

Radiation measurements for THz@PITZ

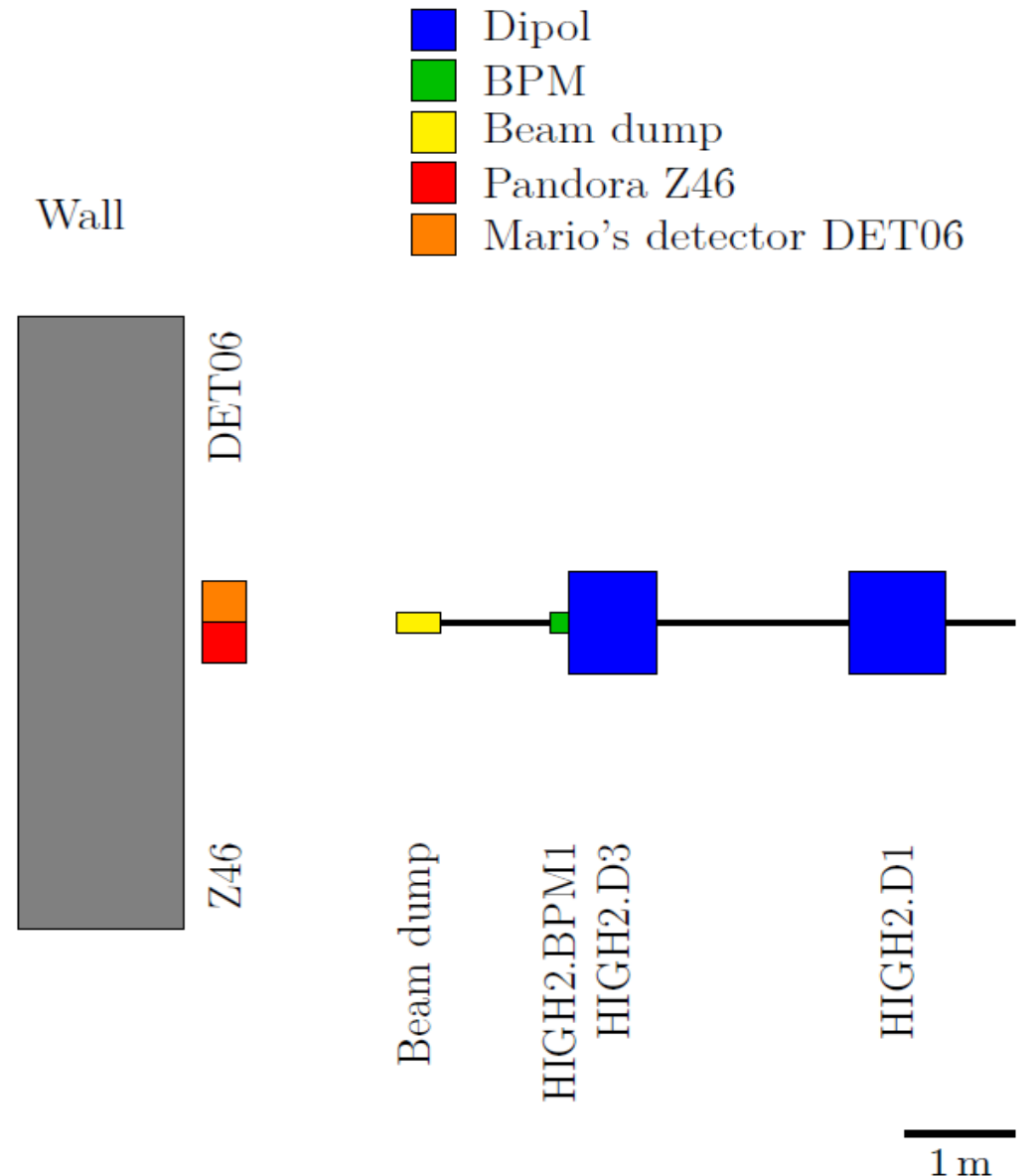
Dose rate measurements with Pandora and PITZ detector for different bunch currents and NOP

- Tobias Weilbach, Zeuthen, April 2nd 2020

Measurement Setup

Two detectors after beam dump to measure dose rates

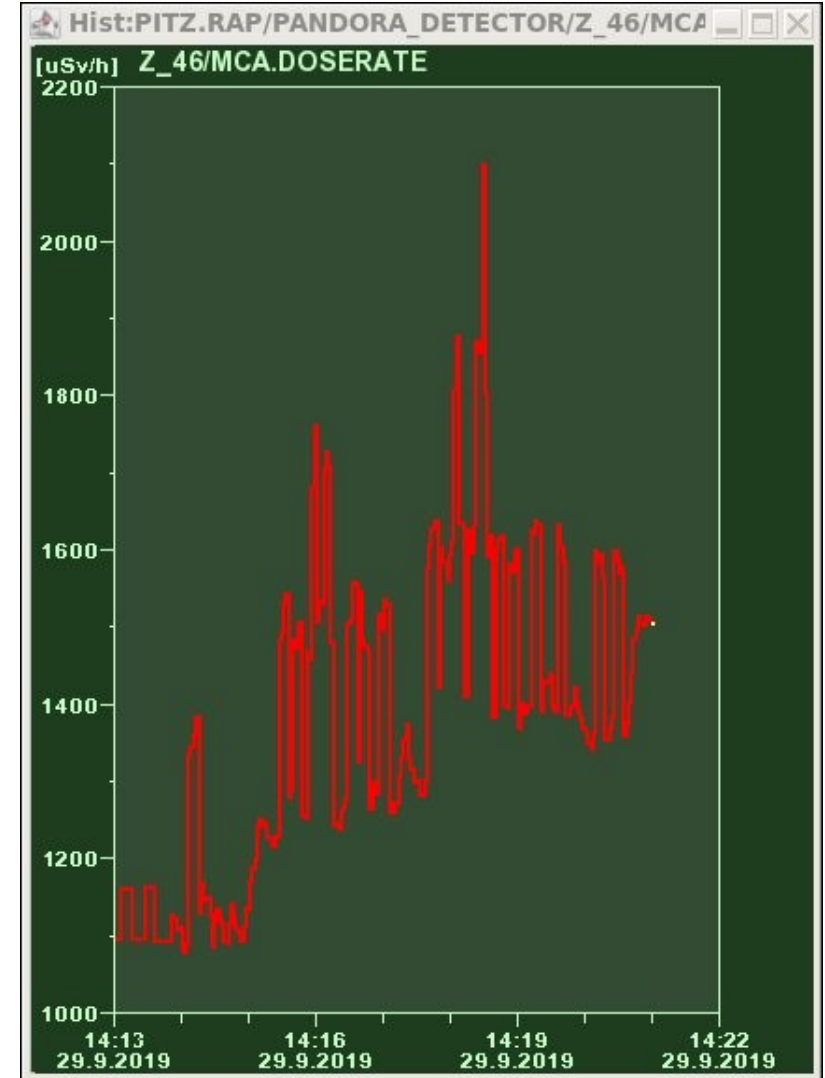
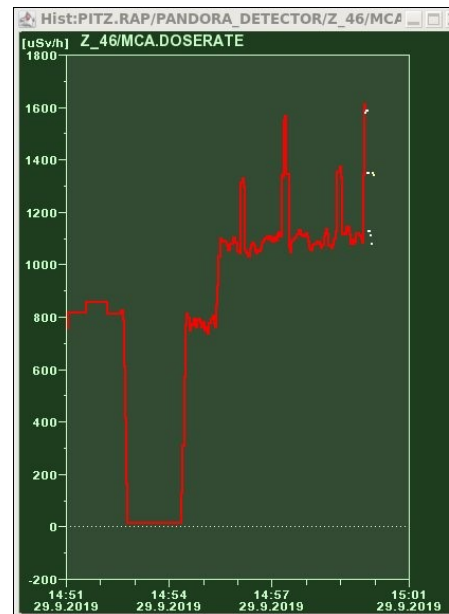
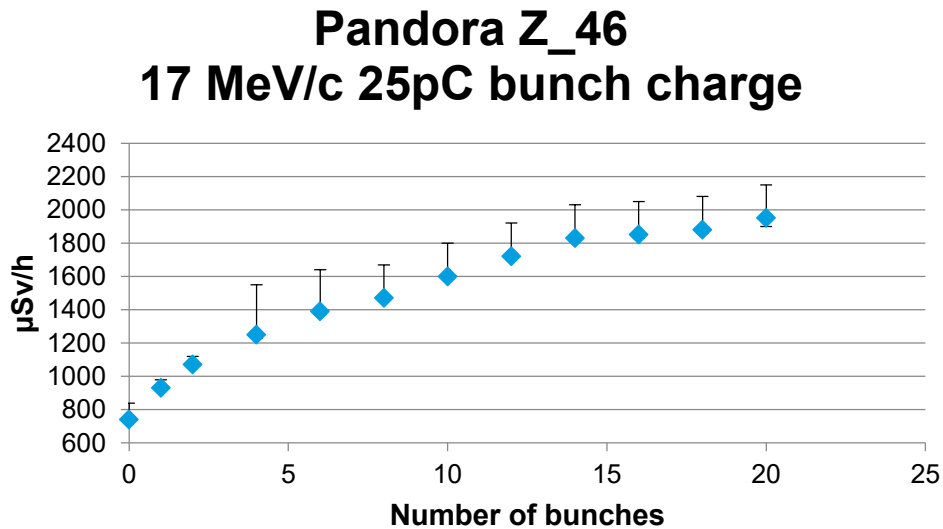
- Measure dose rate for different number of pulses (1 - 20) with 100 pC bunch charge
- Measure dose rate for one bunch with different bunch charges 100 pC to 2000 pC
- Beam energies of 17 MeV/c, 19.5 MeV/c and 22 MeV/c
- Use BPMs to transport beam to beam dump
- Use HIGH2.BMP1 to center beam on beam dump
- Setup beam parameter and measure for 180s with one detector readout per second
- Pandora is Z46, Gamma detector is DET_NEW06



Measurements 09/2019

First observation of fluctuations

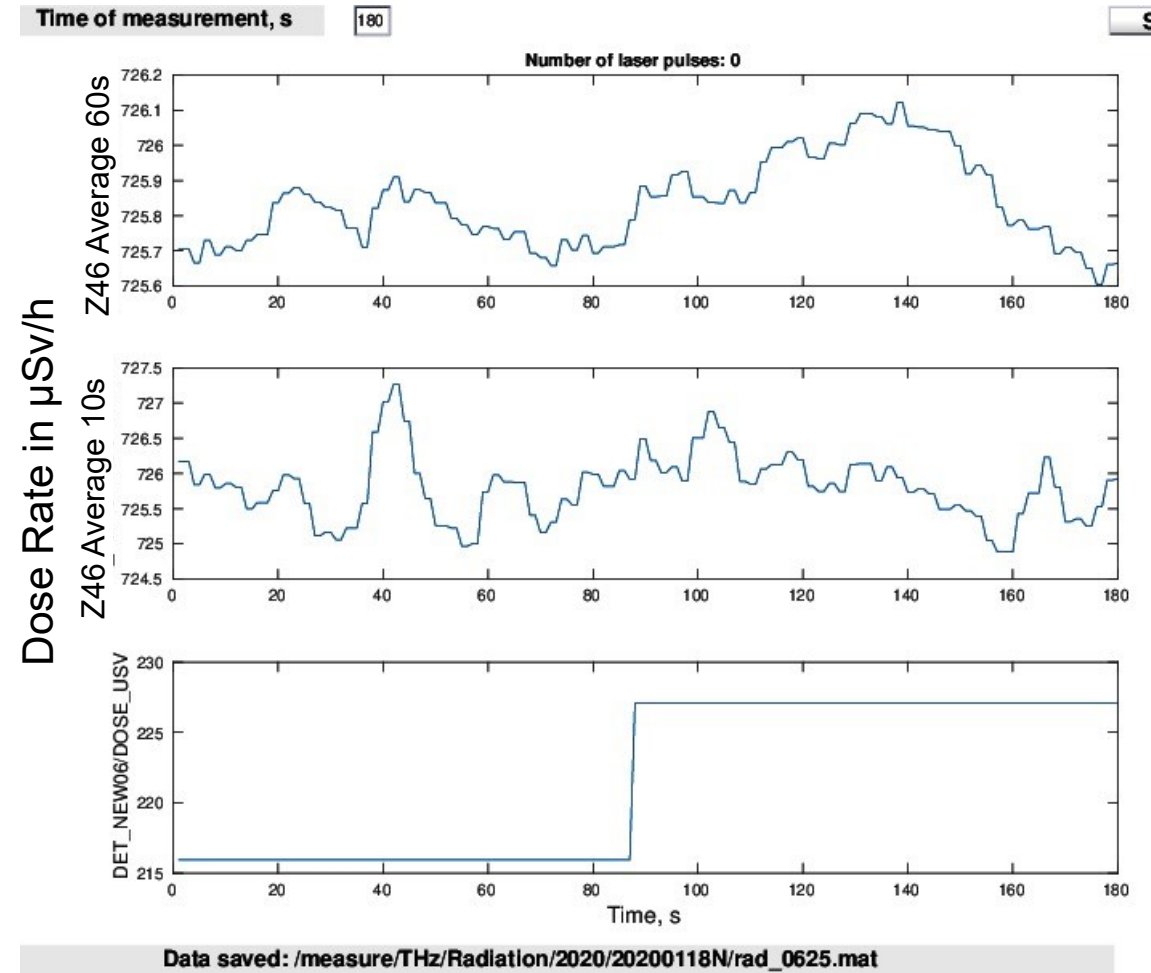
- Observed saturation effect of dose rate starting around 15 bunches
- Background generated in gun, vanished when LOW.FC1 is inserted
- Very strong fluctuations during measurements, dose rate jumps by factor of 2 within one measurement
- Problems with DAQ server were observed and changes were implemented afterwards



Background

Mostly caused by gun, booster bg $\sim 20 \mu\text{Sv/h}$

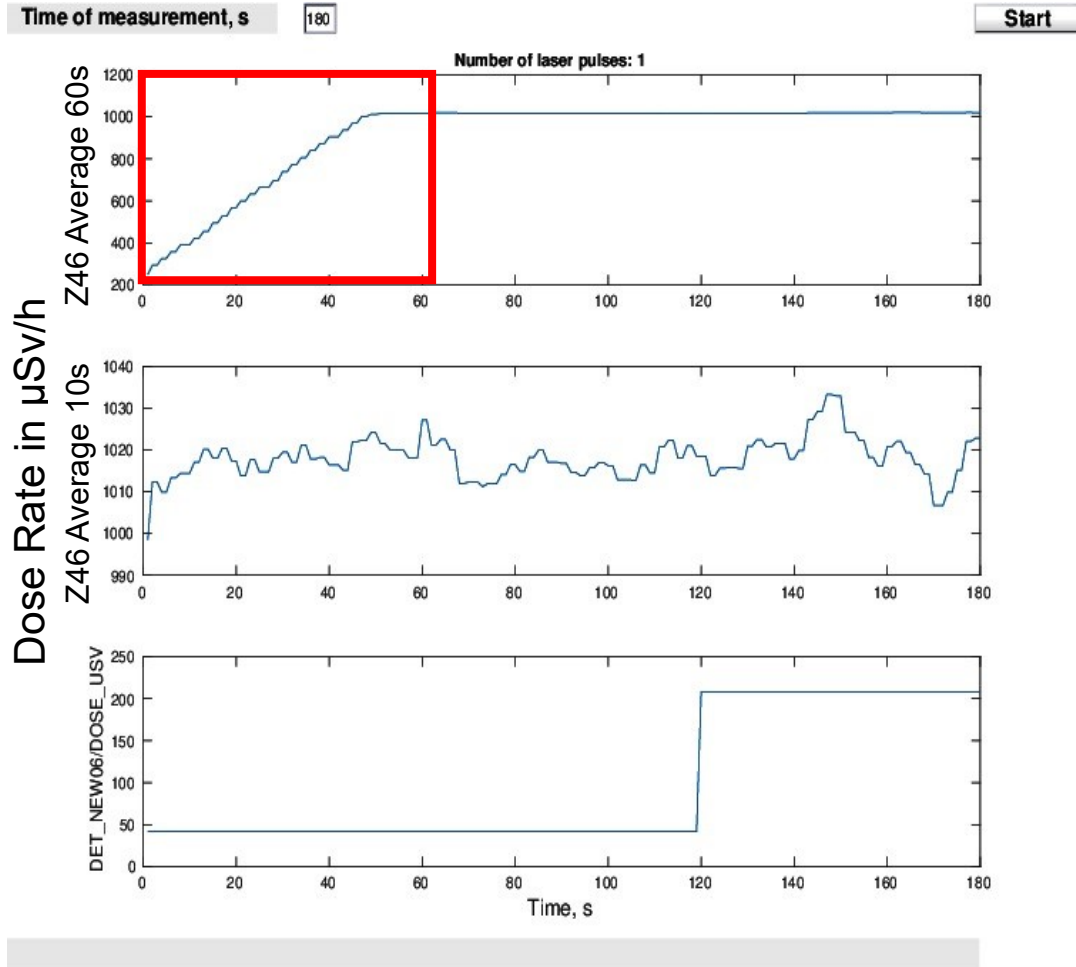
- Z46 Average 60s running average over last 60s
- Z46 Average 10s running average over last 10s
- Signal of Pandora (Z46) is quite stable
- Discrete jumps in Gamma detector signal



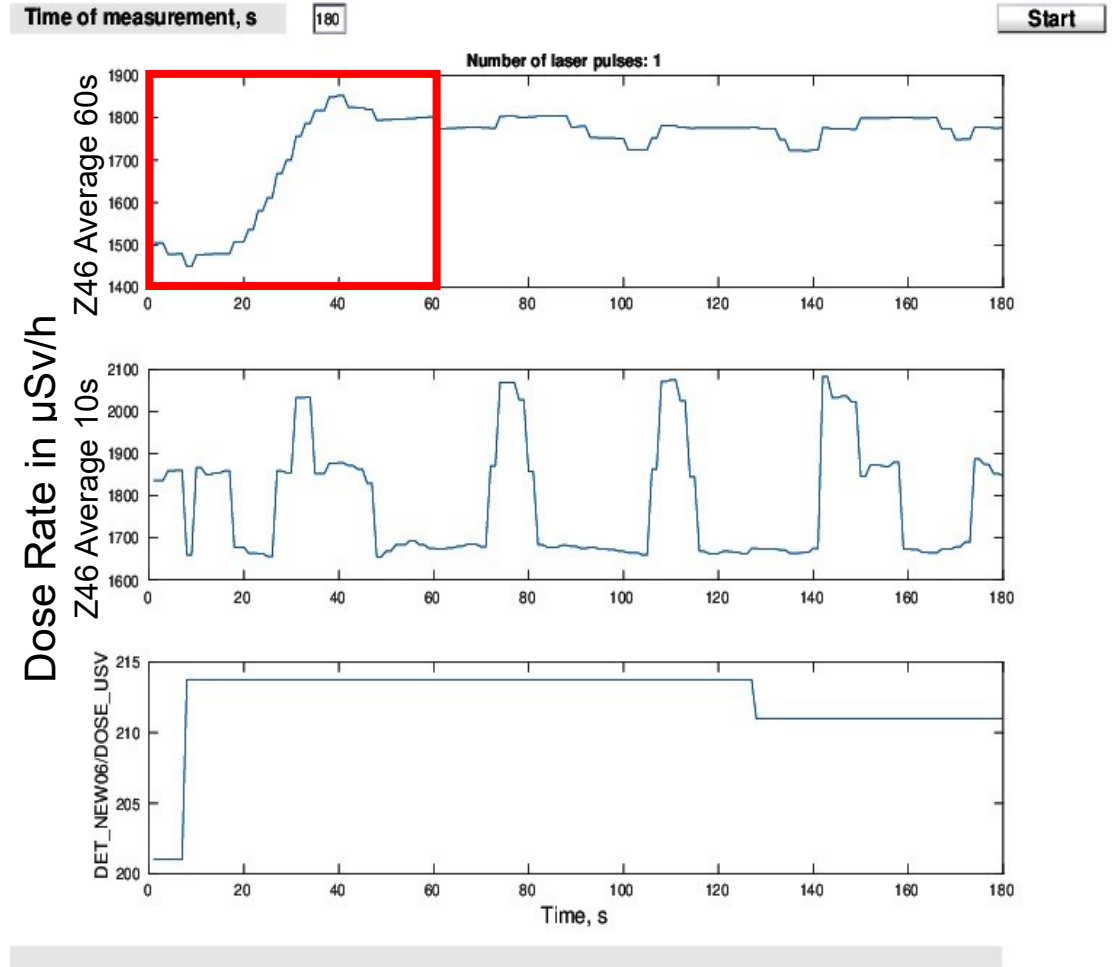
Laser shutter closed

Measurements of different bunch charges

Measurements of smaller bunch charges seem quite stable



19.5 MeV/c 500pC

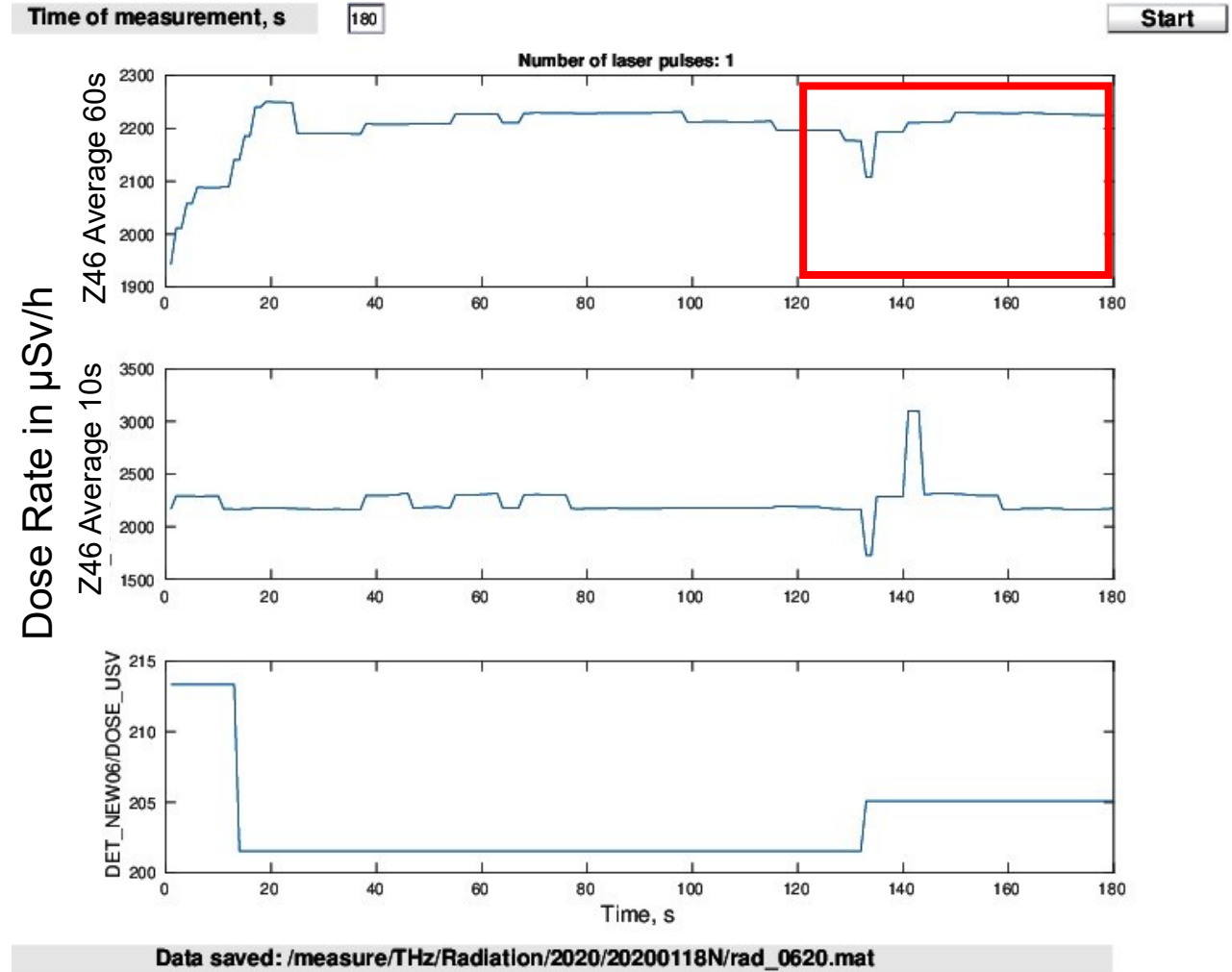


19.5 MeV/c 1500pC

Measurements of different bunch charges

But also measurements like this with high bunch charges

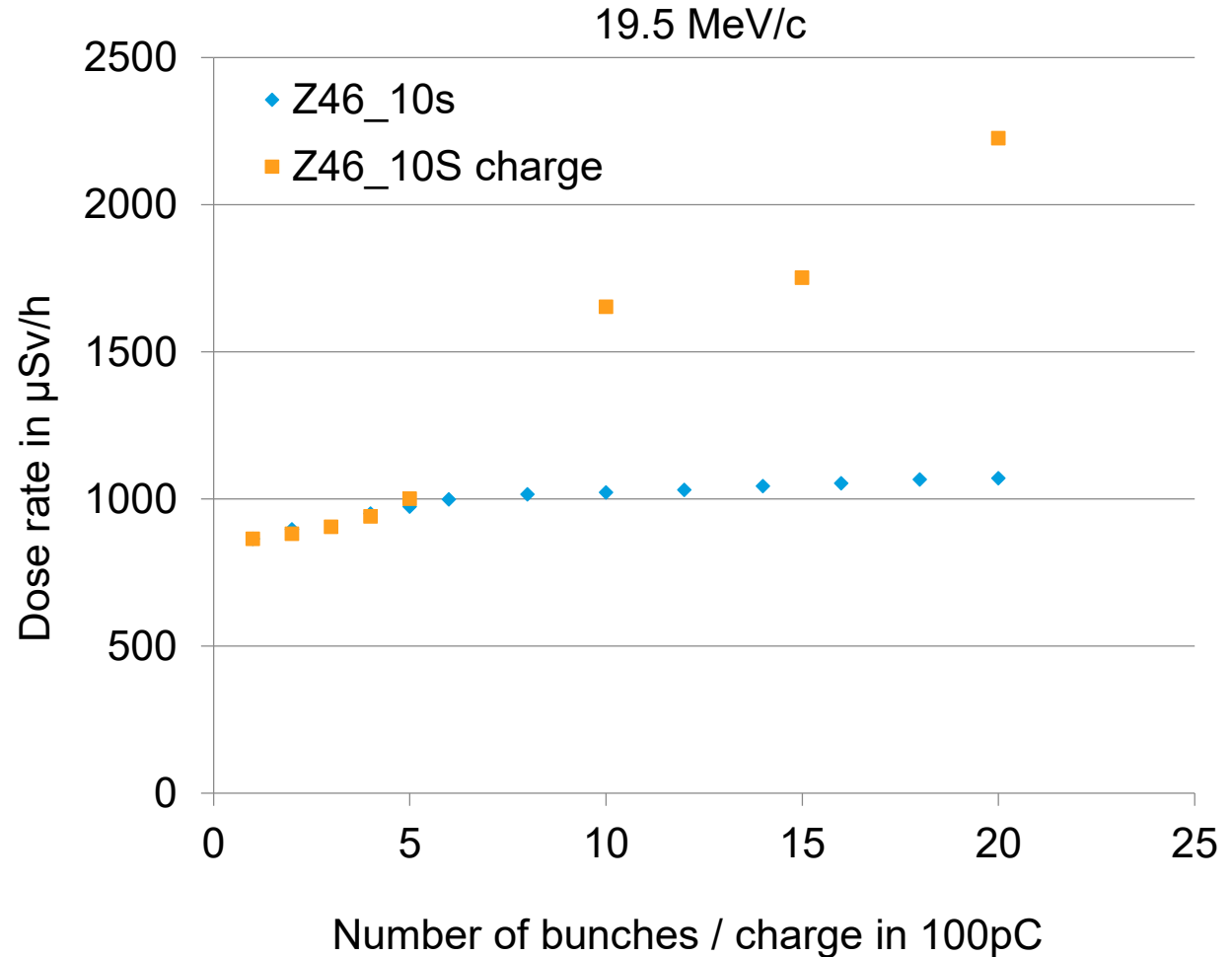
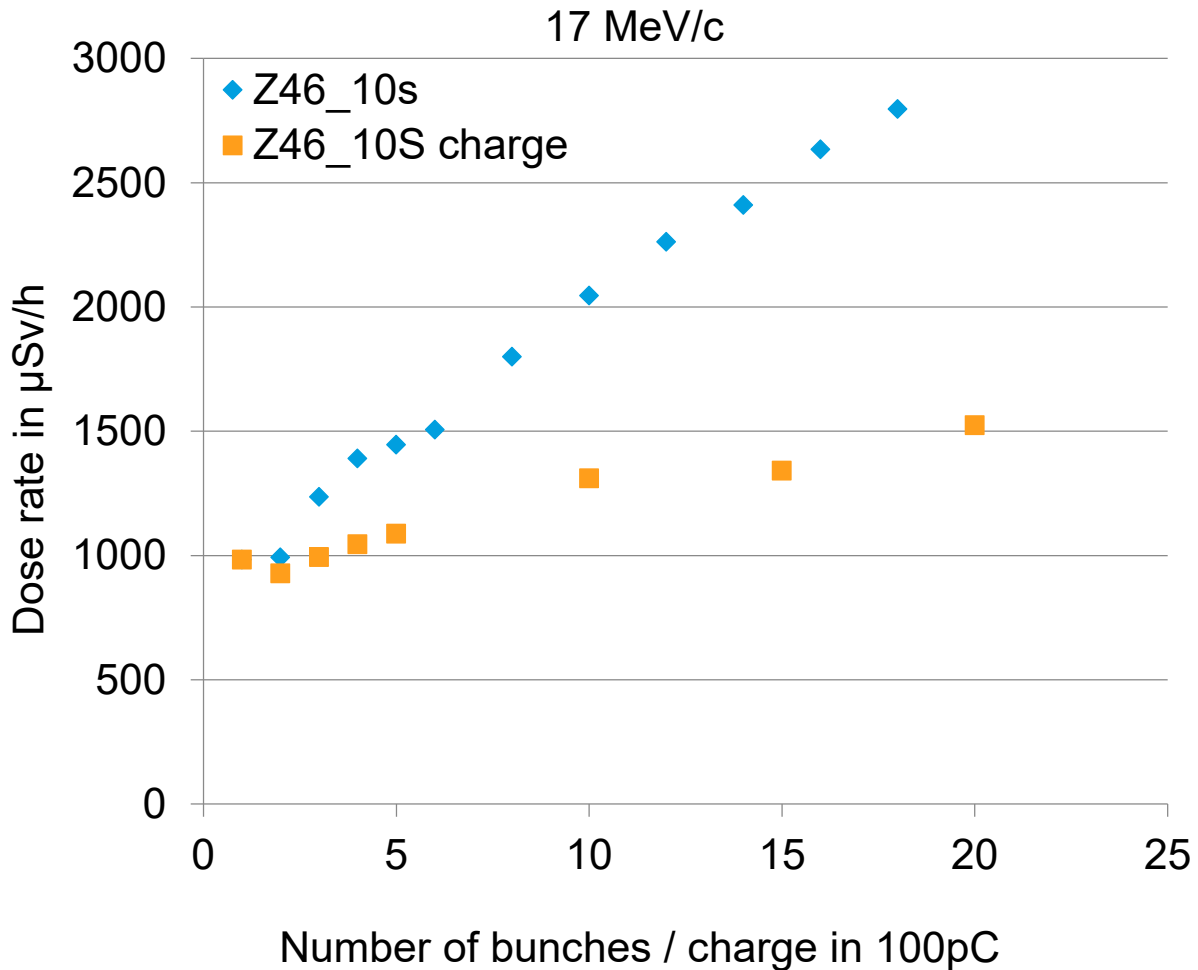
- Still some significant jumps/spikes during measurements
- Measurements of lower charges/NOP seem less spiky
- Z46_60s Signal smoother
- DET_NEW06 shows jumps during measurements consistently
- No difference in Signal behavior (spikes/jumps) for different energies
- Average over last 60 measurements



19.5 MeV/c 2000pC

Average over last 60 measurements at 17 and 19.5 MeV/c

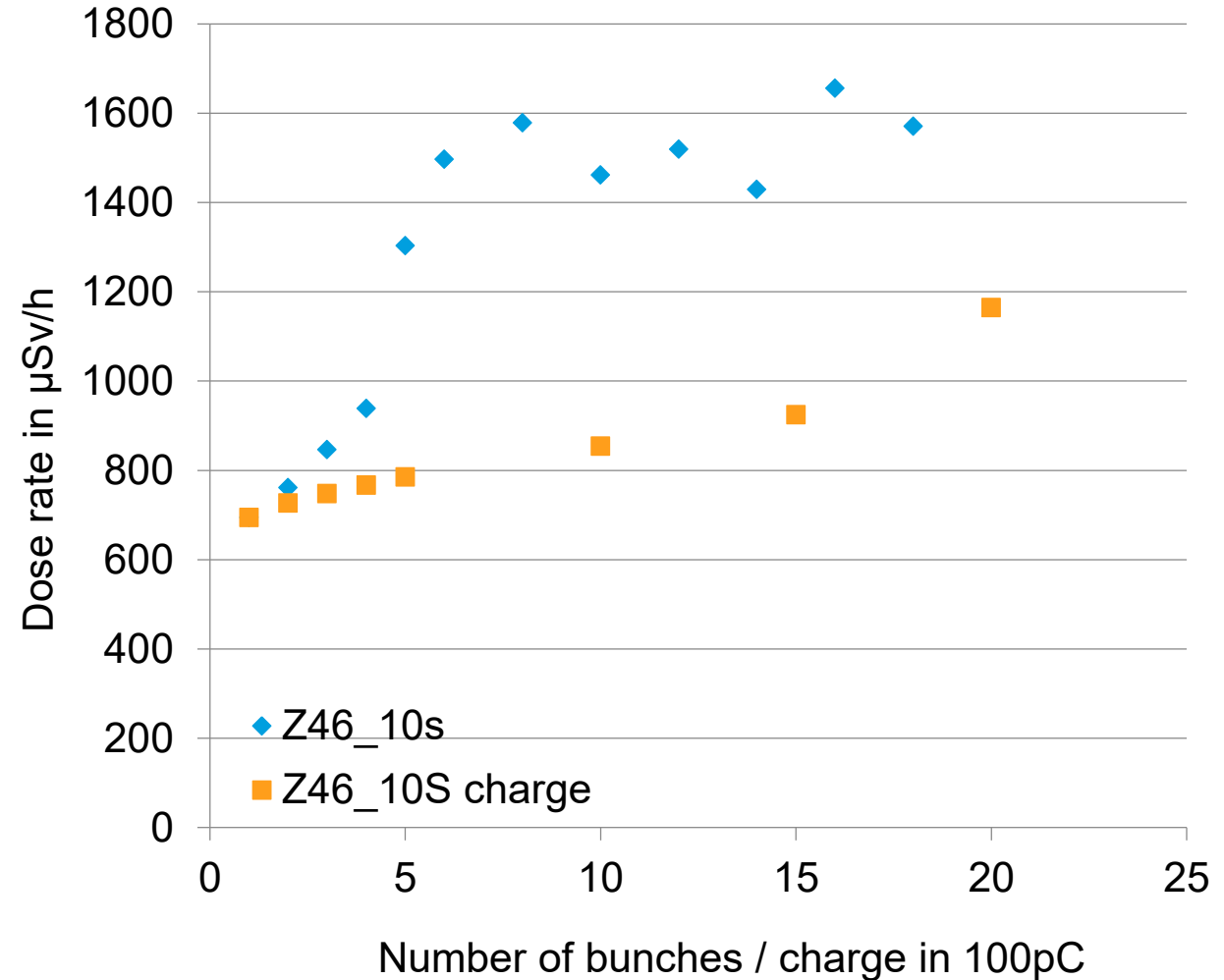
Z46_10s is dose rate vs. NOP Z46_10s charge is dose rate vs. bunch charge



Average over last 60 measurements at 22 MeV/c

Z46_10s is dose rate vs. NOP Z46_10s charge is dose rate vs. bunch charge

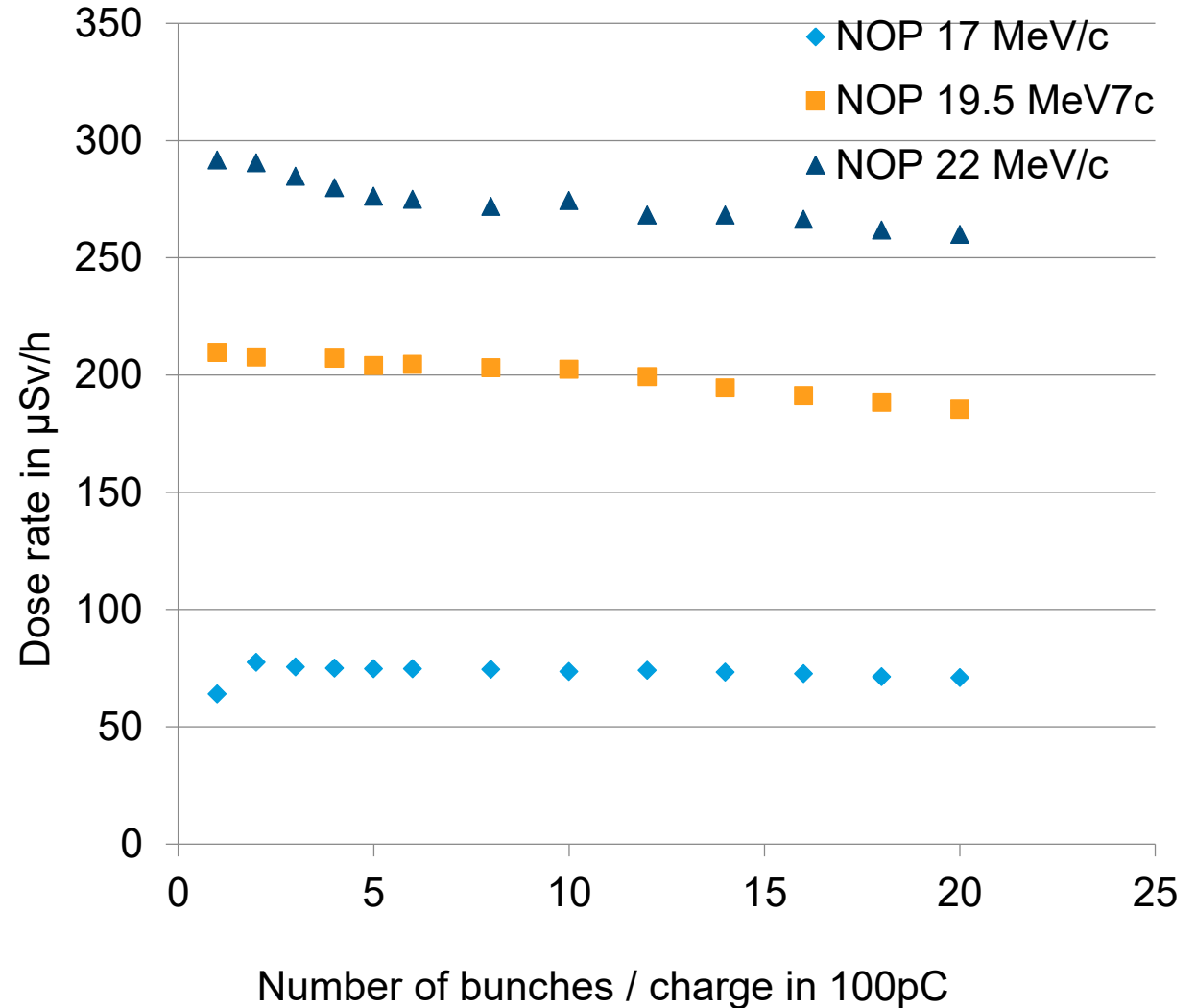
- Pandora measures gammas and neutrons combined
- Separate neutron and gamma rates only in history not in DAQ
- Cross section of neutron production should not depend on beam current, no change in signal
- No saturation in dose rate vs charge
- Saturation seen only for Z46_10s 19.5 MeV/c and 22 MeV/c
- For 17 MeV/c and 22 MeV/c measurement vs NOP have higher Signal than vs charge
- For 19 MeV/c it's the other way around



Measurement 22 MeV/c

DET06 is dose rate vs. NOP DET06_charge is dose rate vs. bunch charge

- Measures only gammas
 - No direct comparison with Pandora signal
- Signal increases with beam energy
- Signal of DET06 drops with increasing NOP
- Paralysement of detector?



Summary & Outlook

Summary

- DAQ server changes improved measurements a bit (low charge/NOP)
- Still quite big jumps during measurements
- Signal strength flip for 19 MeV/c measurements
- Decreasing signal in DET_NEW06

Outlook

- Check for neutron and gamma signals during next beam time
- Discussion with HH colleagues (D3)
- Include neutron and gamma rates in DAQ?

