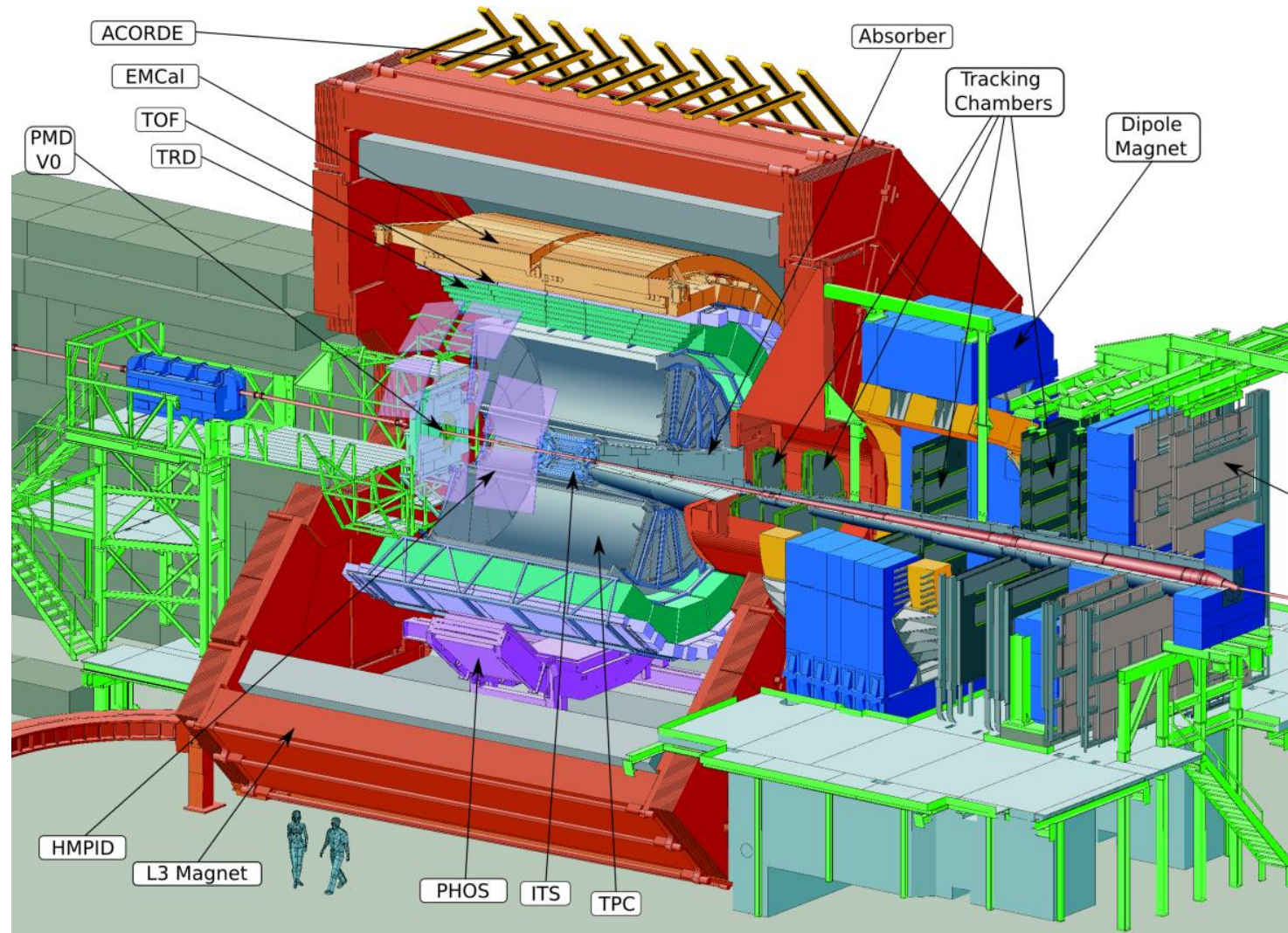


The heavy-ion group in Lund

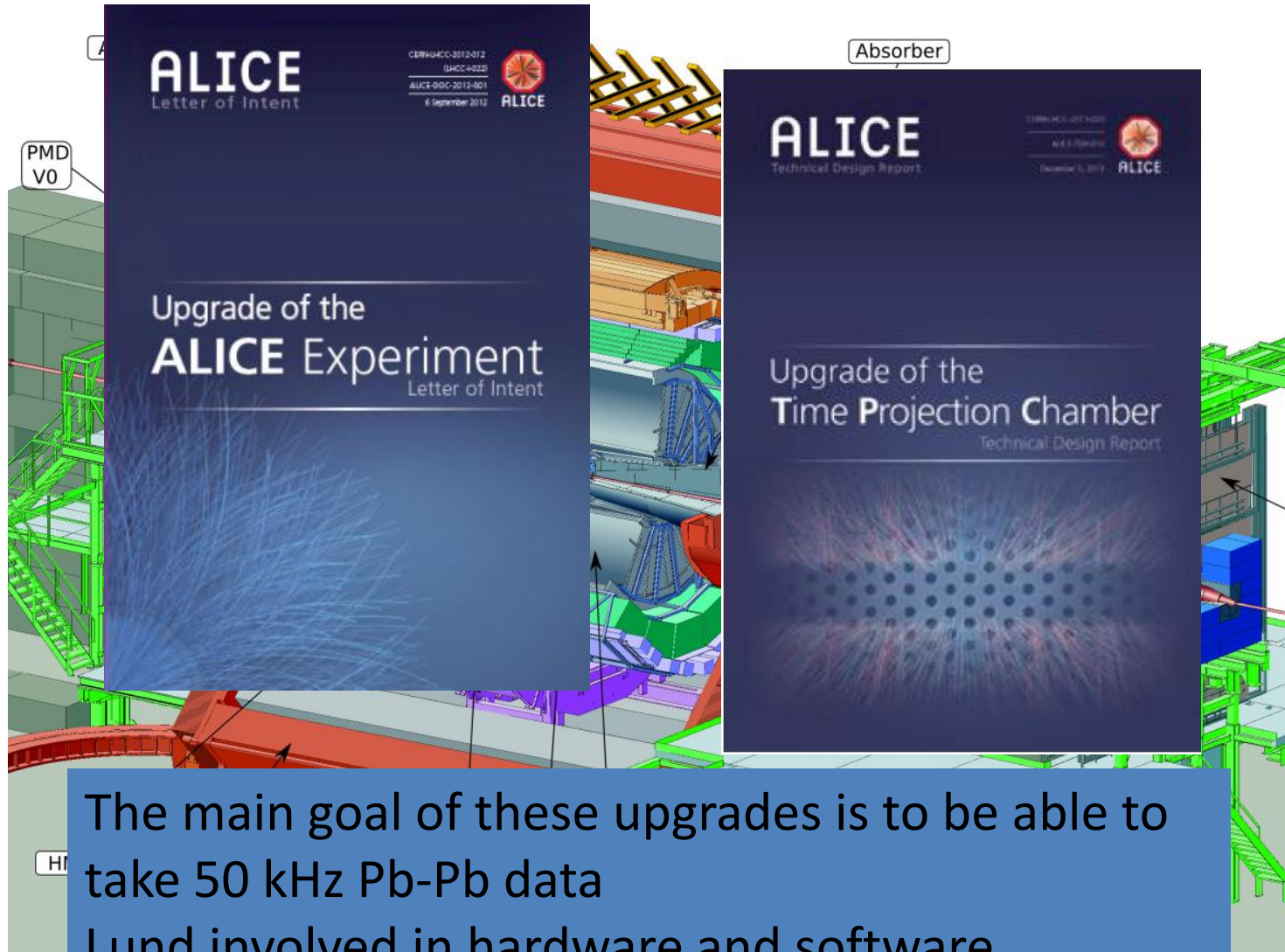
- 3 Seniors
 - Anders Oskarsson, David Silvermyr, Peter Christiansen
- 1 Postdoc
 - Tuva Richert
- 3 Ph.D. Students (+ 3 master students)
 - Jonatan Adolfsson, Martin Ljunggren, Vytautas Vislavicius
- Activities
 - Group: ALICE
 - Individuals works on preparations for: ILC (TPC), nnbar experiment at ESS, ESSvSB



The ALICE experiment



The ALICE TPC Upgrade for run 3



The main goal of these upgrades is to be able to take 50 kHz Pb-Pb data
Lund involved in hardware and software



Characterization, mass test and calibration of SAMPA ASIC

ASIC design by University of Sao Paolo
(ASIC = Application-Specific Integrated Circuit)

Lund Team:

Jonatan Adolfsson

Ulf Mjörnmark

Anders Oskarsson

David Silvermyr

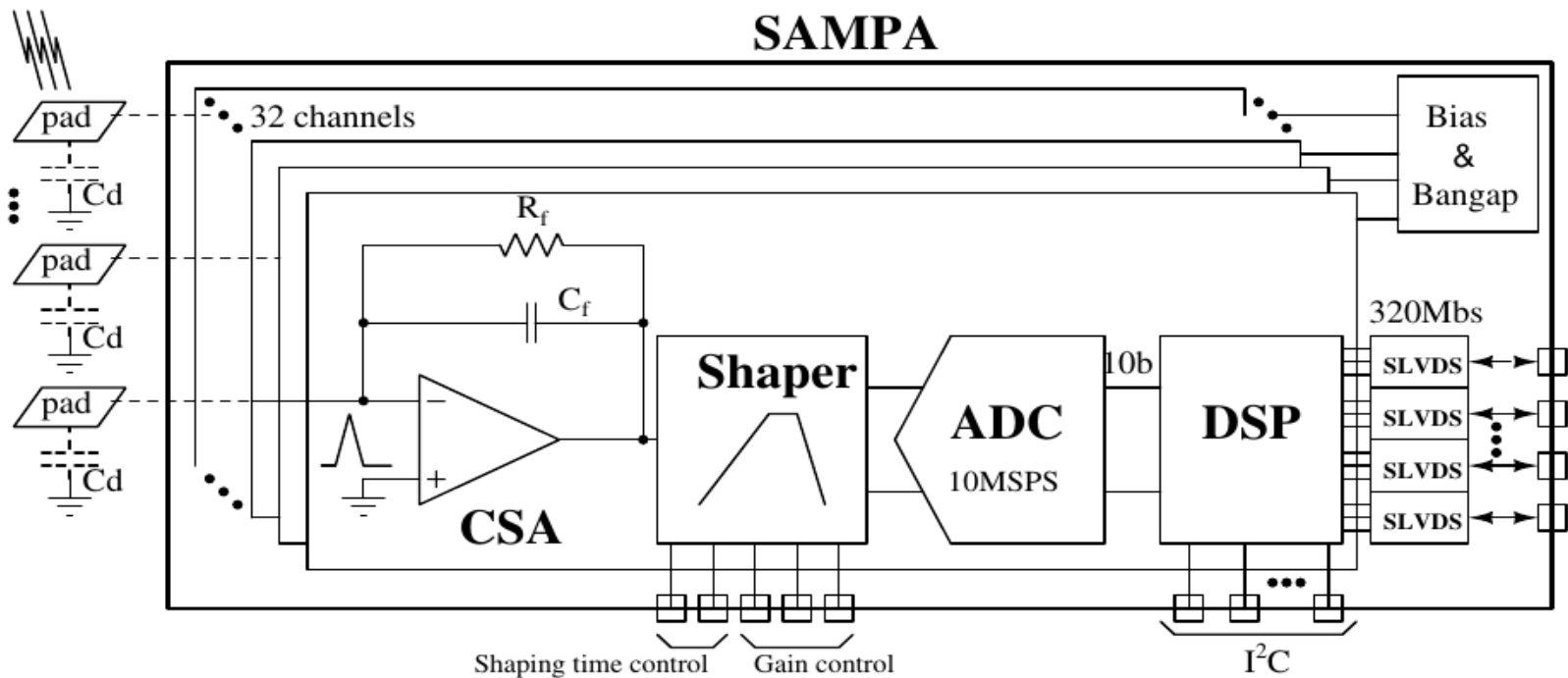
Lennart Österman

- **Evaluate several versions of SAMPA ASIC**
 - **give feedback to designers**
- **July 2016 - Version 2 all functions integrated in 32 cha ASIC**
- **October 2017 - Version 3 (muon tracking) and version 4 (TPC)**
- **October 2018 - Robotic testing of 80000 chips in fabrication**

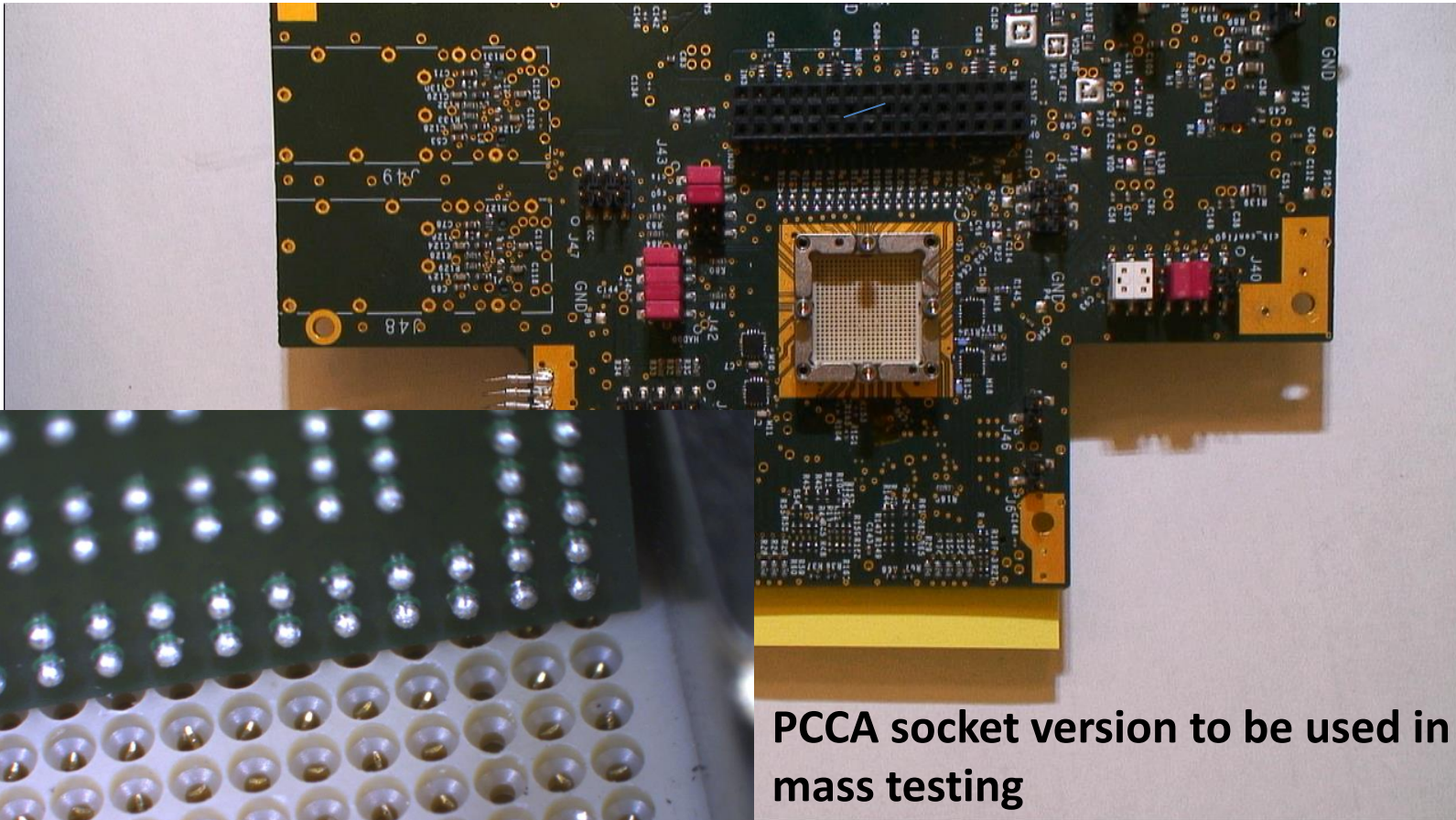


SAMPA block Diagram

Starting from existing ALICE TPC electronics and its modification to ILC-TPC (also Lund)

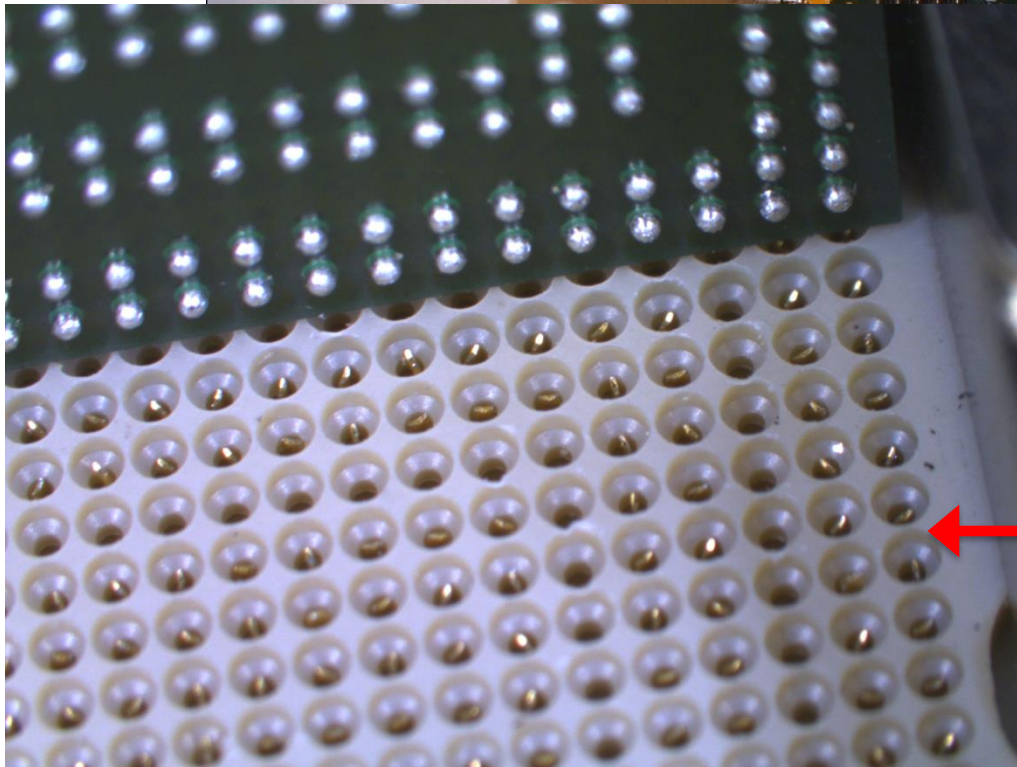


SAMPA test board with socket



SAMPA

PCCA socket version to be used in mass testing



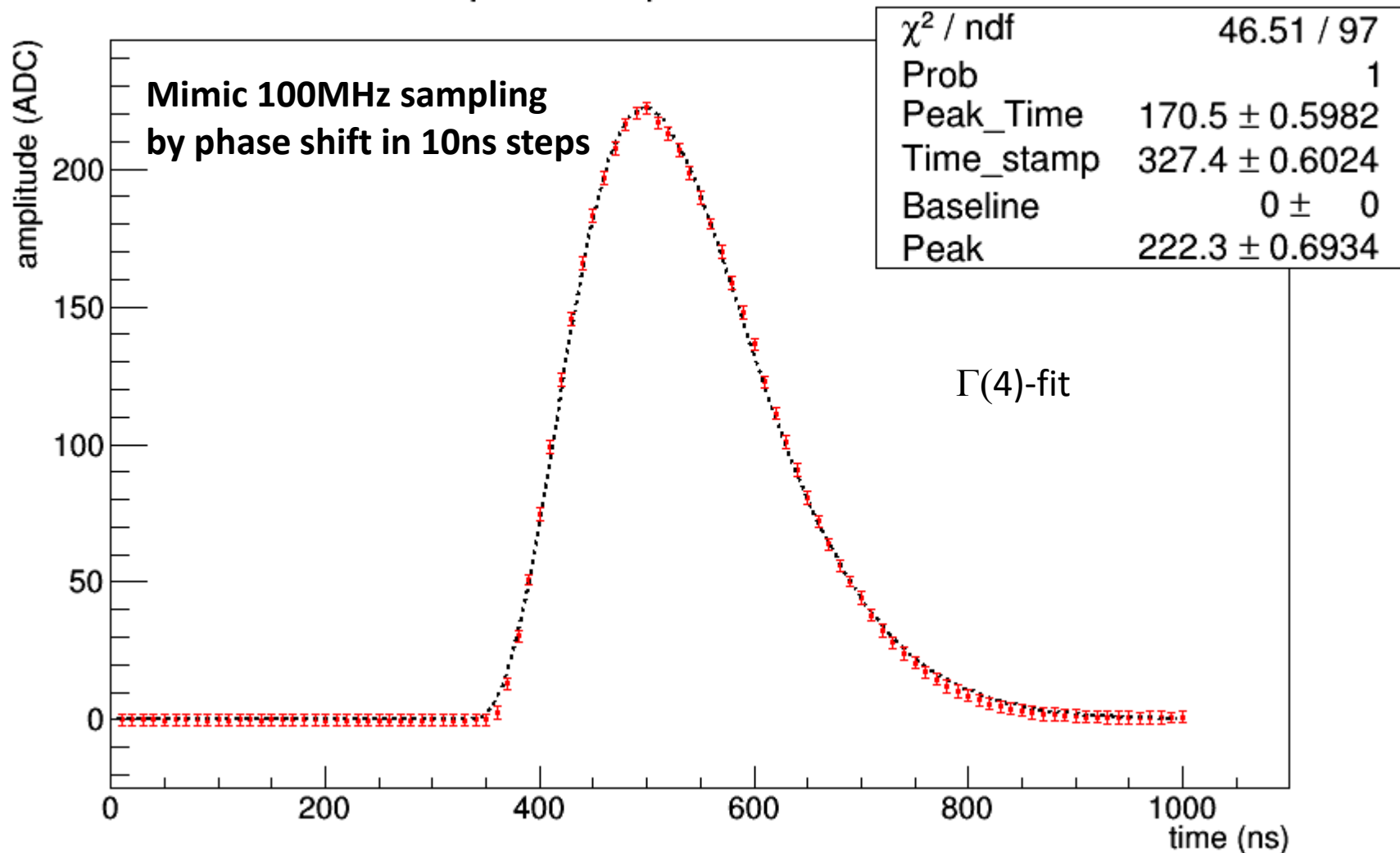
Inside of socket

Pitch 0.65

372 spring loaded pins

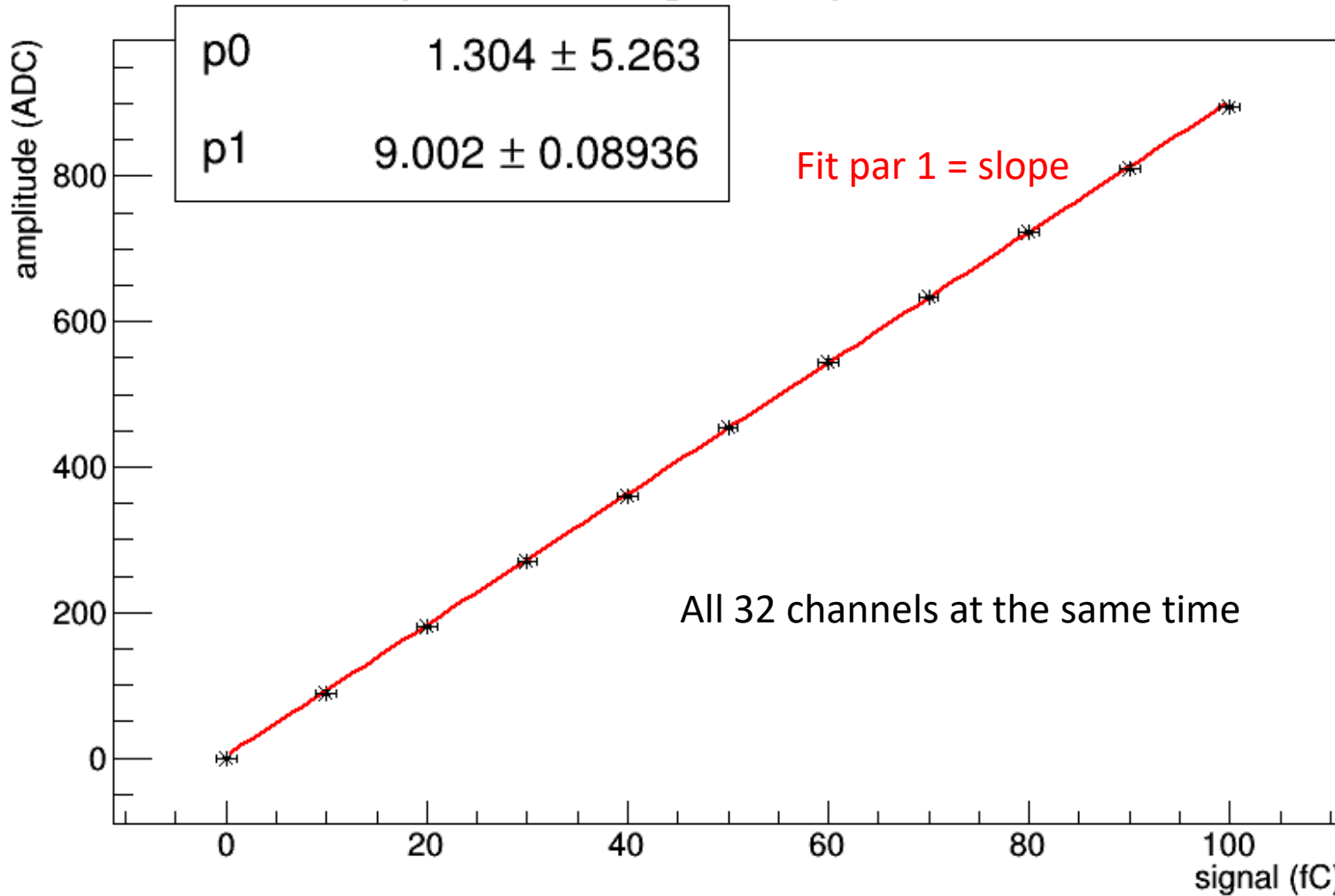
High resolution pulse sampling

Snapshot of pulse in channel 0



Calibration results for each chip and for individual channels

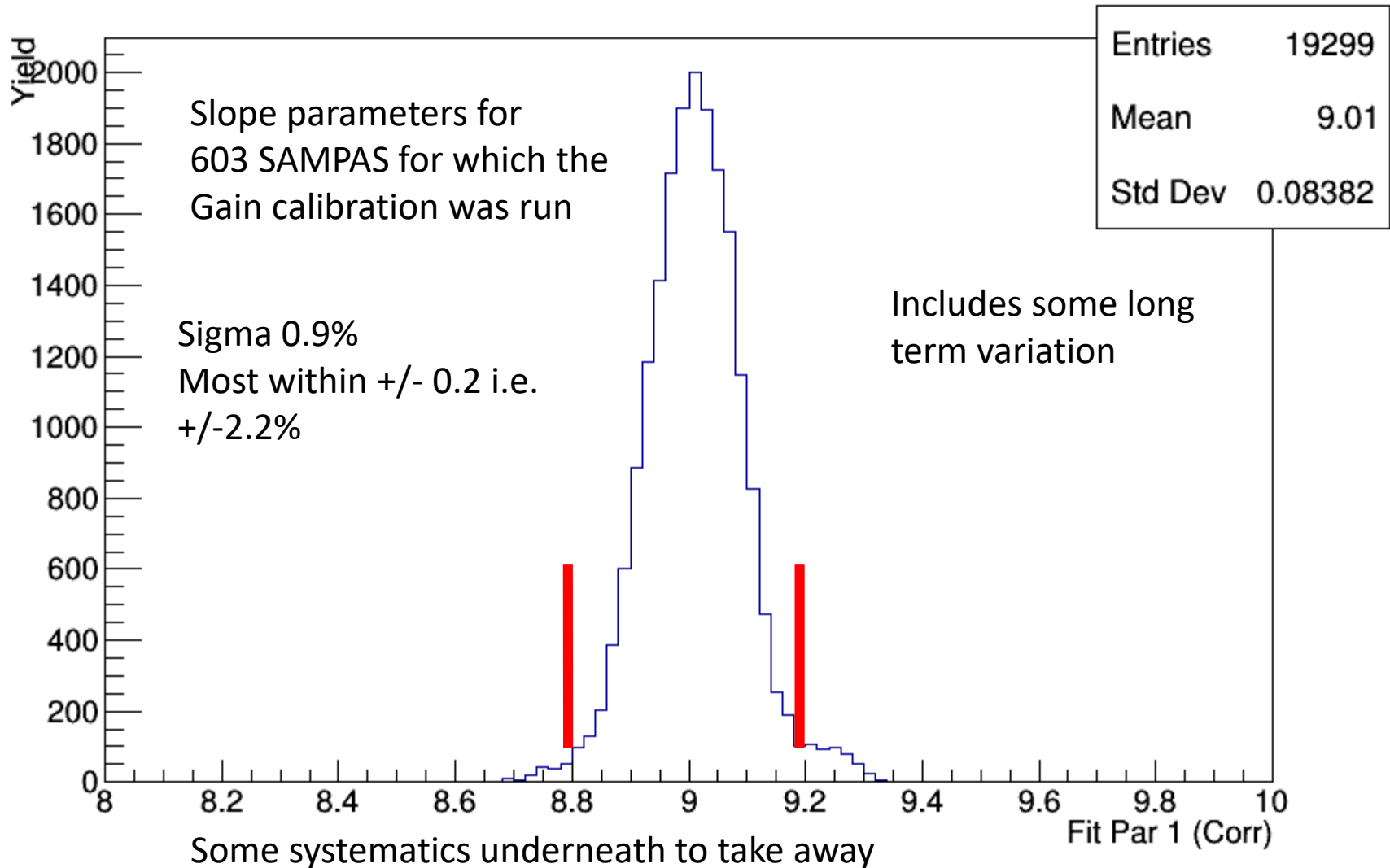
Amplitude vs Sig for chip 664 chan 31





Gain calibration: Fit slope

Fit Par 1 (Corr)

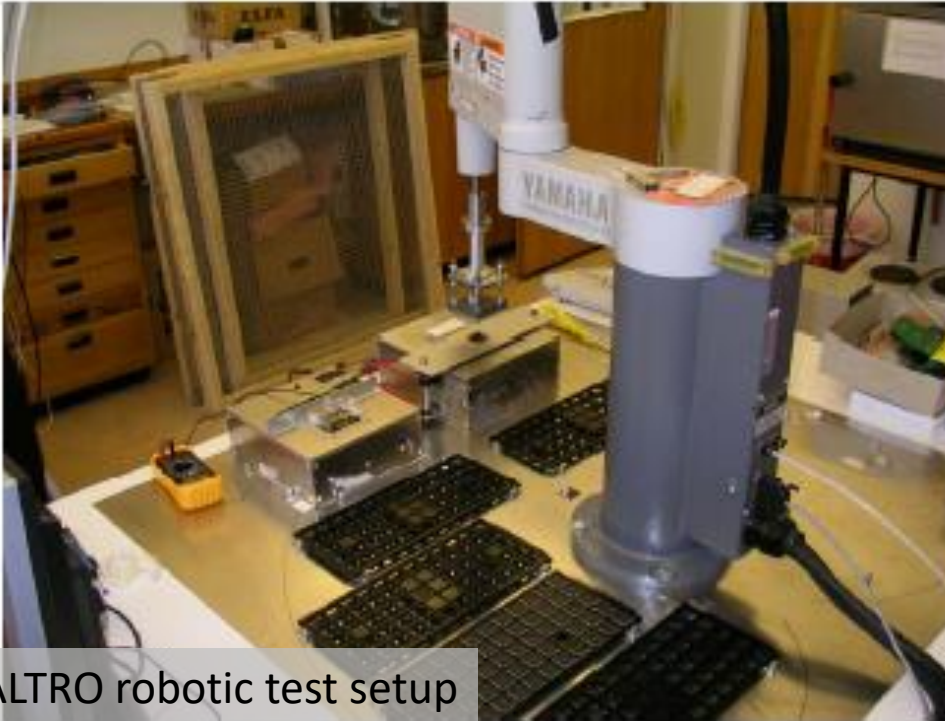




Robotic testing

Robotic production testing in clean room (ISO7)

- automatic mass testing was done for 80000 ALTRO and 80000 PASA
- CHIP handling – chip sorting - database procedures will be re-used
- New test card and readout



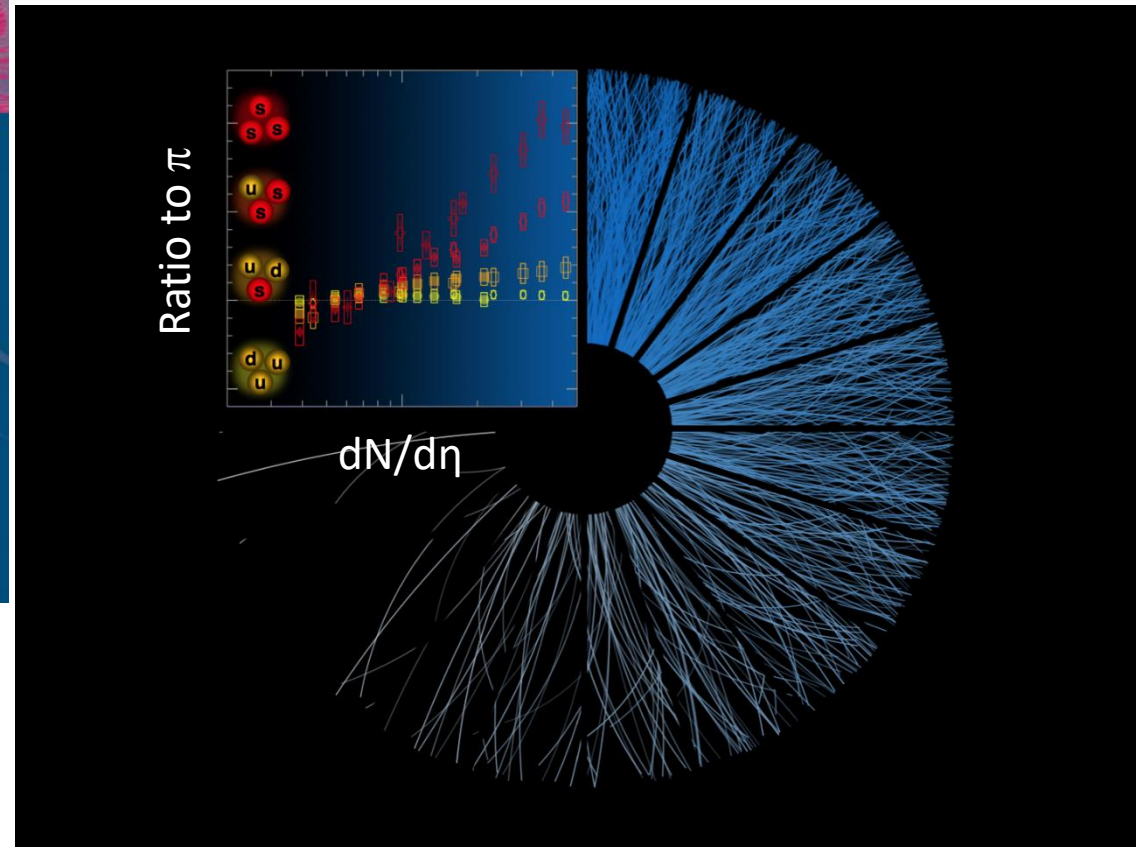
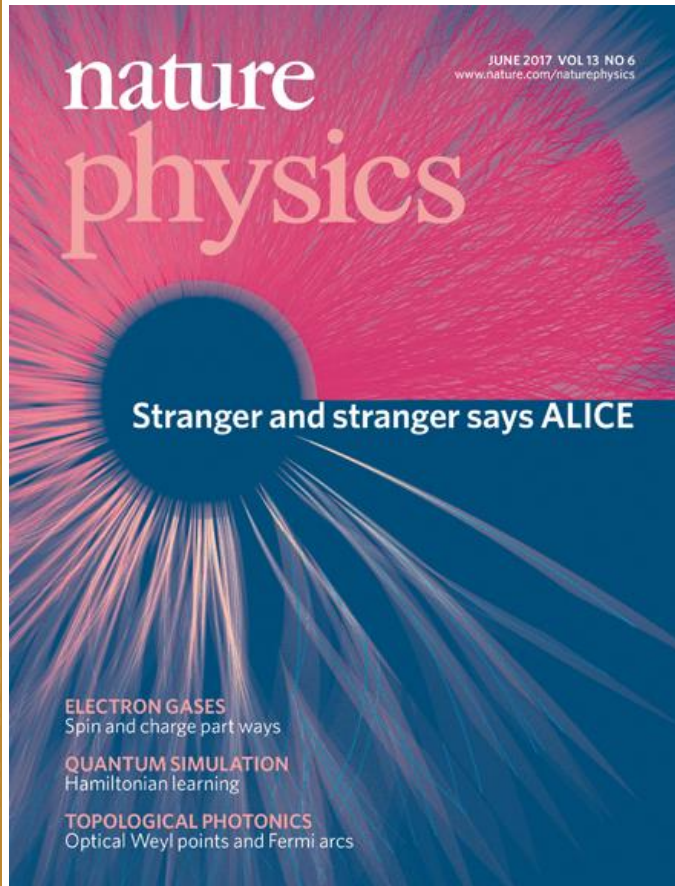
PASA/ALTRO robotic test setup

Full production planned for October 2018

IMPORTANT. No manual handling of individual chips
Manual tray handling. For SAMPA - full table 756 chips. Reload every 16 hours.

Strangeness production in small systems

ALICE at Lund University (P. Christiansen, Lund)





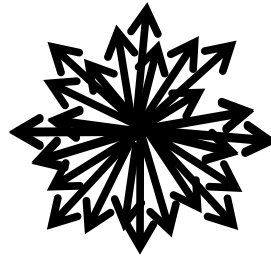
Discovery \rightarrow Control: Transverse spherocity

- In the following analyses, transverse spherocity, S_O , is used to characterize event shapes:
 - Low spherocity: “jetty” events
 - High spherocity: “isotropic” events

Jetty: $S_O \rightarrow 0$

Isotropic: $S_O \rightarrow 1$

$$S_O = \frac{\pi^2}{4} \min_{\hat{n}} \left(\frac{\sum_i \vec{p}_{T,i} \times \hat{n}}{\sum_i p_{T,i}} \right)^2$$





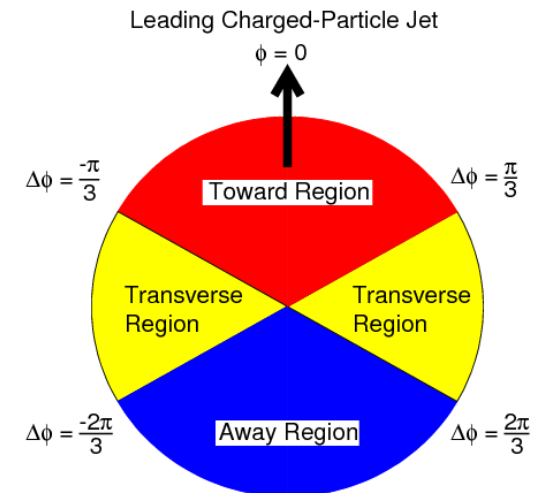
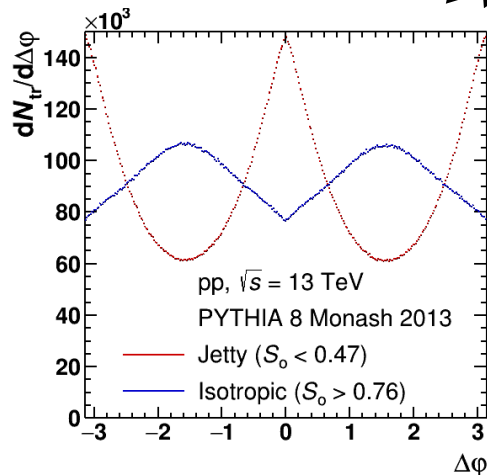
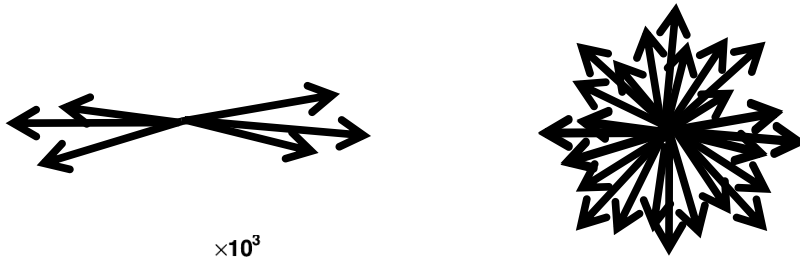
Discovery \rightarrow Control: Transverse sphericity

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 - Low sphericity: “jetty” events
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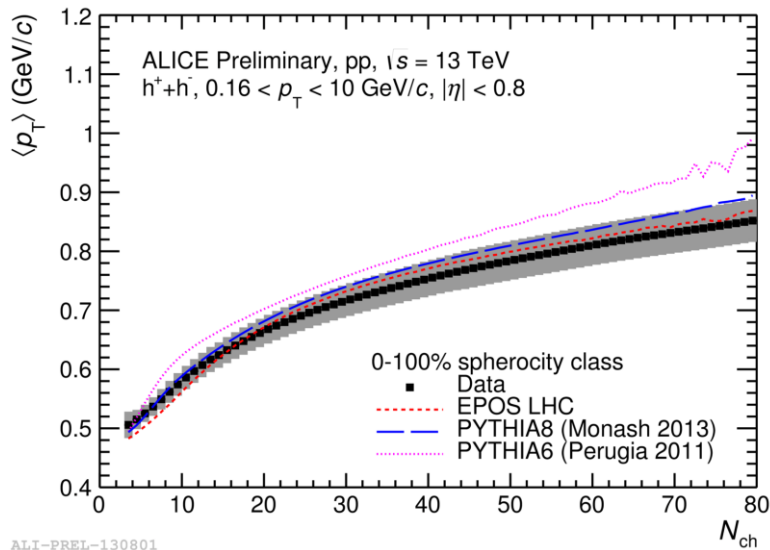
Jetty: $S_O \rightarrow 0$

Isotropic: $S_O \rightarrow 1$

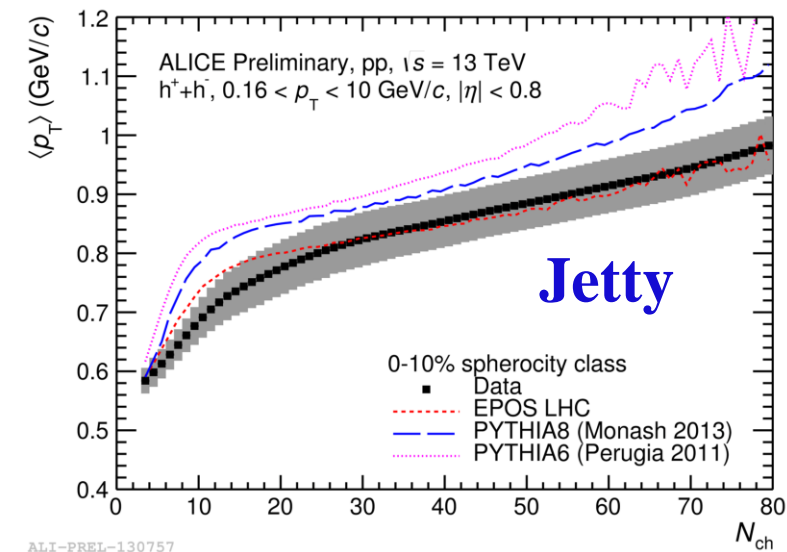
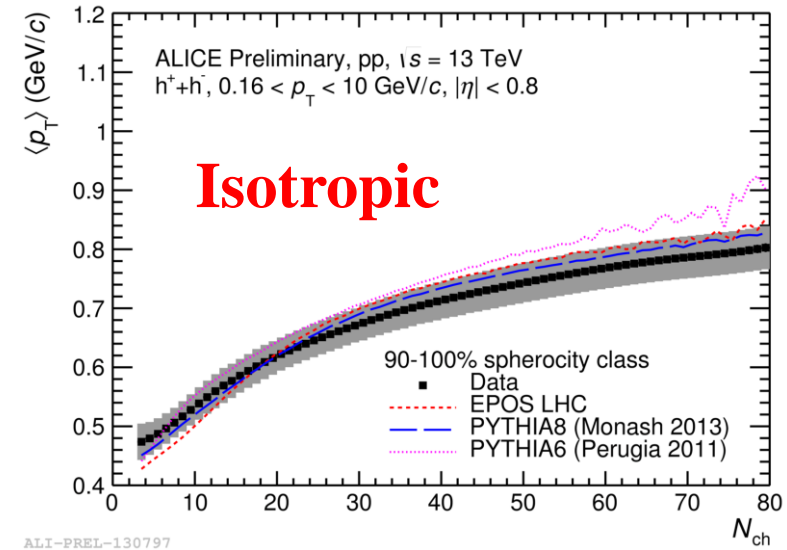
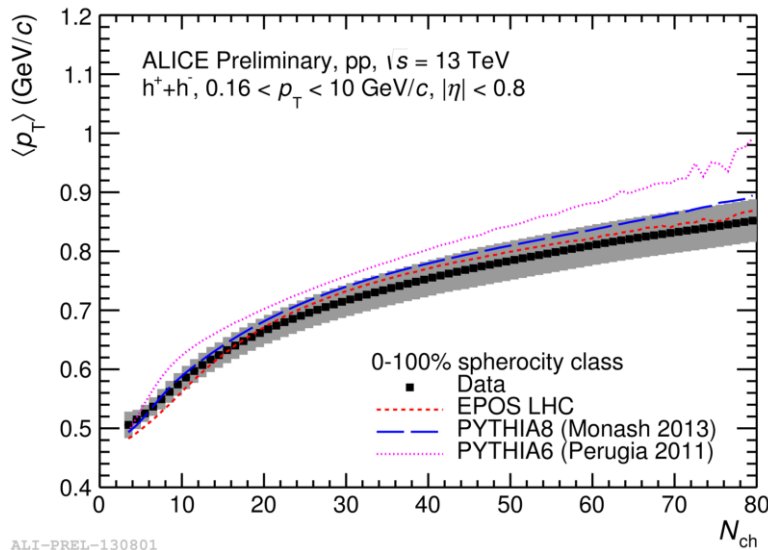
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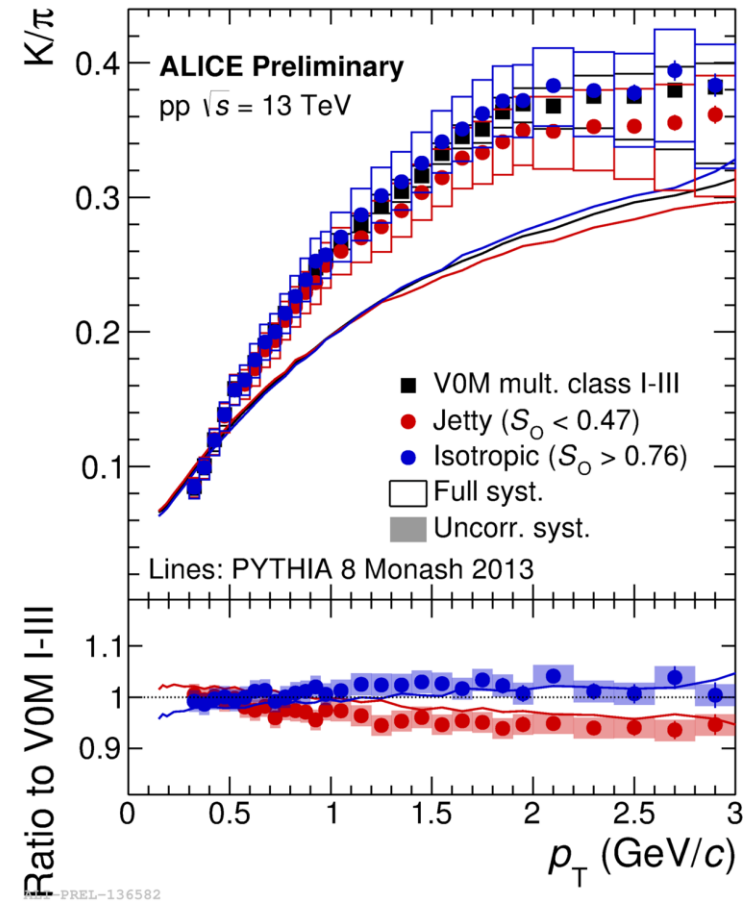
$\langle p_T \rangle$ as a function of multiplicity and S_0



$\langle p_T \rangle$ as a function of multiplicity and S_0



p_T -differential K/ π ratios as a function of S_0



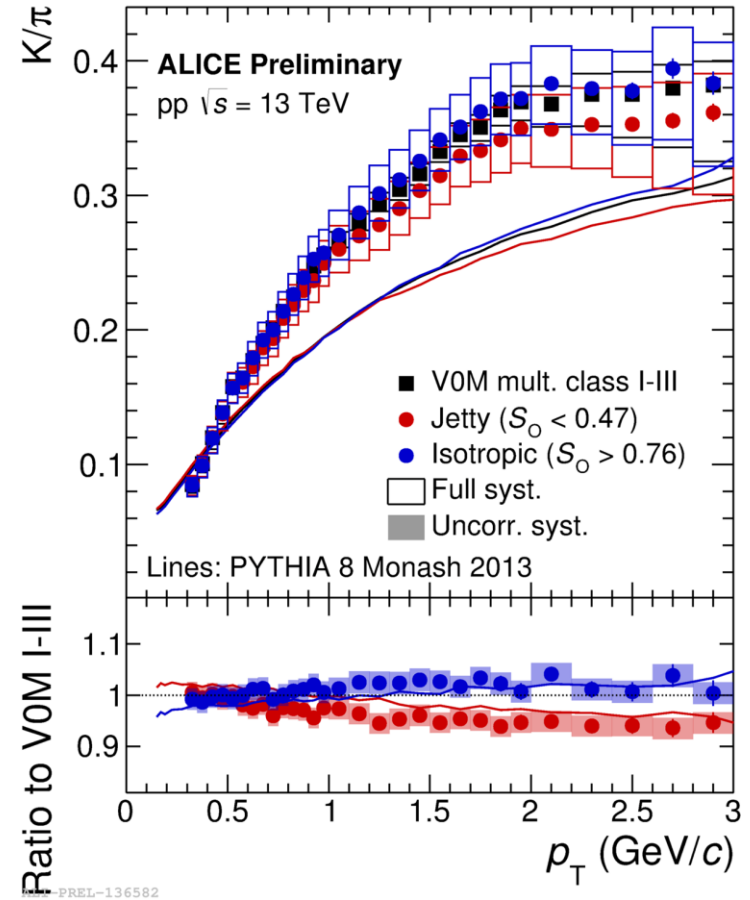
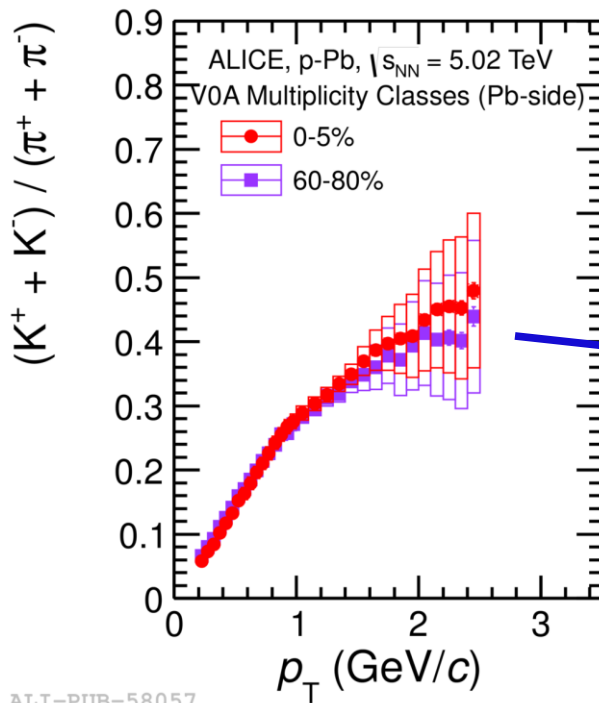
Analysis by
Vytautas Vislavicius





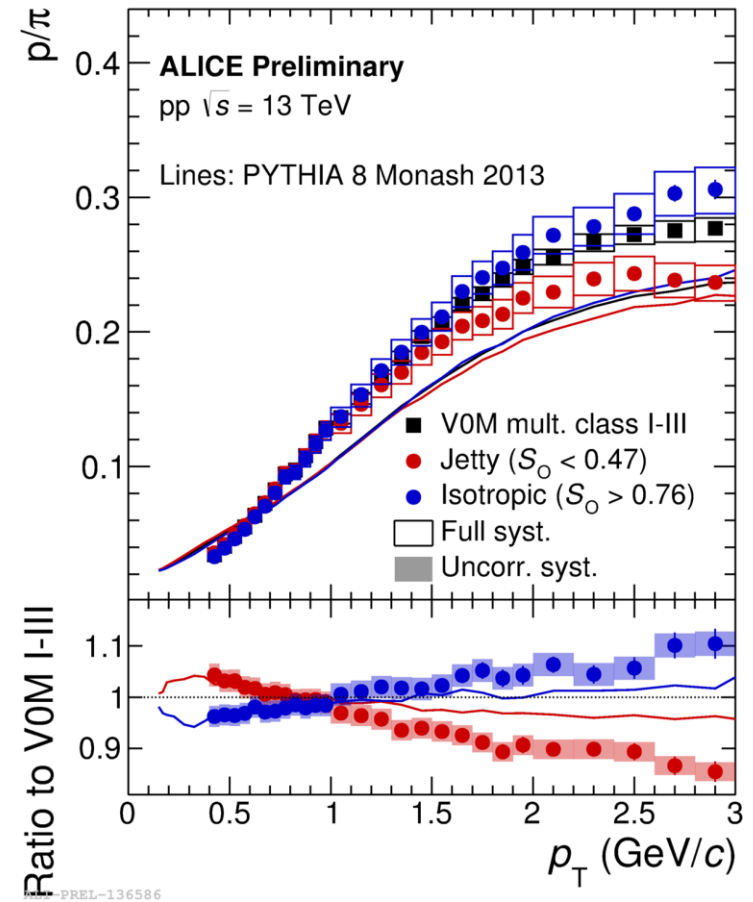
p_T -differential K/π ratios as a function of S_0

- Isotropic:
 - No strong modifications of ratios expected (à la p-Pb)



Analysis by
Vytautas Vislavicius

p_T -differential p/π ratios as a function of S_0

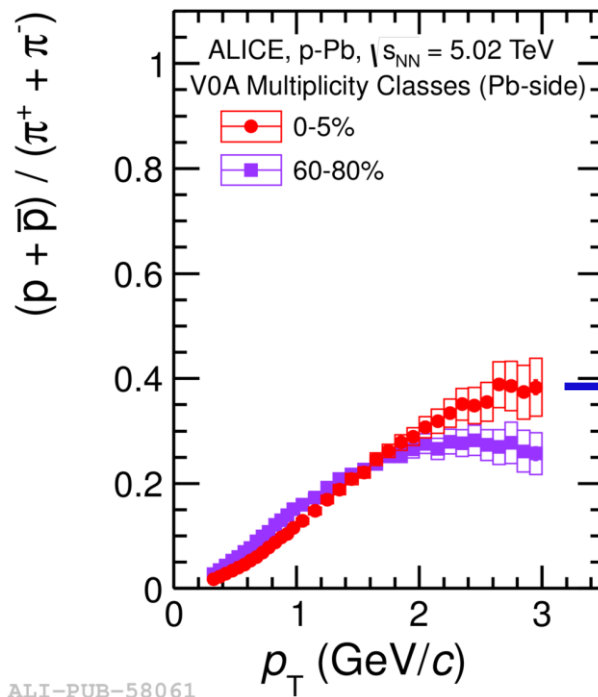


Analysis by
Vytautas Vislavicius



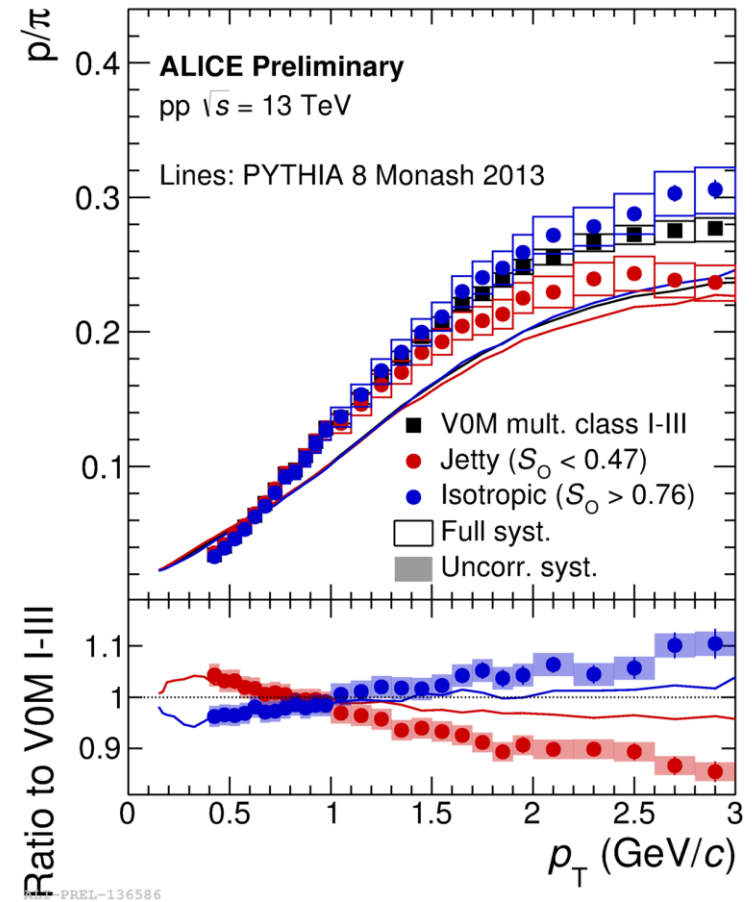
p_T -differential p/π ratios as a function of S_0

- Isotropic:
 - In p-Pb, flow manifests via boosted proton spectra



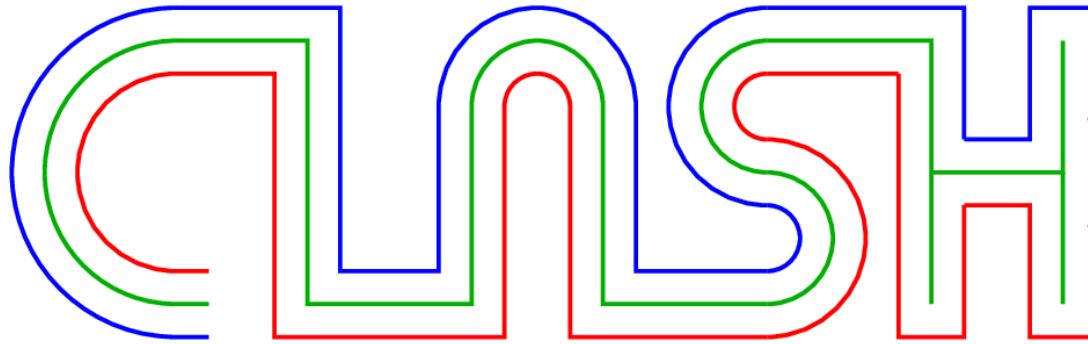
ALI-PUB-58061

Phys. Lett. B 728 (2014) 25-38



Analysis by
Vytautas Vislavicius





Project: **“Pinning down the origin of collective effects in small collision systems”**

Grant: SEK 26 200 000 over five years

Principal investigator: **Associate Professor Peter Christiansen, Lund University**

P. Christiansen (Partikelfysik)

**L. Lönnblad (Teoretisk
högenergifysik)**





Conclusions

- The ALICE TPC
 - Testing of final versions of SAMPA ASIC is ongoing
- Heavy-ion data analysis
 - Small systems continue to puzzle
- Interesting times ahead 😊

Backup



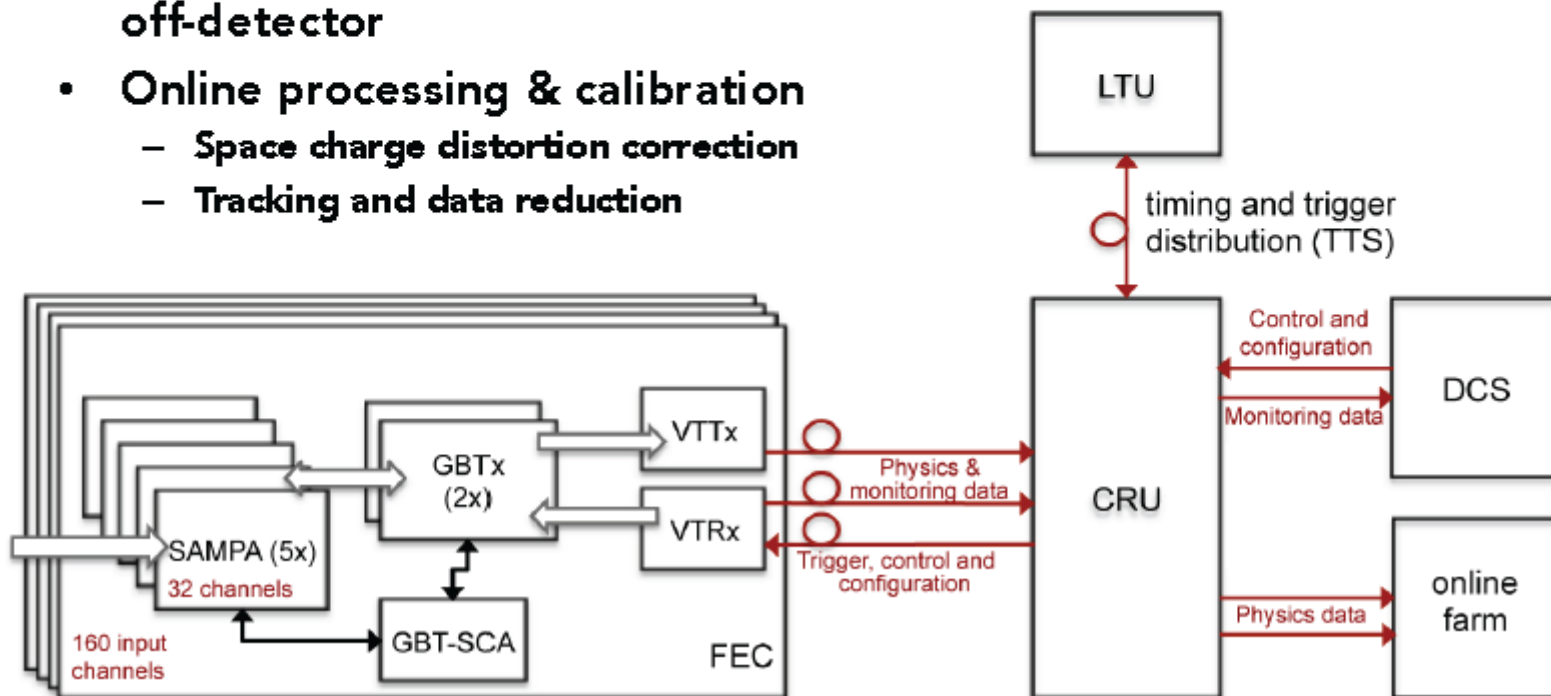


Reduce non-zero data by factor 20 by
Clusterfinding and trackfinding



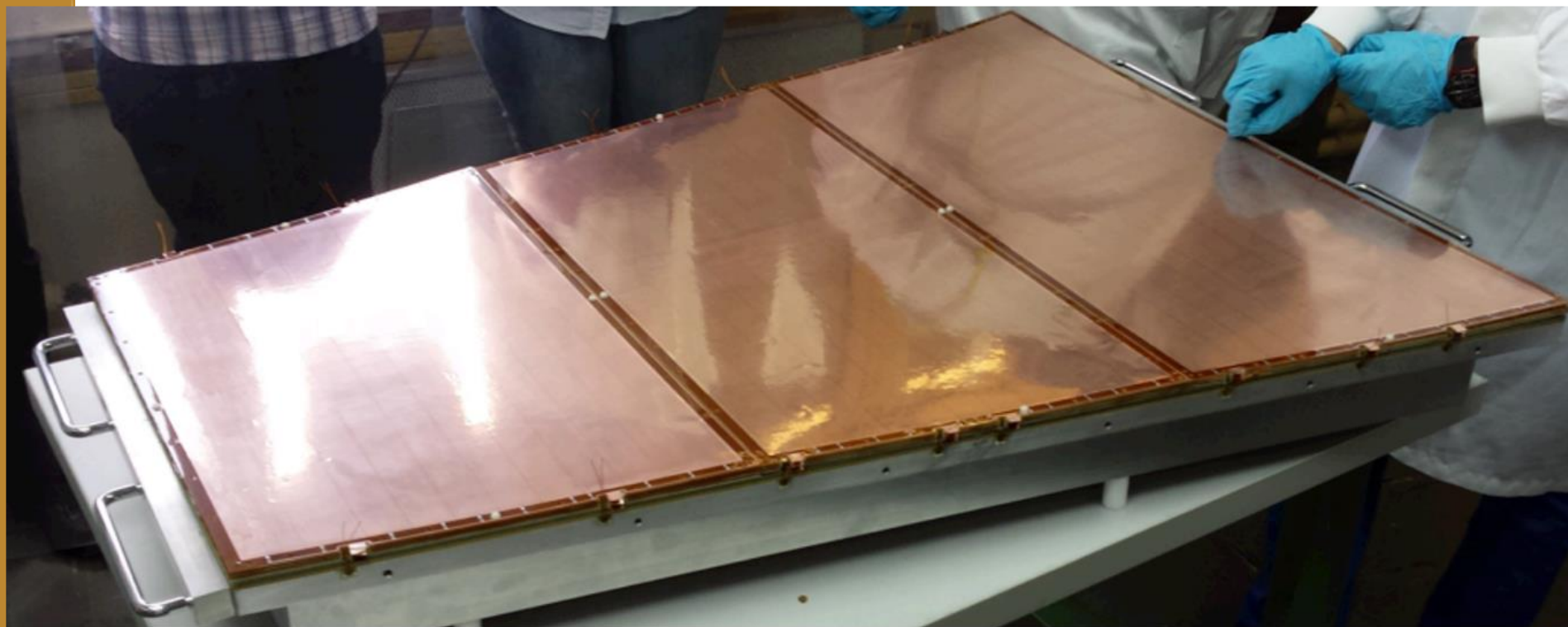
System overview

- **3276 Front End Cards (FEC) on detector**
 - Readout ASIC: SAMPA
 - Readout system: GBT and versatile link
- **360 Common Readout Units (CRU) off-detector**
- **Online processing & calibration**
 - Space charge distortion correction
 - Tracking and data reduction





GEM fabrication modules are large $1/2\text{m}^2$
Substantial progress in fabrication





Noise vs detector capacitance

Noise (Electrons) vs Cap : pcca1_0ohm_20mV_10mhz

