Status of NA62

October 2015

29 Institutes, 233 Collaborators

ACKNOWLEDGMENT

- We are grateful for the proactive commitment of the Funding Agencies
- The NA62 Collaboration wishes to thank for the invaluable support provided by the Support, Technical and Administrative teams of CERN and the Collaborating Institutes

NA62 GOAL

- We aim to measure to 10% or better

$$Br(K^+ \to \pi^+ \nu\bar{\nu})$$

with in-flight kaon decays

- State of the art:

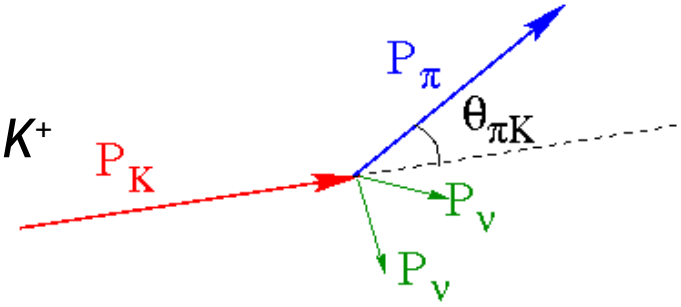
Decay	Branching Ratio ($\times 10^{10}$)	
	Theory (SM)	Experiment
$K^+ \to \pi^+ \nu\bar{\nu}(\gamma)$	0.911 ± 0.072 [1]	$1.73^{+1.15}_{-1.05}$ [2]

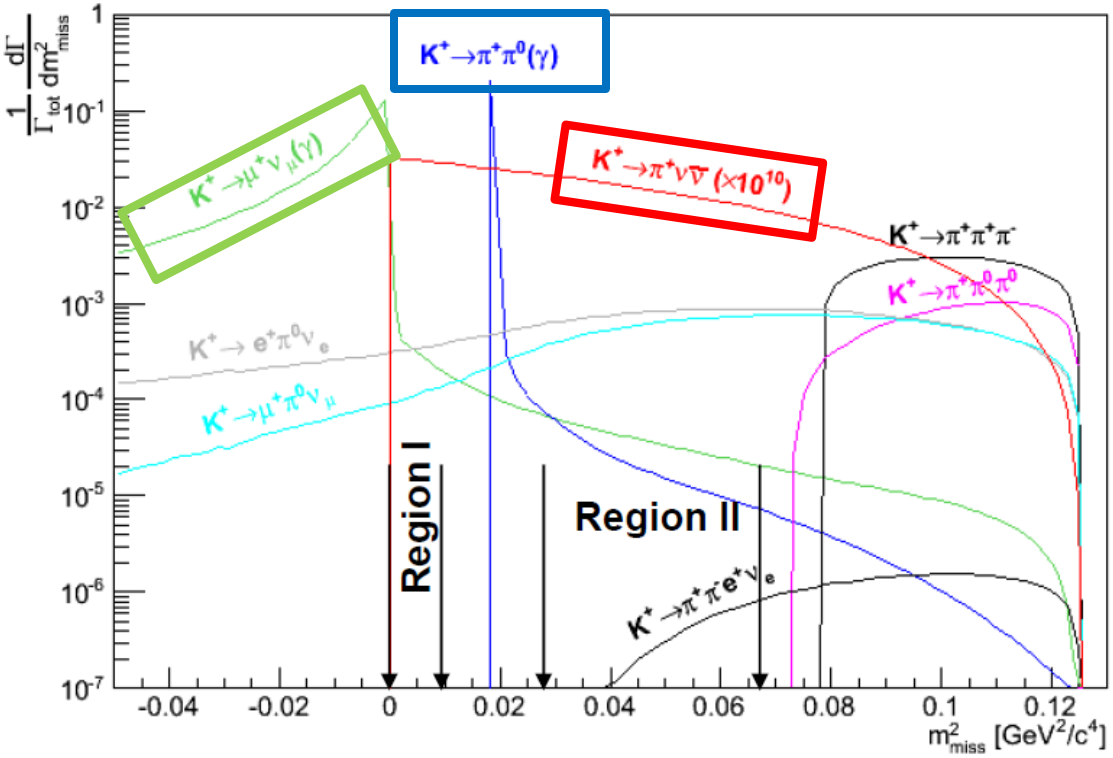
[1] A.J. Buras, D. Buttazzo, J. Girrbach-Noe and R. Knegjens arXiv:1503.02693

[2] AGS-E787/E949 PRL101 (2008) 191802, arXiv:0808.2459

NA62 IN-FLIGHT TECHNIQUE

- Calorimetry to veto extra particles
- Very light trackers to reconstruct the K^+ and the π^+ momenta
- Full particle identification





$$m^2_{miss} = (P_K - P_{\pi^+})^2$$

NA62 EXPERIMENT IN ECN3

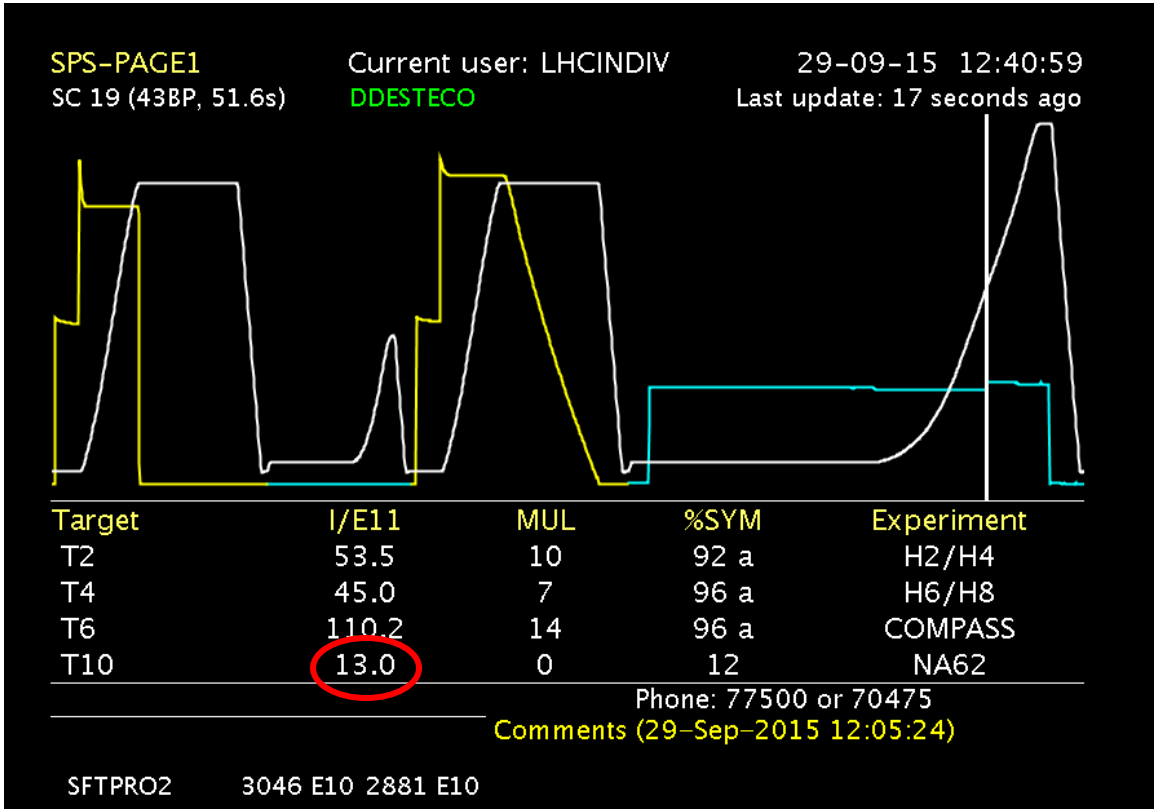
- Beam time 2015: June 22 – November 15
- >10^{10} Kaon triggers on tape
- Intensity: 3 – 13 10^{11} ppp (10 – 40% of nominal)

HIGHLIGHTS SINCE 2014

- MUV1 Installed and commissioned
- GTK TDCpix ASIC thinned to 100 micron (on two of the three installed stations)
- Straw and GTK read out in trigger matching mode
- Digital L0 trigger

Beam Intensity

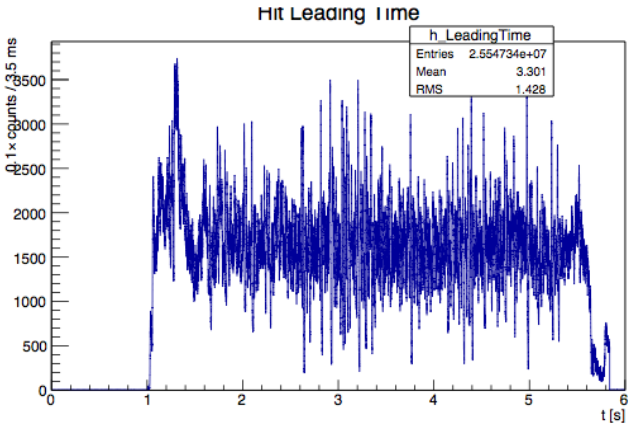
Nominal intensity: 3.3 10^{12}



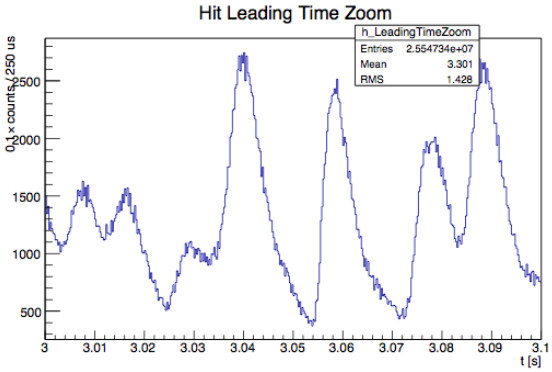
Since the 25th of September we are running at 40% of the nominal intensity

BEAM 50 HZ STRUCTURE

- 50 Hz structure significantly reduced
- Early in the run (seen by GTK):



Zoom in



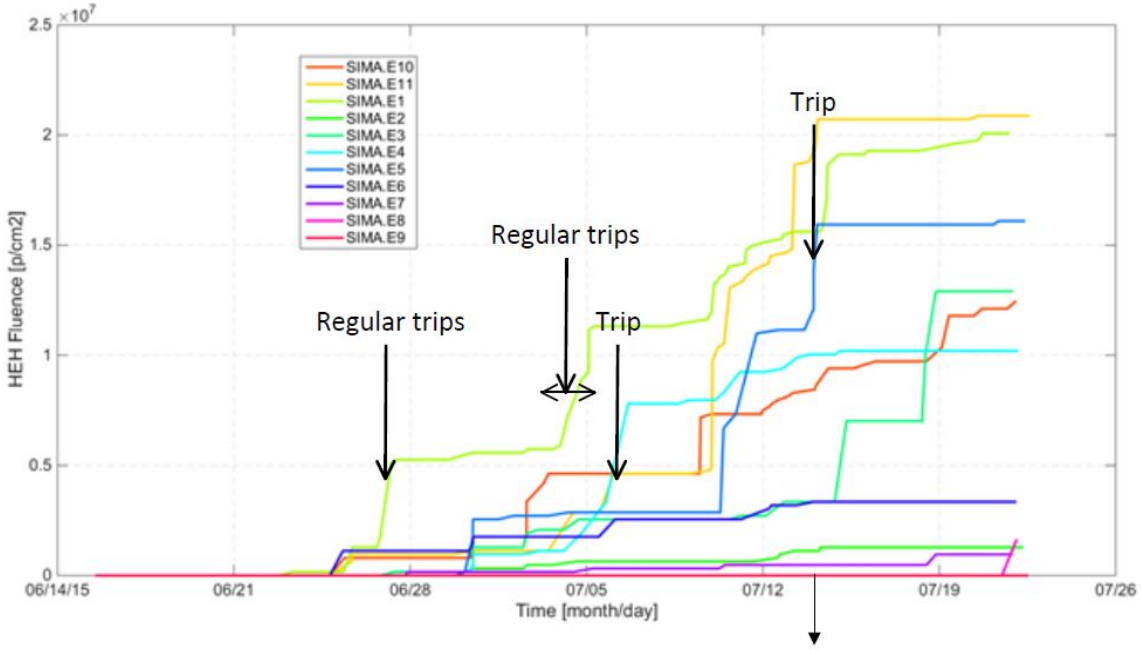
Macroscopically it looked good….

….but microscopically a lot of pressure on the front ends

- SPS experts can reduce the 50-100 Hz structure by feed forward
- Adjustments needed for each change of conditions (e.g. super-cycle etc.)
- The phase of the compensating 50 Hz ripple is adjusted by an automatic procedure, the amplitude not yet

RADIATION AND INTERLOCKS

Dose Rates



Lau Gatignon

- We realized early in the run that the P42 QUADs were not interlocked
- When a QUAD tripped upstream of the target → jumps on the integrated dose

A few critical P42 quads and the main K12 magnets are now in P0-survey. All P42 magnets will be published via DIP so that they can be used by NA62 to flash an alarm box on the screens in the CR. The flatness of the cumulative radiation curves shows the efficiency of the shielding for normal operation

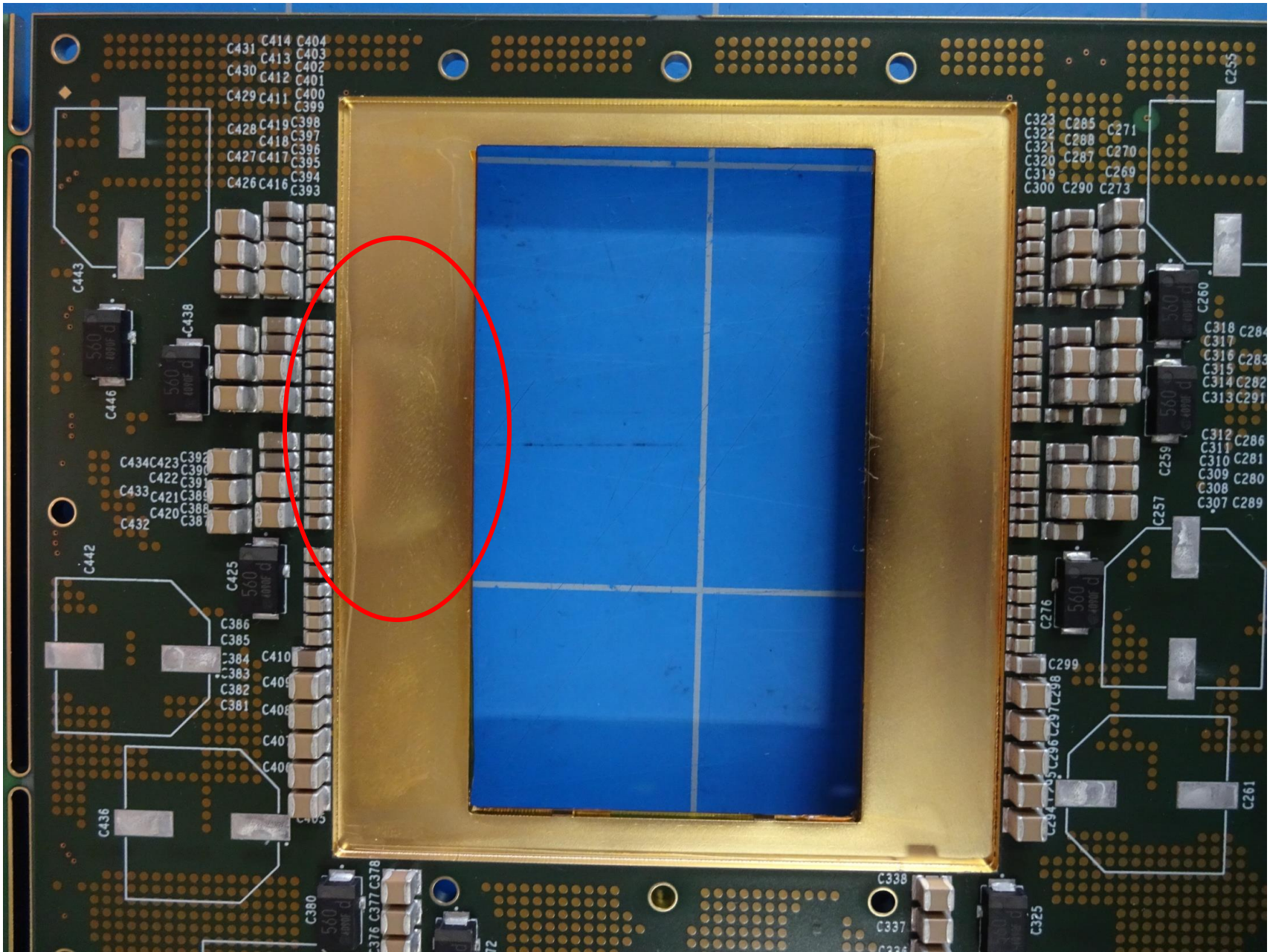
FURTHER SHIELDING IS REQUIRED

- Currently we run at 40% nominal intensity and we need to reload firmware and reset Ethernet switches often
- Further shielding could not be installed during the September Technical Stop
- There is a plan agreed with EN to add shielding for the 2016 run

REQUIRED HARDWARE ACTIONS

- LAV: HV flanges / Connectors / Power Supplies → long term solution
- RICH: (some) piezo-motors / hexagonal mirrors exchange
- LKr: Replacement of the electrolytic capacitors on the transceivers (TX) power supplies
- GTK: Validate Carrier v2, series production of cooling plates, start “industrial” production of 25 detectors
- MUV3: New Constant Fraction Discriminators

After components have been mounted, oven+reflow+cleaning, delamination occurred



Current Read-Out Status

Station 1

- 7 readable chips $\rightarrow$ 7 read-out to PC Farm.

Station 2

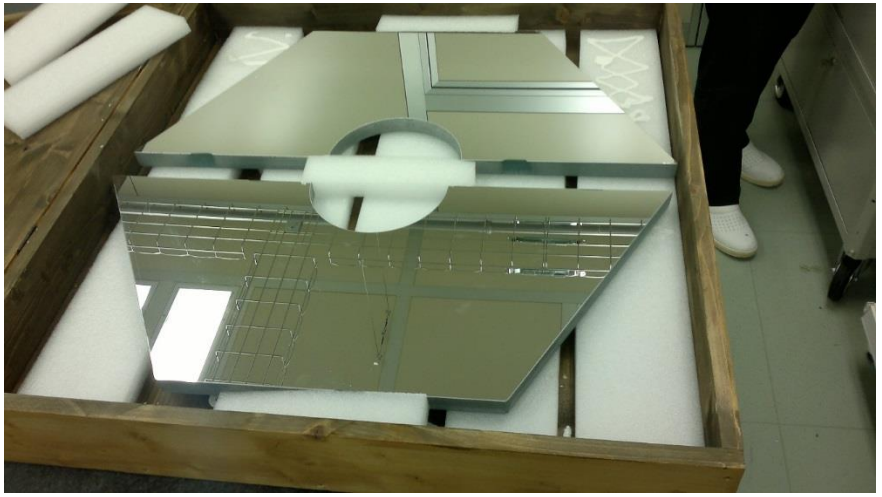
- 8 readable chips $\rightarrow$ 7(+1) read-out to PC Farm.
- one GTK-RO board recently recovered (see later).

Station 3

- 8 readable chips $\rightarrow$ 6 read-out to PC Farm.
- 1(+1) GTK-RO boards with problems (1 probably recoverable).

Spare Mirrors for Replacement

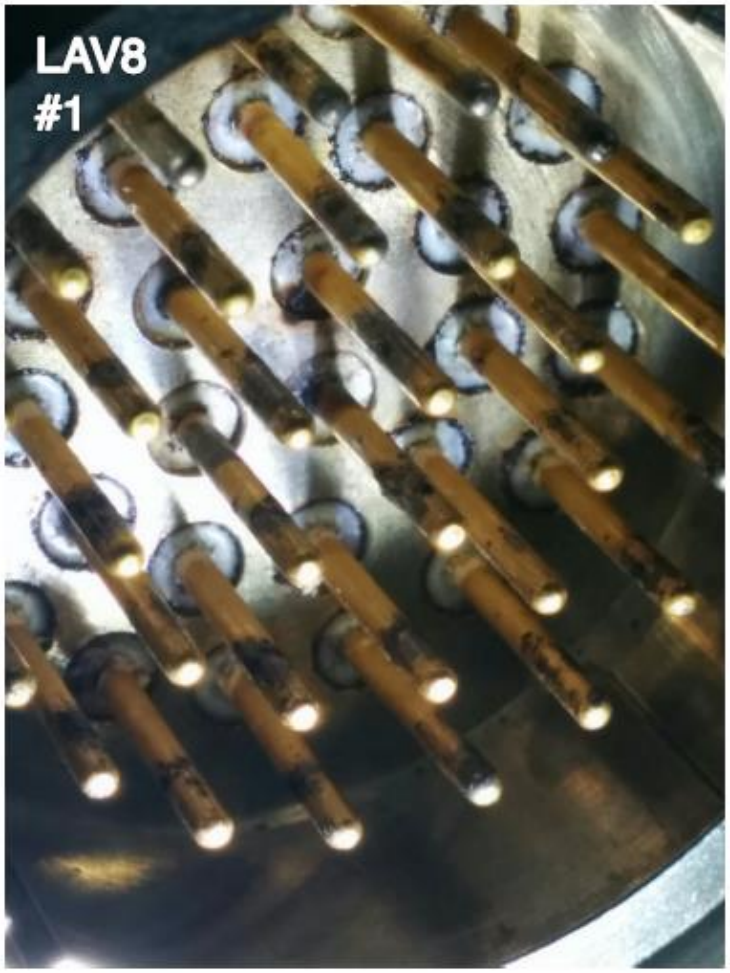
G.Anzivino

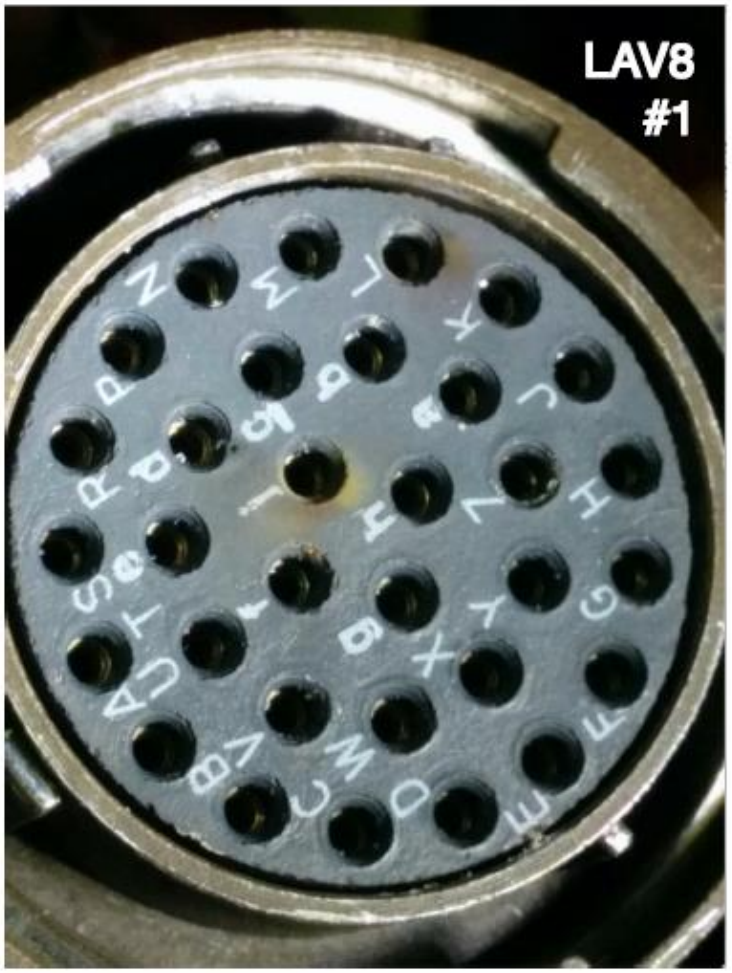


Produced in 2009
Now at Schott to be remachined
Expected back at CERN end of october
Fast optical check
Coating at CERN in november

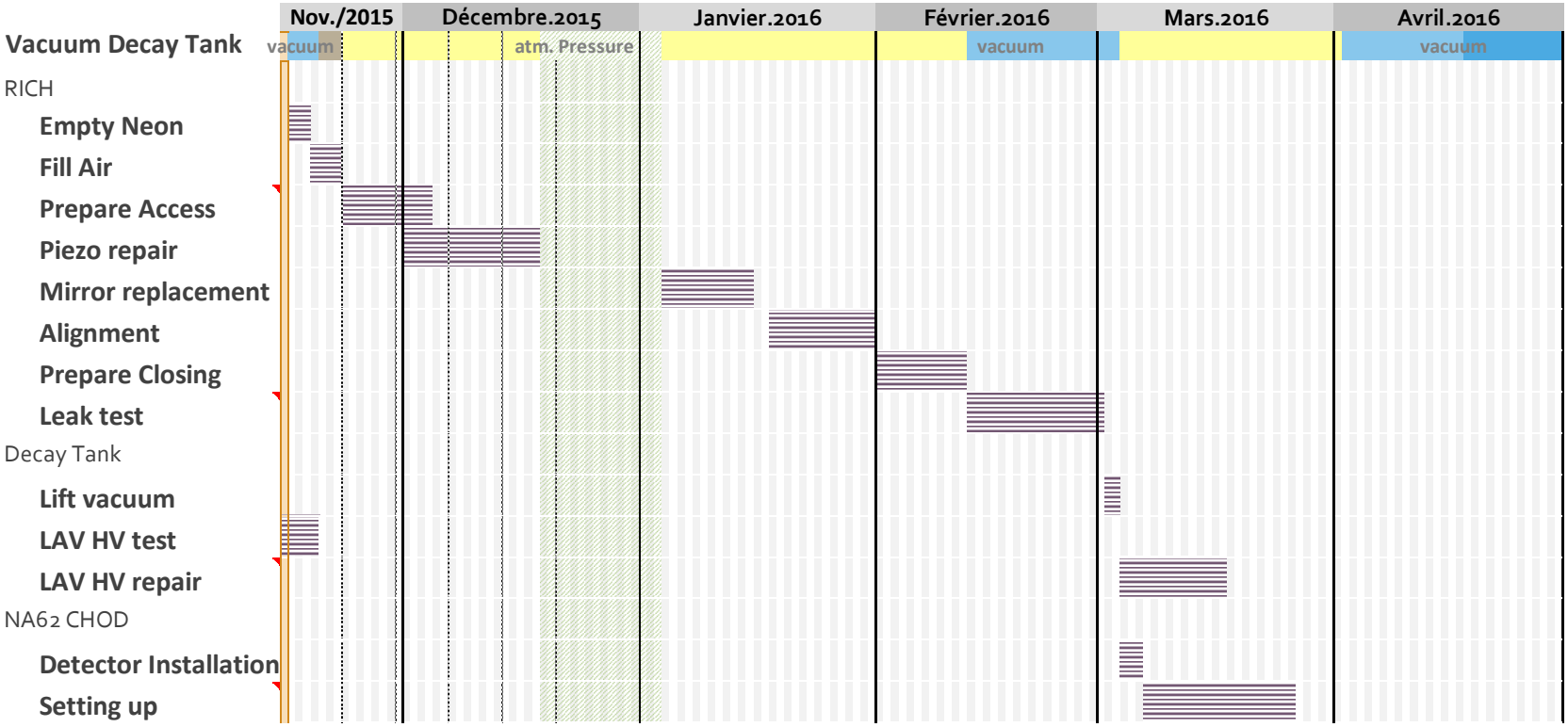
Inspection of LAVs 7, 8

LAV 8 cleaned 6 Aug – LAV 7 cleaned 19 Aug
Both inspected with R. Cometti (Vaqtec) on 23 Sep





Preliminary Shutdown Schedule



Ferdinand Hahn

FIRMWARE / ONLINE

- Stabilize GTK firmware
- Commissioning of the L0 digital trigger (NIM trigger forbidden this year!)
- So far we have run with large L0 downscaling
- The calorimetric trigger (LKr, MUV1 MUV2, IRC, SAC) is being tested
- Network traffic (?) slows down the PC farm operation
- Introduce Multi Event Packet (MEP) > 1 for LKr and Straw
- Evaluate the replacement of the router (no more ports available) / add PC's?
- Implement more elaborated high level triggers

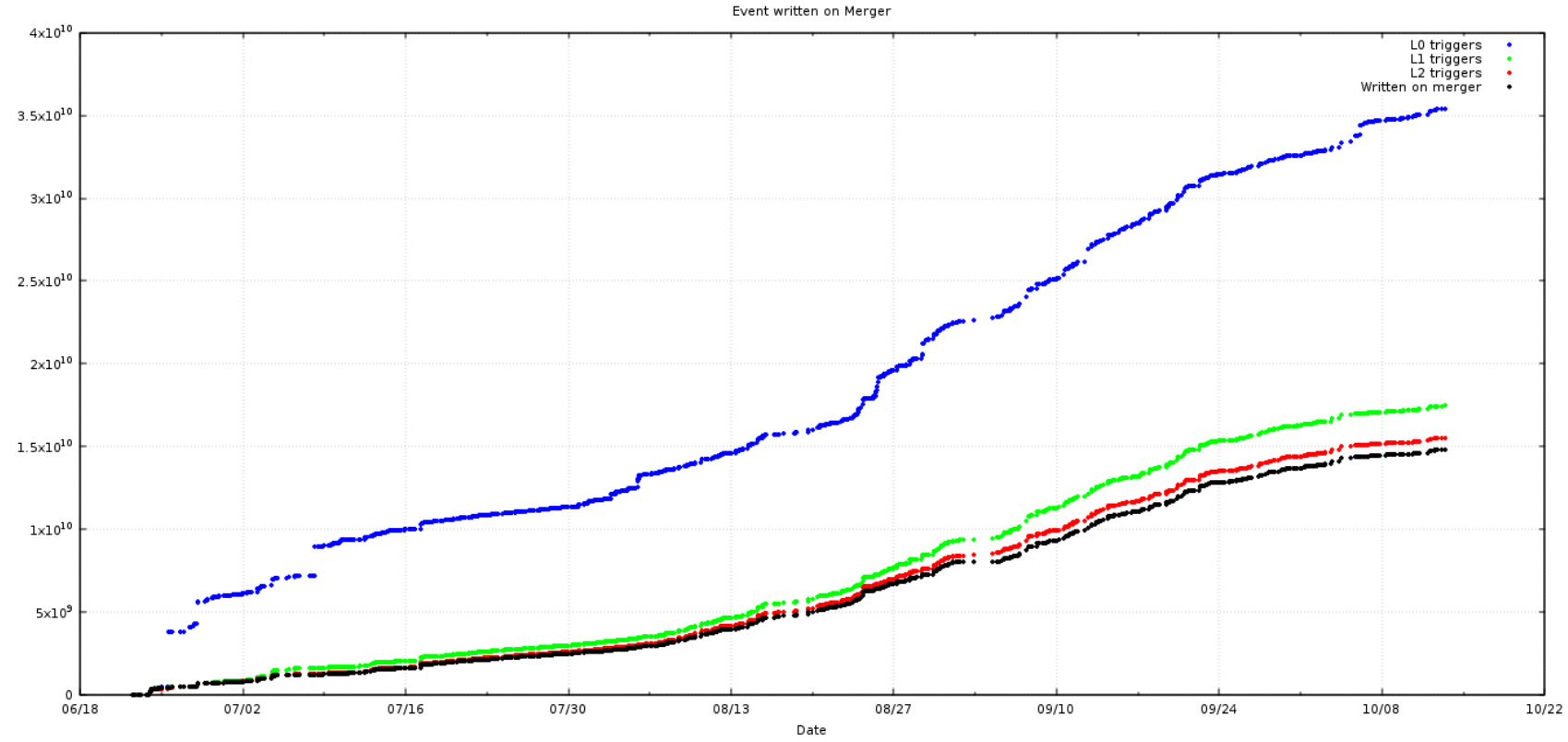
OVERALL SITUATION

- Plan for “stable” PNN data taking for the last few weeks of 2015
- To be in a position to collect a flux of O(10^{13}) decays before LS2 we will need as many days of proton beam as possible
- 100 % nominal intensity not yet established neither for detector capability (40% OK) nor for the digital trigger
- The TDAQ is limiting the experiment
- Requested option to run with 80 10^11 ppp on T4 during the last week (allowing us to reach up to 120 % nominal intensity) in view of next year operations

…AND NOW SOME GOOD NEWS…

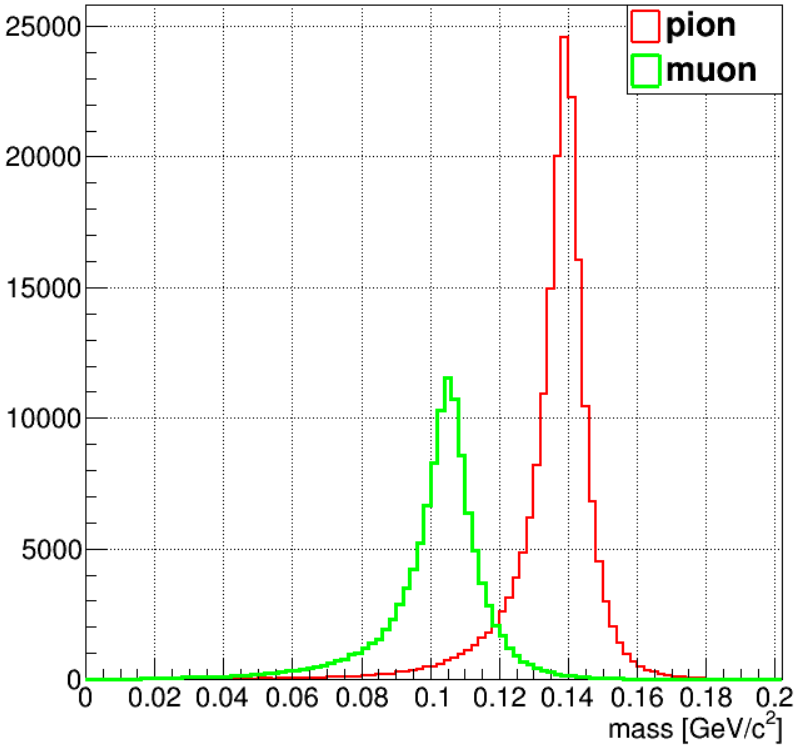
NA62 2015 data, not even preliminary

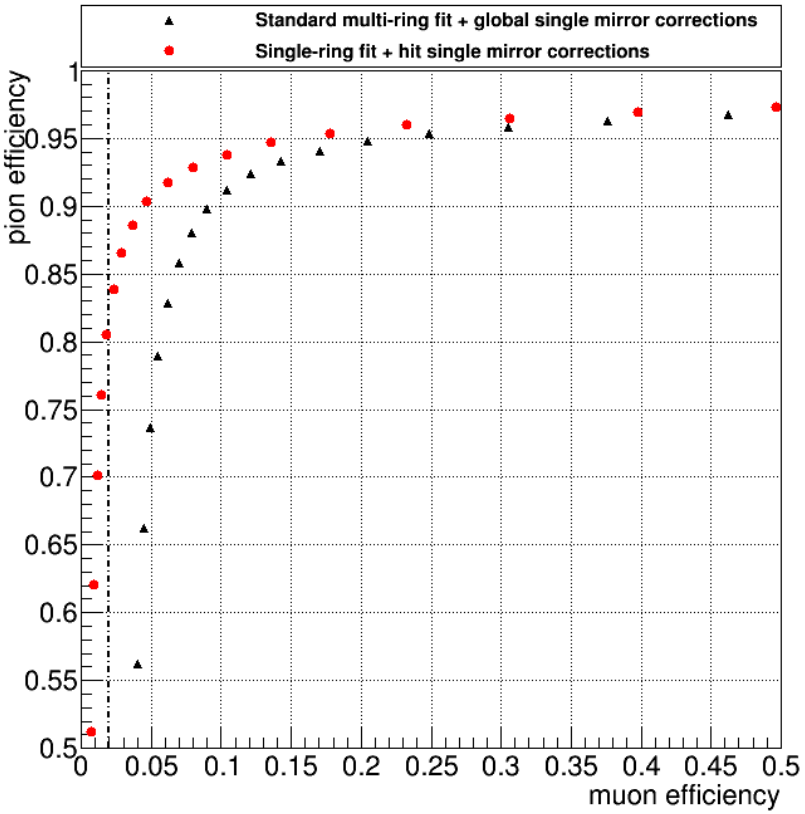
2015 DATA TAKING SO FAR...



RICH pion-muon separation

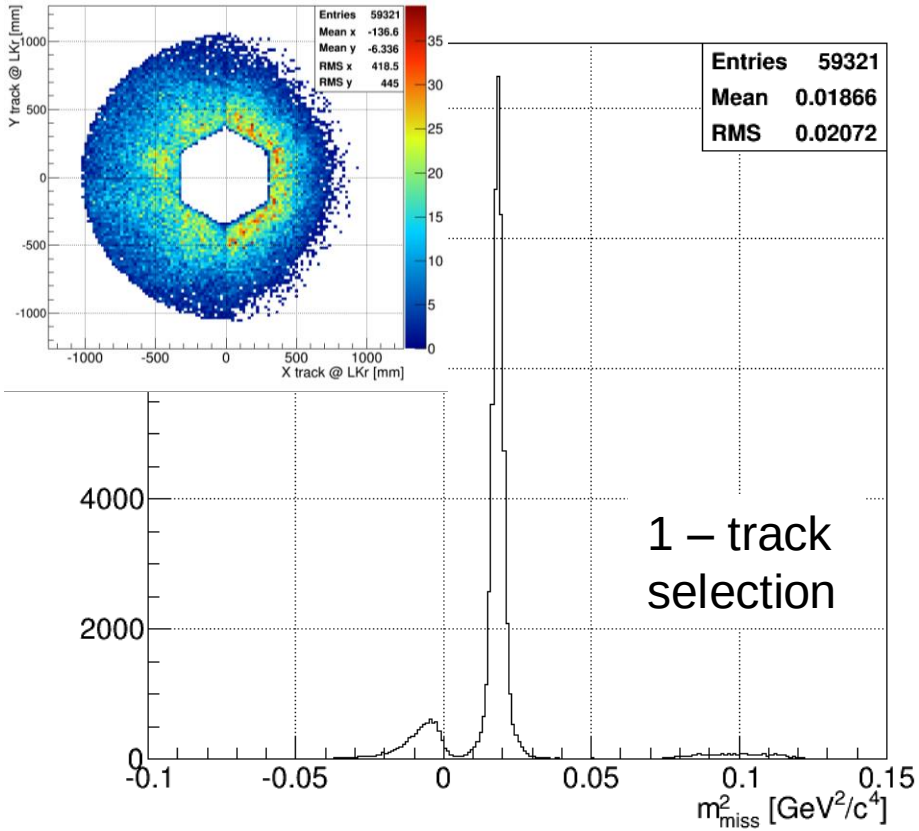
- $\langle m_\pi \rangle = 0.1392\ GeV/c^2$
- $\langle m_\mu \rangle = 0.1050\ GeV/c^2$

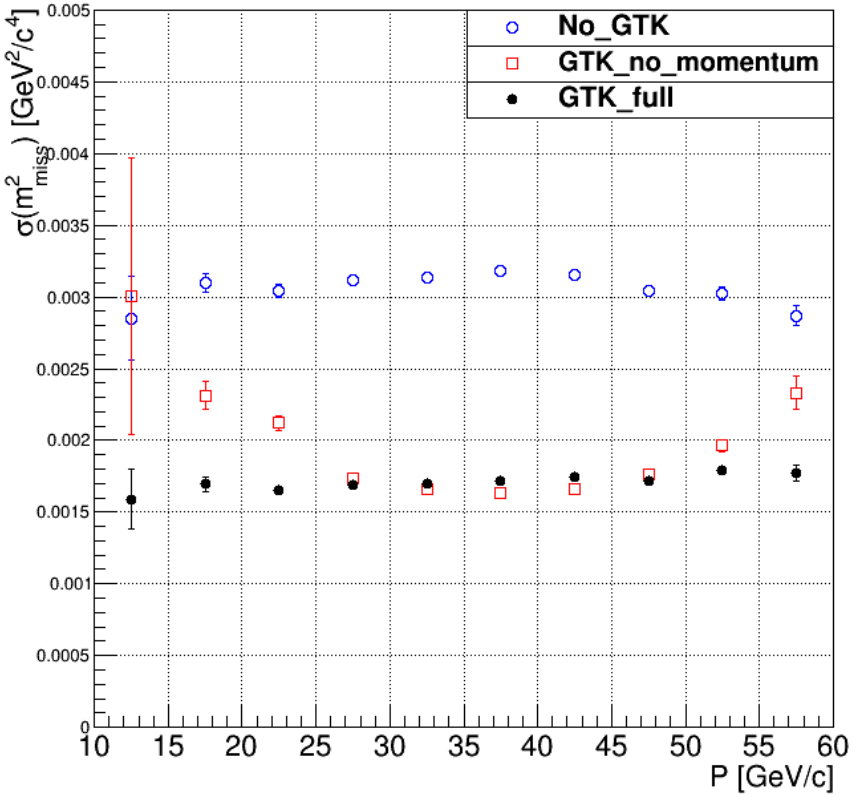




- muon rejection factor x 50, pion efficiency 83% (@ $m_\pi > 0.127\ GeV/c^2$)

Kinematics: GTK + Straw

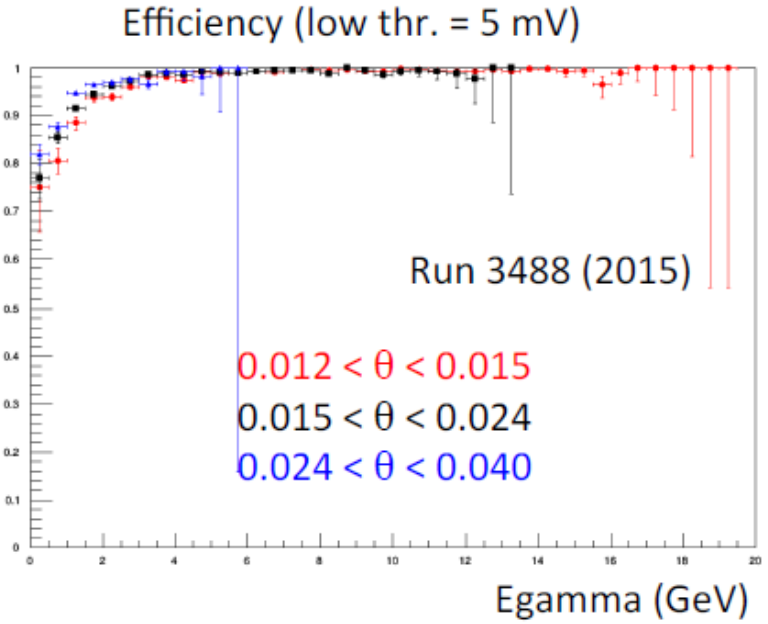




- GTK Beam track time resolution $200 \div 250\ ps$
- CDA vertex resolution ~ 2 mm
- Z vertex resolution < 30 cm

γ – Rejection: LAV efficiency (T.Spadaro)

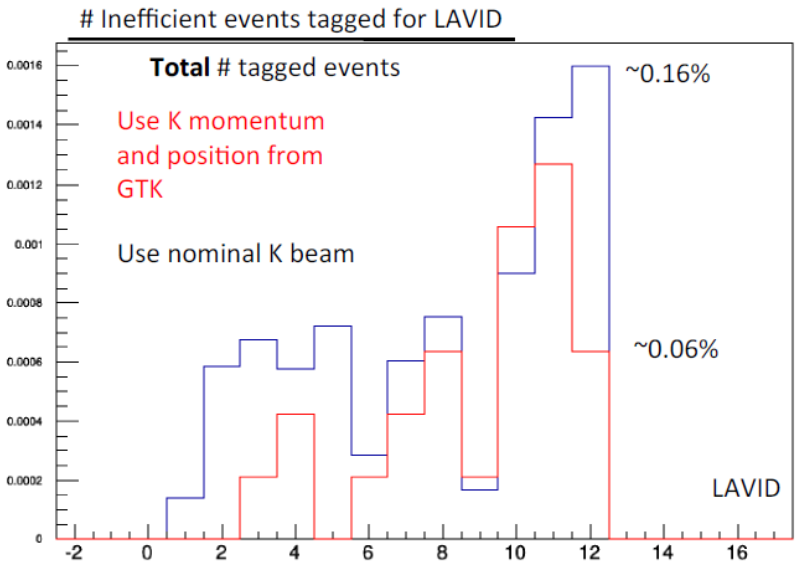
- Method: $\pi^+\pi^0$ events asking for 1 track and 1 photon in LKr to predict the other photon in LAVs' knowing the K momentum.
- Limitation: difficult to disentangle pure LAV inefficiency from geometrical one because of pointer resolution (MC prediction: 15% of inefficient events are due to LAV without GTK).



- Data analysis: hw LAV problems affecting the efficiency randomly experienced in past runs immediately spot by the method (e.g. 1 station missing → up 10% ineff.).

γ – Rejection: LAV efficiency (T.Spadaro)

- Understanding biases of the method

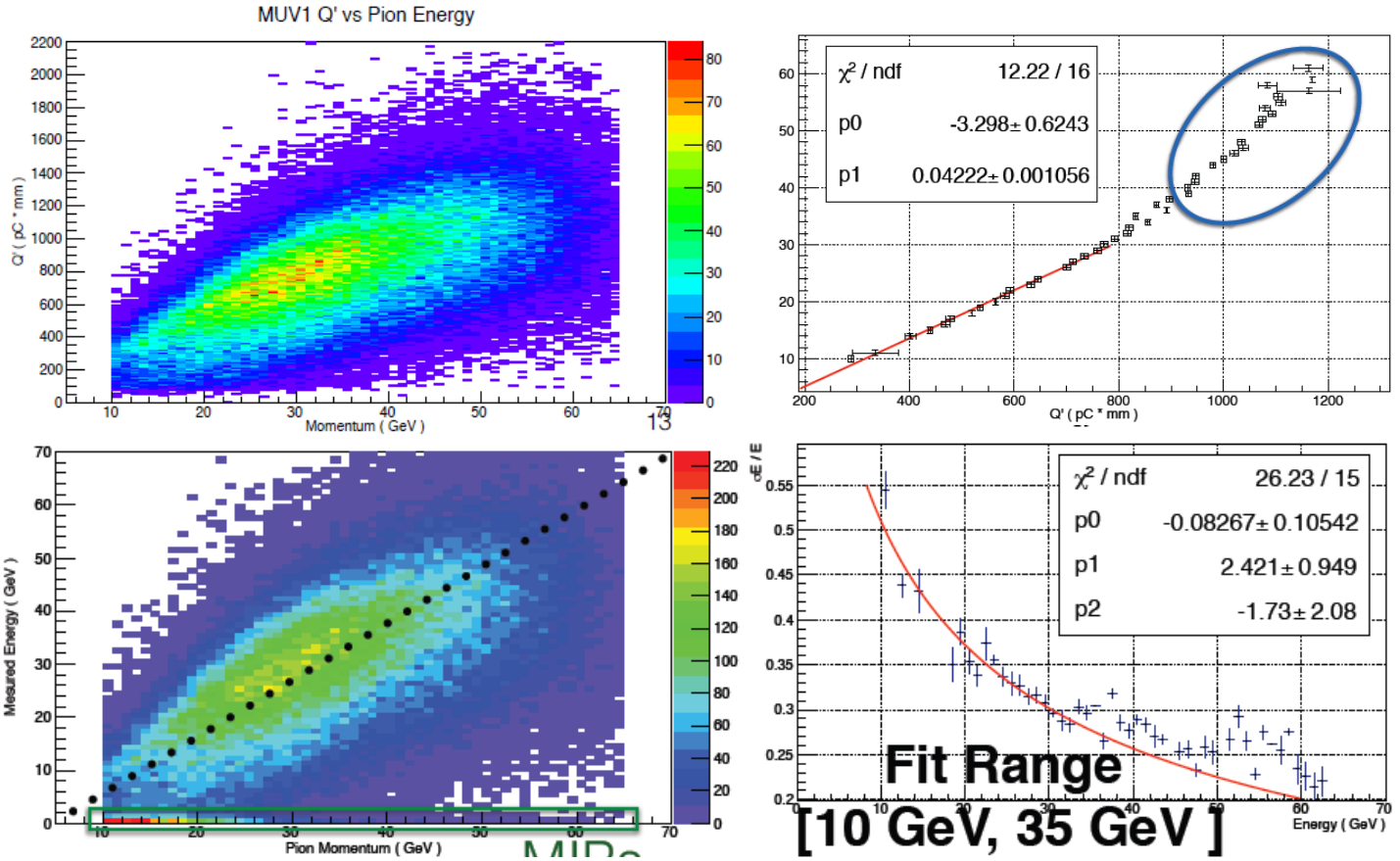


- Improved resolution using GTK: apparent inefficiency 0.84% → 0.5%

- LKr cluster reconstruction inefficiency: apparent inefficiency 0.5% → 0.35%
- Merging clusters in tagging LKr cluster: no evidence
- Photon conversion background: no evidence
- Background from semileptonic K decays: no evidence

PID: Hadronic Showers in MUV1 (R.Aliberti)

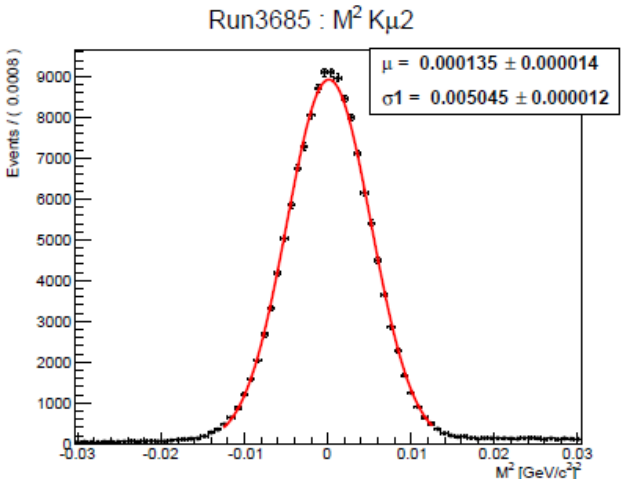
- Variable: $Q' = Q \times SW/NHits$

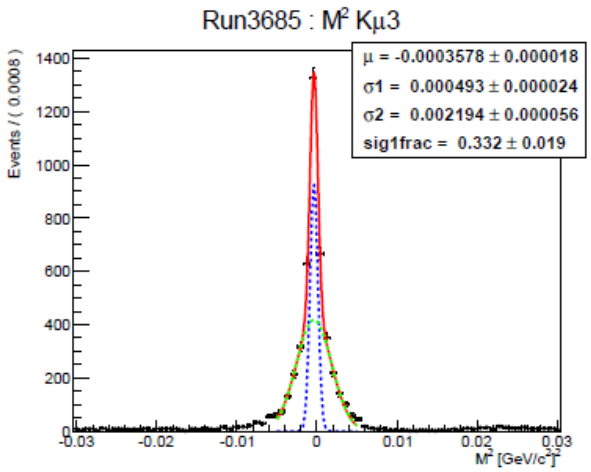


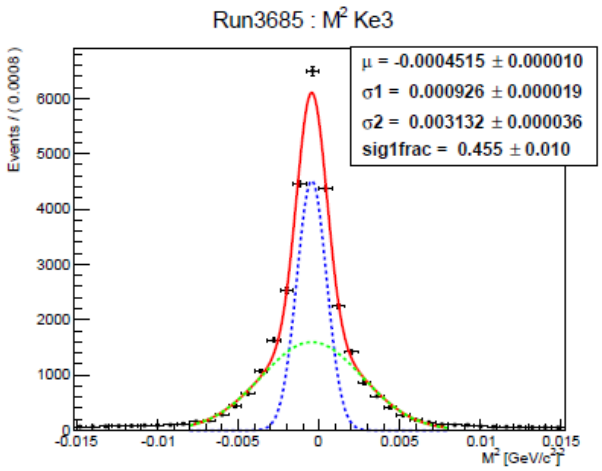
- Energy resolution: 30% at 30 GeV
- The method will be generalized to account for pion showering in LKr, MUV1,2

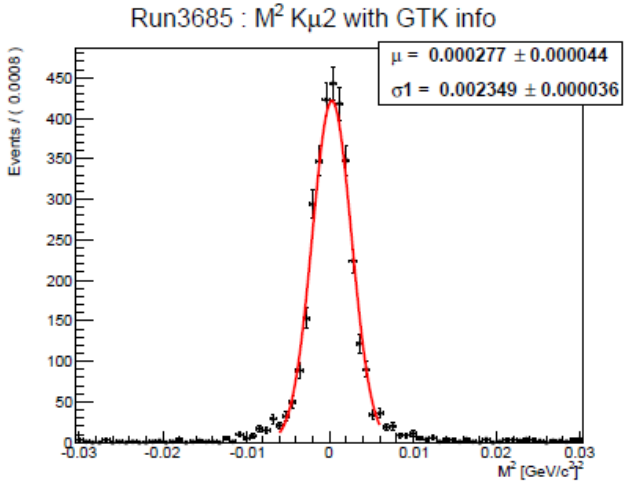
Kaon Main Decay Modes (E.Maurice)

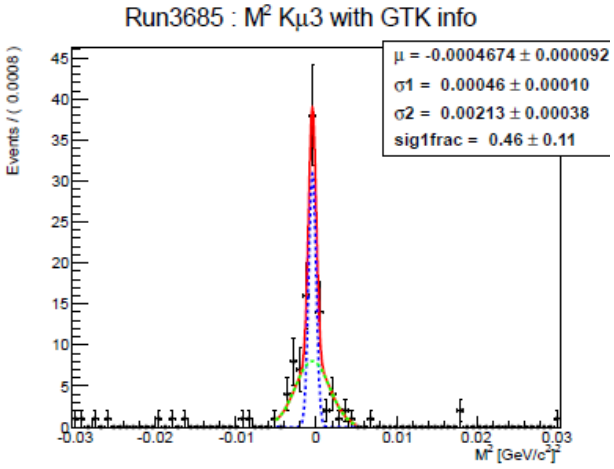
- Run 3685 analyzed. GTK used to test improvements in kinematic resolution.
- Common selection blocks prepared for different decay modes.
- Muon ID, Electron ID, π^0 Reconstruction (LKr), Kaon ID.
- Package well suited also for «online» physics data quality monitoring.

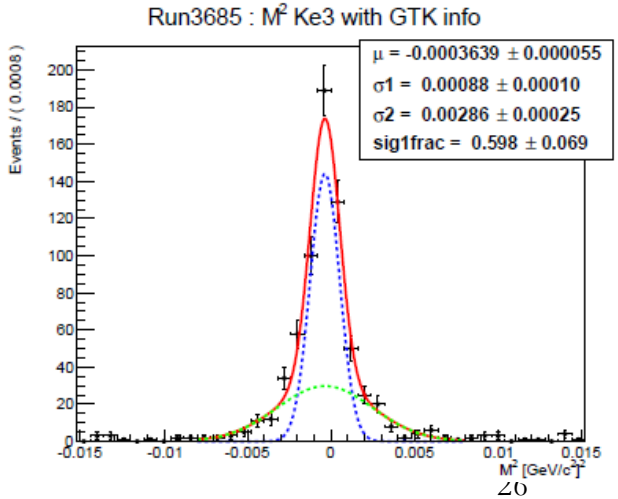












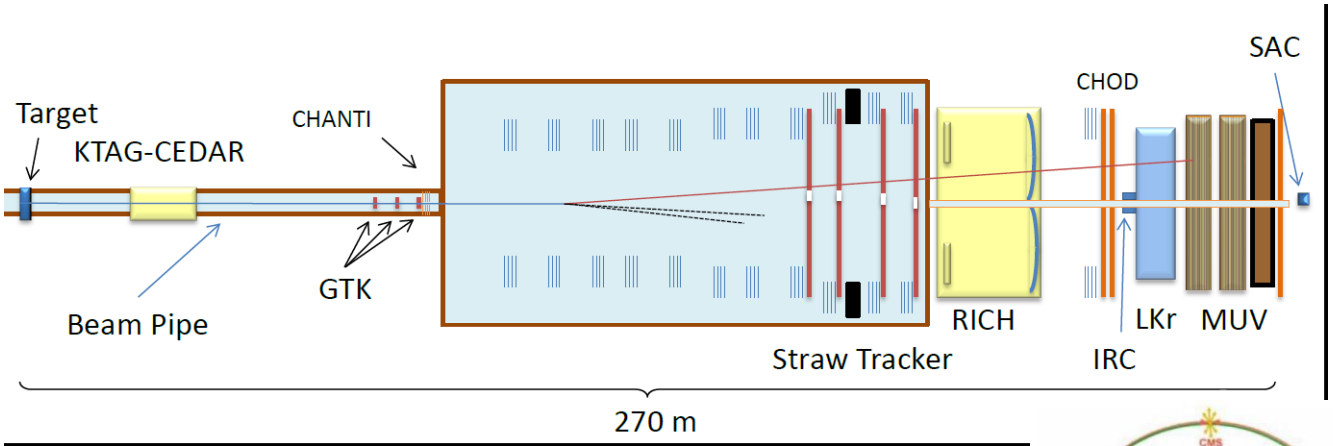
STATUS OF NA62: OUTLOOK

- 2015 was instrumental to collect a first significant sample of kaon decays with the complete detector
- We have fixed a lot of bugs and learned a lot of “features”
- We must improve radiation shielding and operation safety
- We must improve the TDAQ
- We have some hardware intervention to perform during the YETS (RICH, LAV, LKR TX)
- Beam Request 2016:

We request as much as possible proton time in 2016.

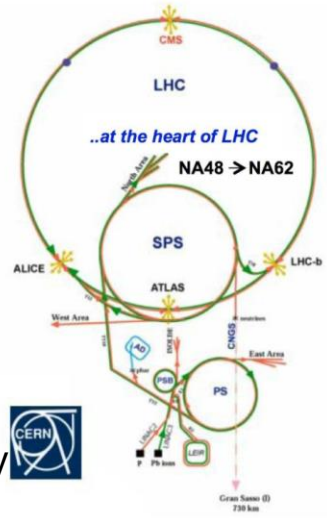
- Goal: Accumulate and analyze O(10^{13}) good kaon decays before LS2

NA62 SCHEMATIC LAYOUT



10^{12} / s protons from SPS (400 GeV/c) on Be target (~1 λ)

750 MHz secondary beam: 75 GeV/c
- **Positive polarity**
- **Kaon fraction ~6%**
- **Δ p/p ~ 1%**
- **Useful kaon decays ~10% (5 MHz)**



NA62 is designed for a specific "silver bullet" measurement. This requires high beam rate, full PID, hermetic coverage, very light, high-rate tracking and state-of-the-art trigger and DAQ. It paves the way to a broad physics program