High rate capabilities of tracking arrays

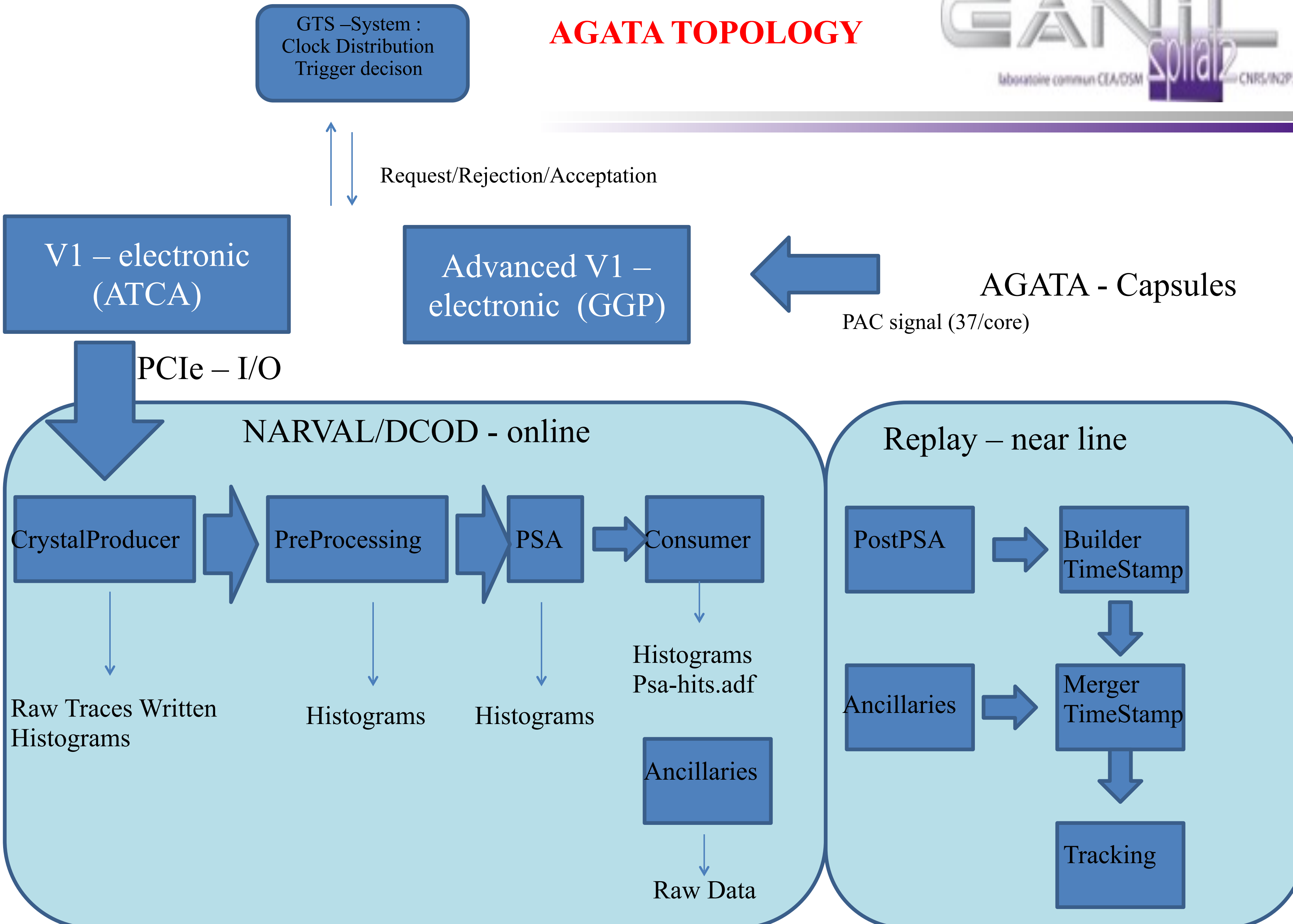
Performances of the AGATA system (tentatively)

Amel Korichi for Emmanuel Clément (GANIL) who prepared these slides

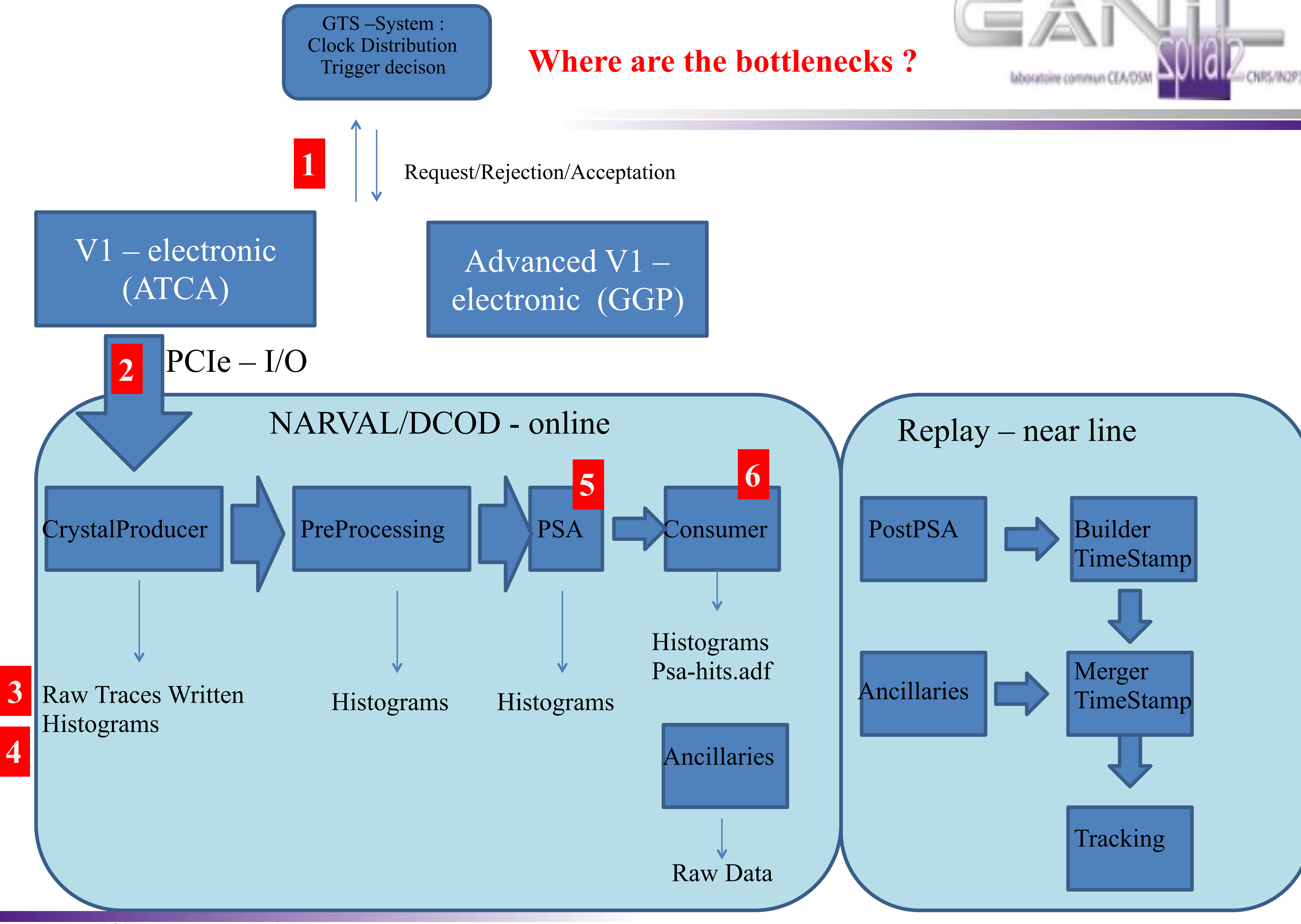
Second AGATA-GRETINA tracking arrays collaboration meeting

4-6 April 2018
CSNSM-CNRS, Orsay

AGATA TOPOLOGY

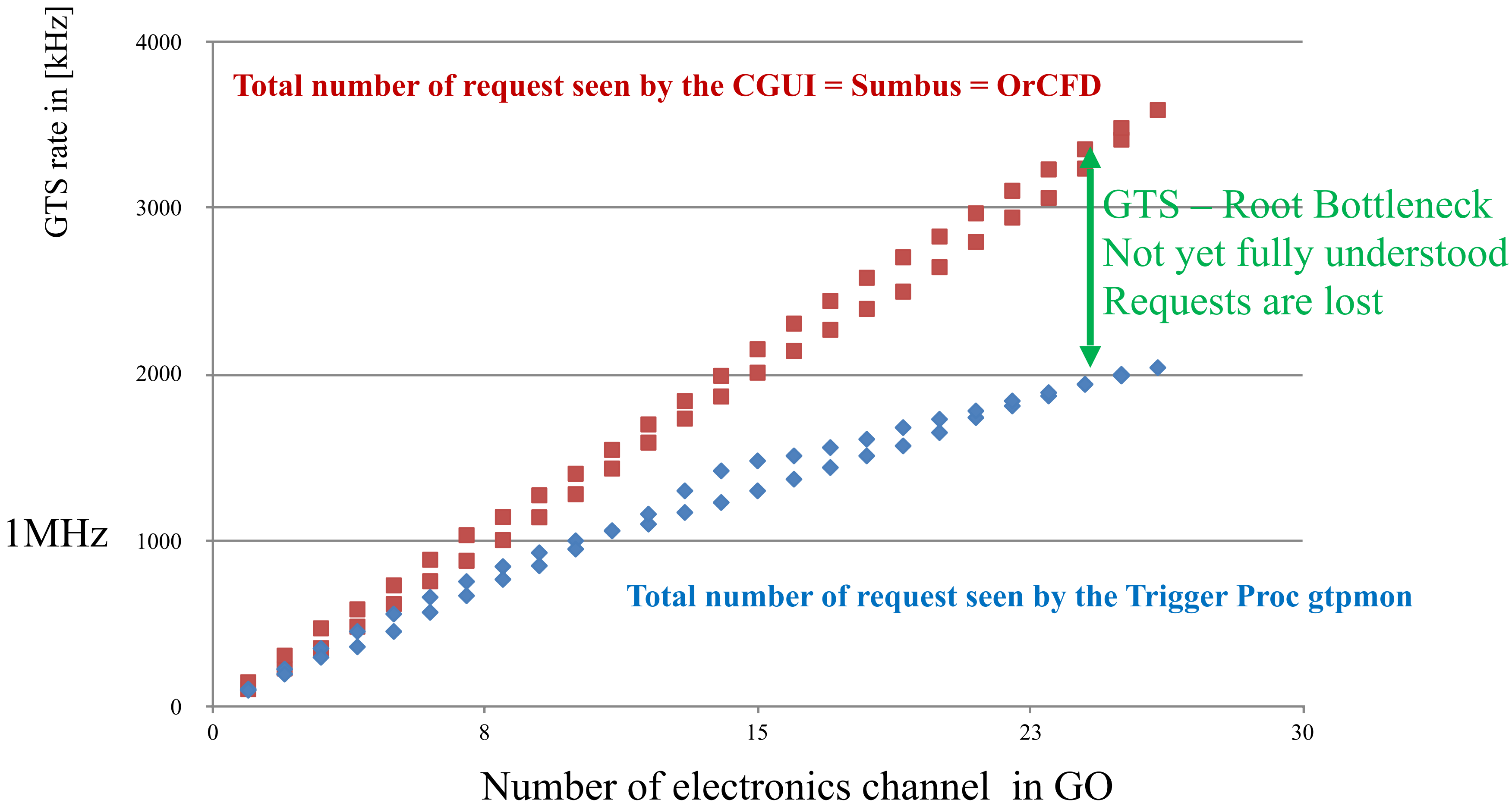


Where are the bottlenecks ?



1 Before the readout : how much rate the trigger system can manage ?

No Readout ! Just request to the trigger system
Electronics on Drain (no data pre-processing/DAQ)

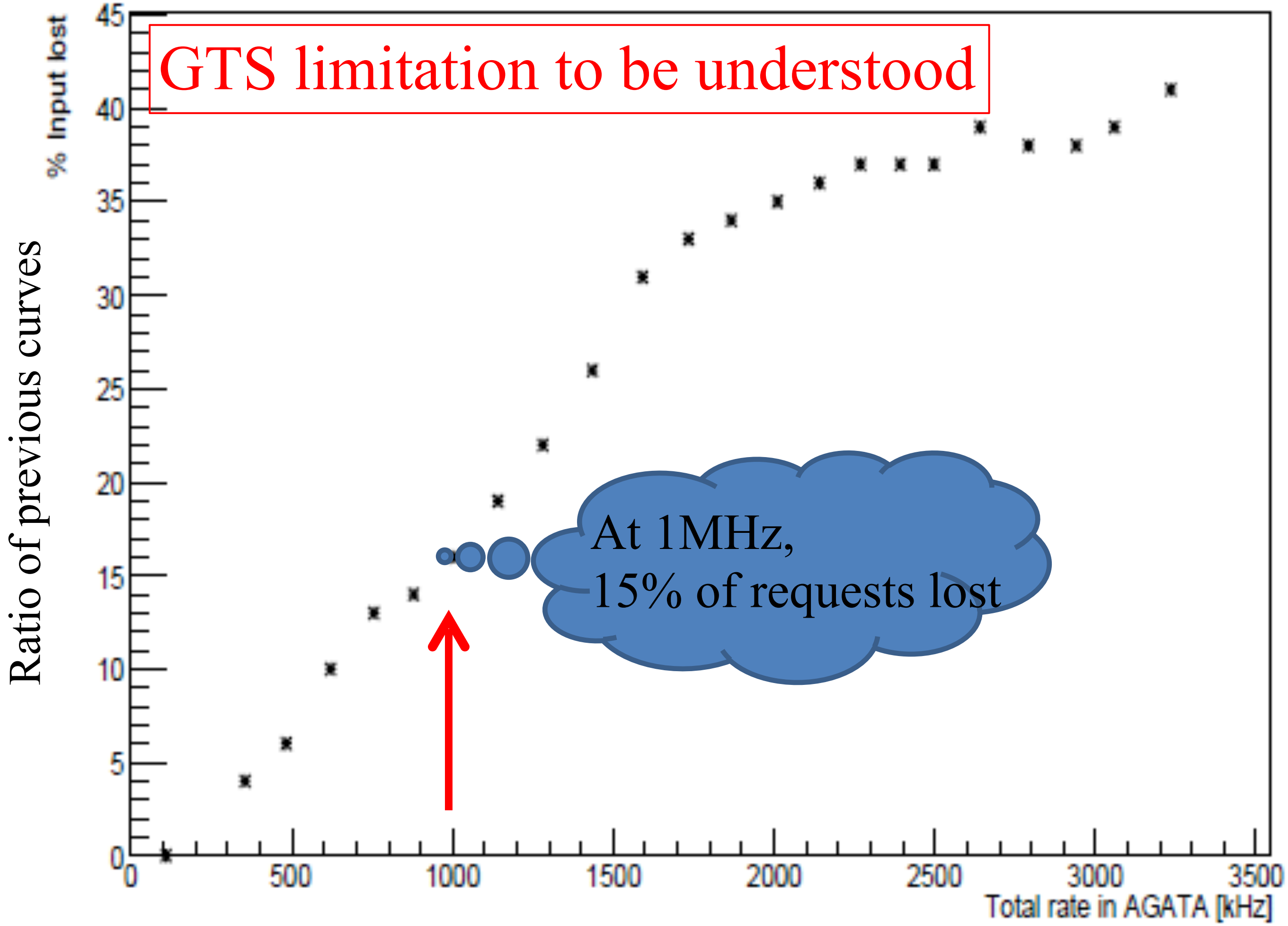


1 Before the readout : how much the trigger system can manage ?

No Readout ! Just request to the trigger system

Electronics on Drain (no data pre-processing/DAQ)

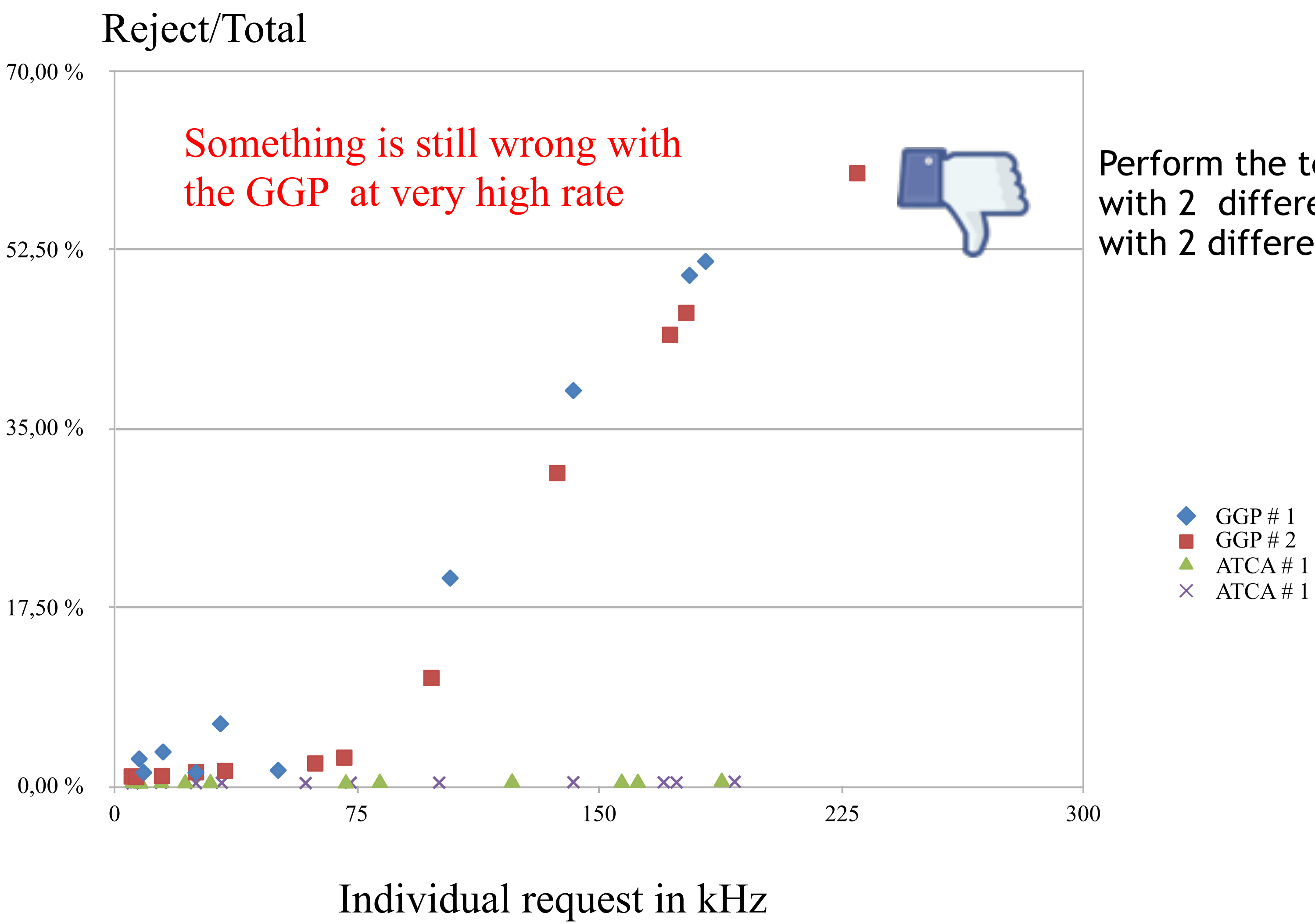
High rate effect 2017 GANIL MBq ^{60}Co source (32 crystals) ATCA + GGP



We often run at this rate at GANIL

1 Before the readout : how much the trigger system can manage ?

Only 1 channel is in GO for each point (no pre-processing/DAQ readout)
Just Increase the rate :



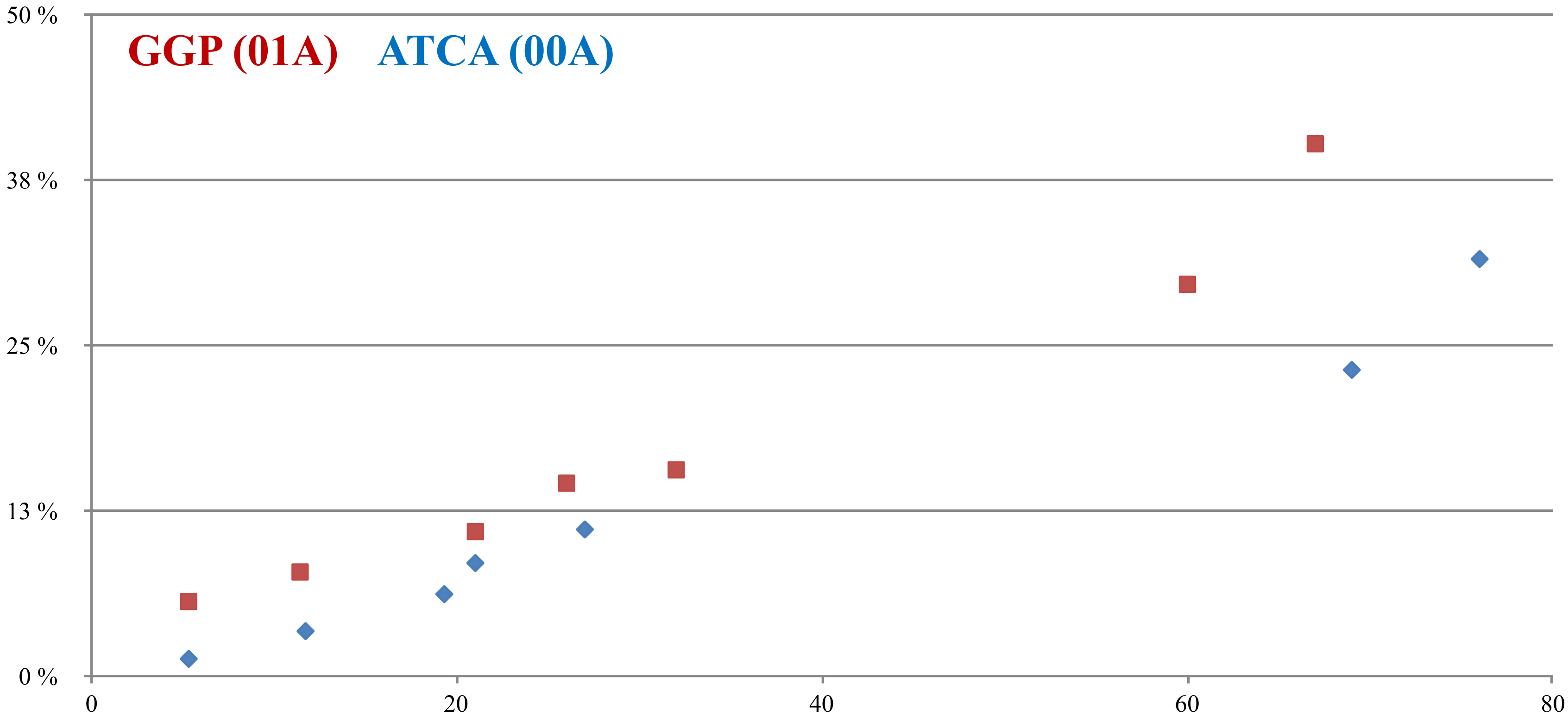
Perform the test
with 2 different GGP cards
with 2 different ATCA cards

1 Before the readout : how much the trigger system can manage ?

ALL ATCA and GGP electronic channels ON
Varying the source activity

→ GGP influences the ATCA dead Time via the GTS-Backpressure common flag

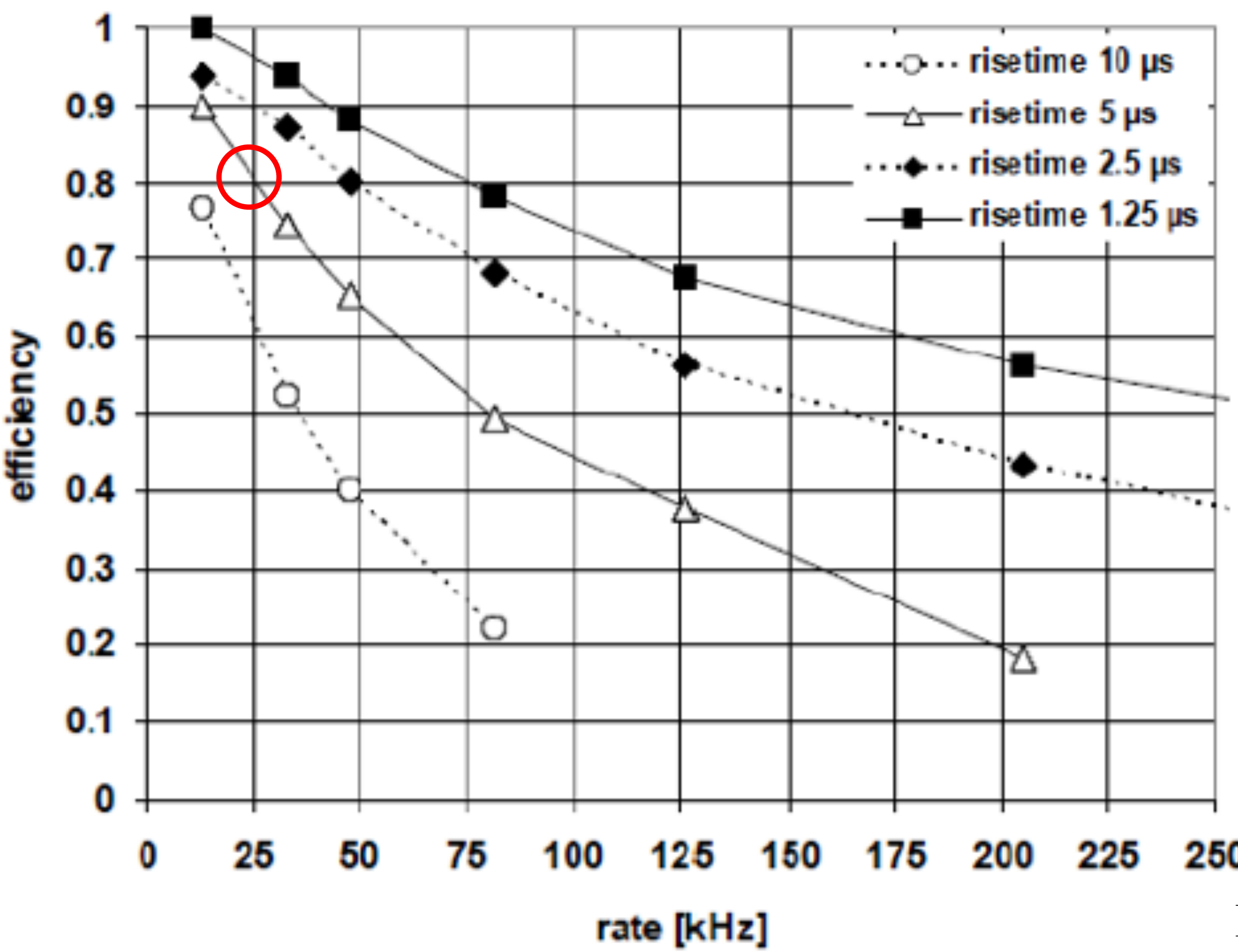
Individual Dead Time



Individual request in kHz

Before the readout : how much the trigger system can manage ?

Trapezoidale filter paramaters matter !
At High rate, pile-rejection reduces a lot the efficiency and quality of the data

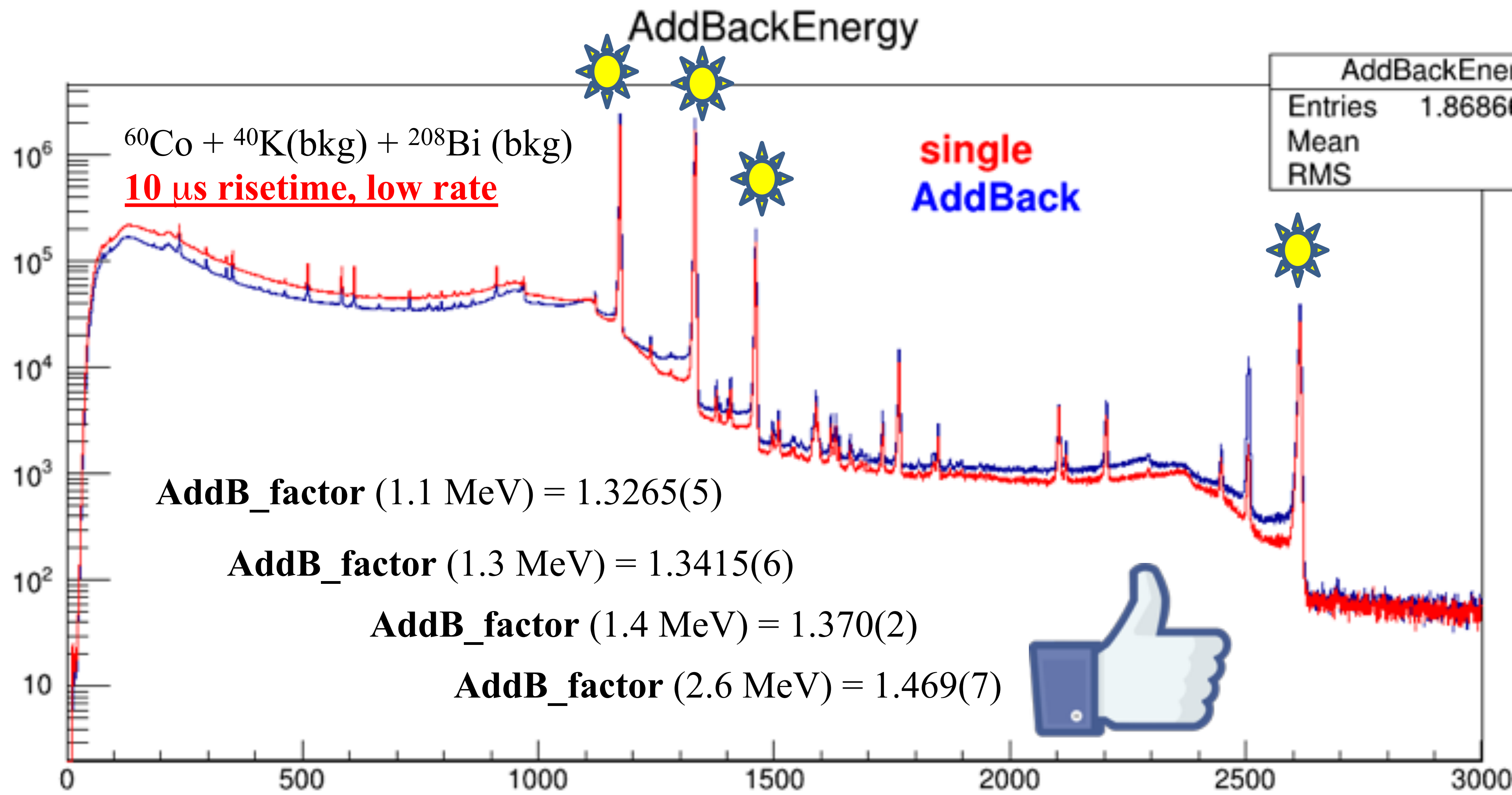


→at 25kHz/core, a too large risetime (k-parameter) costs 20% of losses
(this is known)

F. Recchia et al. LNL report

1 Before the readout : how much the trigger system can manage ?

Inappropriate RiseT vs AddBack factor



AddB_factor (1.1 MeV) = 1.3265(5)

AddB_factor (1.3 MeV) = 1.3415(6)

AddB_factor (1.4 MeV) = 1.370(2)

AddB_factor (2.6 MeV) = 1.469(7)

To make it easy : only core (E0) energies are considered. No Tracking but a simple AddBack procedure using neighboring cores **AddB_factor** = Int(AddB)/Int(Single)

1 Before the readout : how much the trigger system can manage ?

AGATA crystals are not in common dead time

AGAVA

Ancillary.sh { 100 Hz AGAVA }
Coincidence 2.2 us

100Hz Pulser
=Low coinc rate
=Low readout

Ancillary.sh
Mult gamma>=1

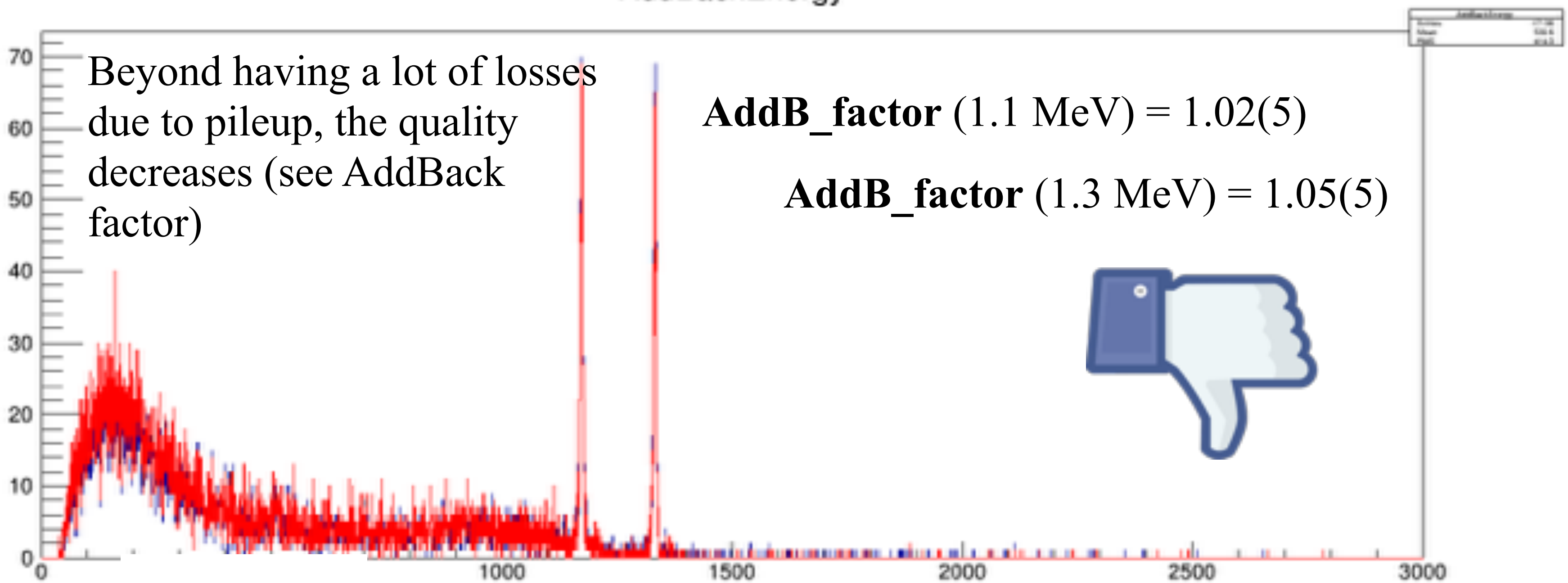
AGATA

>50kHz/core
CFD

^{60}Co MBq

10 µs RiseT Pile up will reject 60% of the requests

Total input rate in GTP = 1.6 MHz



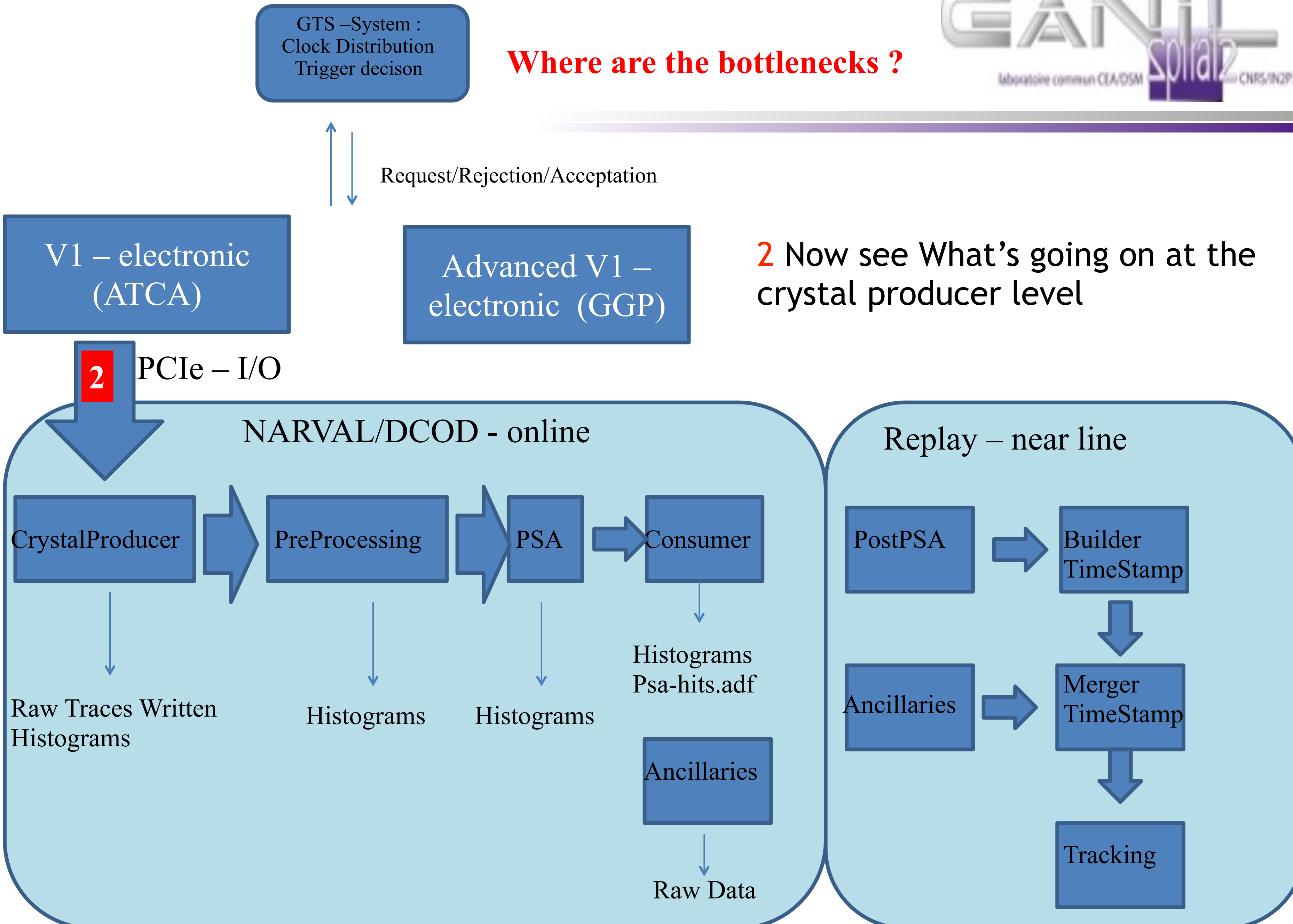
Beyond having a lot of losses due to pileup, the quality decreases (see AddBack factor)

AddB_factor (1.1 MeV) = 1.02(5)

AddB_factor (1.3 MeV) = 1.05(5)

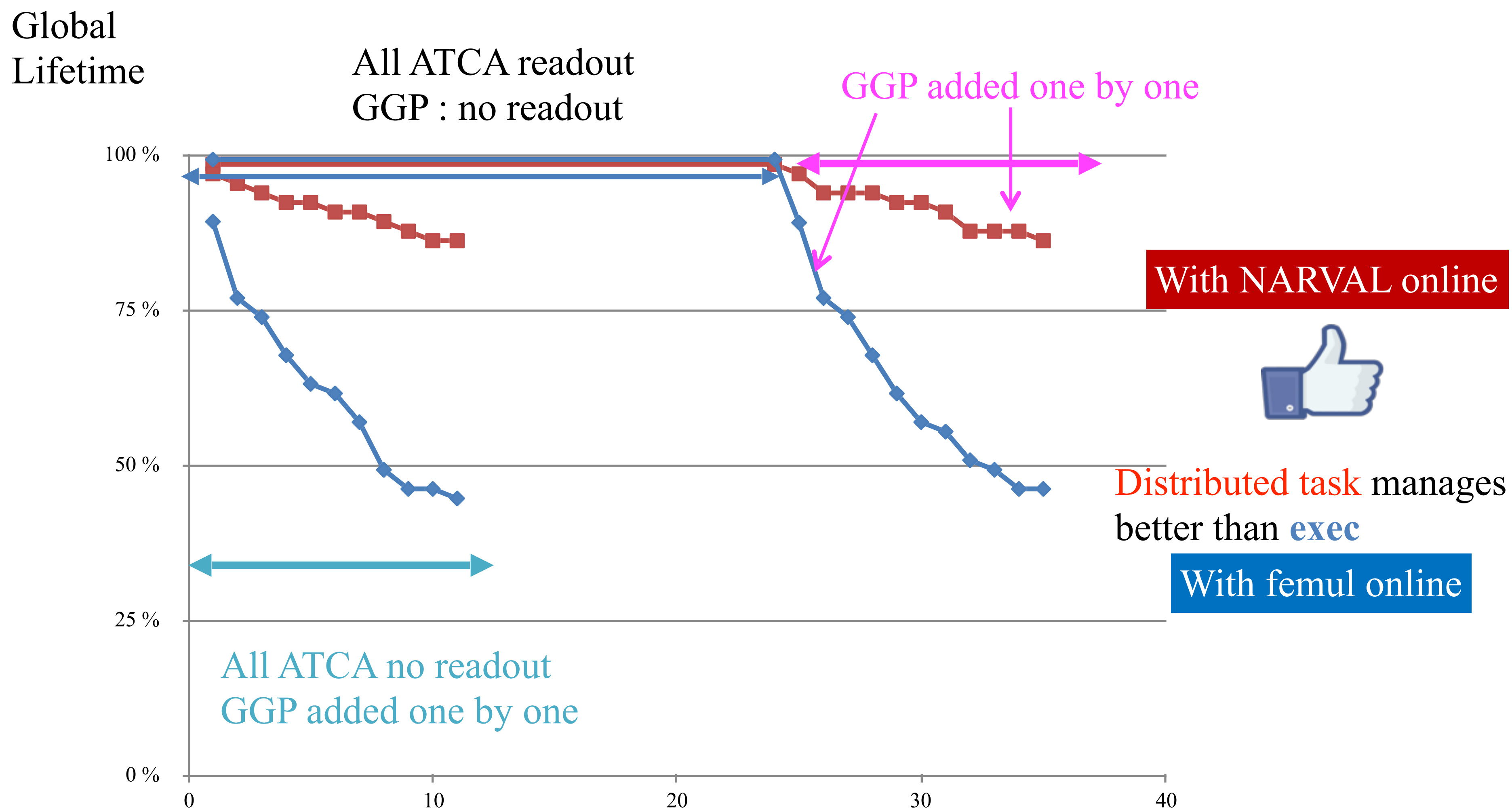
Where are the bottlenecks ?

2 Now see What's going on at the crystal producer level



The delicate process of the PCIe readout

Problem with the GGP readout before 2018



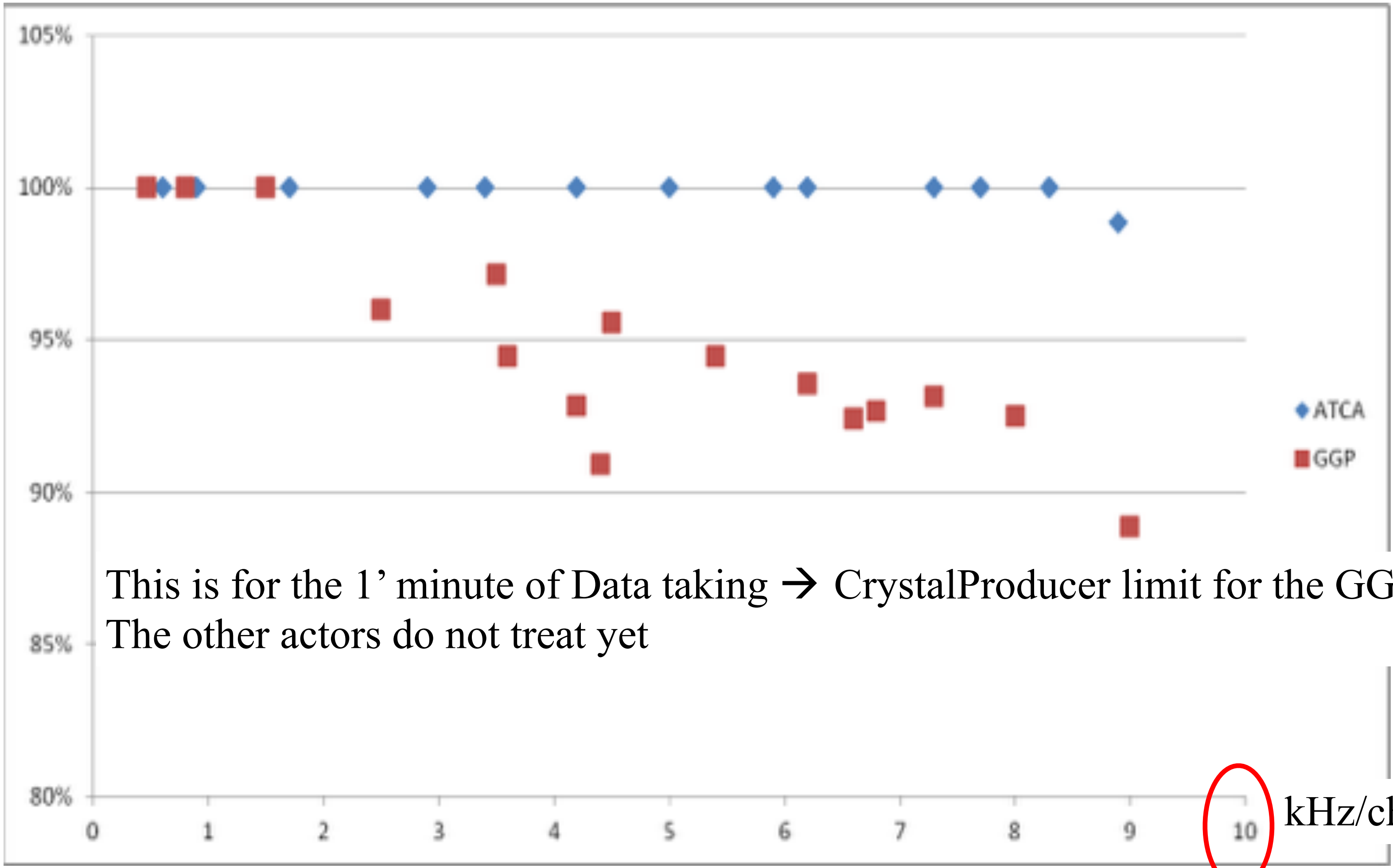
Distributed task manages better than **exec**

Number of channel writing data (24 ATCA + 11 GGP = 35) **~3kHz/core**

The delicate process of the PCIe readout in DCOD

Problem with the GGP readout before 2018

Individual Lifetime



This is for the 1' minute of Data taking → CrystalProducer limit for the GGP
The other actors do not treat yet

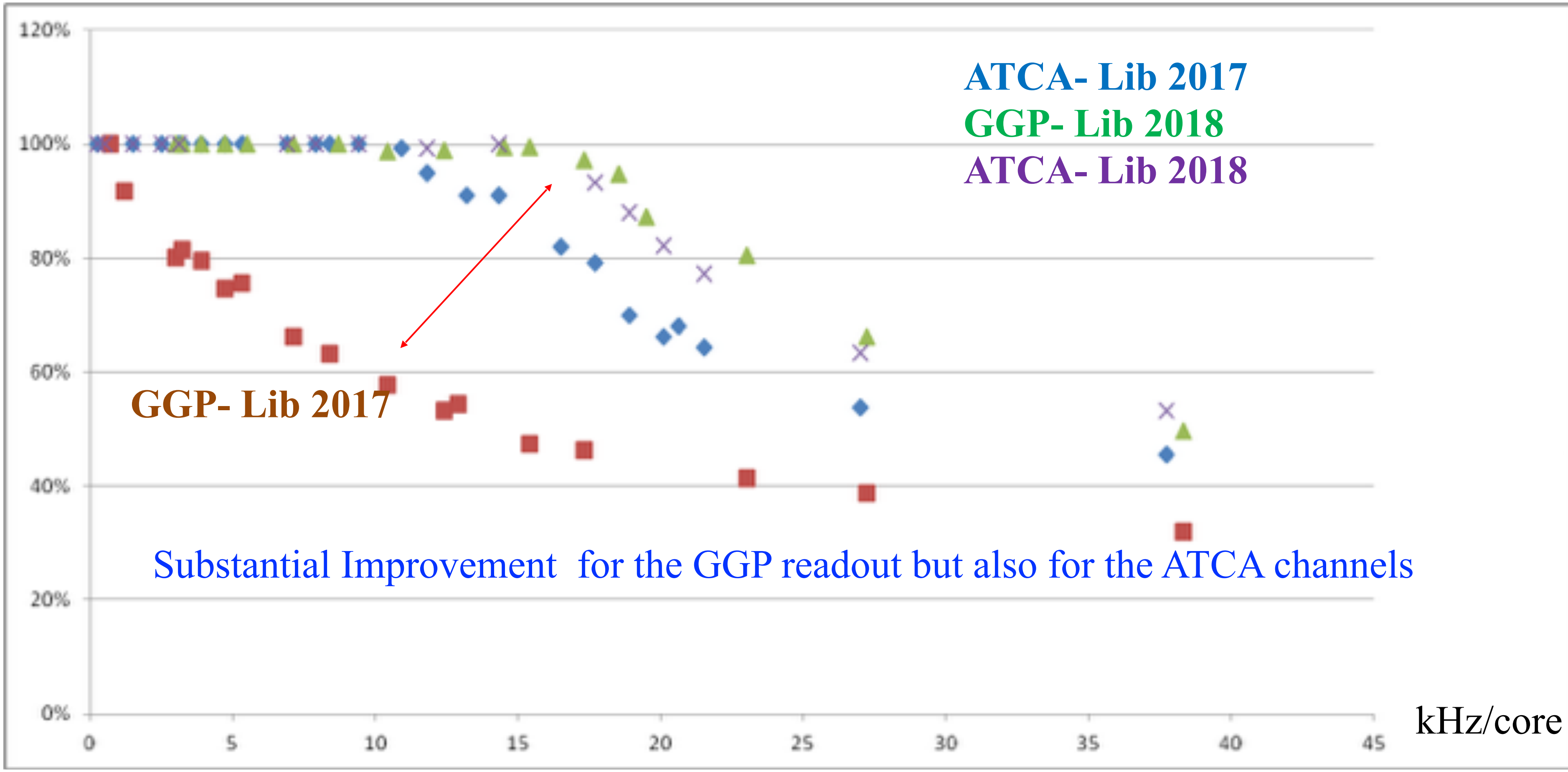
kHz/channel

One channel at the time is taking data

No Trace, no Histo, no PSA, only adf

2 The delicate process of the PCIe readout in DCOD

Major release of the CrystalProducer in 2018 (D. Bazzacco)
→ Massive use of Threads in the DMA readout

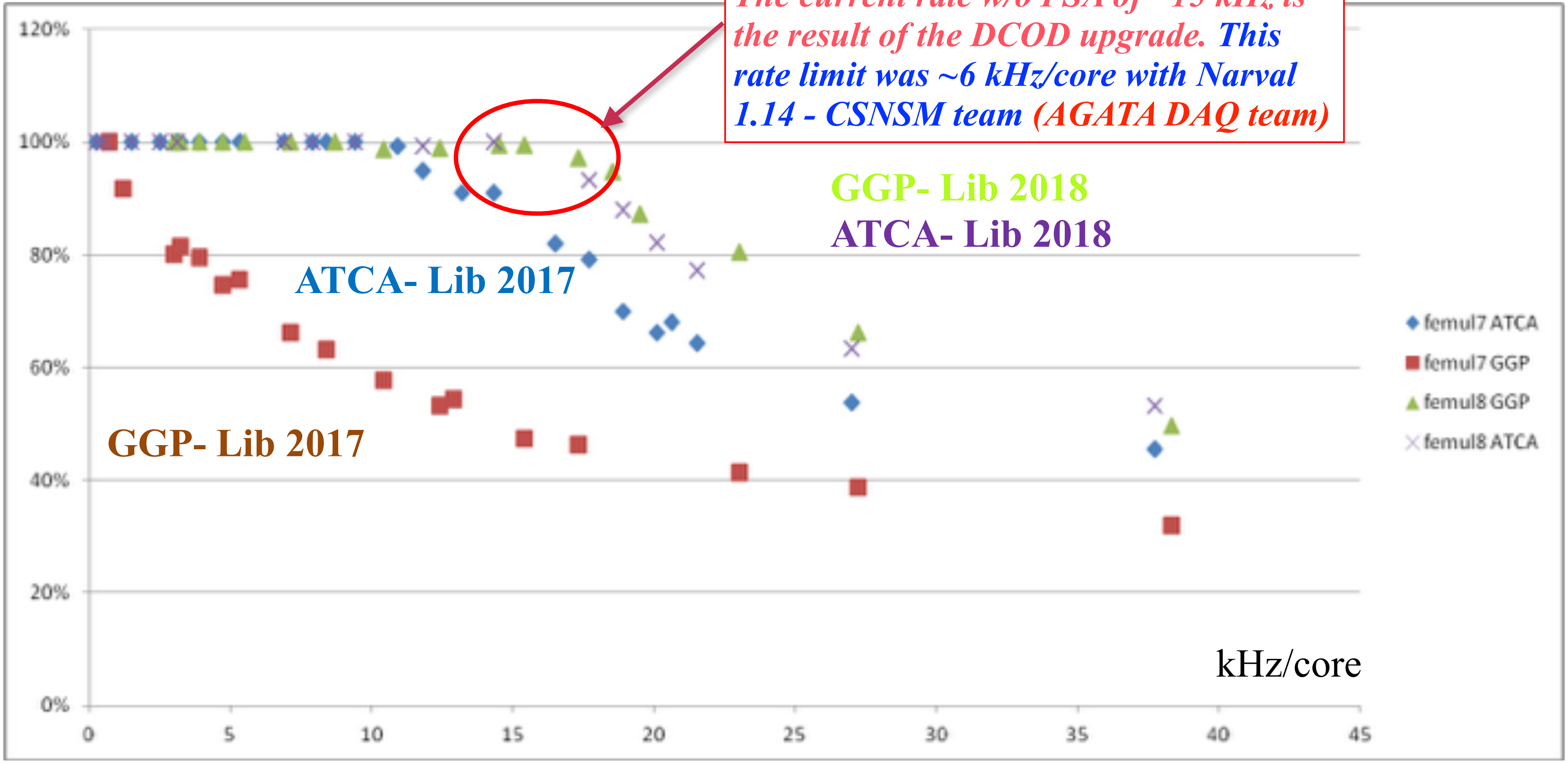


No Trace, no **PSA**, no Histo, only adf files → We do not yet look at the PSA limitation

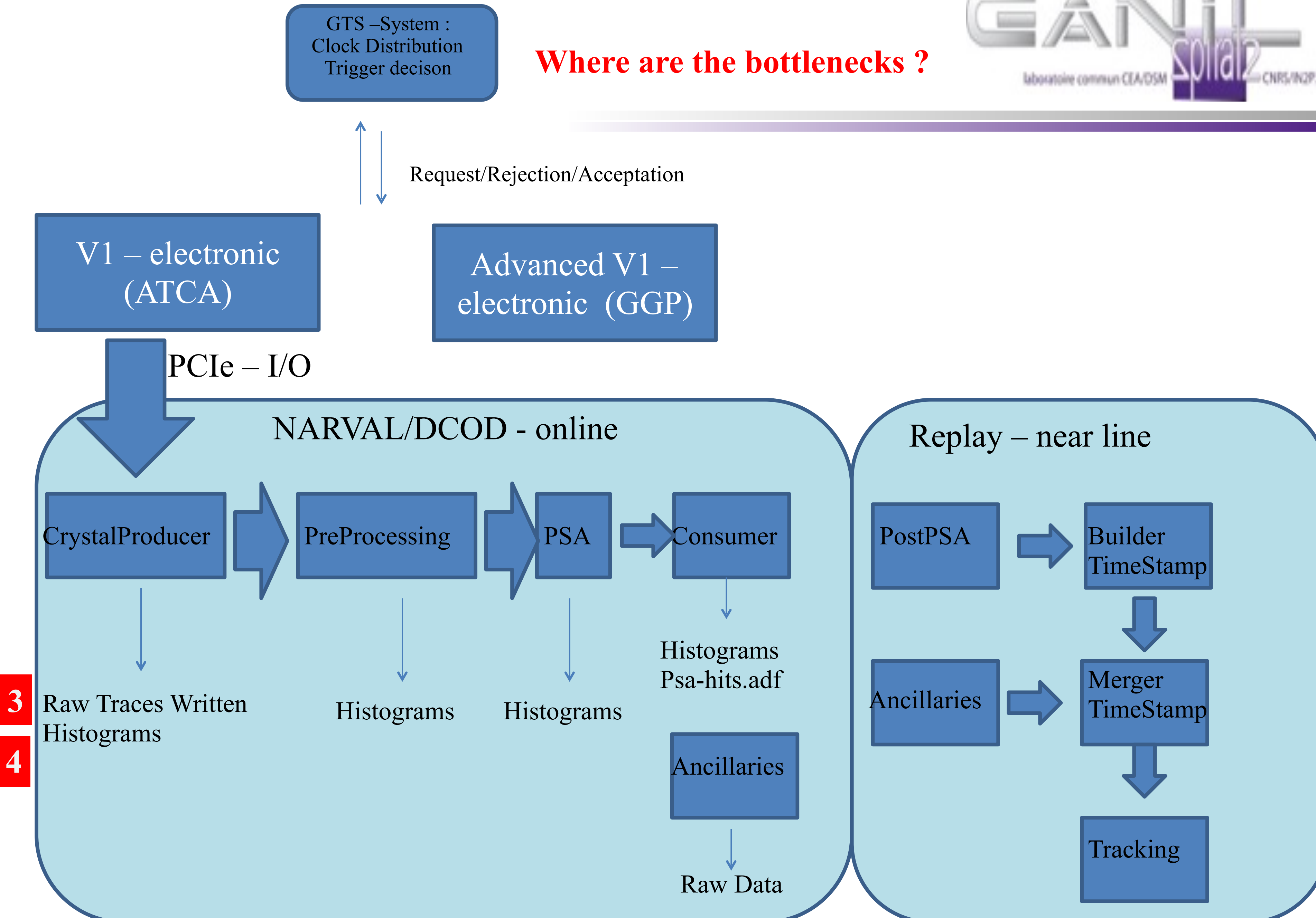
The delicate process of the PCIe readout in DCOD

Major release of the CrystalProducer in 2018
→ Massive use of Threads in the DMA readout

The current rate w/o PSA of ~15 kHz is the result of the DCOD upgrade. This rate limit was ~6 kHz/core with Narval 1.14 - CSNSM team (AGATA DAQ team)



Where are the bottlenecks ?



3 4 More access to disk with traces and histograms

Workstation are busy when doing disks access to write the short traces and the histograms and do not acquire the data meanwhile

The minimum is to keep the “adf” hits position and energy after the psa but one can save the short traces to re-run the psa if desired. This has an impact (and this is rate dependent)

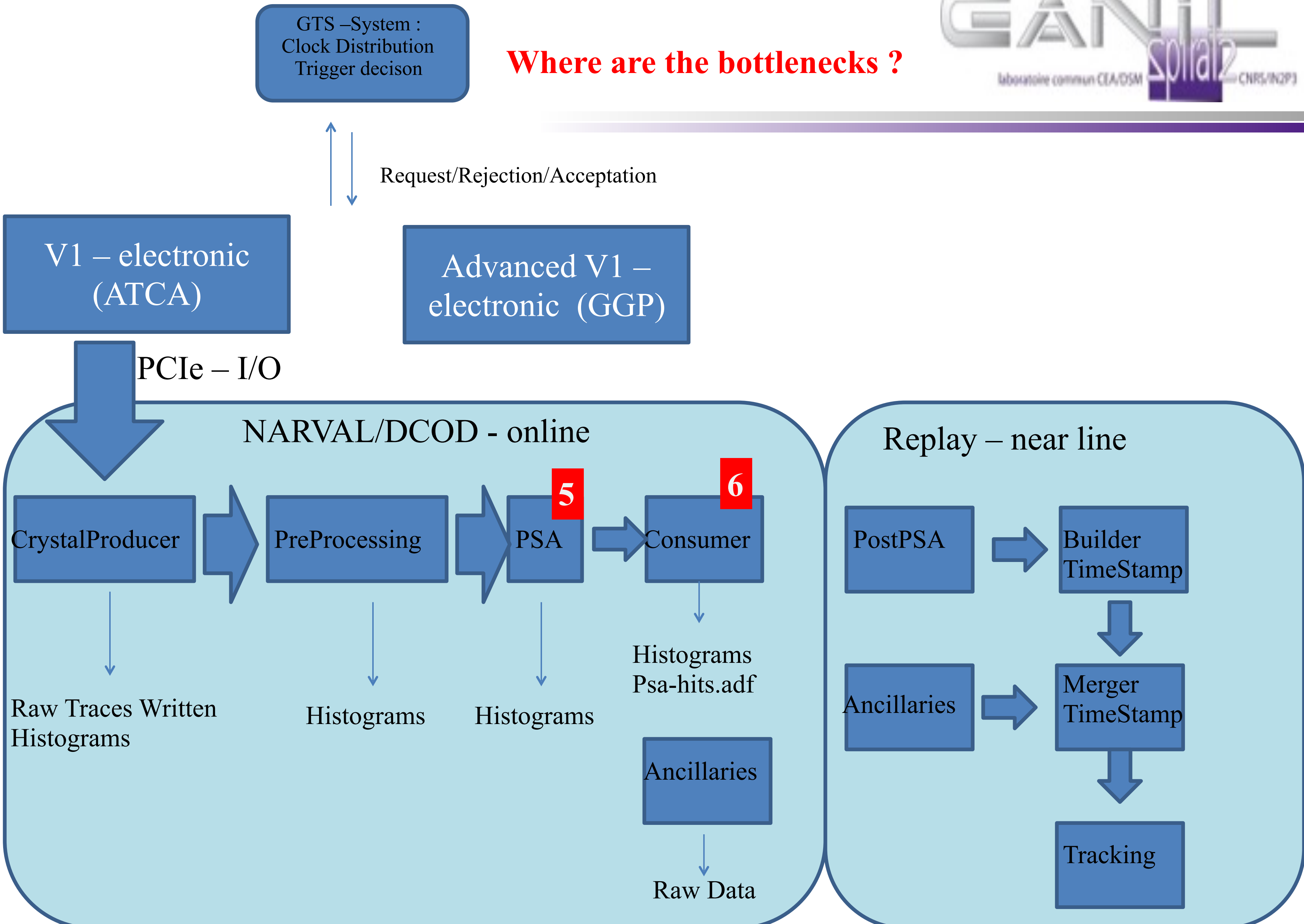
✓Cdat (traces) induce a ~4% dead time at low rate (200 Hz/core) and ~15% at 2-4kHz/core

✓Binary (TkT) spectra induce a ~3 % dead time at 2-4 kHz/core

Of course if the validation by crystal is low (high trigger condition by fold or ancillaries coincidence), this is not an issue.

At VAMOS, we were validating ~100 Hz/core in coincidence with a particle in the spectrometer, therefore these additional outputs have a marginal effect (but fill the disks)

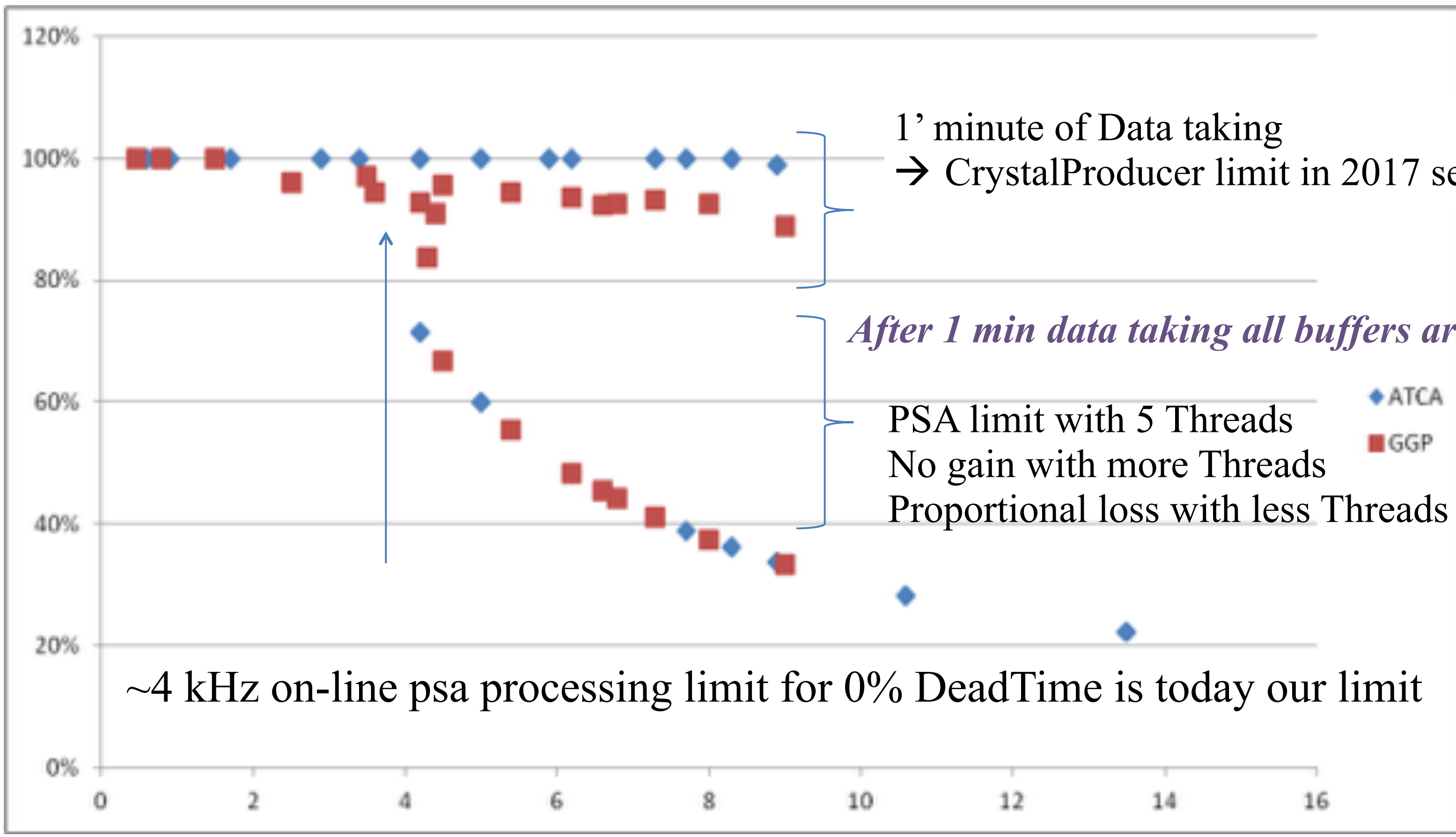
Where are the bottlenecks ?



5 Effect of the online PSA

The PSA library runs on-line with Threads. We usually run with a configuration per workstation (managing 1 crystal) having 5 threads of 300 events each.

Individual Lifetime



1' minute of Data taking
→ CrystalProducer limit in 2017 see **2**

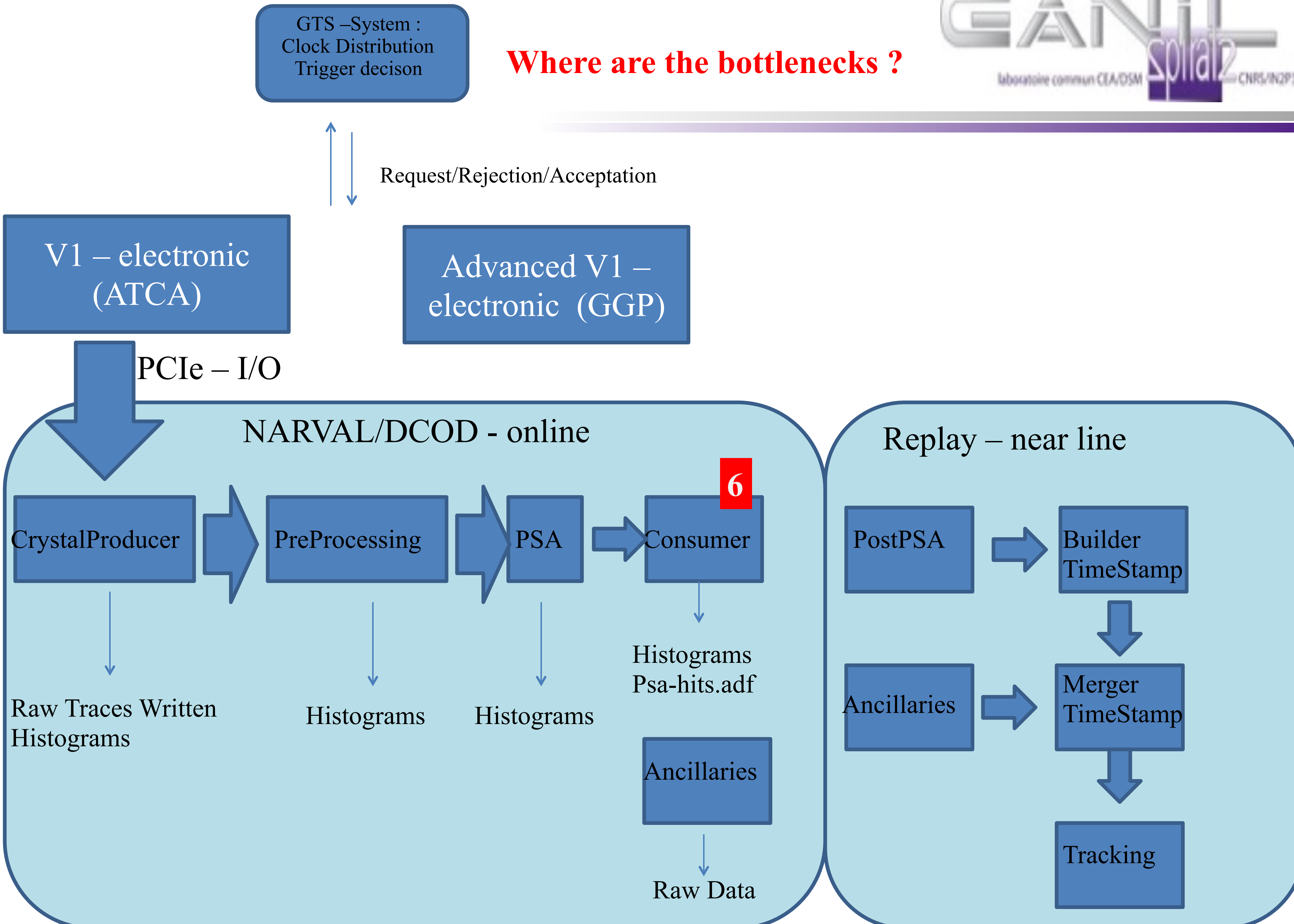
After 1 min data taking all buffers are sent

PSA limit with 5 Threads
No gain with more Threads
Proportional loss with less Threads

~4 kHz on-line psa processing limit for 0% DeadTime is today our limit

kHz/channel

Where are the bottlenecks ?



Acces to the disk for the minimum

The current minimum is to keep the output of the local level processing (psa.adf)

Even there, there are limitations (not yet easy to quantify) with online data at high rate

Writting each psa.adf cost backpressure to the system