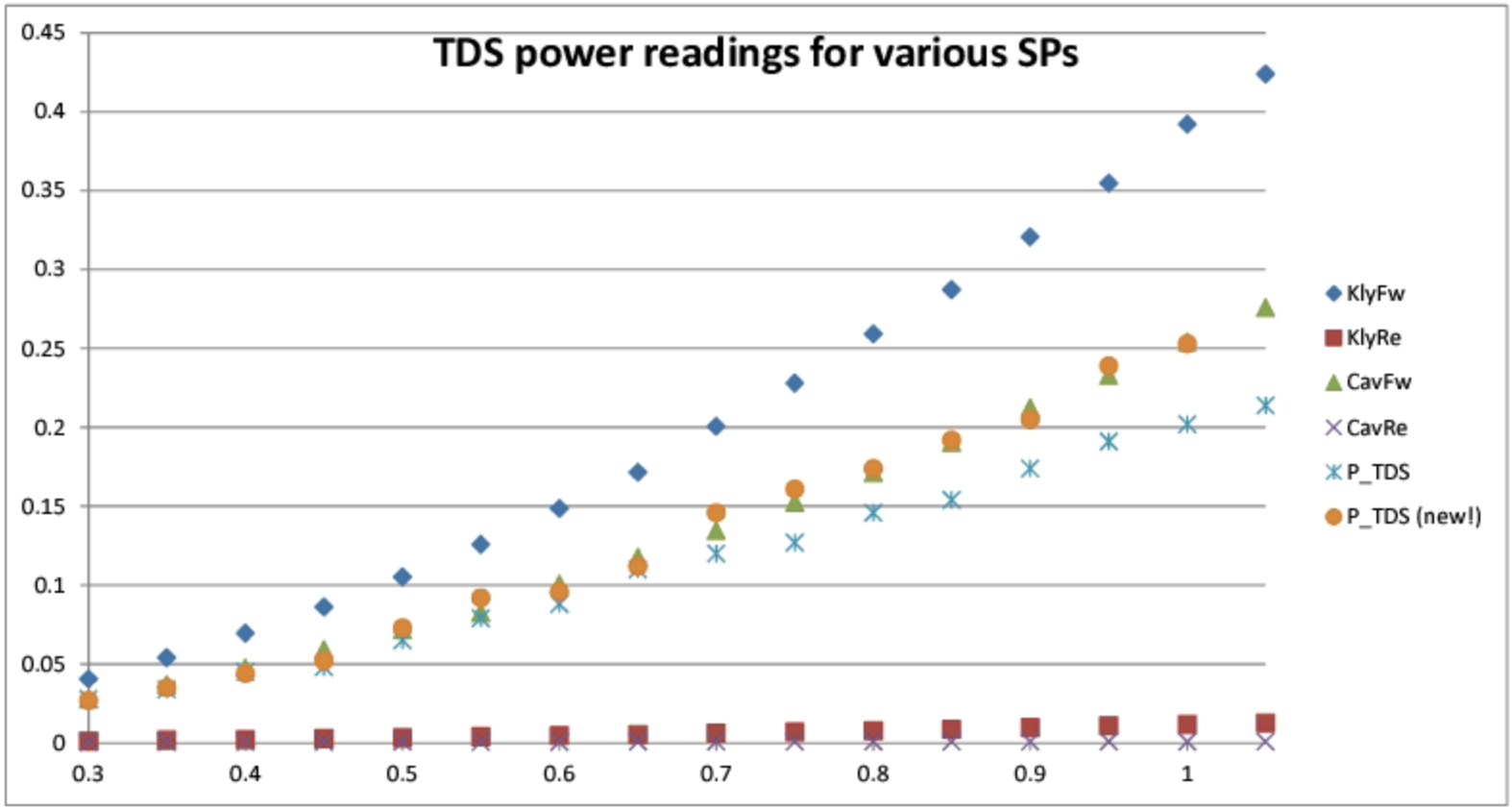






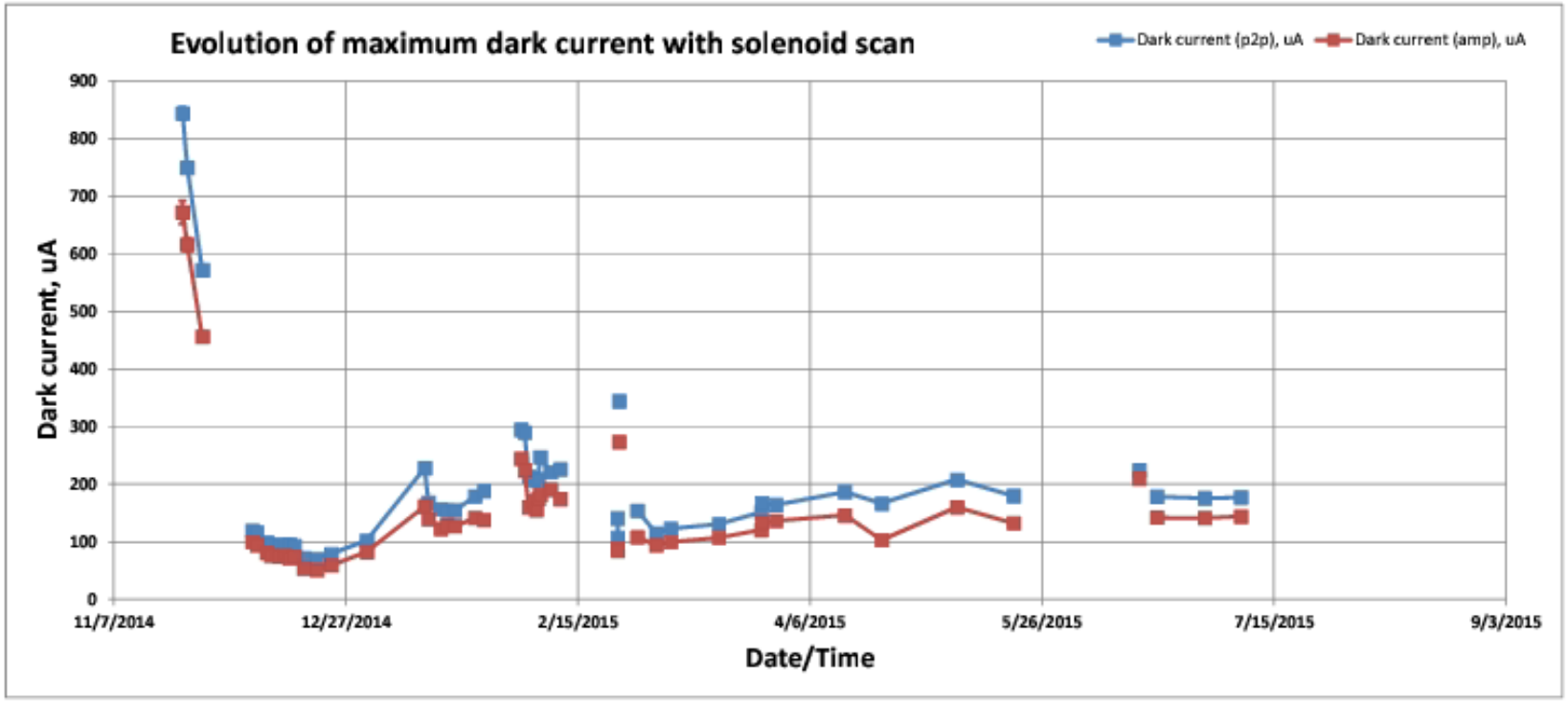
Calibration

- Wednesday new version of TDS tool, now reliable results that fit very well to coupler data!



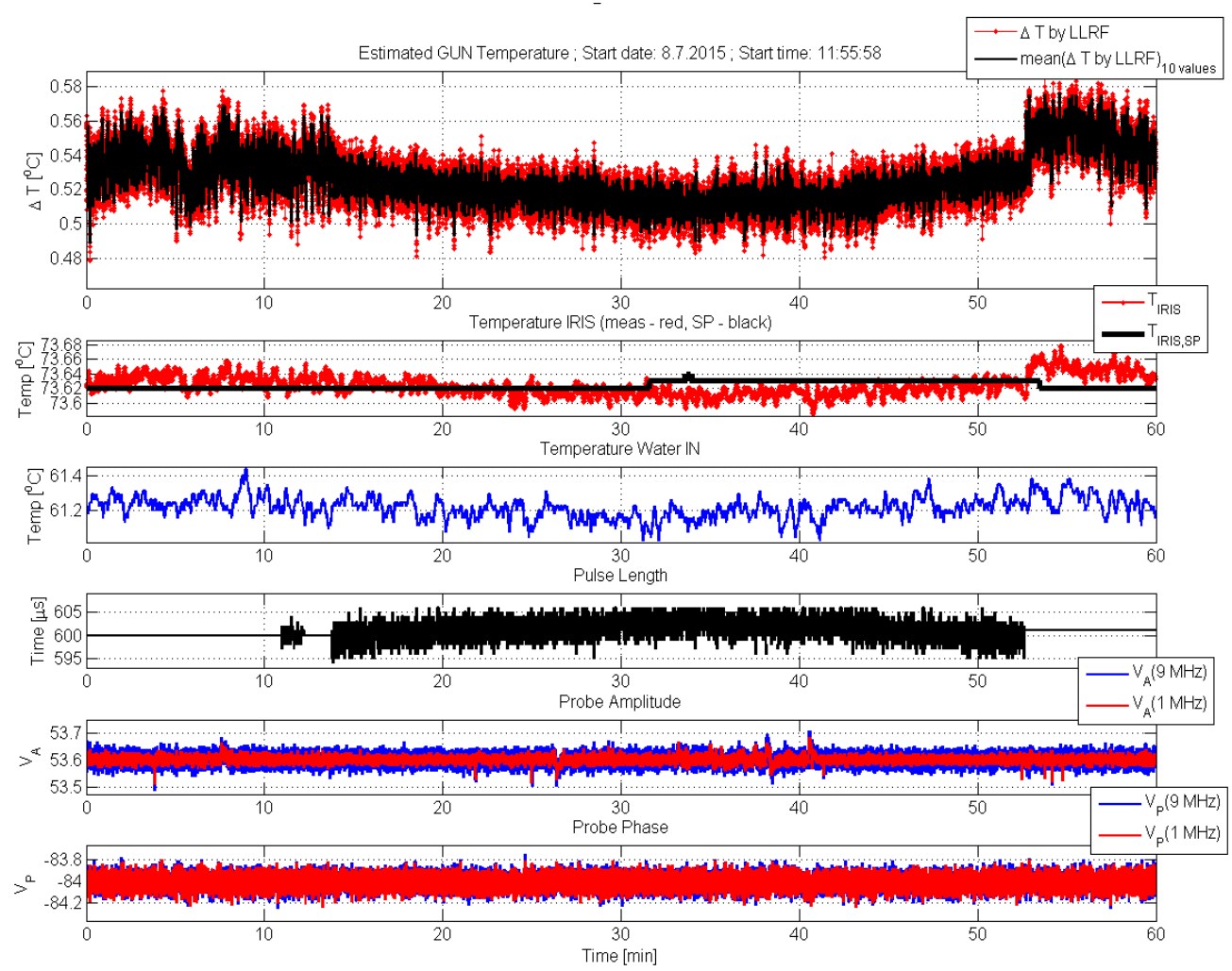
Stable dark current

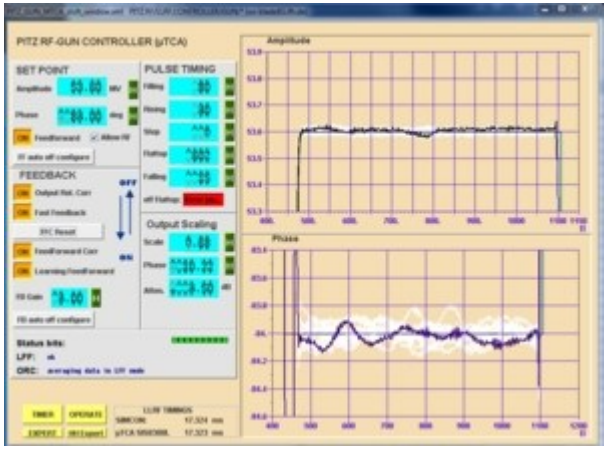
6/15/2015 20:50	160/200	6.38	360	224.1	2	360	210.2	2.2
New cathode 679.1 (Cs2Te) is inserted 19.06.2015								
6/19/2015 16:10	160/200	6.38	370	178.5	1.5	370	142.1	2.1
6/30/2015 00:00	160/200	6.37	360	176.1	1.5	360	141.3	4.3
7/7/2015 19:15	160/200	6.37	360	177.5	0.7	370	144.5	4.7



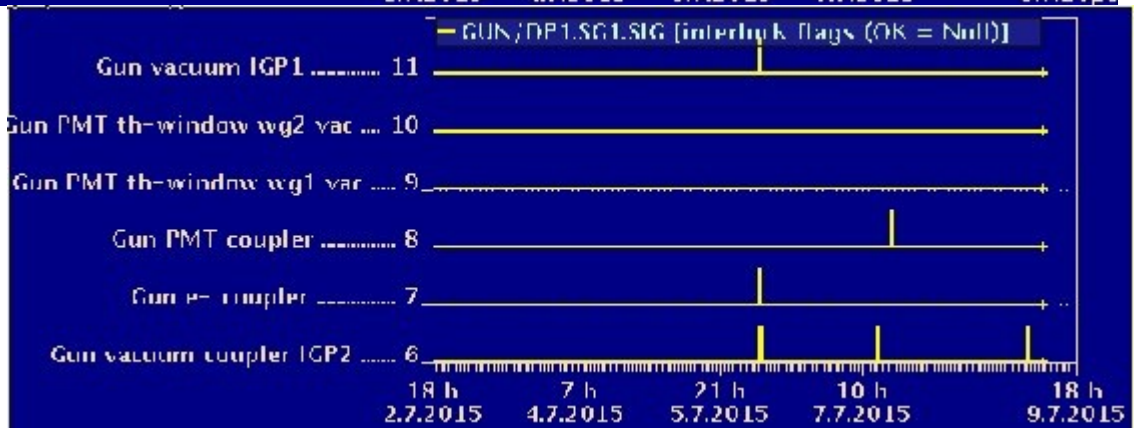
RF GUN – Pulse Length Modulation
Pulsweitenmodulation (PWM) → S.Pfeiffer rem. from HH

- Result for stable run of about 40 minutes (meaningless FB gain 200, with automatic IRIS SP adjustment - see minute 31-32).
- Limiting factor seems to be the RF field stability (large oscillation visible in amplitude and phase)
- PWM changes the flattop length, see 4th subplot. If PWM is active, the estimated temperature improves by a factor of about 1.5 (\sigma(T) from 0.013K to 0.0087K if detrend is done using 4th order fit - slow drifts are compensated by LFF).
- However this improvement is not visible on A/P of Probe - last 2 subplots, because its dominated by an oscillating mode. Furthermore, this large field degradation by the oscillation will change the stored RF field in GUN from pulse to pulse which leads to a change of heat source (RF GUN) from pulse to pulse, while PWM requires an almost constant heat source (RF GUN) which is in theory (and at FLASH) ensured by stable RF field regulation.

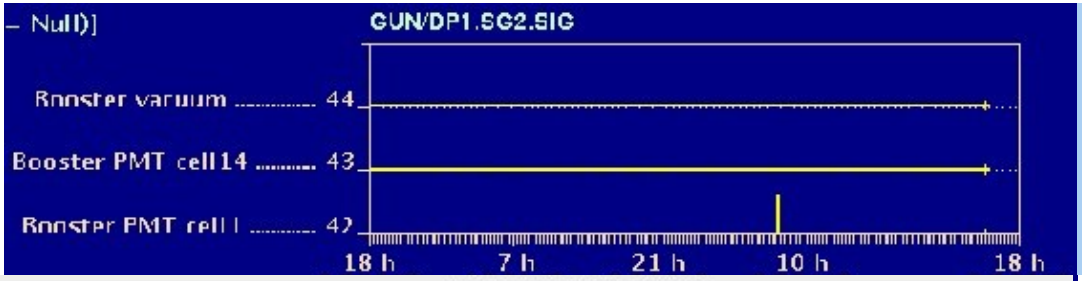




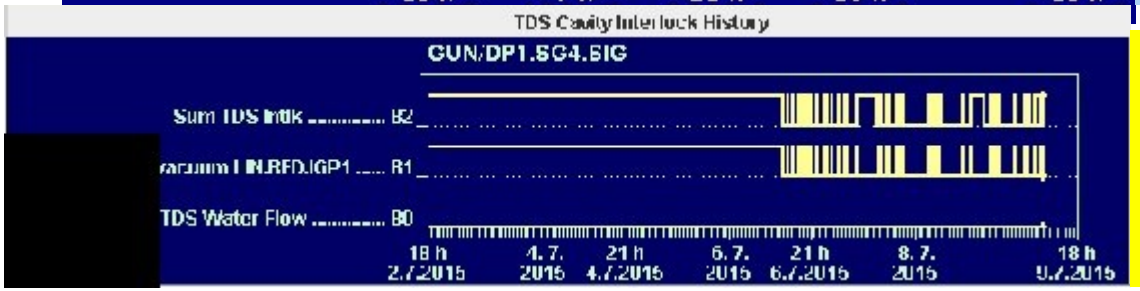
History of the Week: ILs



gun



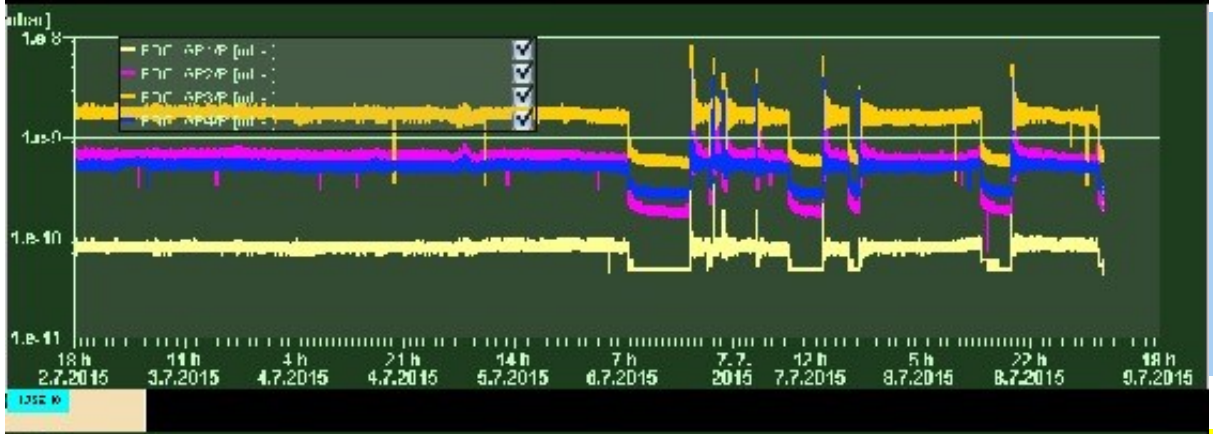
booster



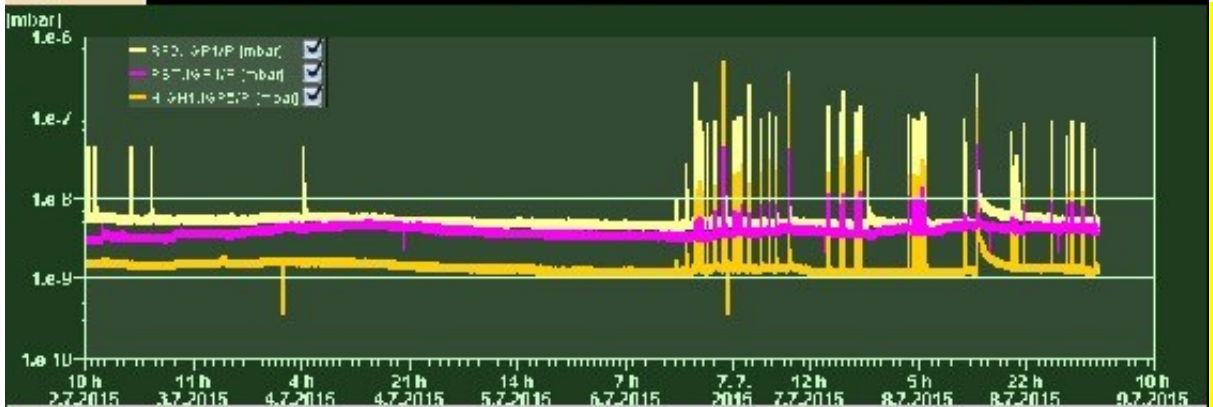
TDS

History of the Week: vacuum

gun



booster



TDS

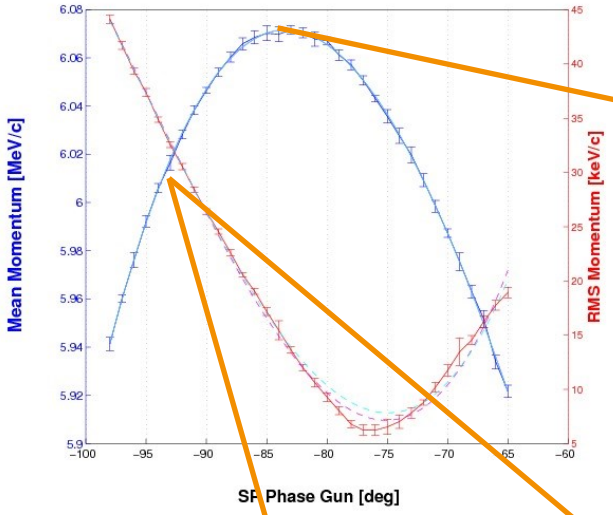
Problem: multi-spike structure in LEDA

Measured at: LEDA

$\langle p \rangle_{max}$ = (6.0716 ± 0.0017)MeV/c at –83°

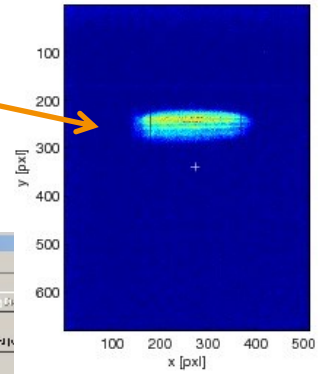
p^{RMS}_{min} = (6.2 ± 0.5)keV/c at –76°

Imain = 419.9A
Idip = –1.5698A
Stats: Img(Bkg): 20(10)
4 pulses
LT = 2%
SP–Pforw = 52.6
Power = 5.00MW
Reflection = 70%%



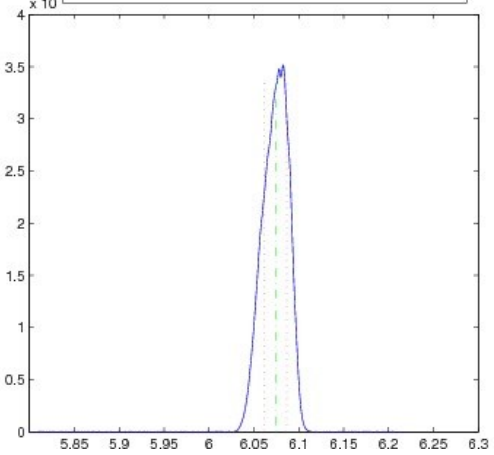
Phase: –83°

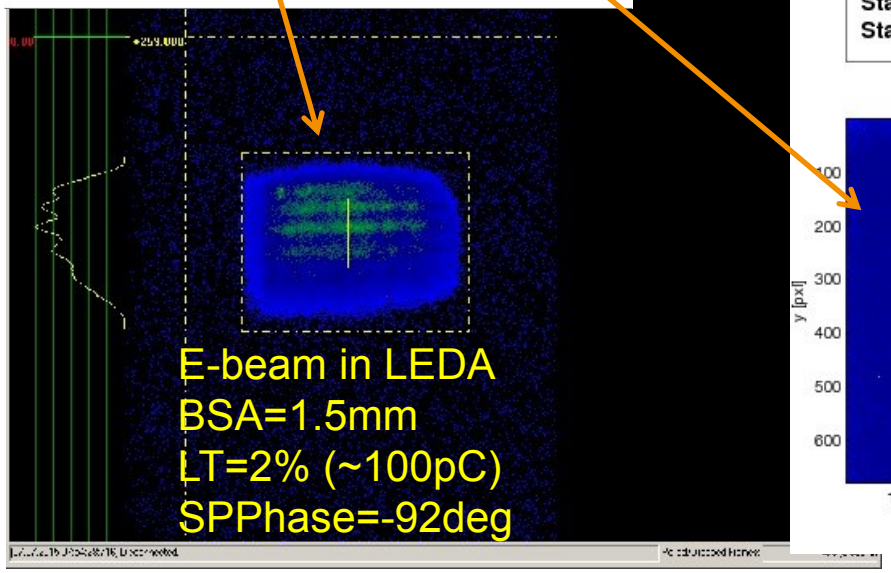
Statistics (Img): 30
Statistics (Bkg): 10



p_{mean} = (6.074 ± 0.003)MeV/c

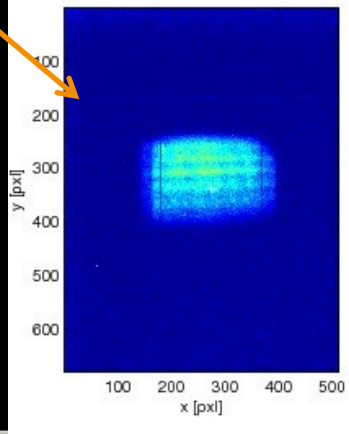
p_{RMS} = (12.8 ± 0.3)keV/c





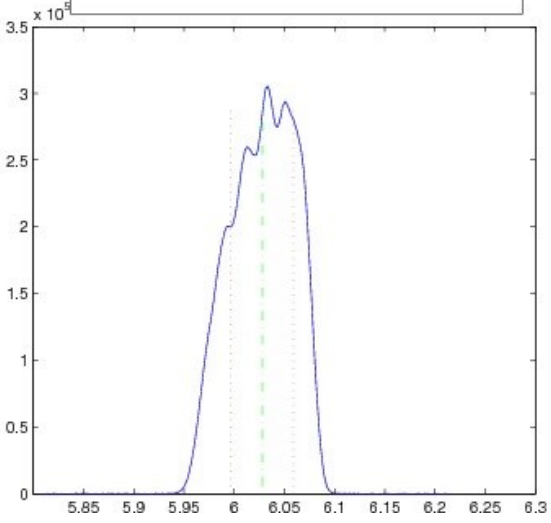
Phase: –92°

Statistics (Img): 30
Statistics (Bkg): 10



p_{mean} = (6.028 ± 0.002)MeV/c

p_{RMS} = (31.0 ± 0.3)keV/c



Plan for rest of the week

- **TDS conditioning**

- **Bunch length vs. Charge**
- **Bunch length vs. Booster phase**

- **Optimize HEDA2 resolution, get some full longitudinal phase space images**

- **Get pulse shaper into operation, measure flat-top beam profile.**