

NP02 operations: short status report (DAQ+back end)

Denis Pugnère, Elisabetta Pennacchio (IPNL)

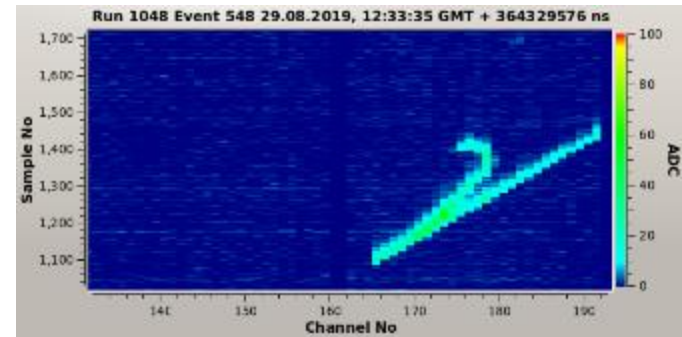
IT-protoDUNE coordination meeting

03/10/2019

A short timeline and milestones

- ✓ Cryostat filling completed on August 9th
- ✓ Bubbles from field cage clips seen since the beginning → operation of the cryostat with **high pressure cycles**, initial issue with HV feedthrough extender
- ✓ CRPs level meters calibration and alignment activities and HV tests performed until August 28th → **grids of all 4 CRPs exceeding 7kV**
- ✓ **Observation of first short tracks on 29/8** with CRP1 LEMs brought to 2.9 kV DV, grid voltage 6kV, electrons lifetime 200 us

One of the very first tracks →



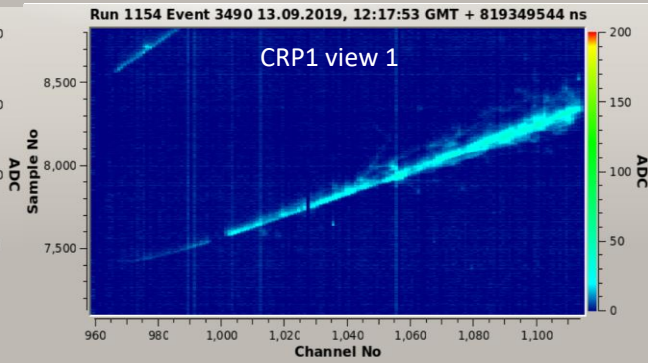
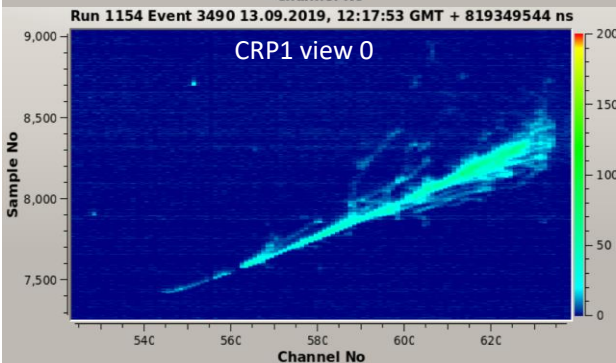
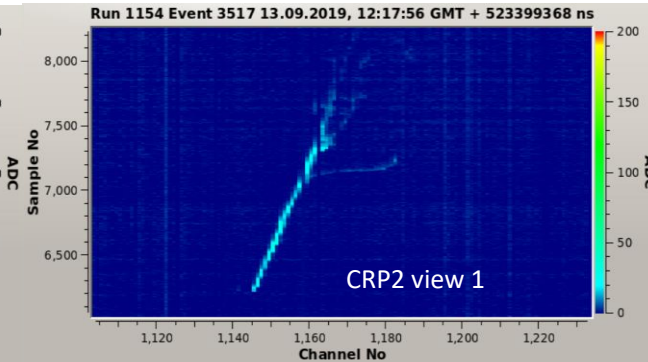
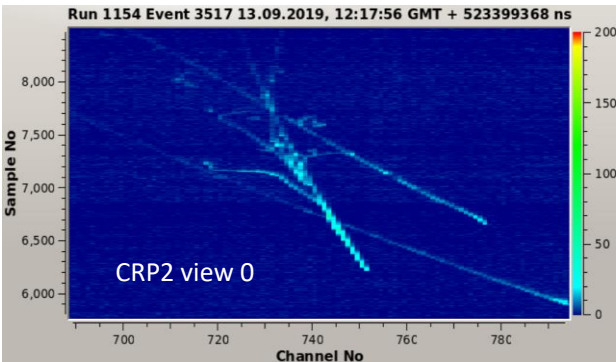
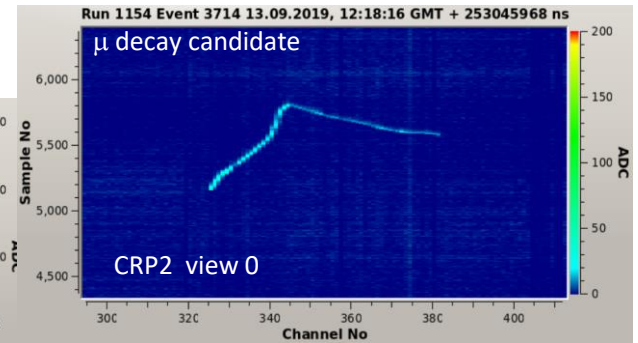
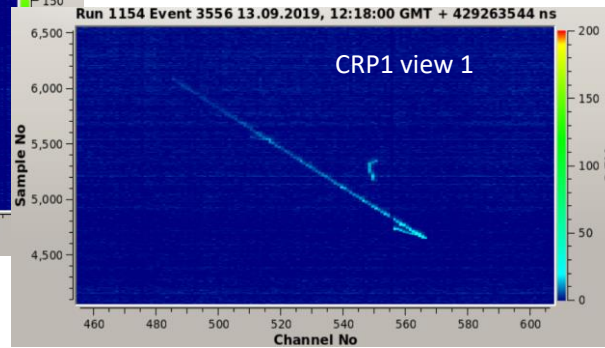
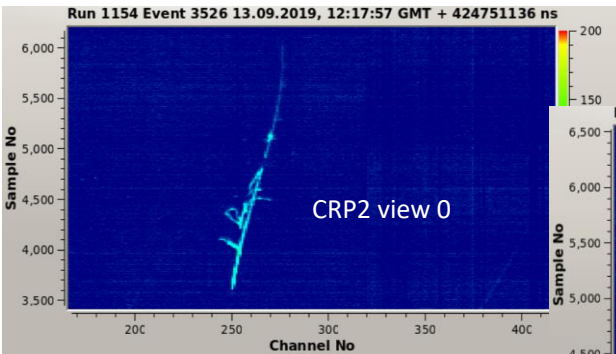
- ✓ At the same time regular operation of **photon detection system** during commissioning and for data taking
- ✓ Since first operation on 29/8 **LEM**s of both CRPs operated in stable way at 2.9 kV DV, with **negligible LEMs sparking rate**
- ✓ **Simultaneous operation with two CRPs with LEMs (CRP1 and CRP2) systematically ongoing since September 6th.**

A short timeline and milestones (II)

- ✓ **Automatic CRP tracking** of liquid level implemented in order to follow liquid expansion during high pressure cryostat cycles
- ✓ **LEM DV being gradually increased** after first operation phase at 2.9 kV. 3.0 kV tested since 16/9. **3.0 kV and 3.1 kV already** operated during extended high pressure cycle of 18/9
- ✓ **Electronics noise at a good level: ~1.5 ADC counts, still dominated by coherent noise due to external grounding of slow control cabling** which is being improved → goal: bring to intrinsic electronics noise $\sim < 1$ ADC count
- ✓ Smooth operation of DAQ with random triggers (cosmic trigger counters being set up) **990k events** (4 ms drift) **~105 TB** acquired since 29/8, data transferred to CERN and FNAL
- ✓ **Operation time limited by the need of high pressure cycles (related to the LAr surface issue and bubbling)**. The high pressure cycles have to be repeated every day restarting the detector operation from scratch (imply waiting a few hours to calm the surface, immerse and realign the CRPs, ramp up grids and LEMs HV and then cathode)

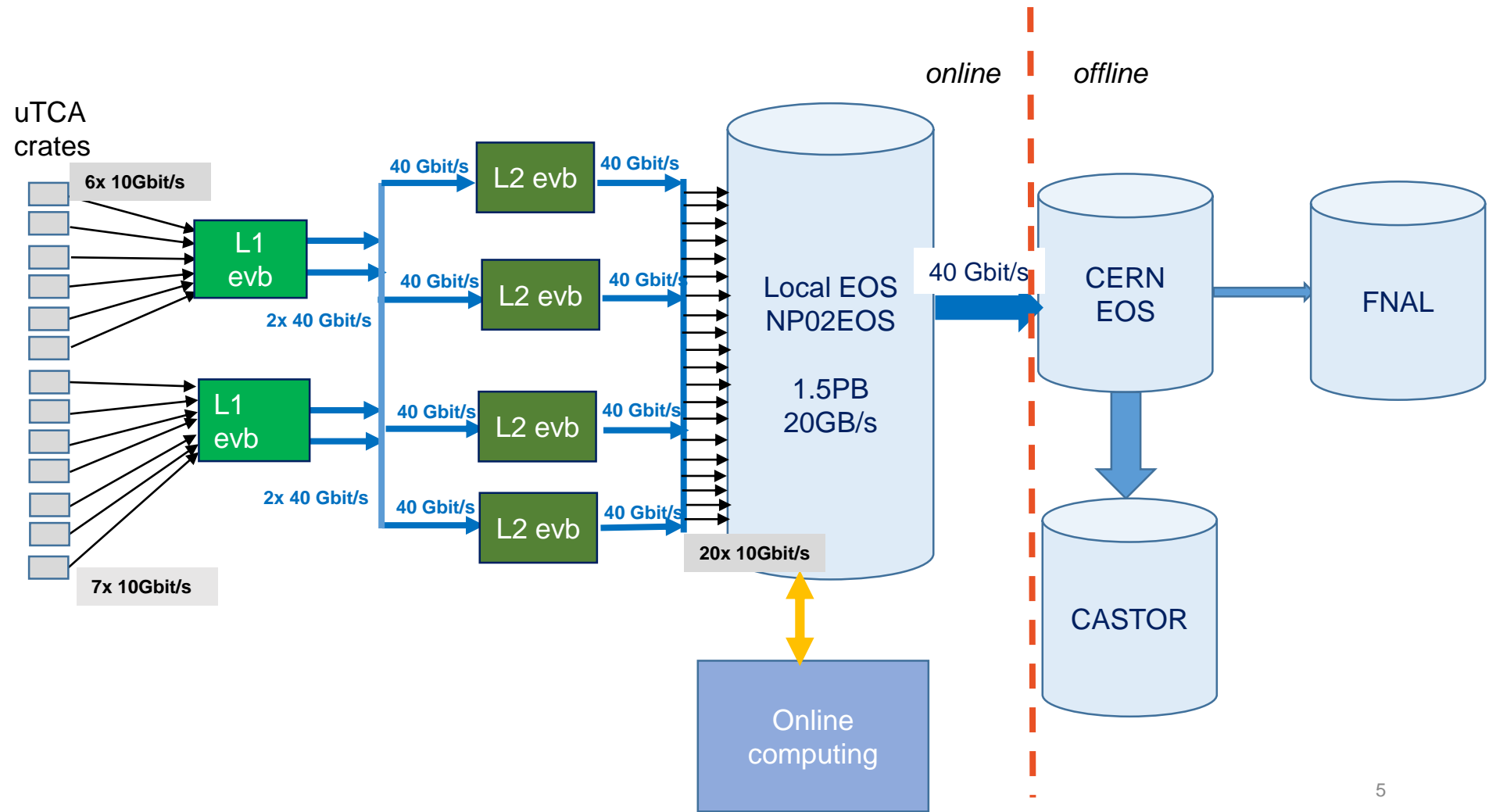
→ Different operation conditions now reproduced several times during high pressure cycles. Looking now for cryogenic/liquid level conditions to suppress the bubbles and directly operate at normal pressure for longer periods

Gallery of tracks (13/9) (LEMs at 2.9 kV, grids at 6 kV, cathode at 50 kV, random trigger, 400 us lifetime, raw data display, no noise filtering)



Zoom on same track details observed from the two perpendicular views

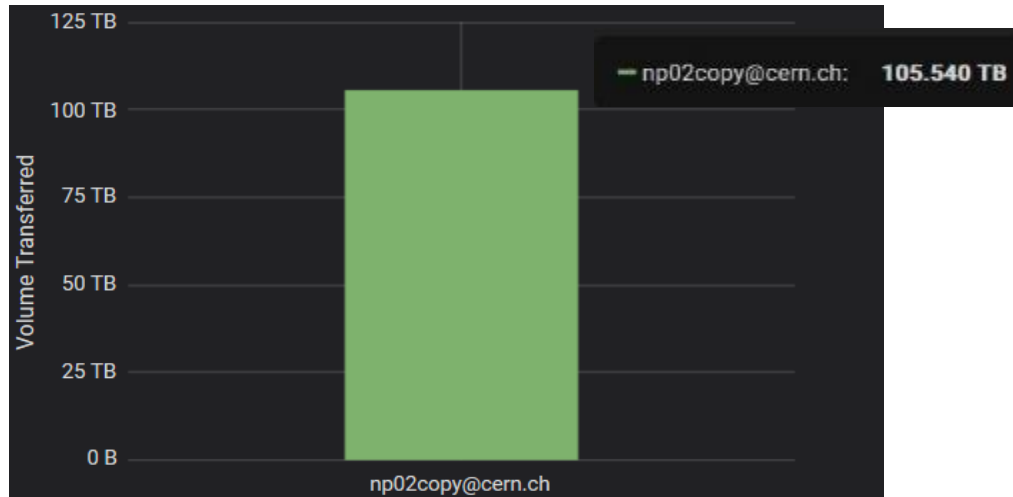
NP02 DAQ/network infrastructure



DAQ and Back-end

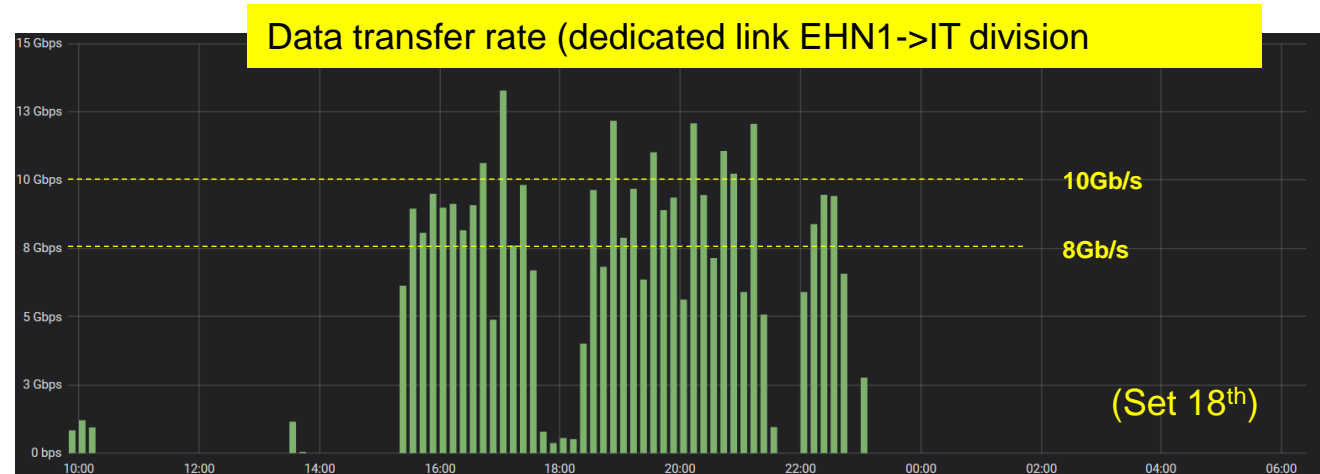
- The DAQ and the back-end system (2 levels of event builders, the network infrastructure, and the online storage facility) are working smoothly with no particular issues. Random triggers, mostly used, cosmic trigger counters being set up. DAQ typically running at 10-30 Hz with no compression. Typical file size of a run sequence ~3GB containing 30 events
 - From **August 28th until September 20th ~990 K events have been taken, corresponding to ~33k data files, for a data volume of ~ 105TB**
 - All these files have been moved from the /ramdisk of the four L2 event builders first to the online storage facility *np02eos* and then to **EOSPUBLIC**
(*/eos/experiment/neutplatform/protodune/rawdata/np02/rawdata*)
- (*np02eos*: High bandwidth (20GBytes/s) distributed EOS file system 20 machines, up to 1.44 PB total disk space, 10Gb connectivity for each storage server)
- To allow their transfer to **CASTOR** and **Fermilab** JSON files have been generated and copied on **EOSPUBLIC**
 - All steps of raw data online treatment are stored in a dedicated **online database**.
 - Experience with tracks collected up to now to optimize reconstruction parameters for the online processing. *SLURM* has been installed, tested and commissioned. **The online facility is running without problems**, The online processing is used for DQM

Raw data flow monitoring



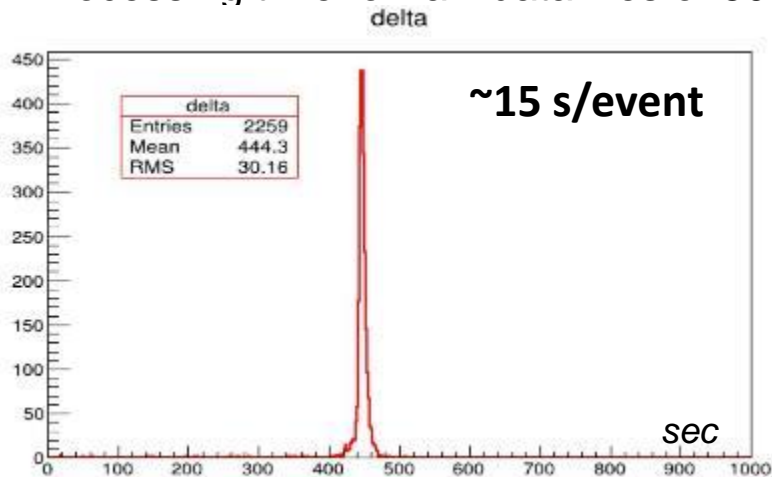
Raw data volume August 29th →
September 20th :

~105TB
corresponding to ~990 k events



Online computing

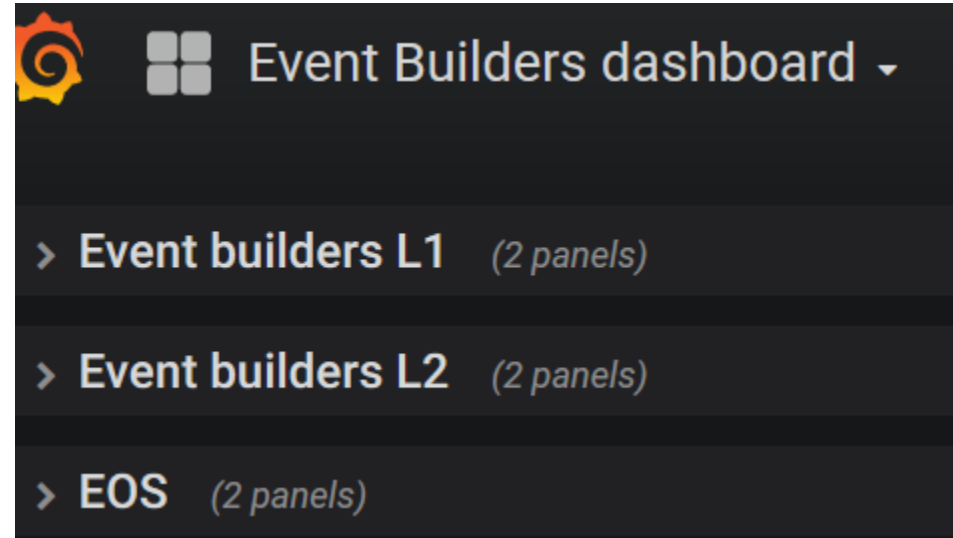
- As soon as a raw data file is transferred to np02eos, it is scheduled for fast online reconstruction on the online processing facilities:
 - 30 servers Poweredge C6620 II → **450 cores, 9270 HES06 computing units**;
workload manager: SLURM
- The tracks segments collected in the data up to now have been used in order to optimize the reconstruction parameters for the online processing. Tests to optimize the submission scripts have already been performed. **Now in final shape for systematic production.**
- The results from this fast online reconstruction are foreseen to be used for basic data quality monitoring. They will also be copied to **EOSPUBLIC**
- Processing time for raw data files of 30 events:



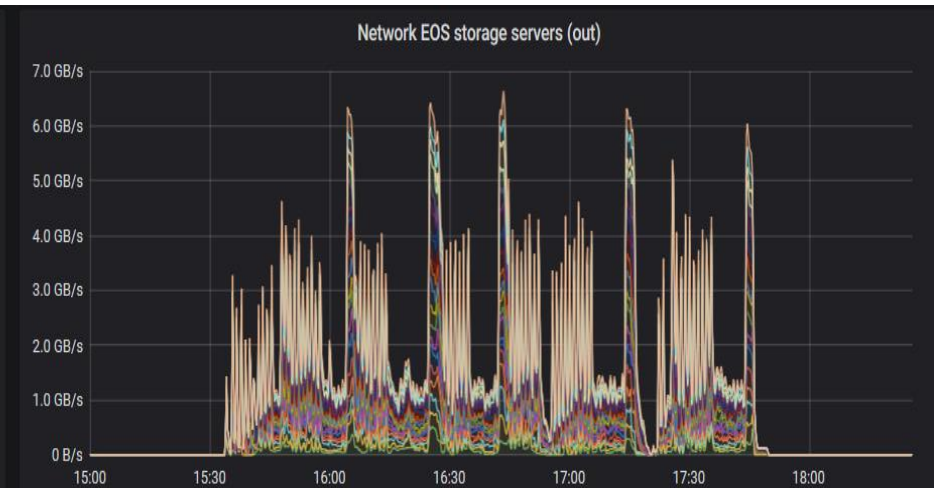
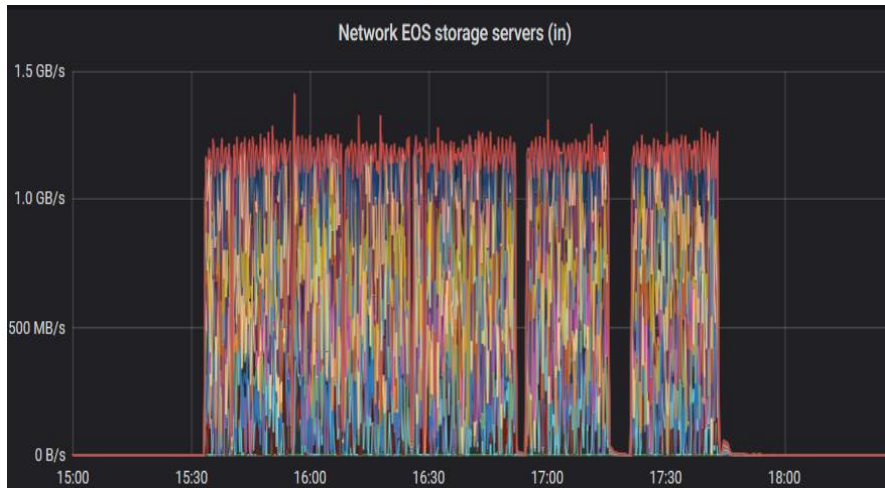
Monitoring

2 main Grafana dashboards

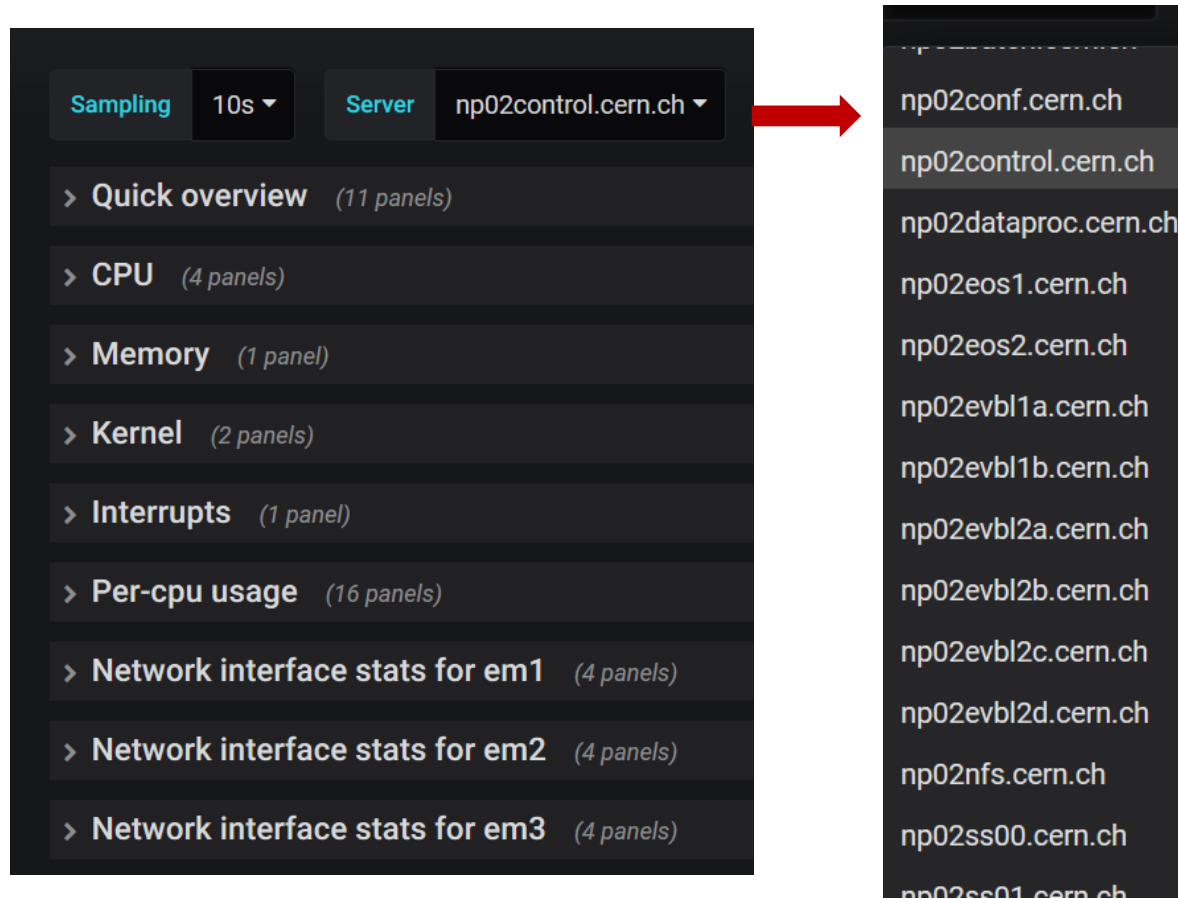
1) **Event Builders dashboard** →
monitoring of network bandwidth of
EVBL1, EVBL2, Storage servers



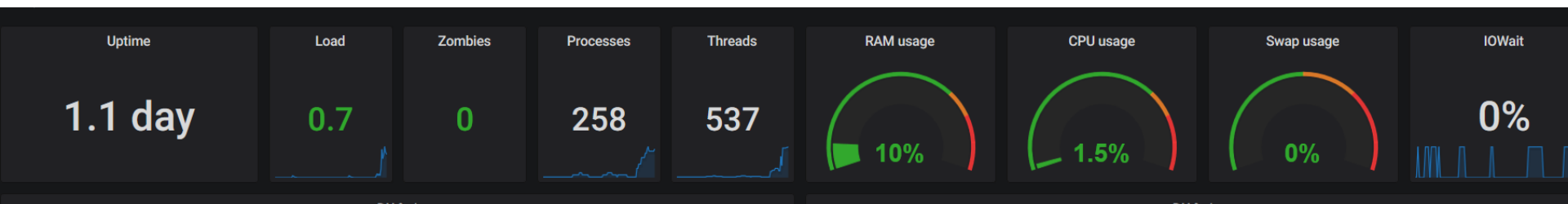
Storage servers



2) **NP02 online cluster dashboard** → detailed system view of each server in the cluster.

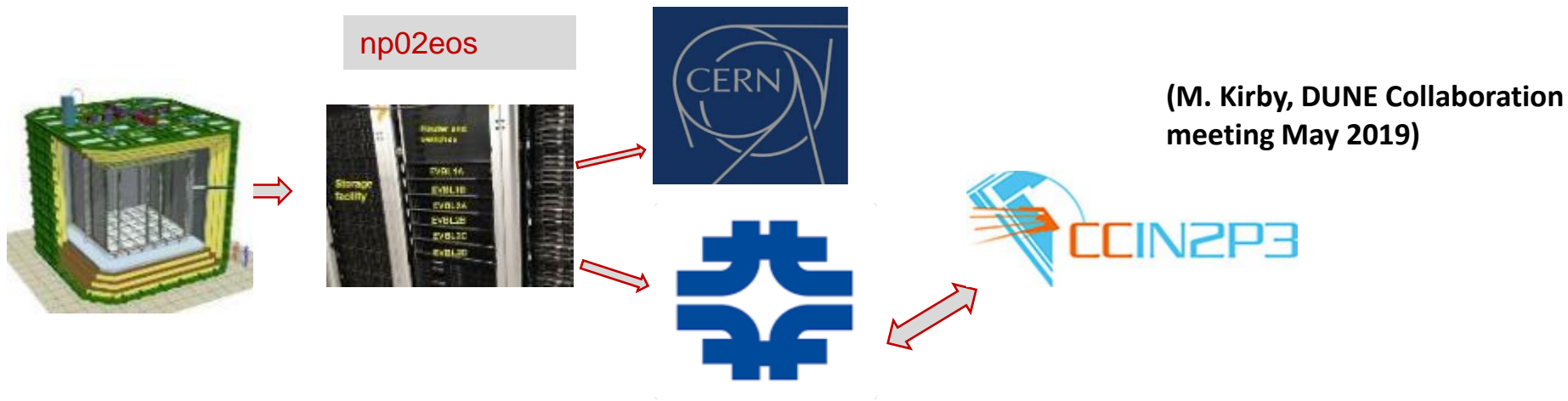


The screenshot shows the NP02 online cluster dashboard. At the top, there are controls for 'Sampling' (set to 10s) and 'Server' (set to np02control.cern.ch). Below these are several expandable sections: 'Quick overview (11 panels)', 'CPU (4 panels)', 'Memory (1 panel)', 'Kernel (2 panels)', 'Interrupts (1 panel)', 'Per-cpu usage (16 panels)', 'Network interface stats for em1 (4 panels)', 'Network interface stats for em2 (4 panels)', and 'Network interface stats for em3 (4 panels)'. A red arrow points from the 'Server' dropdown to a list of server names in a separate panel on the right. The server names in the list are: np02conf.cern.ch, np02control.cern.ch, np02dataproc.cern.ch, np02eos1.cern.ch, np02eos2.cern.ch, np02evbl1a.cern.ch, np02evbl1b.cern.ch, np02evbl2a.cern.ch, np02evbl2b.cern.ch, np02evbl2c.cern.ch, np02evbl2d.cern.ch, np02nfs.cern.ch, np02ss00.cern.ch, and np02ss01.cern.ch.



Offline processing

- The raw data files are treated online with the fast online reconstruction code, used so far also for first analysis of tracks and gain measurements, and are foreseen to be processed with LarSoft. (see software and data access howto: https://twiki.cern.ch/twiki/pub/CENF/DUNEProtDPOps/software_howto_v1.1.pdf)
- The interface from raw data to Larsoft was finalized and tested in July (see ProtoDUNE simu/reco [meeting](#))
- We are now in the process of completing the validation of the basic functionality of all the Larsoft reconstruction steps on the ProtoDUNE-DP data (thanks to D. Adams for helping with the data preparation stage).
- As soon as the software is validated and it is stable together with the data sets the systematic reconstruction of the data sets is going to be launched
- The whole chain was defined with Fermilab people (data management and processing group) and tested during a dedicated data challenge (DC3) run in July 2019.



DC3 data processing occurred at both IN2P3 and on WLCG (official prod) . The reconstruction output was stored at CCIN2P3

Conclusions

- NP02 operations started on August 27th : the DAQ and back-end system are working smoothly, in automatic way with no need of manual intervention
- The fast online reconstruction is in shape for systematic productions
- The offline processing scheme is well defined

02/10/2019-→ Yesterday all machines went off very roughly due to a power outage: it took several hours to go back to a normal situation. (no power backup)