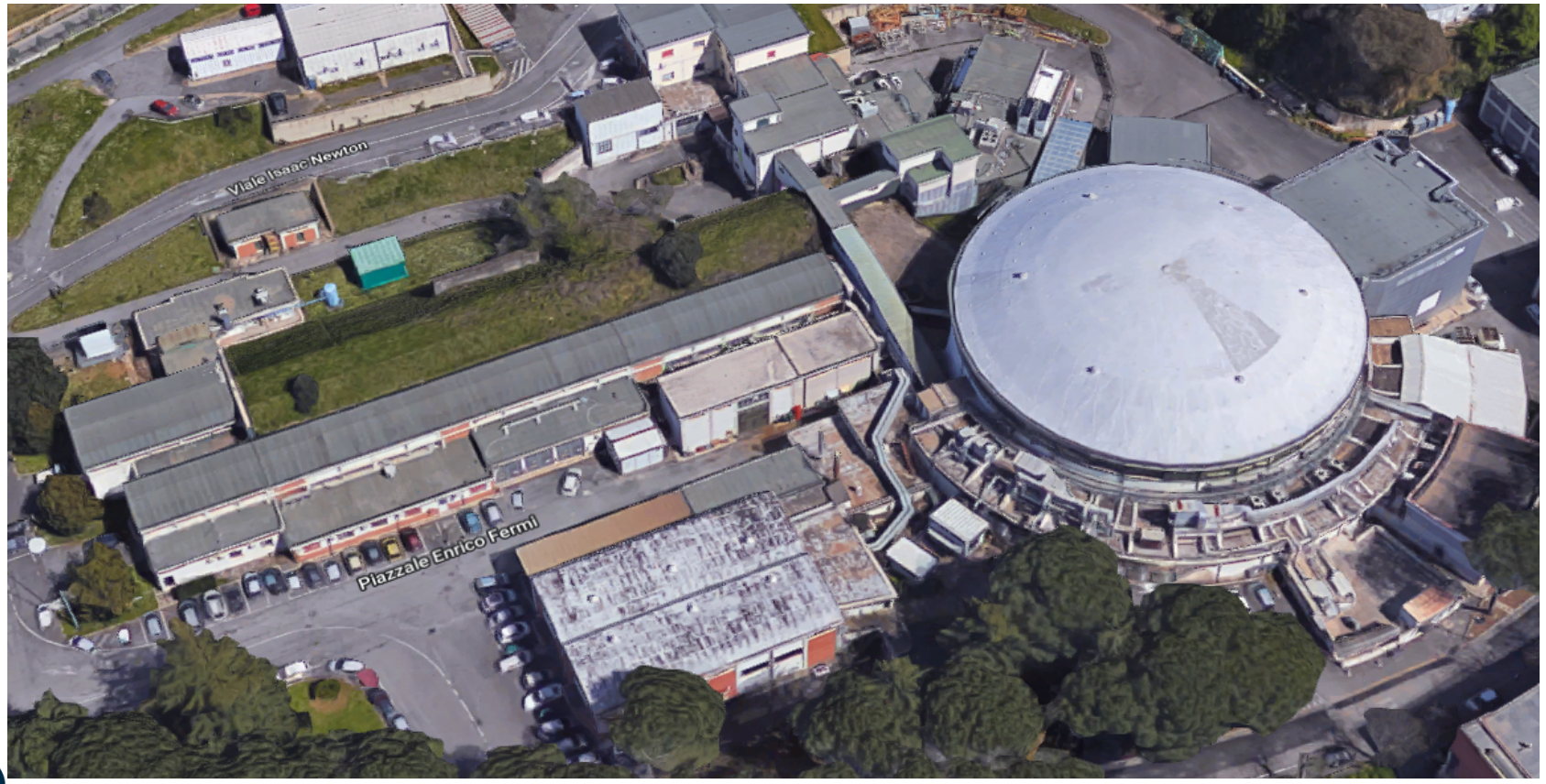
Accelerator Division

DAFNE Status



Antonio De Santis (LNF)

on behalf of DAFNE team

INFN
Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

DAFNE Team

C. Milardi, D. Alesini, S. Bini, M. Boscolo, B. Buonomo, M. Cianfrini, S. Cantarella, A. De Santis, C. Di Giulio, G. Di Pirro, A. Drago, A. D'Uffizzi, G. Franzini,L. Foggetta, A.Gallo, R. Gargana, S. Incremona, A. Liedl, A. Michelotti, L. Pellegrino, R. Ricci, U.Rotundo, L. Sabbatini, A. Stecchi, A. Stella, A. Vannozzi, M. Zobov.

On leave

DAFNE Operation overview

Since last SciCom (Nov 2021):

- **Winter 2021 operations**
  - Started November, 25th
  - Closed December, 21th
  - Major interventions for LINAC (Jan-Mar 2022) ***[see L. Foggetta: BTF Status]***

- **Spring 2022 operations**
  - LINAC conditioning in March
  - Started April, 4th
  - Collider mode planned until mid of July (with some flexibility)
  - Power saving operations considered to keep under control the cost of the DAFNE run

Ring optics

- Working point of the two rings are respectively:
  - **Q_x(e-) = 0.0970; Q_y(e-) = 0.1545**
  - **Q_x(e+) = 0.1028; Q_y(e+) = 0.1429**

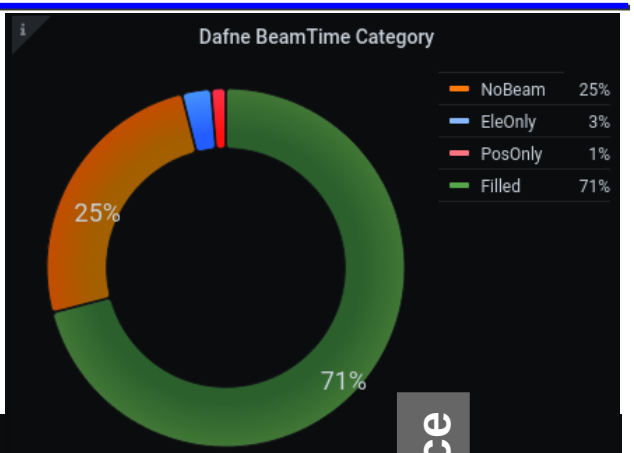
- Sextupoles for Crab-Waist collision scheme are powered at 110 A w.r.t. the 200 A nominal

- The residual coupling in the two rings is 0.3% and 0.6% for electron and positron, respectively. Corrected down to 0.3% for both beams.

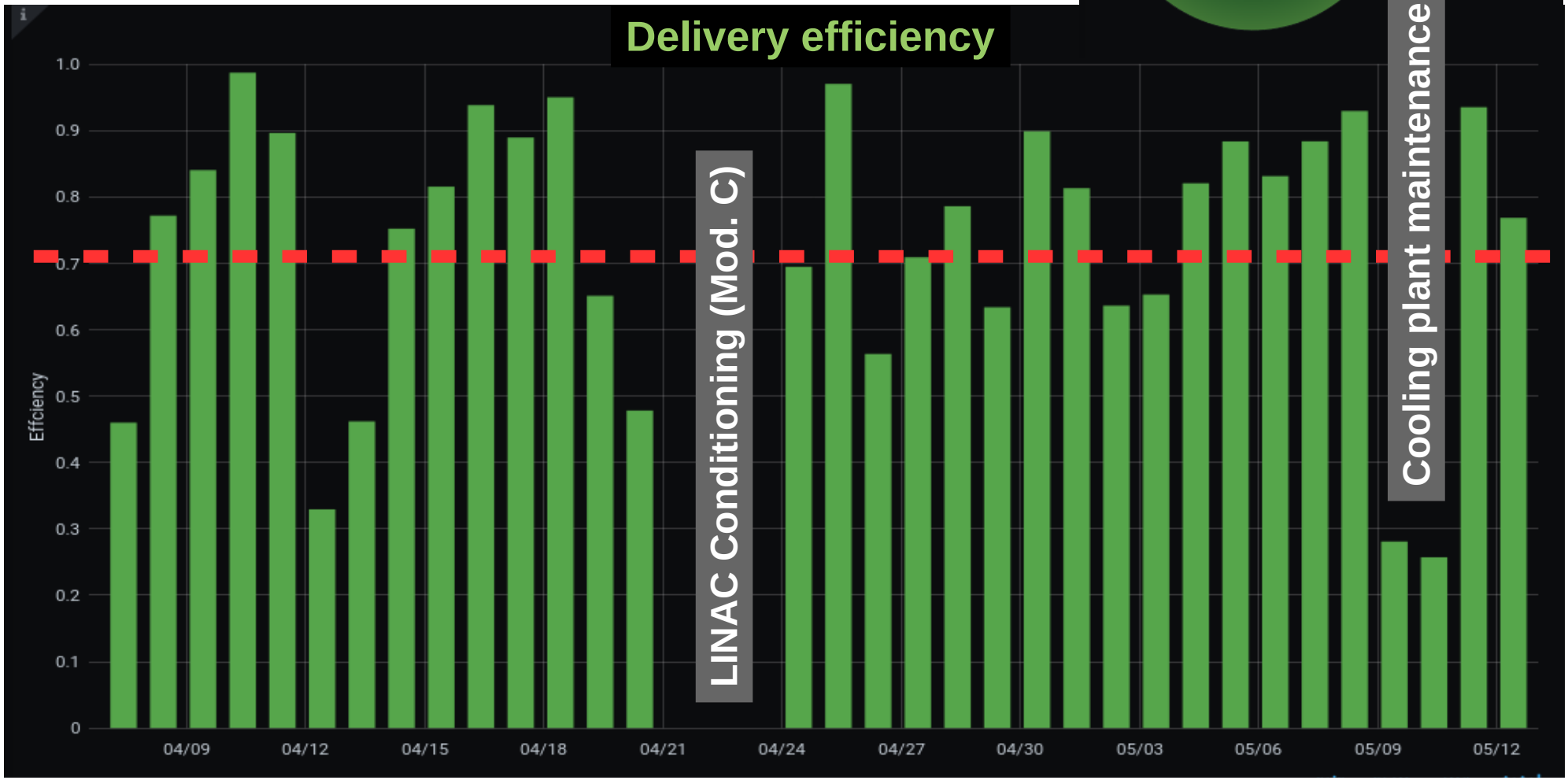
- A skew quadrupole in MRp has a very large set (15A) pointing to a possible localized source of coupling

DAFNE Collision uptime: Spring 2022

The DAFNE run was immediately devoted to collisions. Only few days have been used to transport the beam from LINAC to MR's and store them in order to start collisions.



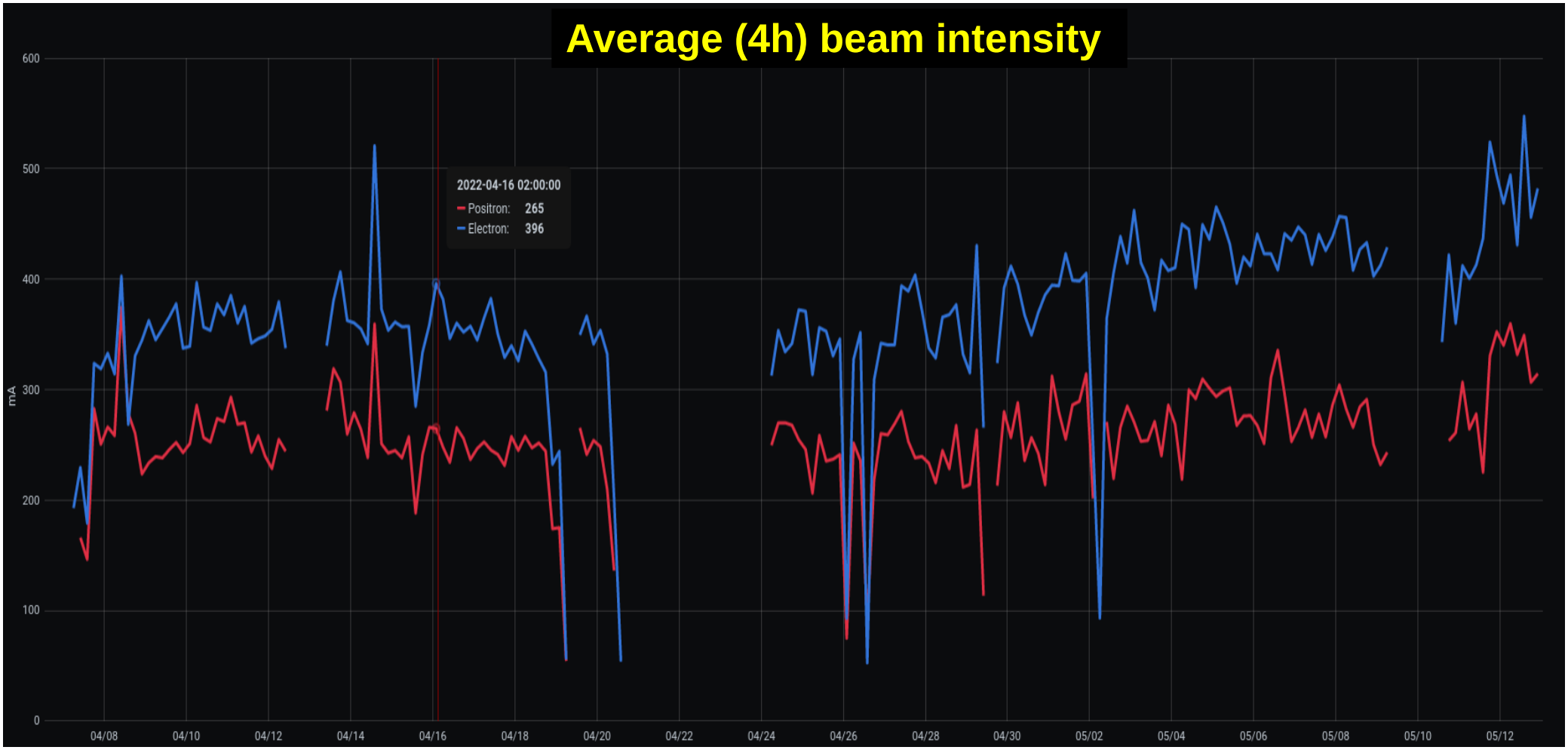
Average value: 71%



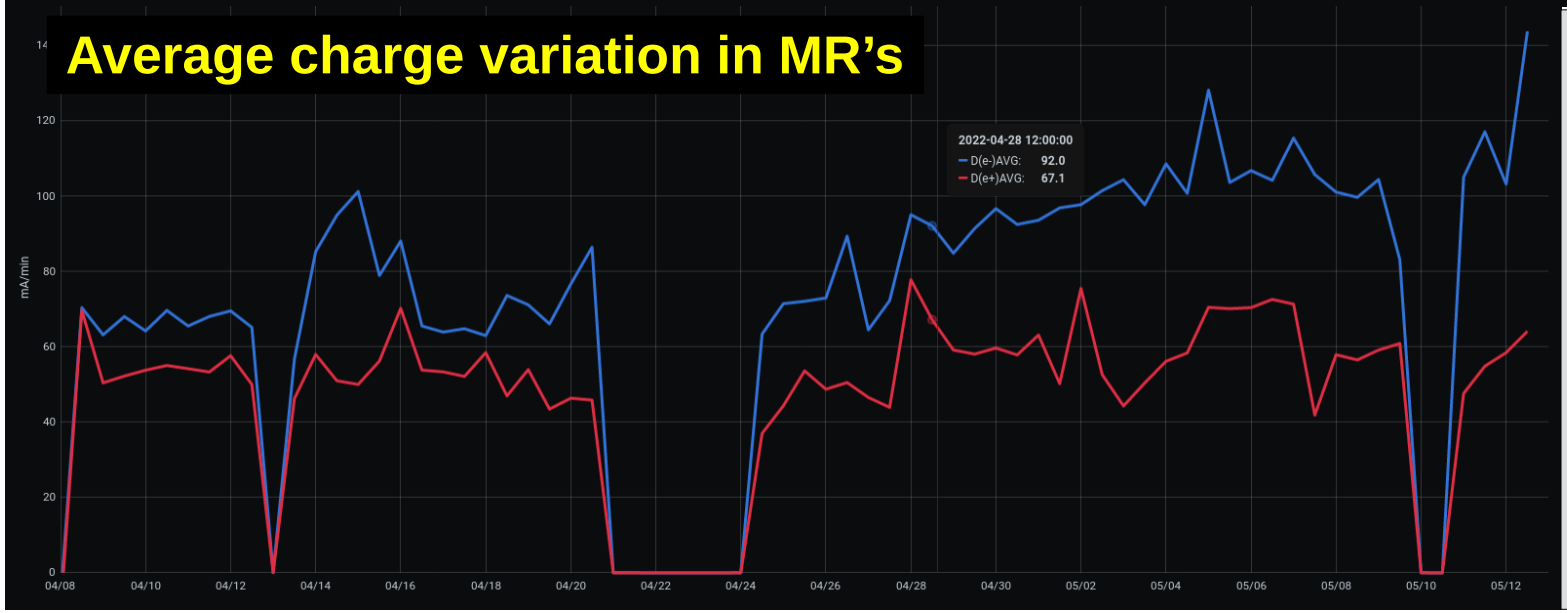
Stored beam intensities

Maximal stored beam intensity are (single beam mode):
Electron 940 mA
Positron 710 mA

In collisions maximal positron intensity lowers to 640 mA. Average currents stored in the rings are steadily increasing.



Injection improvements



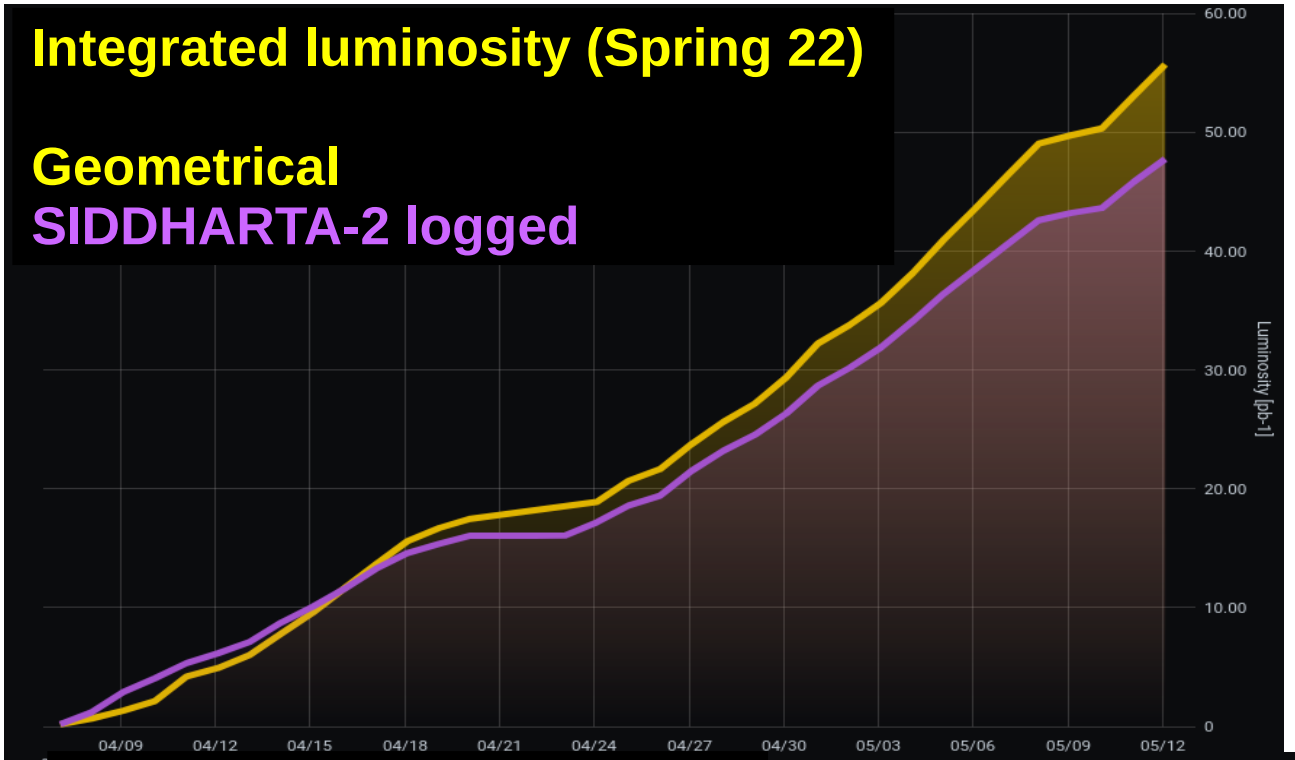
Injection rate has been improved increasing the charge per shot, using more shots (all the available for positrons) and improving the transport efficiency.

Instantaneous luminosity

Instantaneous luminosity
Geometrical
SIDDHARTA-2 logged

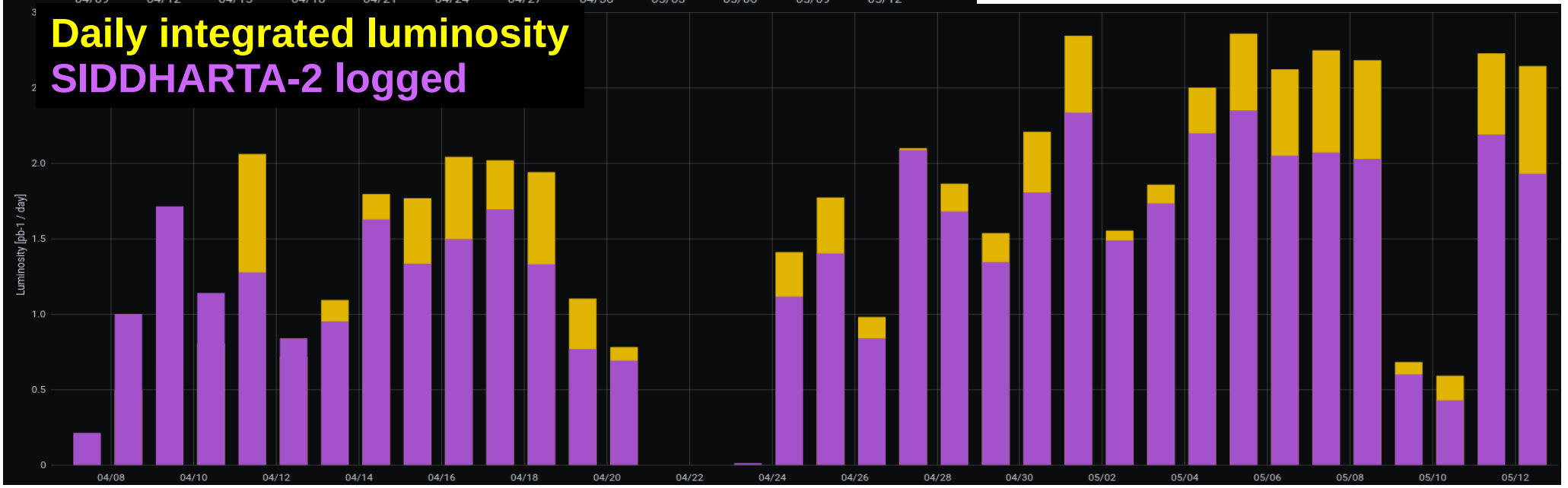
SIDDHARTA-2 experiment provides luminosity using normalized charged kaon pairs counting in the horizontal plane.
The Kaon monitor is vetoed during the injection (full veto)
Good agreement with respect to the estimated geometrical luminosity.
Some issue with background subtraction (offline only) is observed.

Data delivery

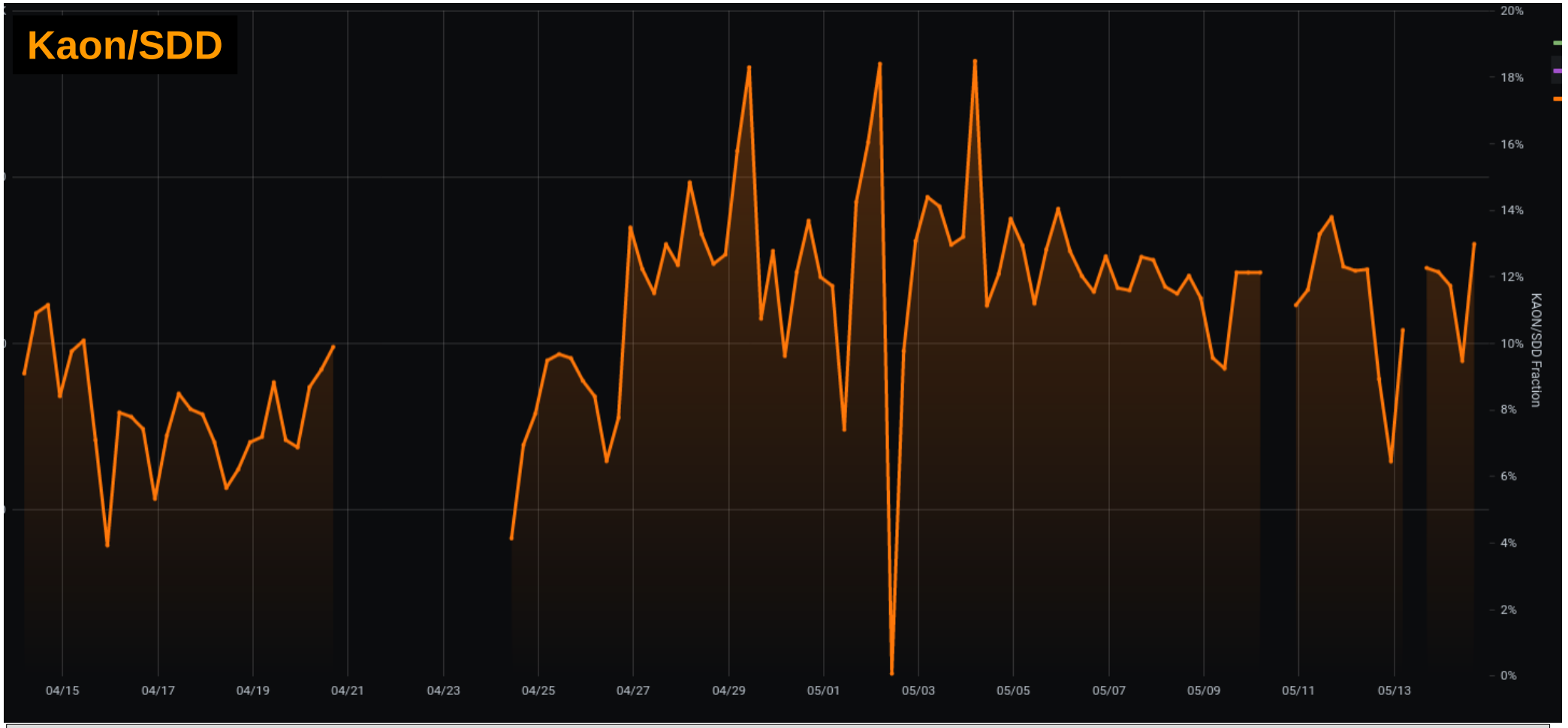


Data delivery is increasing Since the beginning DAFNE is providing luminosity in order to complete the commissioning of the new detector hardware (new SDD and Active VETO system).

The daily efficiency is increasing as for the average instantaneous luminosity.

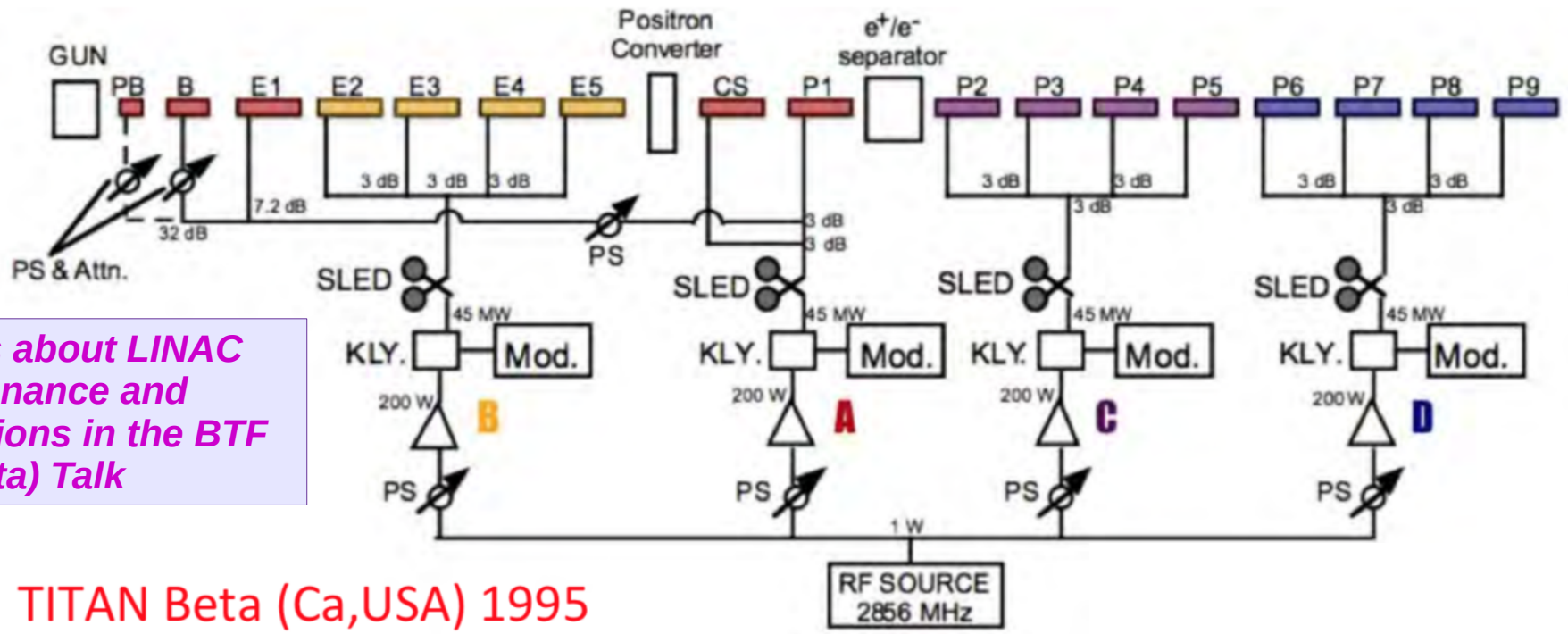


Background evolution



Average ratio between Kaon Trigger rate and SDD normalized rate. The situation is slightly improved along the run. As a reference the average value of K2SDD ratio at the end of SIDDHARTINO run was above 30%.
Dedicated shifts of signal/background minimization have to be performed in order to improve the machine performance on that respect.

Sub-system status: LINAC



Details about LINAC maintenance and operations in the BTF (Fogetta) Talk

TITAN Beta (Ca,USA) 1995

- LINAC repetition rate is currently 25Hz (50Hz max)
- MOD-B set point is kept constant for electrons and positron in order to have a safer operations. This allows to reduce related faults, but has the drawback of having lower positron current.
- MOD-C discharge was frequent. Special procedure have been set-up in order to minimize faults at the cost of small increase in the time for ramping-up the power in the klystron.

Sub-system status: Feedback

ELECTRONS:

The maximum achievable current is 950 mA. At this current level a sudden lost of the circulating beam occurs, without any clear sign of instabilities. This behaviour appeared for the first time in the middle of last year. It is not clear what is the reason behind and if feedbacks are involved in this.

Optimization of the digital filter and temporization of the feedback signals were performed to overcome this current limit, with small improvements so far.

POSITRONS:

The maximum achievable current is roughly 650 mA in collision. At this current level a sudden lost of 100-200 mA of the circulating beam occurs, without any clear sign of instabilities. This limit started to appear after the stop of operations (it was in the range of 800-900 mA). It is not clear what is the reason behind it and if feedbacks are involved in this.

Optimization of the digital filter and temporization of the feedback signals were performed to overcome this current limit. After these adjustments, we were capable to obtain the same level of circulating currents with lower amplitudes of correction signals of the feedback (i.e. feedback efficiency was increased).

HARDWARE:

Two new PC's were bought, configured and fully tested to act as spares for the Main Feedback Client and Tune/Spectrum Measurements client.

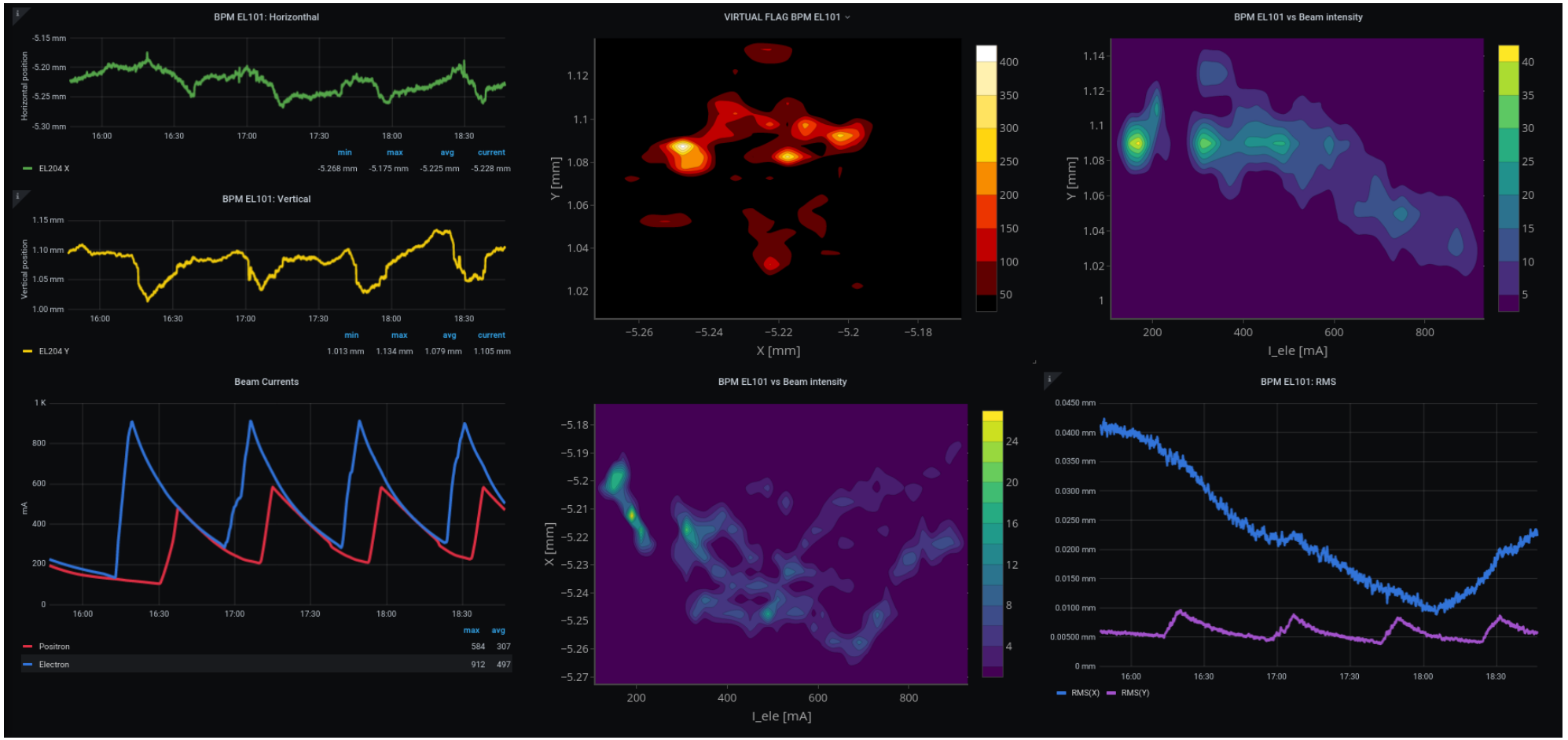
An analysis of the signals (e.g. amplitude, delay) involved in the back-end longitudinal feedback systems was done, in order to detect any possible malfunction. No problems were detected.

Minor adjustments of trigger thresholds within the system were performed in order to avoid system faults which occurred from time to time.

Sub-system status: Control System

The transition toward new orbit acquisition system has been almost completed. This allows to connect the BPM acquisition with !CHAOS infrastructure (data exchange only) having the full access to the entire services ecosystem (data-logging/on-line processing/data display)

Single BPM dashboard



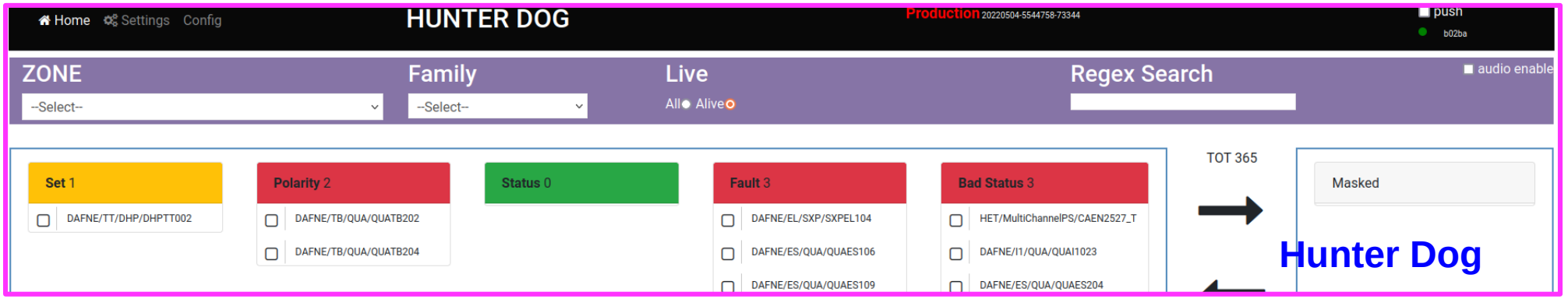
Sub-system status: Control System II

Several sub-systems are interfaced with !CHAOS services:

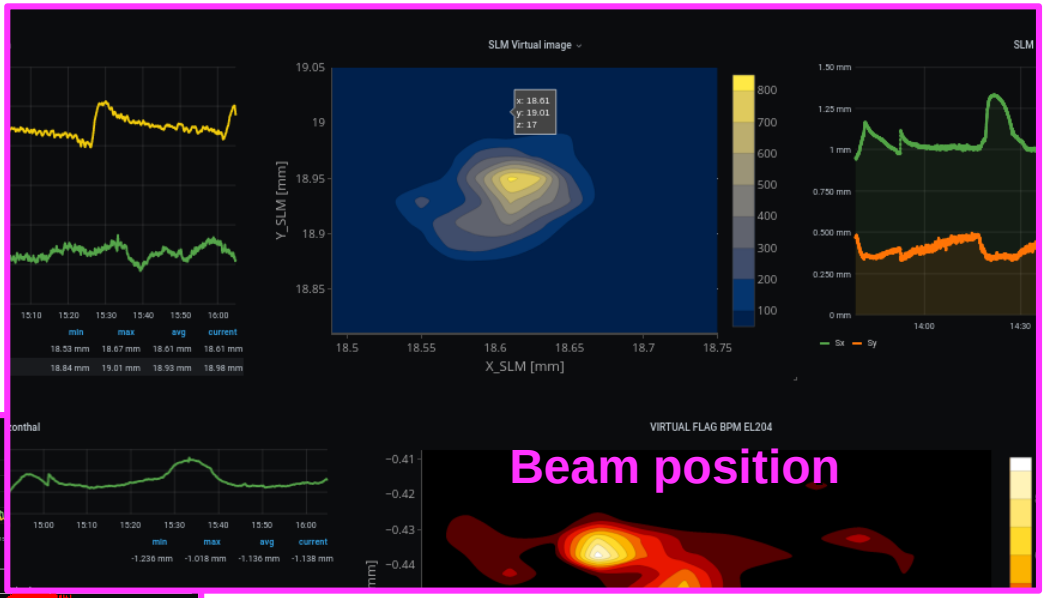
- Magnets (whole complex)
- Vacuometer (MR only)
- SLM cameras (MR only)
- BPM (MR/Accumulator only)
- Luminometer DAQ
- SIDDHARTA-2 monitors
- Beam Intensity measurement
- Kickers (power and delay settings)

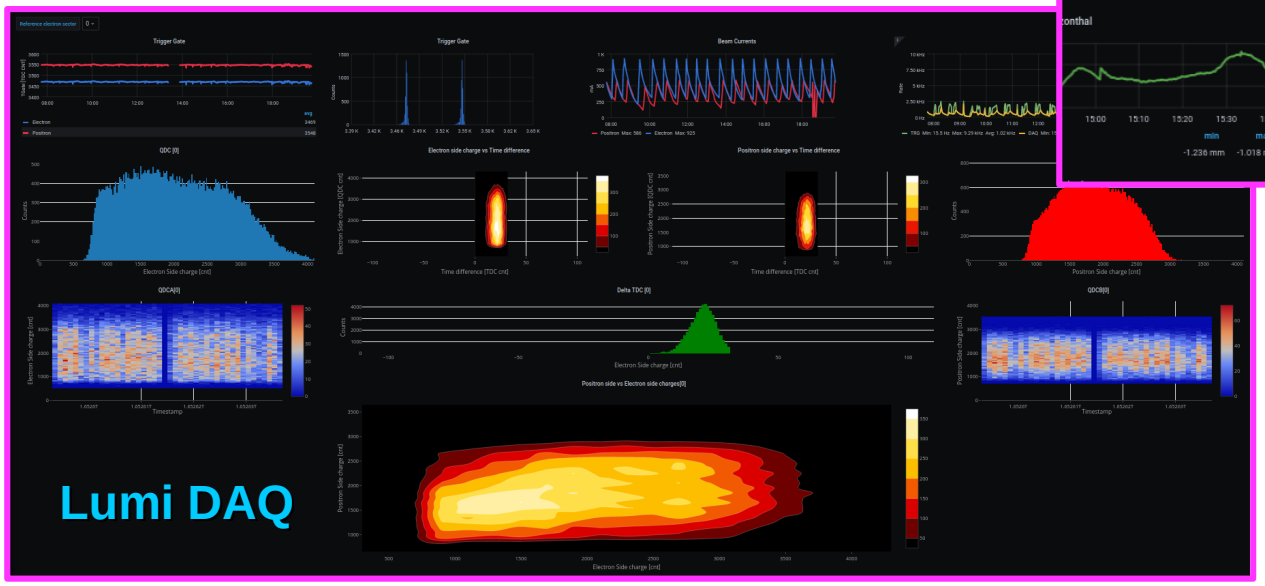
The possibility of data-logging and display allows continuous online monitoring and offline study of machine configuration to speed-up DAFNE tuning.

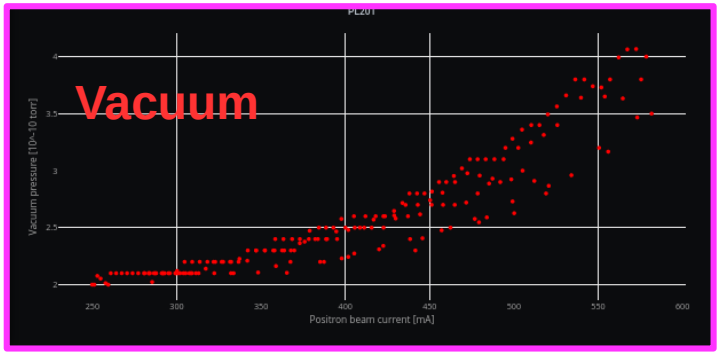
CHAOS/GRAFANA evolutions



Using the CHAOS services has been possible to set-up several dashboard to check automatically element status and issue alerts (**Hunter Dog**), monitor DAFNE status parameters (**Vacuum**, **Beam position**) and on-line analysis (**Lumi DAQ**)





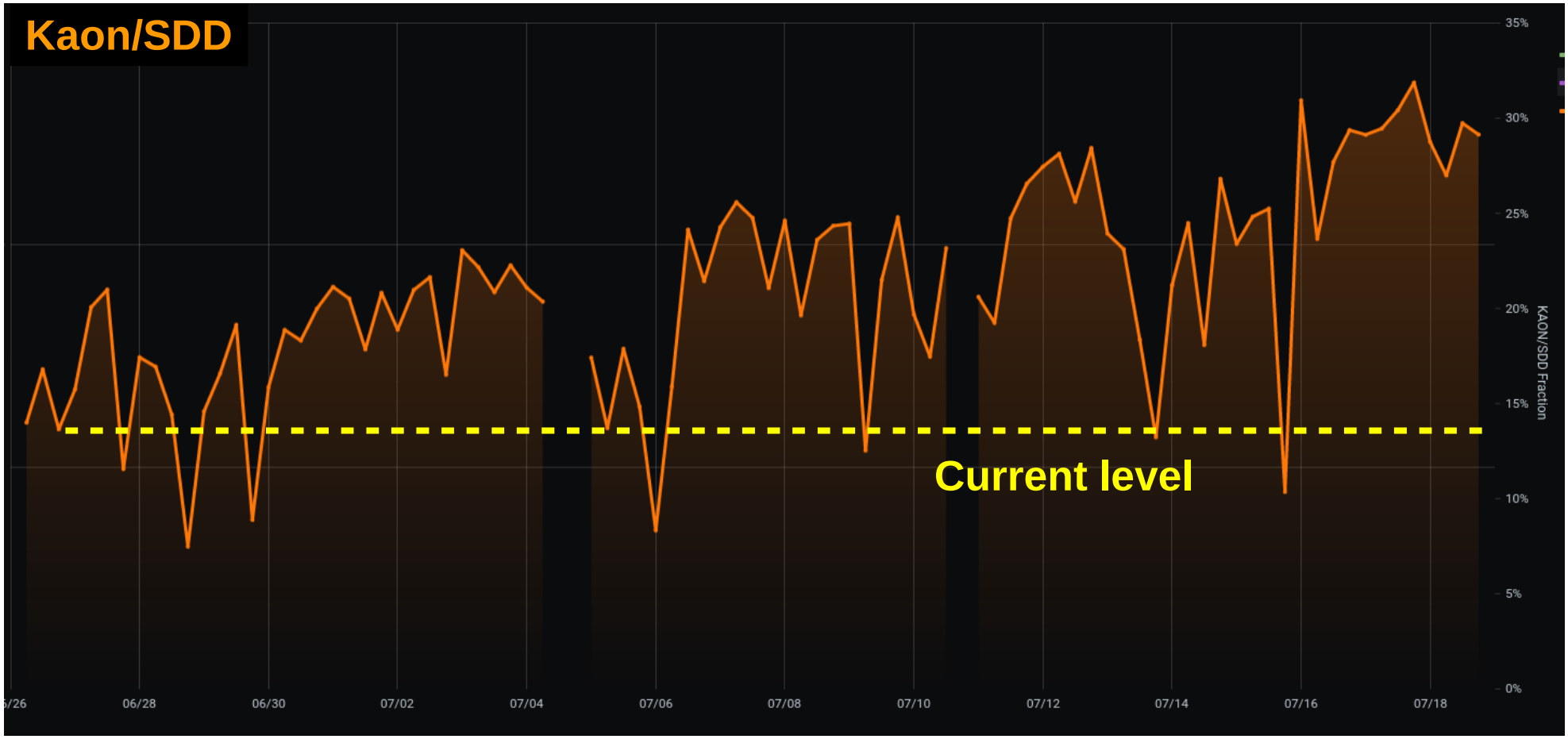


Conclusions and outlook

- DAFNE is currently delivering an integrated luminosity of ~3 pb-1/day to allow the experiment to finalize the commissioning of new hardware;
- Beam intensity are still moderate and **signal to background ratio is lower than the best achieved** during SIDDHARTINO phase;
- Several **limiting factors have been identified** and the corresponding action will be taken in the next month of operation:
  - Fine tuning of the natural MRp coupling;
  - Tuning of scrapers to reduce machine background hitting the detector;
  - Improve the injection (efficiency and charge per shot) to reduce as much as possible the detector dead-time.
- **DAFNE operation master plan has been defined** in order to complete the detector commissioning and start the active data-taking with deuterium target.

SPARES

Background evolution during SIDDHARTINO Run



Beam size vs currents