The NA62 Experiment: Status and Perspectives

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CERN, 10/03/2015

Outline

- Kaon Physics: overview
- (Brief) theoretical introduction to $K \rightarrow \pi\nu\bar{\nu}$
- NA62 @ CERN SPS
- Conclusions

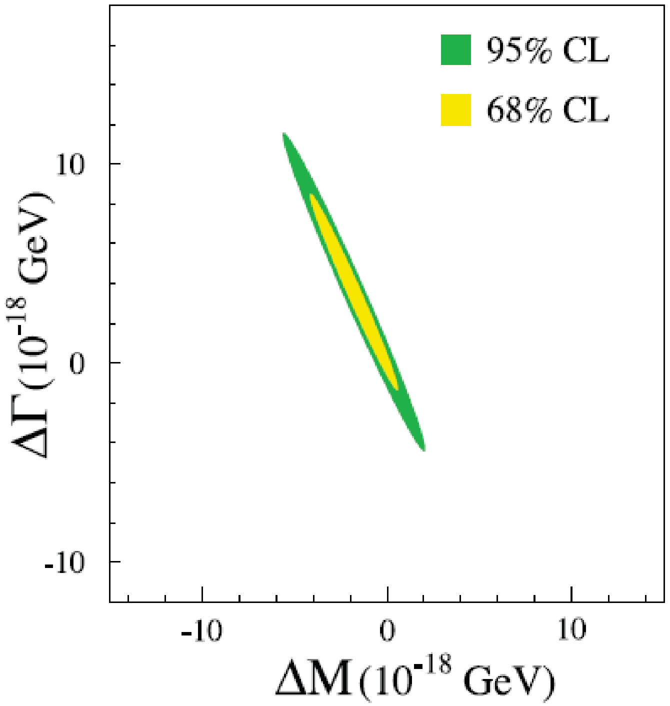
Kaon Physics: a Building Block of the Standard Model

- Discovery of strange particles: first observation of a quark-flavour not present in the ordinary matter *[Nature 160 4077 (1947) 855]*
- Postulation of neutral meson oscillation *[Phys. Rev 97 (1955) 1387]*
- θ - τ puzzle: first hint of P violation *[Phys. Rev. 104 (1956) 254]*
- Discovery of CP violation in the K^0 mixing *[Phys. Rev. Lett. 13 (1964) 138]*
- 3 quark-model to describe the observed meson / baryon spectra *[Phys. Lett. 8 (1964) 214]*
- Prediction of the c quark to explain the unexpectly low observed branching ratio of the decay $K_L \rightarrow \mu^+\mu^-$ *[Phys. Rev. D 2 (1970) 1285]*
- First evidence of direct CP violation in the K^0 (NA31@ CERN) *[Phys. Lett. B 206 (1988) 169]*
- Measurement of direct CP violation in the K^0 (NA48@CERN, KTeV@FNAL) $\mathcal{Re}(\varepsilon'/\varepsilon) = (16.8 \pm 1.4) \times 10^{-4}$ *[Phys. Lett. B 544 (2002) 97, Phys. Rev. D 83 (2010) 092001]*

Kaon Physics: Toward the Present Era

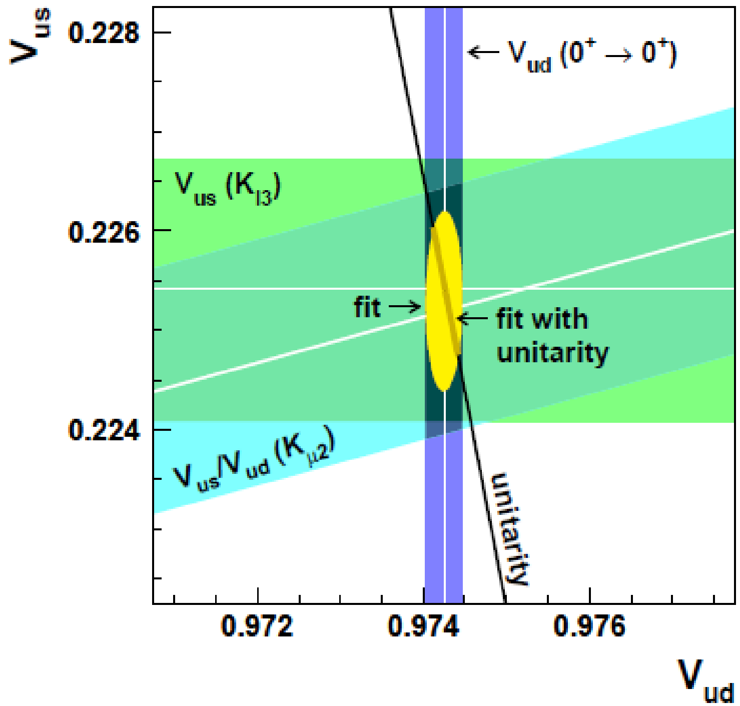
- Kaon Experiments [1995 – 2010]
  NA48 (CERN), KTeV (FNAL), KLOE (LNF), CPLEAR (CERN), E865 (BNL), ISTRA+ (Protvino)

- Test of CPT symmetry invariance



[K.A. Olive et al. (Particle Data Group, Chin. Phys. C, 38, 090001 (2014)].

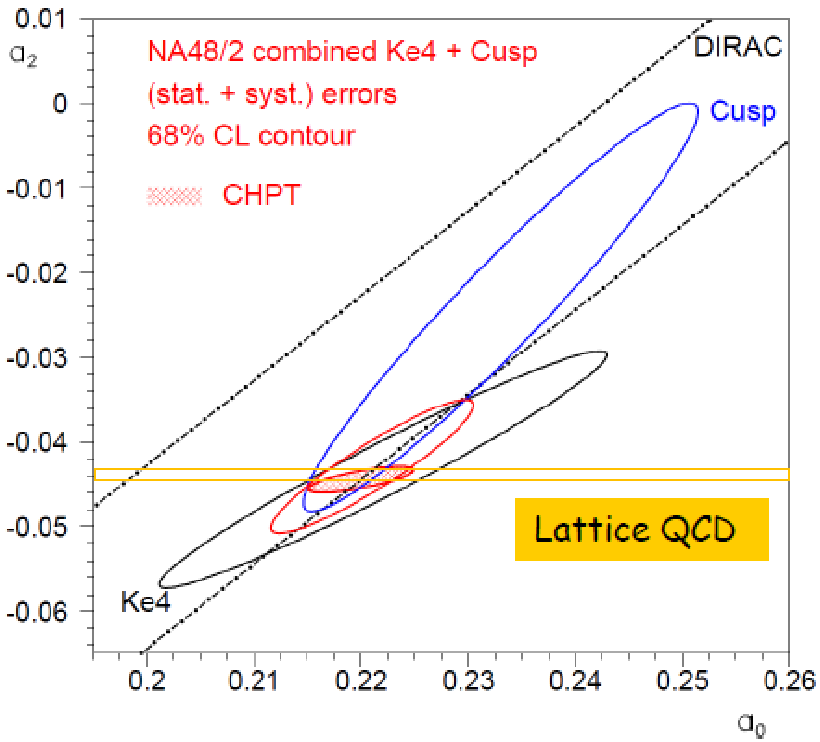
- Precision test of the CKM unitarity



[Eur. Phys. J. C 69 (2010) 399].

Kaon Physics: Toward the Present Era

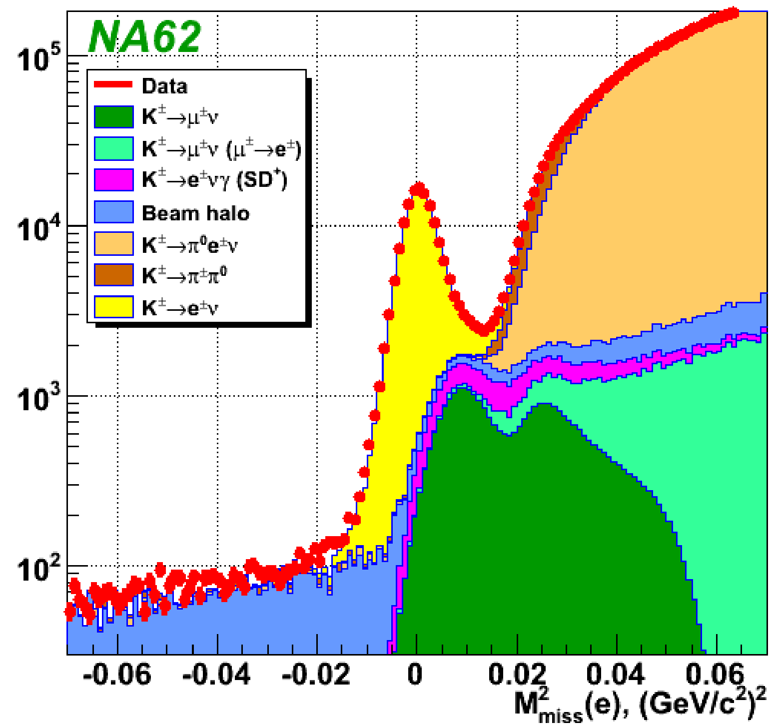
- Tests of low energy QCD



[Eur. Phys. J. C 70 (2010) 635]

- Test of lepton universality

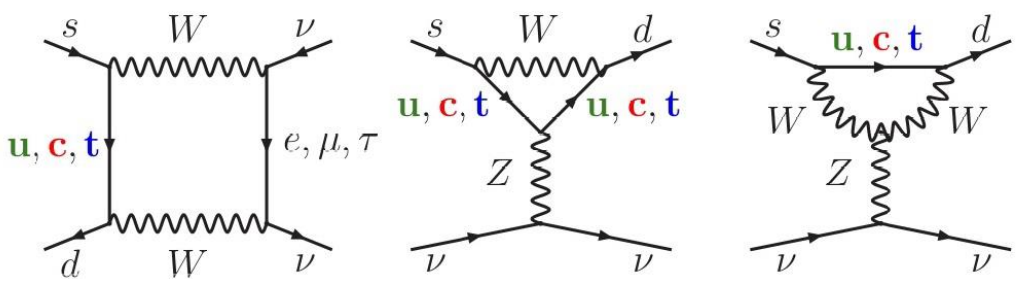
$$R_K = \frac{\Gamma(K^\pm \to e^\pm \nu)}{\Gamma(K^\pm \to \mu^\pm \nu)} = (2.488 \pm 0.010) \times 10^{-5}$$



[Phys. Lett. B 719 (2013) 326]

The $K \to \pi\nu\bar{\nu}$ decays: a theoretical clean environment

- FCNC loop processes: s→d coupling and highest CKM suppression



- Very clean theoretically
  - Short distance contribution
  - No hadronic uncertainties

- SM predictions *[Brod, Gorbahn, Stamou, Phys. Rev. D 83, 034030 (2011)]*
  [G. Buchalla, A.J. Buras, Nucl. Phys. B 412, 106 (1994)]

$BR(K_L \to \pi^0 \nu\nu) = (2.43 \pm 0.39 \pm 0.06) \times 10^{-11}$

$BR(K^+ \to \pi^+ \nu\nu) = (7.81 \pm 0.75 \pm 0.29) \times 10^{-11}$

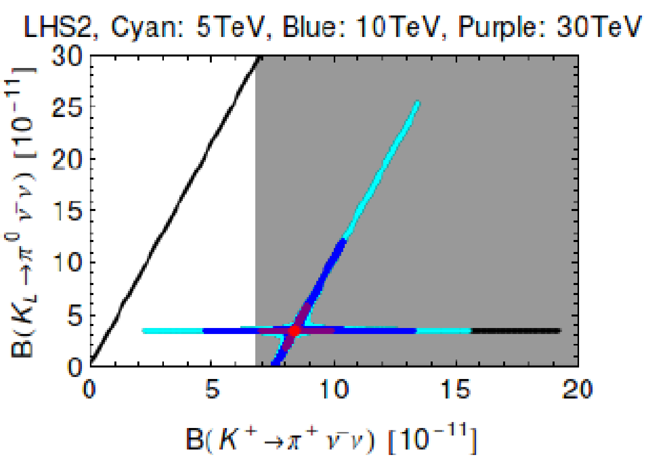
1° error: uncertainty from input parameters

2° error: pure theoretical uncertainty

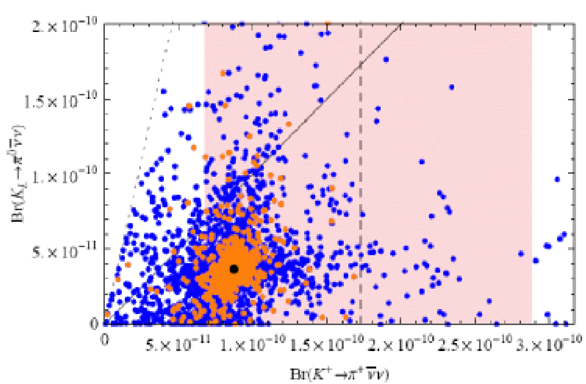
$K \to \pi\nu\bar{\nu}$ NP Sensitivity

- Z′ gauge boson mediating FCNC at tree level *[A.J.Buras et al., JHEP 1302 (2013) 116; A.J.Buras et al. Eur. Phys. J. C74 (2014) 039]*
- Littlest Higgs with T-parity *[Acta Phys. Polon. B 41 (2010) 657]*
- Custodial Randall-Sundrum *[JHEP 0903 (2009) 108]*
- Best probe of MSSM non-MFV (still not excluded by LHC) *[JHEP 0608 (2006) 088]*

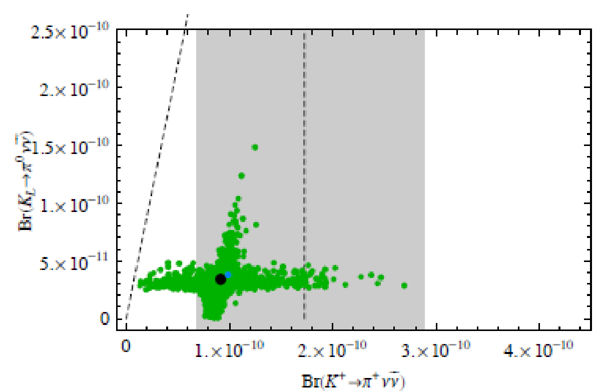
Z′ model



Randall - Sundrum



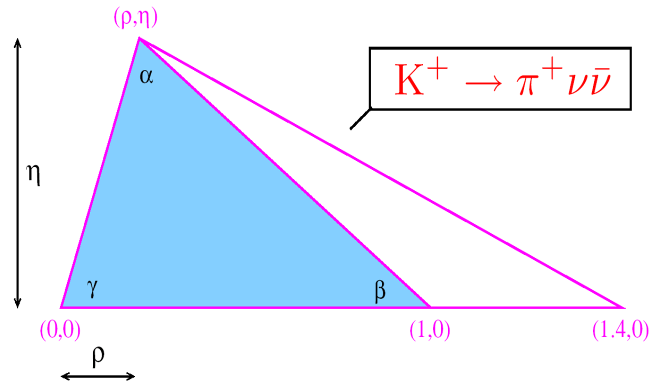
Littlest Higgs



Connection with Flavour Physics

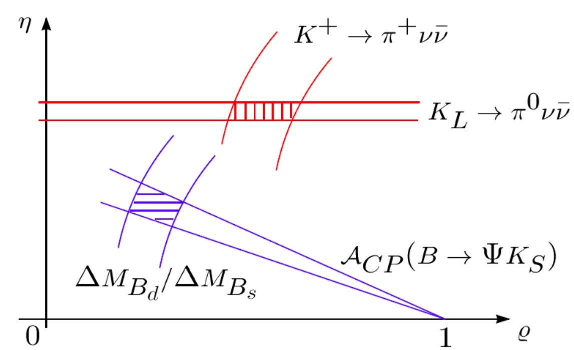
$K_L \to \pi^0 \nu\bar{\nu}$

$$K_L \to \pi^0 e^+ e^- \begin{cases} K_S \to \pi^0 e^+ e^- \\ K_L \to \pi^0 \gamma\gamma \\ K_L \to e e \gamma\gamma \end{cases}$$



$$K_L \to \mu^+ \mu^- \begin{cases} K_L \to \gamma\gamma,\ K_L \to e^+ e^- \gamma \\ K_L \to e^+ e^- e^+ e^-,\ e^+ e^- \mu^+ \mu^- \end{cases}$$

- K physics alone can fully constrain the CKM unitarity triangle.
- Comparison with B physics can provide description of NP flavour dynamics

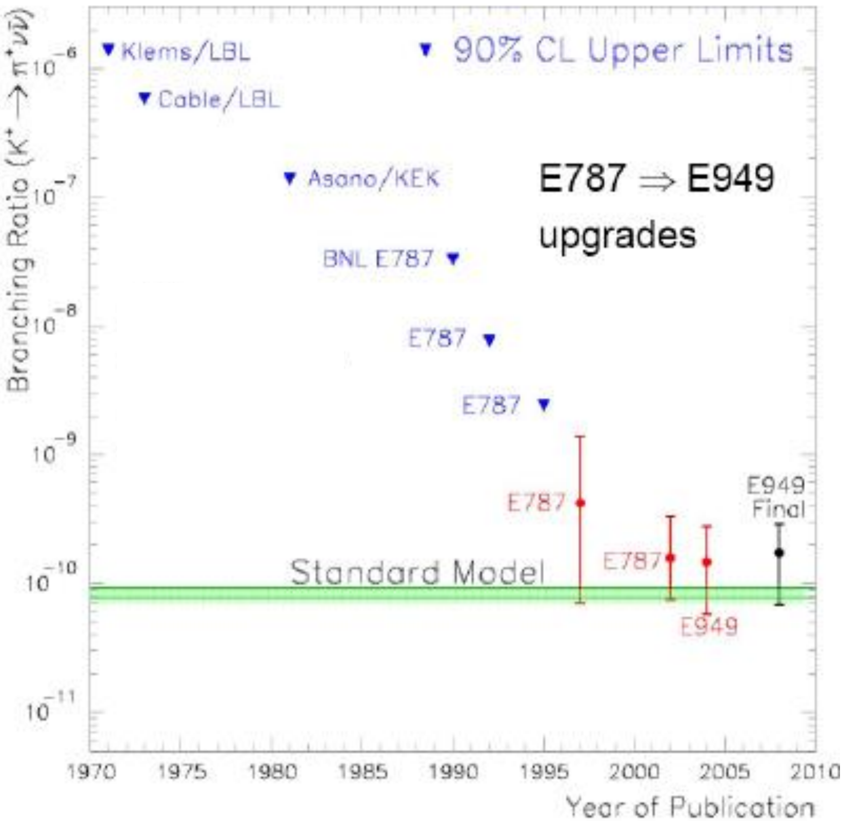


$K \to \pi\nu\bar{\nu}$ in the LHC era: Experimental Requirement

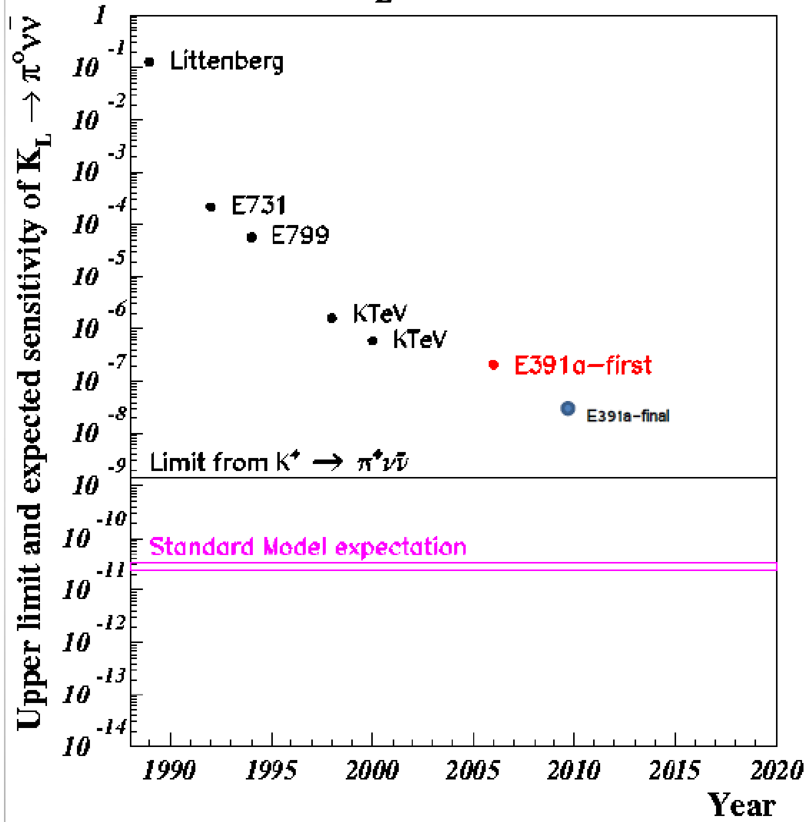
BR($K \to \pi\nu\bar{\nu}$) measurement with < 10% accuracy

$K \to \pi\nu\bar{\nu}$ Experimental State of the Art

$K^+ \to \pi^+\nu\bar{\nu}$



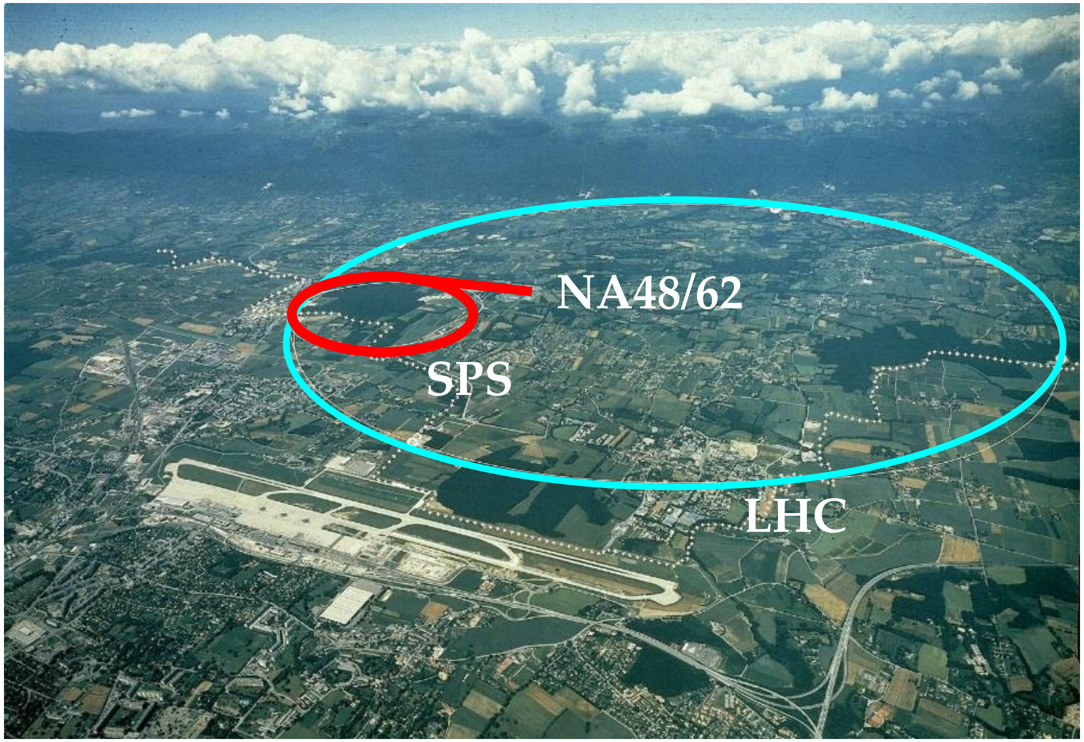
$K_L \to \pi^0\nu\bar{\nu}$



$$BR(K^+ \to \pi^+\nu\bar{\nu}) = \left(1.73^{+1.15}_{-1.05}\right) \times 10^{-10}$$

Phys. Rev. D 77, 052003 (2008), Phys. Rev. D 79, 092004 (2009)

Kaon @ CERN - SPS



'97-'01	NA48: ε'/ε
'02	NA48/1: K_S rare decays
'03-'04	NA48/2: $K^{\pm}$ CP violation, semileptonic, low energy QCD
'07-'08	NA62: Lepton universality (using the NA48 apparatus)

The NA62 Experiment for $K^+ \to \pi^+ \nu \bar{\nu}$

2005 Proposal

2009 Approved

2010 Technical design

2012 Technical run (partial layout)

2014 Pilot Run

2015-18 Physics Runs

Birmingham, BNL, Bratislava, Bristol, Bucharest, CERN, Dubna (JINR), Fairfax, Ferrara, Florence, Frascati, Glasgow, Liverpool, Louvain-la-Neuve, Mainz, Merced, Moscow (INR), Naples, Perugia, Pisa, Prague, Protvino (IHEP) , Rome I, Rome II, San Luis Potosi, SLAC, Sofia, TRIUMF, Turin

The NA62 Experiment for $K^+ \to \pi^+ \nu\bar{\nu}$

- Experiment at CERN – SPS, replacing the NA48 apparatus

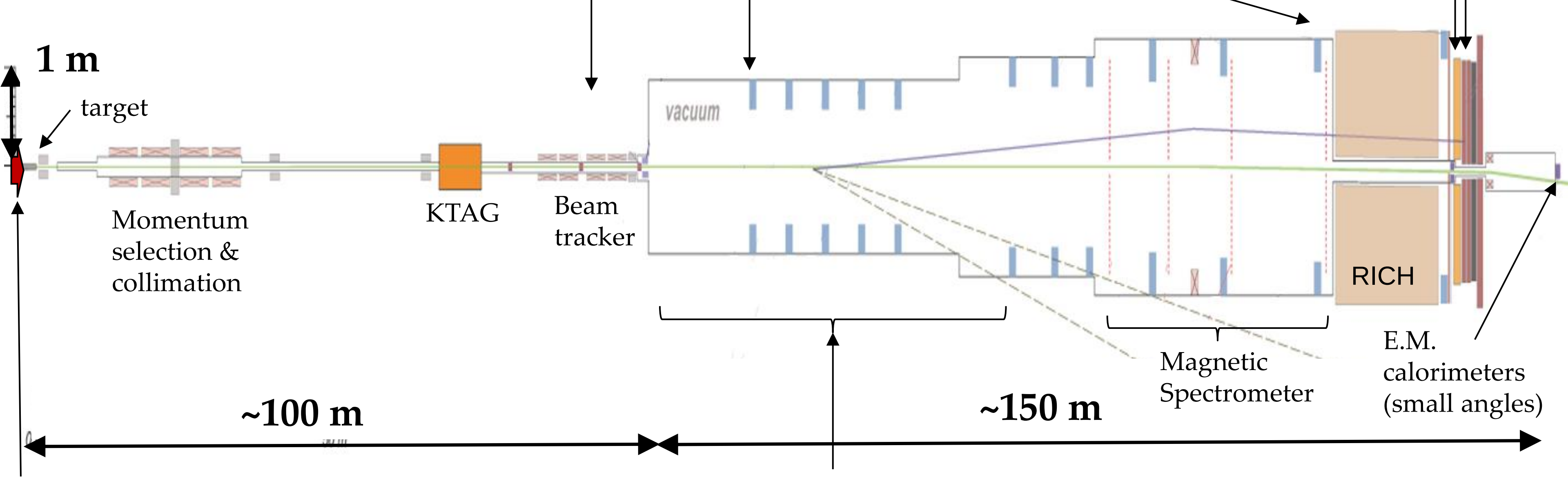
- Goal:
  - 10% precision BR($K^+ \to \pi^+ \nu\bar{\nu}$) in 2 years of data

- Requirements:
  - Statistics: O(100) events [BR(SM) ~ 8 x 10^{-11}]
  - K decays (2 years) 10^{13}, Signal acceptance ~ 10%
  - Systematics: <10% precision background measurement
  - >10^{12} background rejection (<20% background)

- Technique:
  - K Decay – in – flight

NA62 Apparatus

Detectors for Secondary Beam
Kaon ID (KTAG, Cerenkov)
Kaon Tracking



SPS proton
400 GeV
10^{12} p/s

Secondary Beam
$p = 75$ GeV/c
$\Delta p/p \sim 1\%$
X,Y Divergence < 100 μrad
$K(6\%), \pi(70\%), p(23\%)$
750 MHz
Beam size: 6.0 × 2.7 cm²

Kaon Decay
~5 MHz
$4.5 \times 10^{12}/year$
60 m length
10^{-6} mbar vacuum

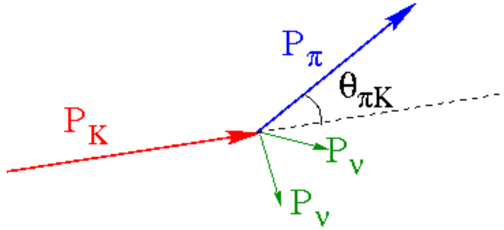
Detectors for decay products
Charged particle tracking
Charged particle Time Stamping
Photon detection
Charged particle ID
Pion and muon identification

Status of NA62

- Installed (almost completely)
- Pilot run: mid October – mid December 2014
- Detector commissioning
- Data quality studies

Scheme for $K^+ \to \pi^+ \nu\bar{\nu}$ Analysis

- Signal



- Background
  - K+ decay modes; accidental events
- Main analysis requirements
  - Timing and spatial K-π matching
  - $P_\pi < 35$ GeV/c
  - Fiducial decay region: 5 – 65 m from the beginning of the decay volume

	K+ main decays	BR
~92%	$K^+ \to \mu^+ \nu$	0.6355
	$K^+ \to \pi^+ \pi^0$	0.2066
	$K^+ \to \pi^+ \pi^+ \pi^-$	0.0559
	$K^+ \to \pi^+ \pi^0 \pi^0$	0.0176
~8%	$K^+ \to \pi^0 e^+ \nu$	0.0507
	$K^+ \to \pi^0 \mu^+ \nu$	0.0335
	$K^+ \to \pi^+ \pi^- e^+ \nu$	4.257×10^{-5}

- Required background suppression factors $O(10^{12})$

Kinematics	$O(10^4\text{-}10^5)$
Charged Particle ID	$O(10^7)$
γ detection	$O(10^8)$
Timing	$O(10^2)$

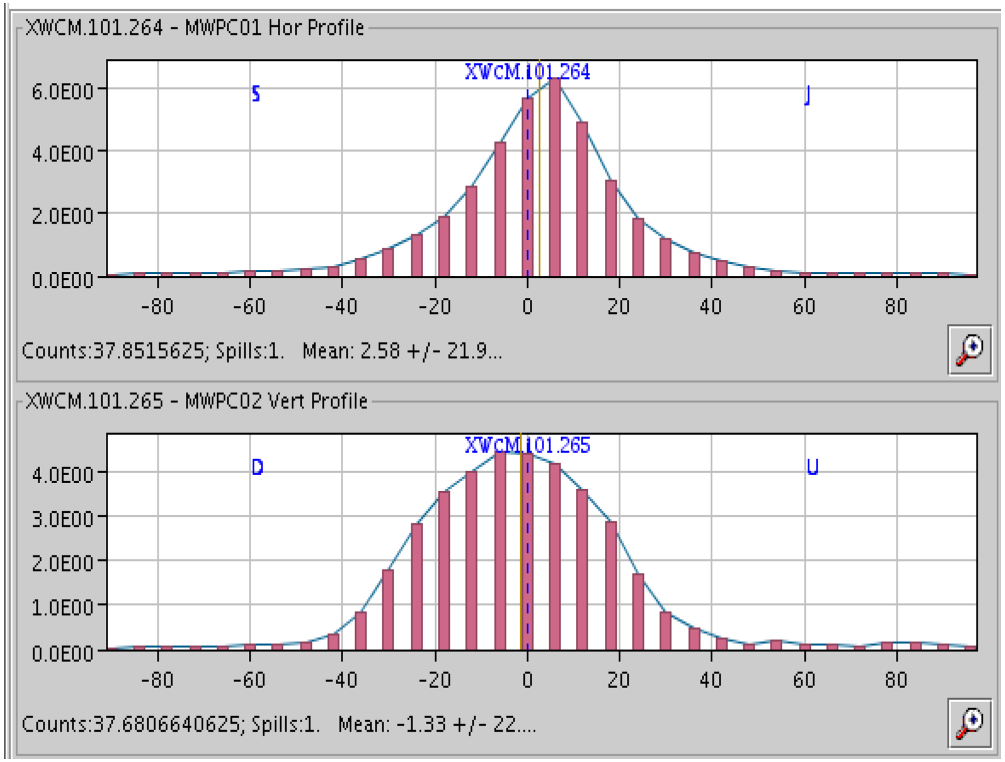
- Measurement of background suppression factors from data

$K^+ \rightarrow \pi^+ \nu \bar{\nu}$ Analysis Sensitivity (MC)

Decay	event/year
$K^+ \rightarrow \pi^+ \nu\nu$ [SM] (flux 4.5×10^{12})	45
$K^+ \rightarrow \pi^+ \pi^0$	5
$K^+ \rightarrow \mu^+ \nu$	1
$K^+ \rightarrow \pi^+ \pi^+ \pi^-$	< 1
$K^+ \rightarrow \pi^+ \pi^- e^+ \nu$ + other 3 tracks decays	< 1
$K^+ \rightarrow \pi^+ \pi^0 \gamma$(IB)	1.5
$K^+ \rightarrow \mu^+ \nu \gamma$(IB)	0.5
$K^+ \rightarrow \pi^0 e^+ (\mu^+) \nu$, others	negligible
Total background	< 10

The Beam

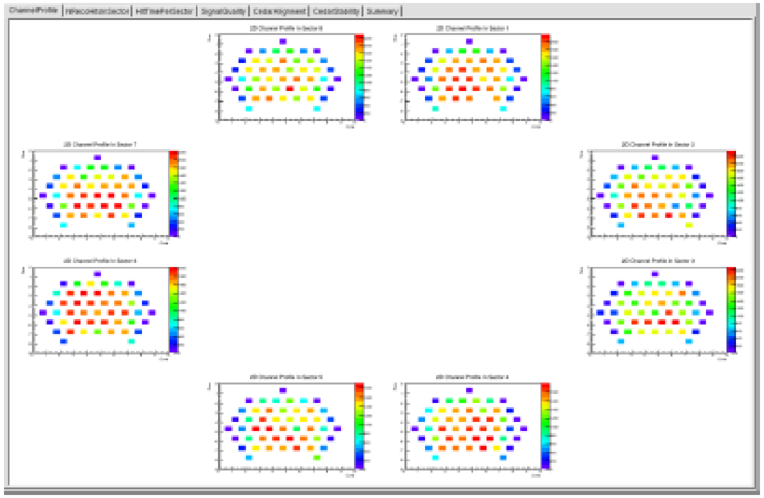
- Proton beam line before target commissioned up to 20% nominal intensity
- Secondary beam line fully commissioned.



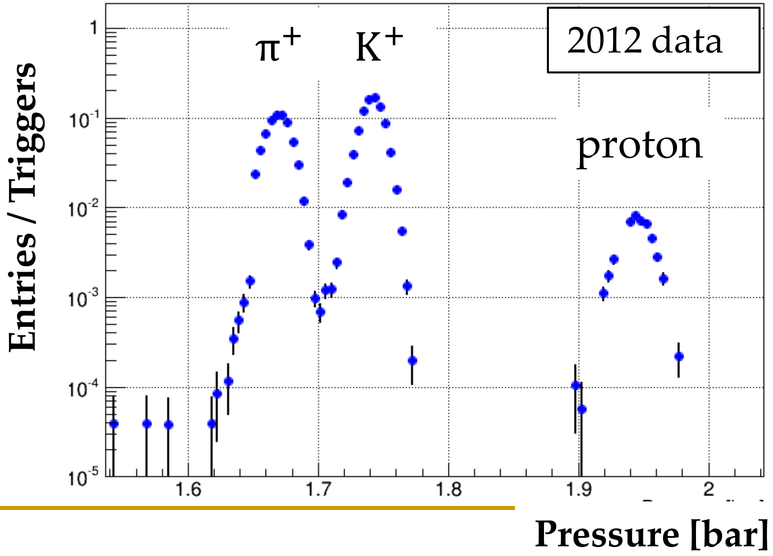
Kaon ID and timing: KTAG

- CEDAR optics (radiator N_2)
- Cerenkov light split in 8 spots
- TDC readout (48 x 8 PMs)
- < 100 ps time resolution
- > 95% K ID efficiency (> 99.9% purity)
- Rate at full intensity 50 MHz
- Commissioned in 2014

PM occupancy screenshot from 2014 data

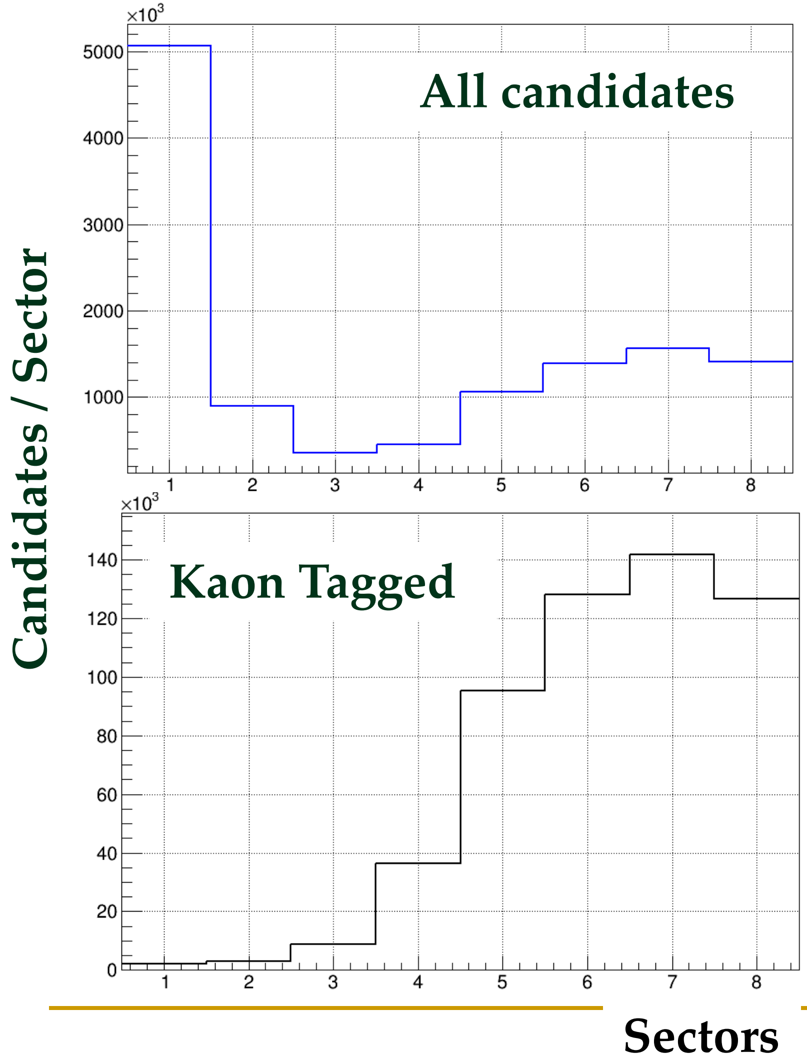


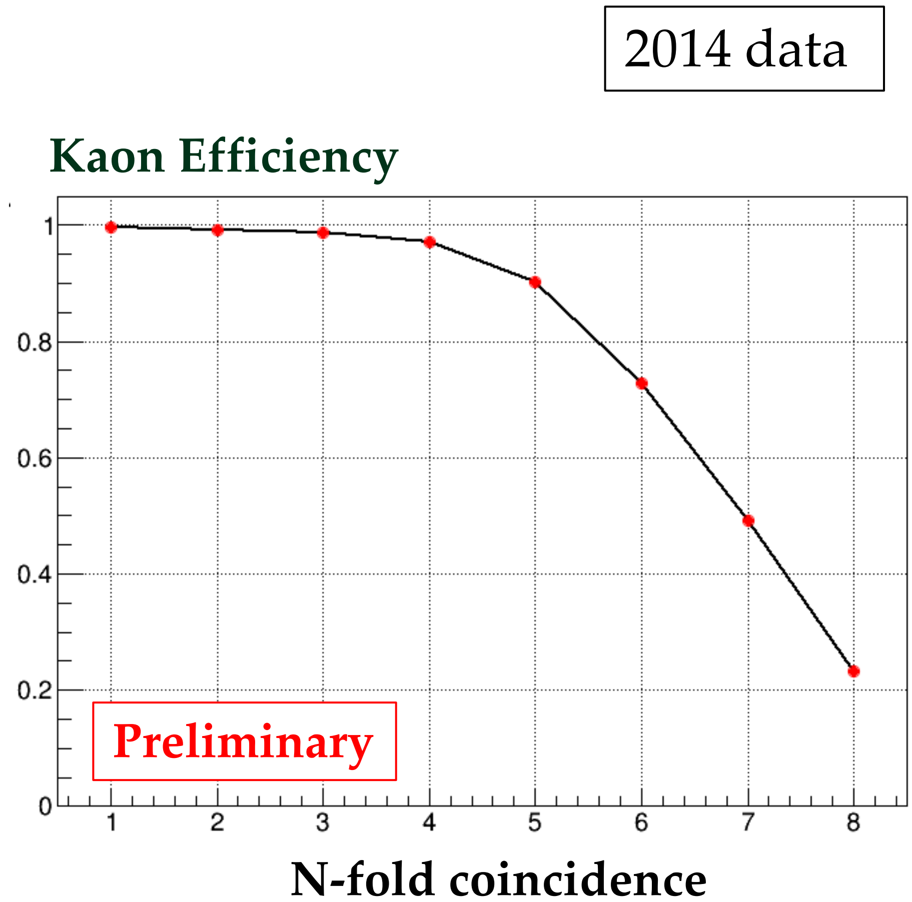
KTAG K/π/p separation



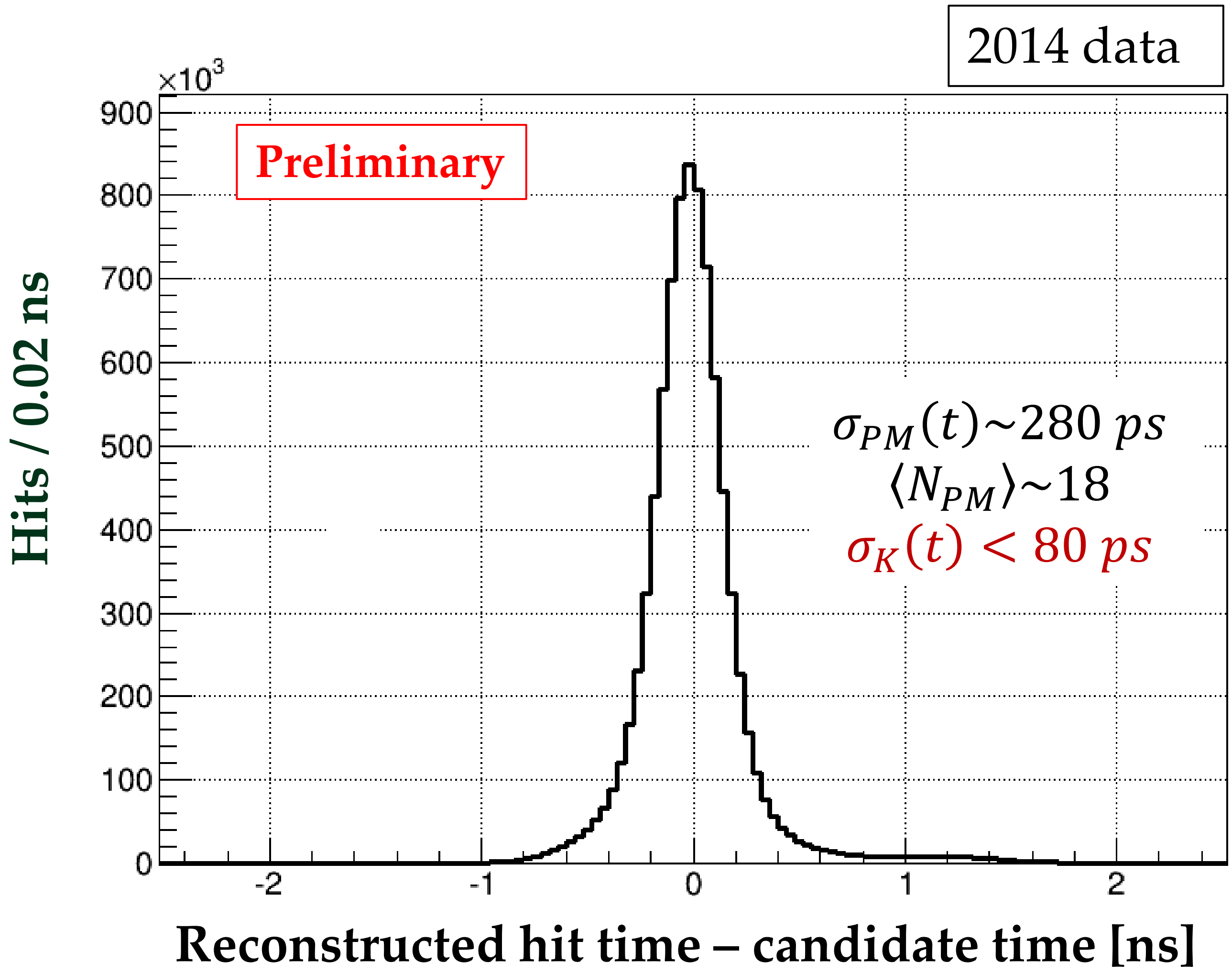
Kaon ID

- Kaons tagged by selecting a $\pi^+\pi^0$ decay topology in the detectors downstream





Kaon timing

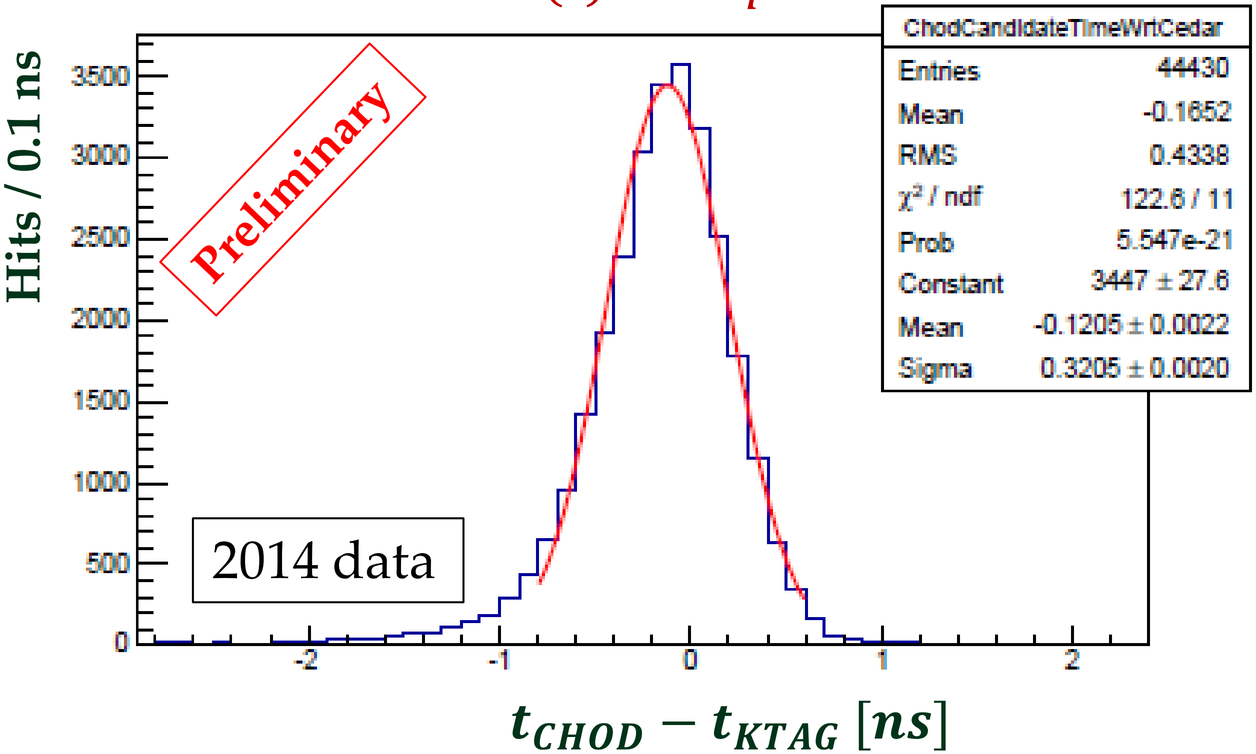


2014 data
Preliminary
×10^3
900
800
700
600
500
400
300
200
100
0
-2
-1
0
1
2
Hits / 0.02 ns
Reconstructed hit time – candidate time [ns]
$\sigma_{PM}(t) \sim 280\ ps$
$\langle N_{PM} \rangle \sim 18$
$\sigma_K(t) < 80\ ps$

Pion timing

- Array of horizontal and vertical scintillator slabs (CHOD, from NA48)

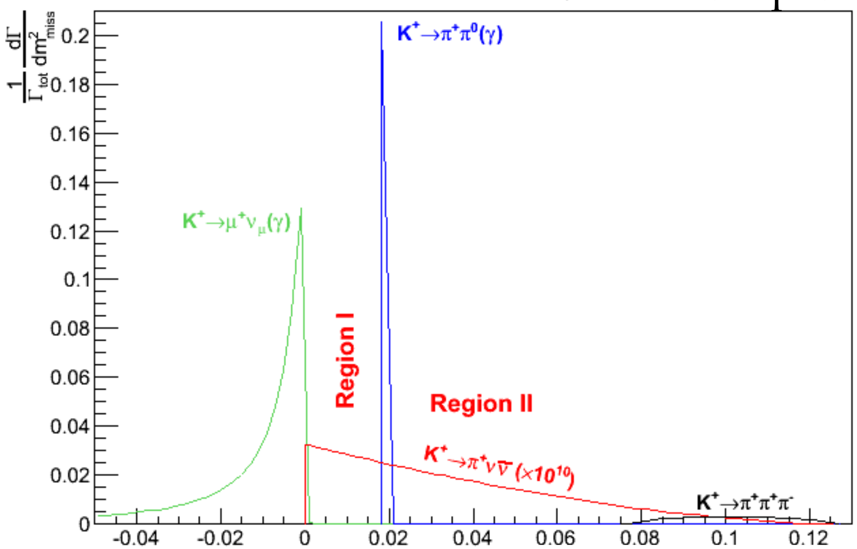
$\sigma(t) \sim 300\ ps$



Kinematics and Background Suppression

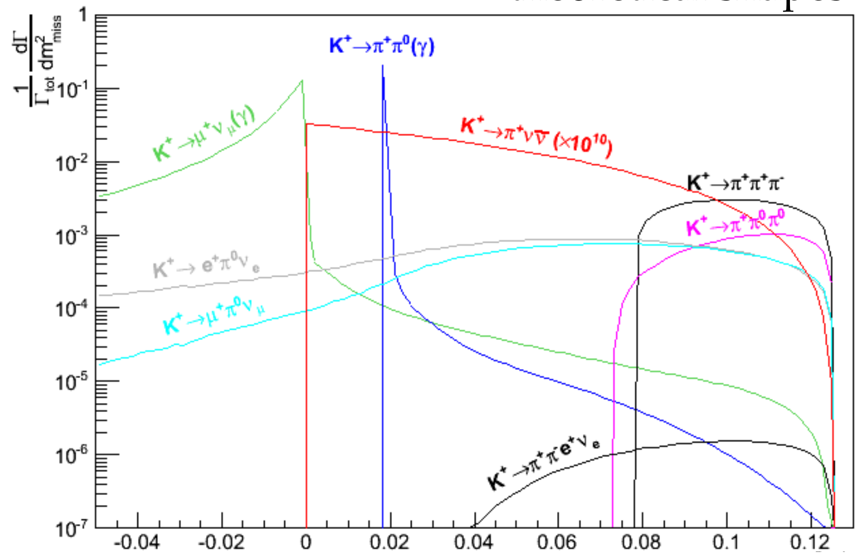
- Kinematic variable: $m^2_{miss} = (P_K - P_{\pi^+})^2$

theoretical shapes



$m^2_{miss}\ [GeV^2/c^4]$

theoretical shapes

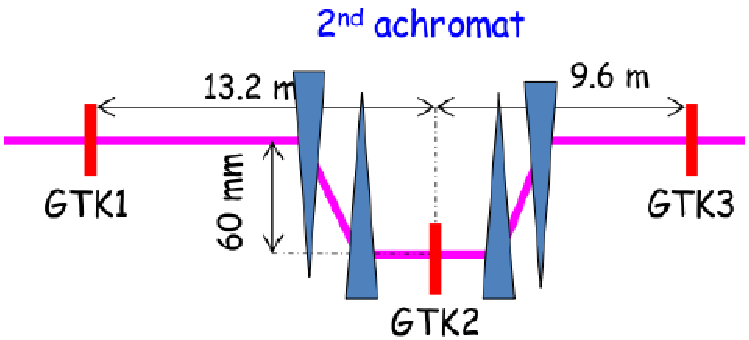


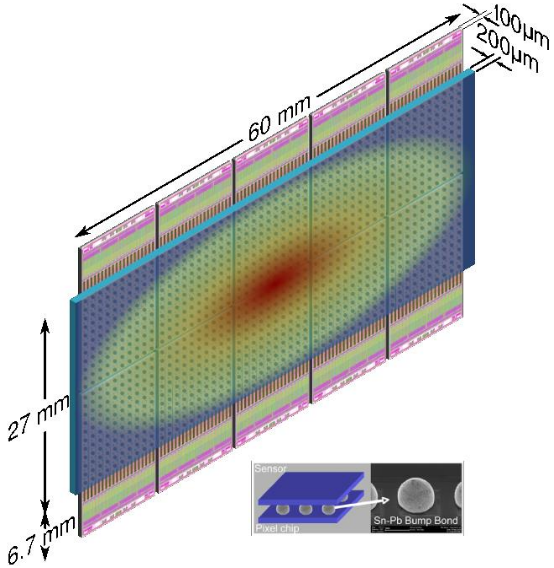
$m^2_{miss}\ [GeV^2/c^4]$

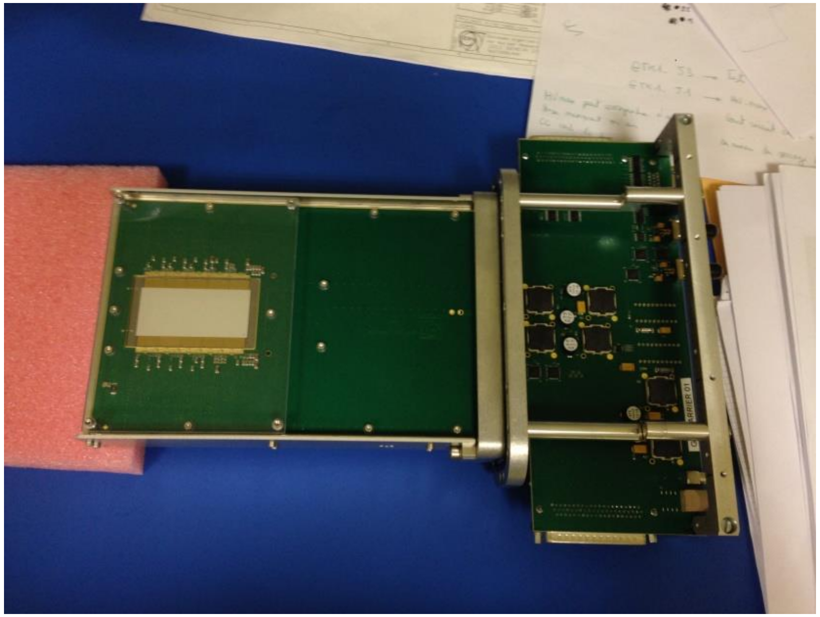
- Main goal: O(10^4) suppression of the main background modes.
- Measurement of the K track $[\sigma(P_K)/P_K \leq 0.2\%,\ \sigma(\theta_K) \leq 20\ \mu m]$
- Mesurement of the π^+ track $[\sigma(P_\pi)/P_\pi \leq 1\%,\ \sigma(\theta_\pi) \leq 60\ \mu m$ in 10-50 GeV region$]$
- Analysis requirement: 2 signal m^2_{miss} regions, $P_{\pi^+} < 35$ GeV/c (separation from $K^+ \to \mu^+\nu$)
- Limitations to background suppression: resolution tails, $\pi - K$ matching

Tracking Systems: Beam tracker

- Gigatracker: 3 Si pixel stations on the beam
- $300 \times 300\ \mu m^2$ pixels
- Cooled down using a microchannel technique
- On sensor TDC readout chip (~54000 pixels)
- $X/X_0 < 0.5\%$ / station, $\sigma(t) \sim 200\ ps$
- Rate at full intensity 750 MHz
- Partially commissioned in 2014

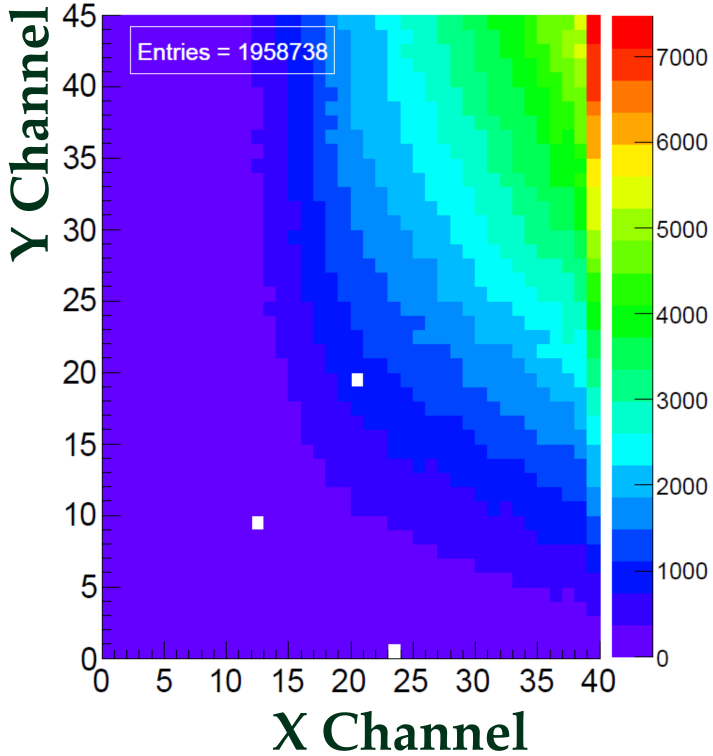


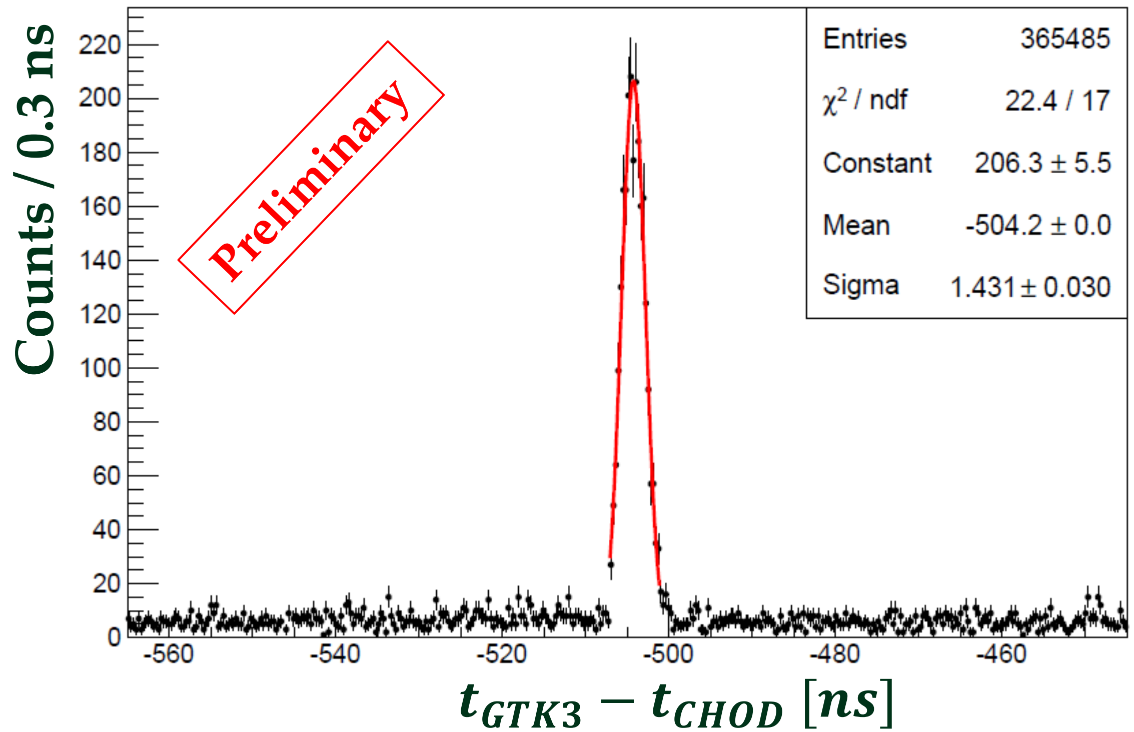




Gigatracker: 2014 data

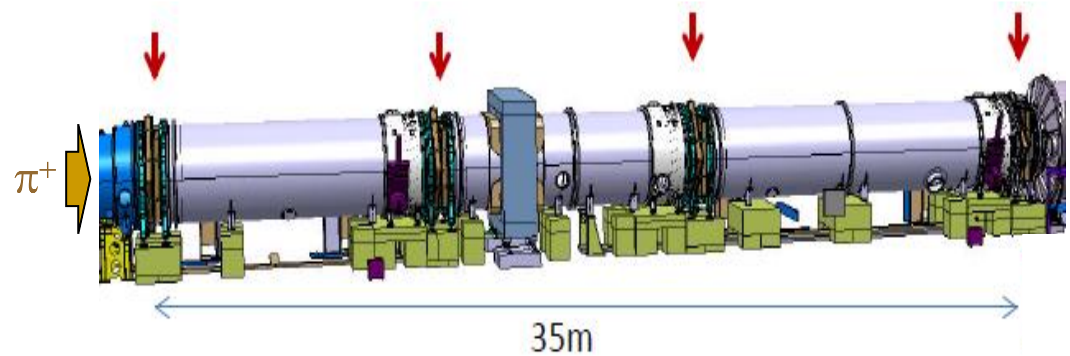
- Online snapshots (1 chip / 10).
- No T0s' and time walk corrections.

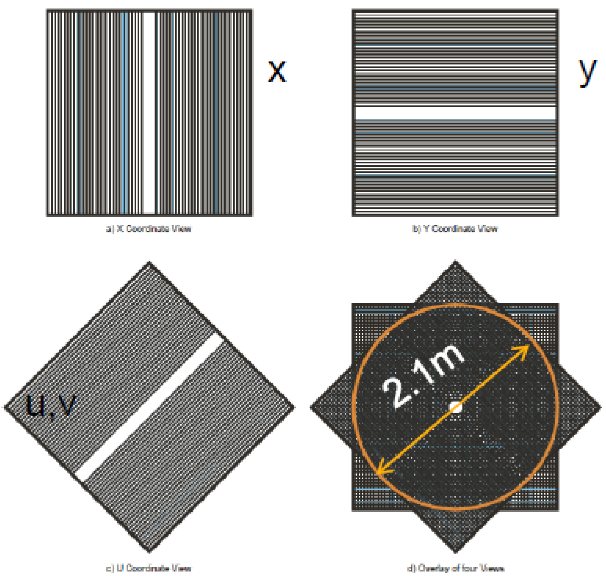




Tracking Systems: Pion Spectrometer

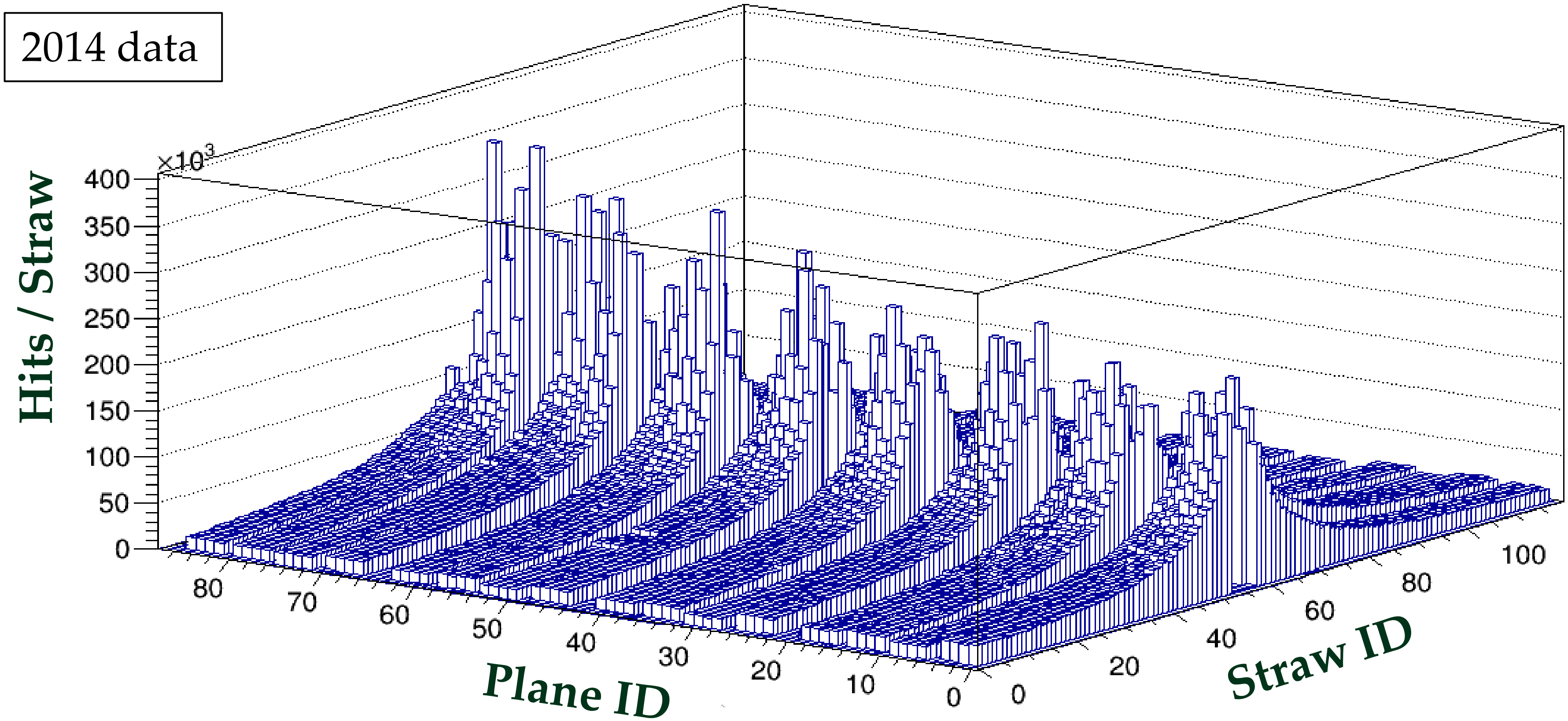
- Straw spectrometer in vacuum
- 4 Chambers; 1 cm ∅ straws
- $X/X_0 < 0.5\%$ / chamber
- 0.5 Tm magnet (2x2 aperture)
- TDC readout (~8000 straws)
- Rate at full intensity 10 MHz
- Fully commissioned in 2014





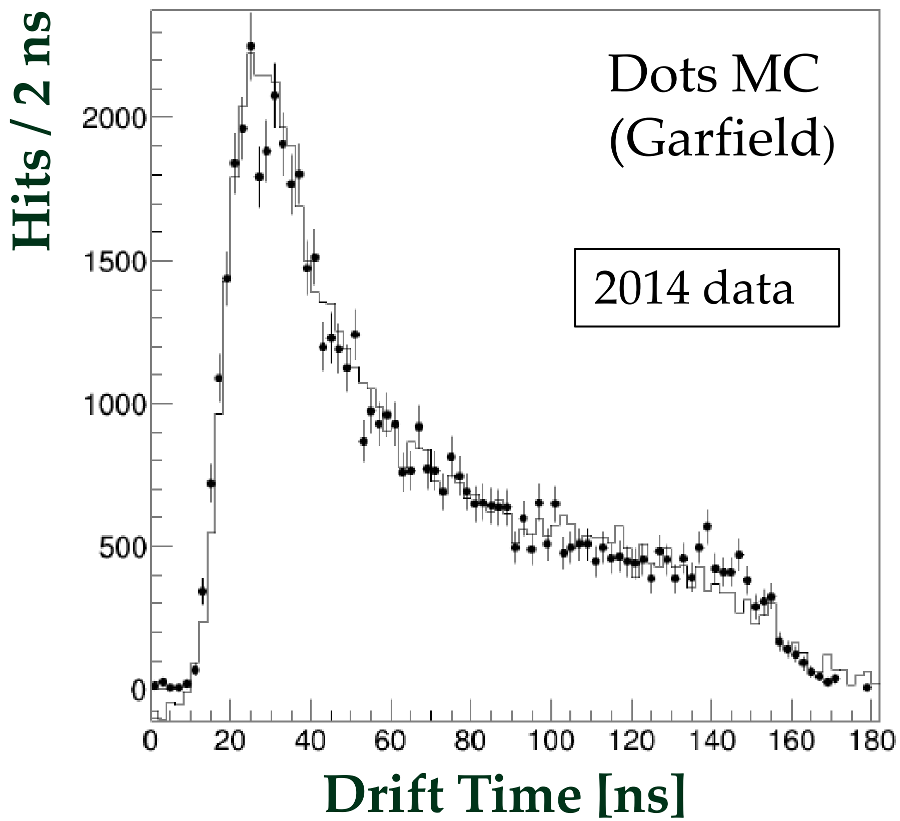
Straws Illumination

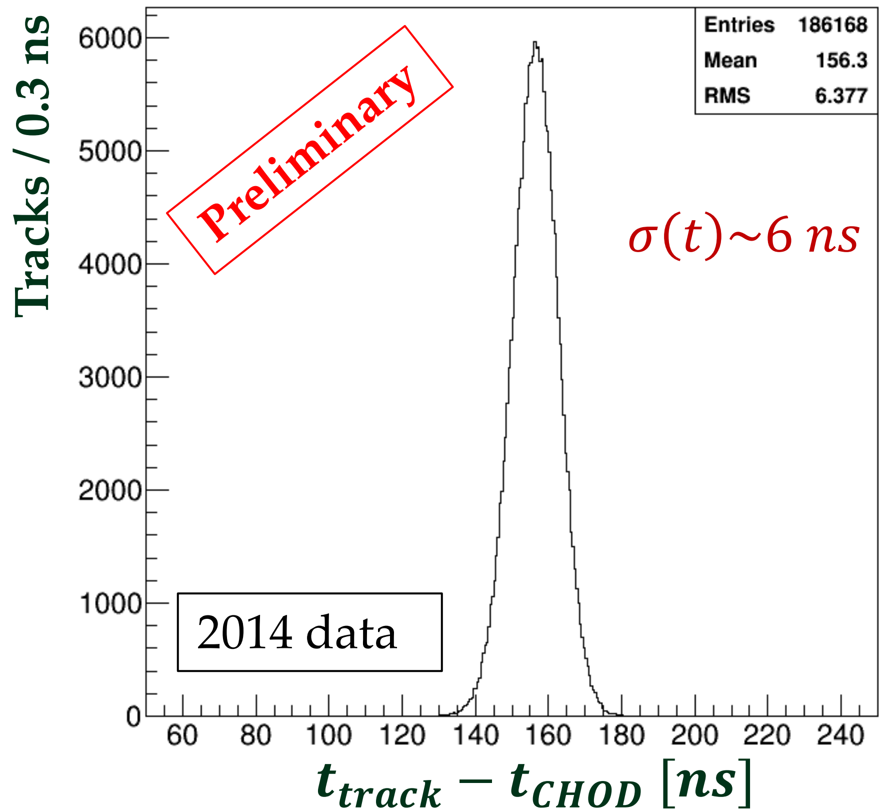
2014 data



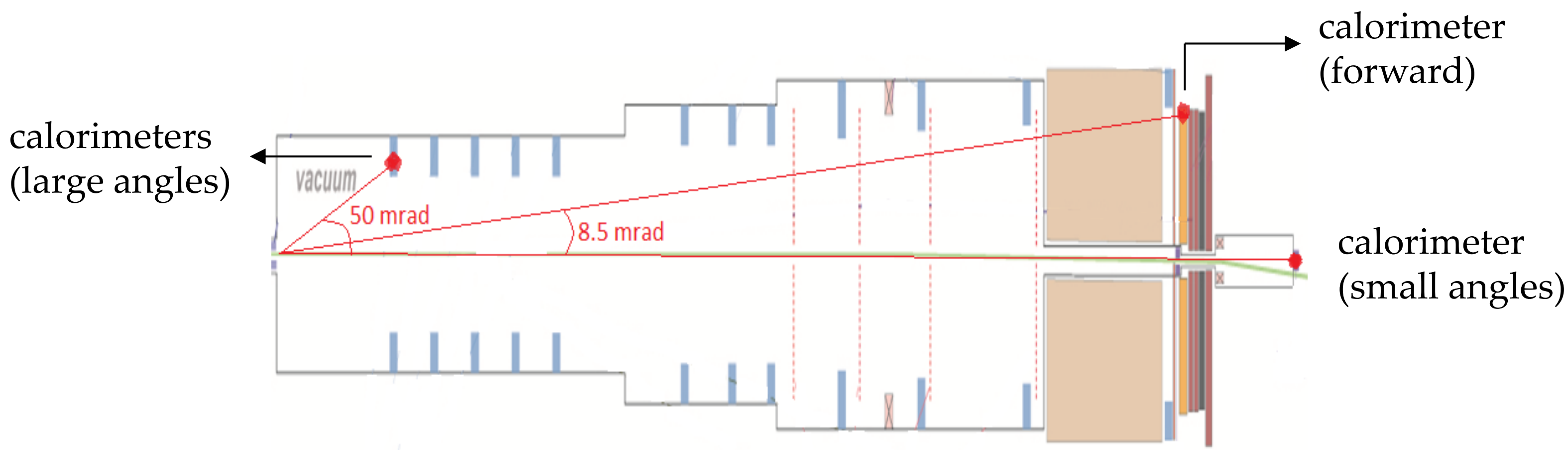
Straw Signals

- Preliminary track reconstruction
- Track time reconstructed from straw trailing time.

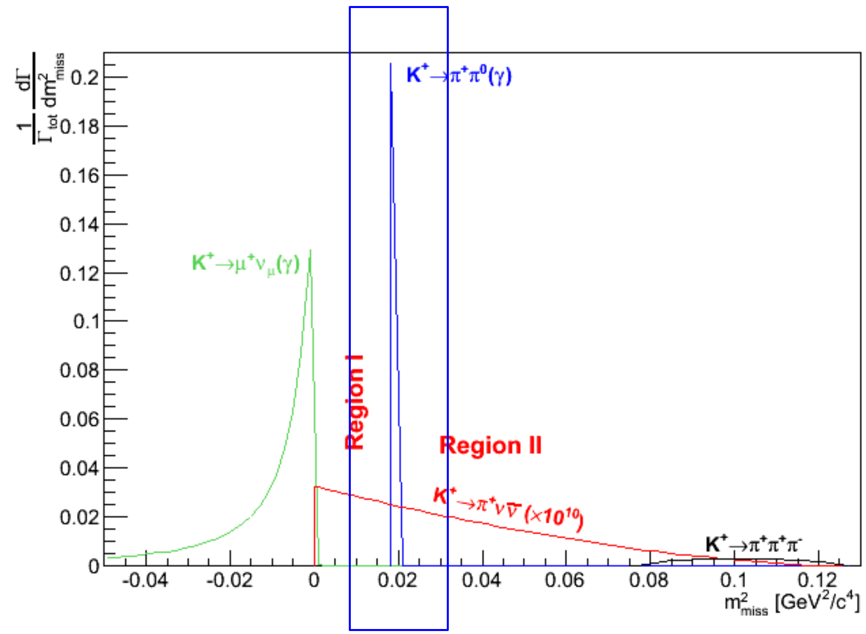




Photon rejection



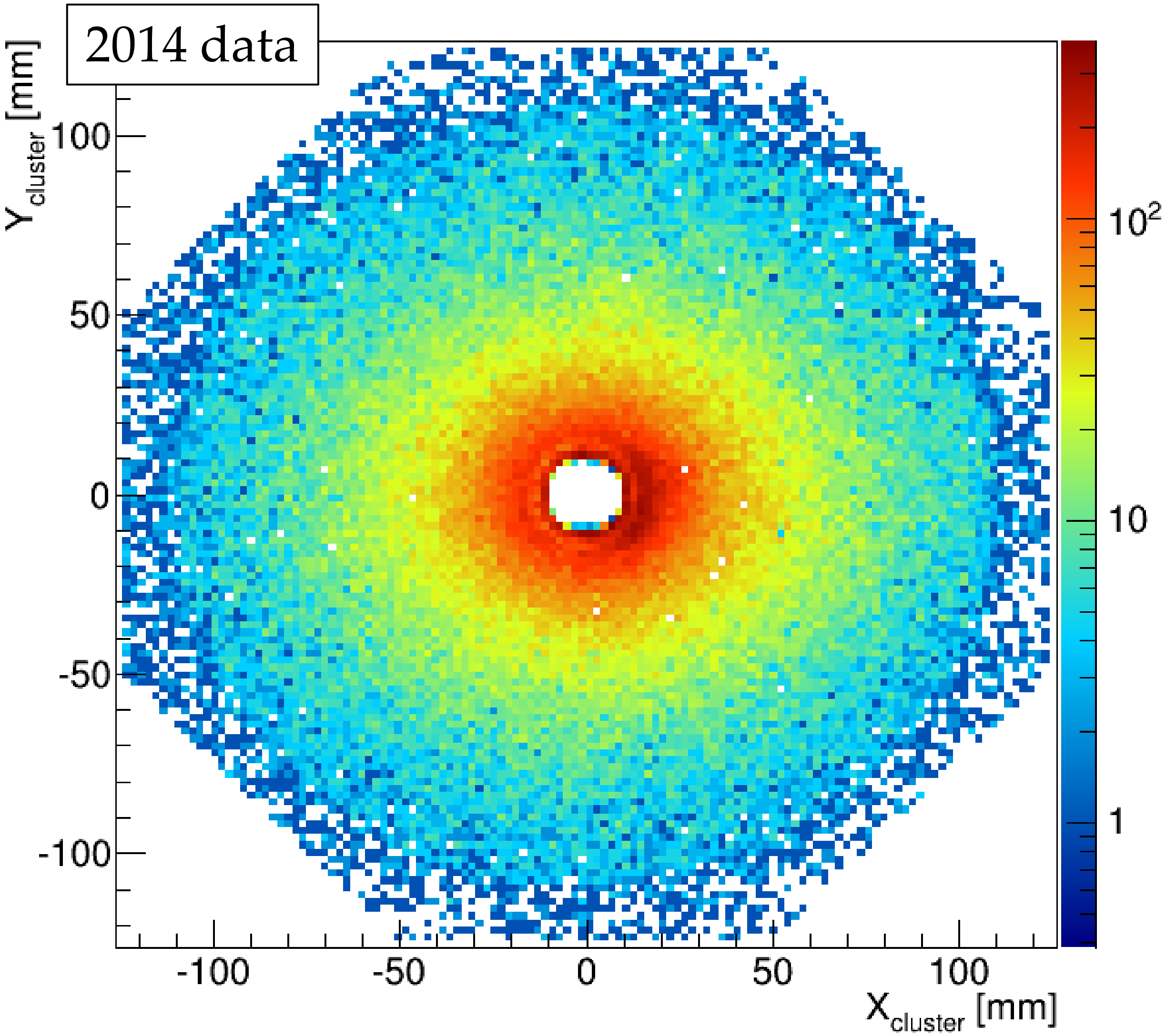
- Main goal: O(10^8) on π^0 rejection from $K^+ \to \pi^+\pi^0$
- Analysis: $P_{\pi^+} < 35$ GeV/c $\to E_{\pi^0} > 40$ GeV
- Geometrical hermeticity: up to 50 mrad
- Inefficiency requirements on γ: $10^{-3} - 10^{-5}$



Photon Detectors: (1, 8.5) mrad region

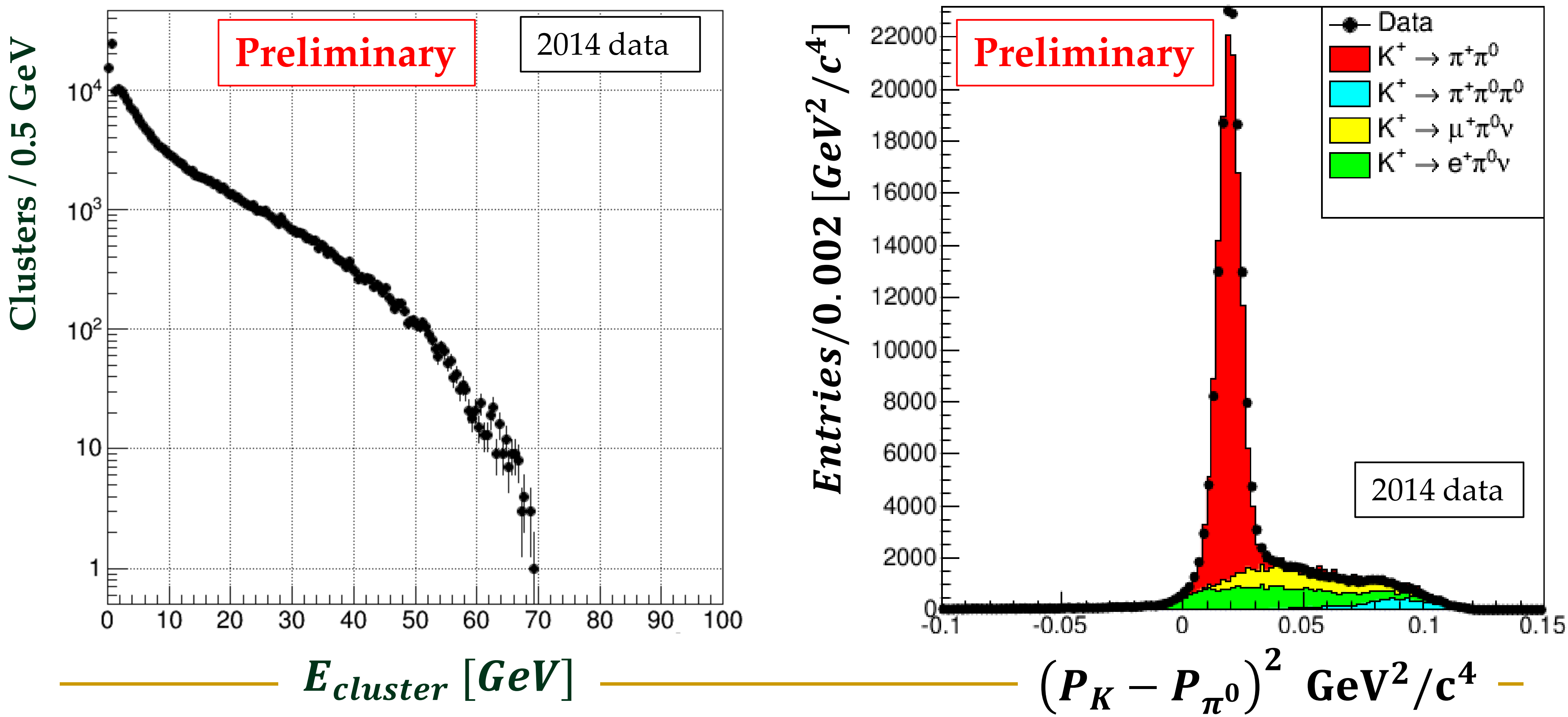
- Quasi-homogeneous calorimeter at liquid Krypton (LKr, from NA48)
- 14-bit FADC readout (~13500 channels)
- High energy, time, position resolution
- $< 10^{-5}$ inefficiency for $\gamma > 10$ GeV (measured on NA48 data)
- Rate at full intensity 10 MHz
- New electronics commissioned in 2014

Liquid Krypton Illumination



Liquid Krypton Energy Reconstruction

- Preliminary calibration
- $K^+ \rightarrow \pi^+\pi^0$ reconstructed using the liquid Krypton calorimeter only:
  - π^0 mass imposed on a observed pair of em-like clusters
  - Nominal Kaon direction and momentum assumed

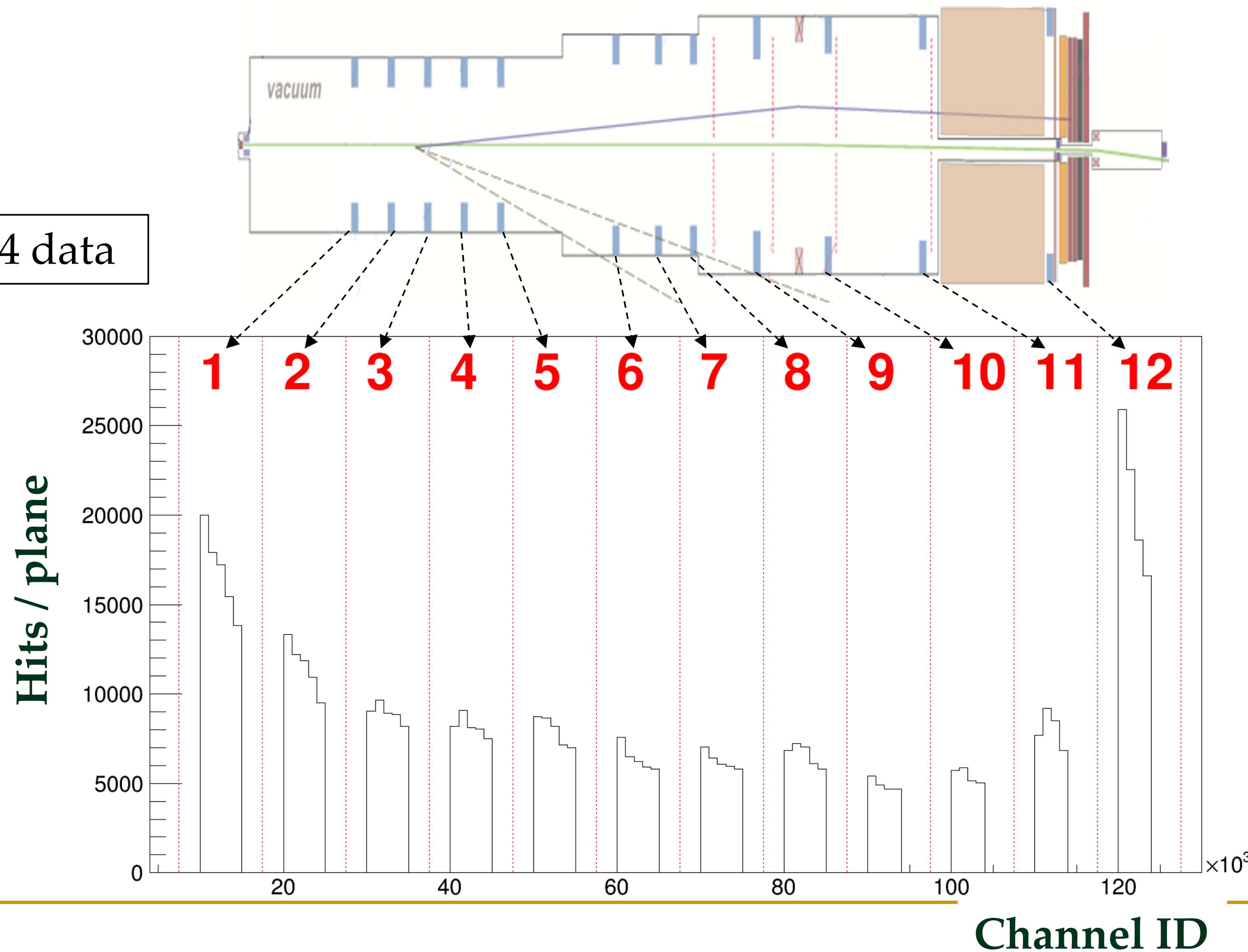


Photon Detectors: (8.5, 50) mrad region

- Large Angle Veto (LAV)
- 12 Lead glass ring calorimeters (1-11 in vacuum)
- Lead glass blocks from OPAL
- TDC readout (~2500 blocks)
- $(10^{-3} \div 10^{-4})$ inefficiency down to 150 MeV photons (measured in test beam with electrons)
- ~1 ns time resolution
- Rate at full intensity 1 MHz (OR of 12 stations)
- Commissioned in 2014

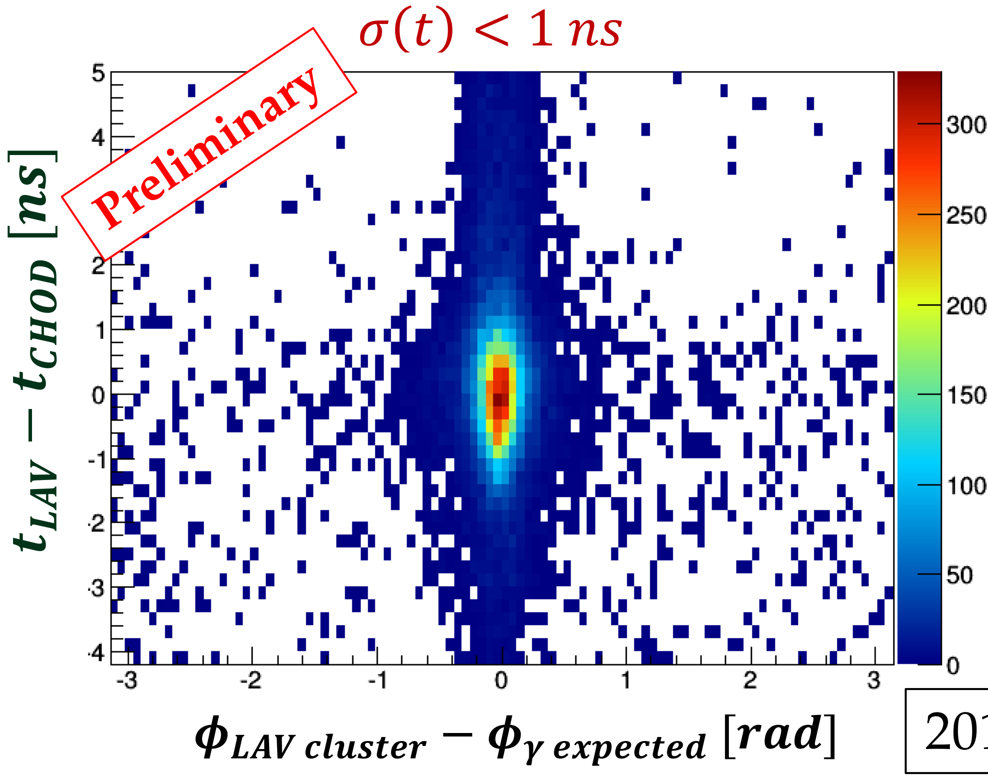
LAV Illumination

2014 data

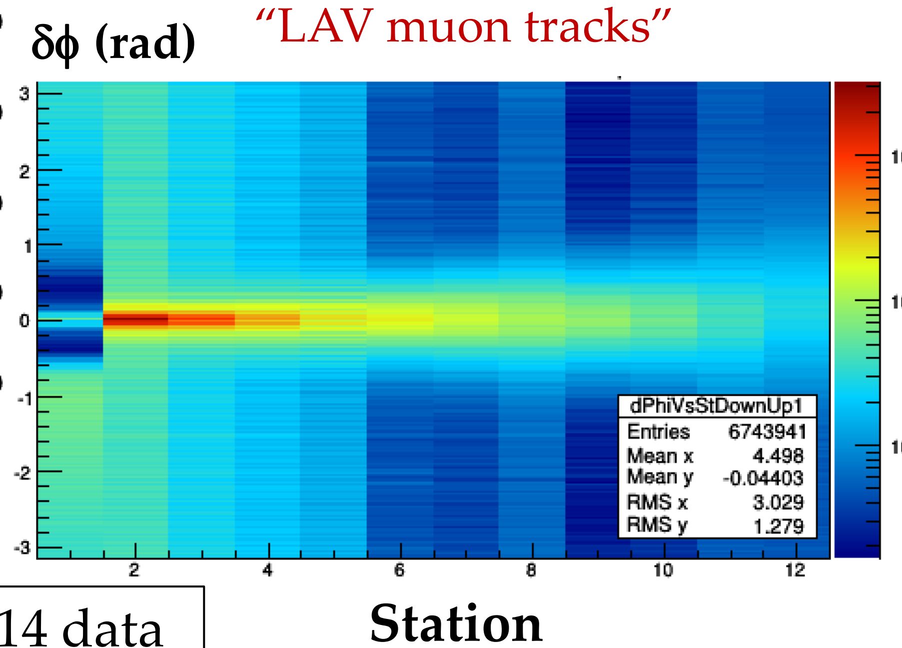


LAV Signals

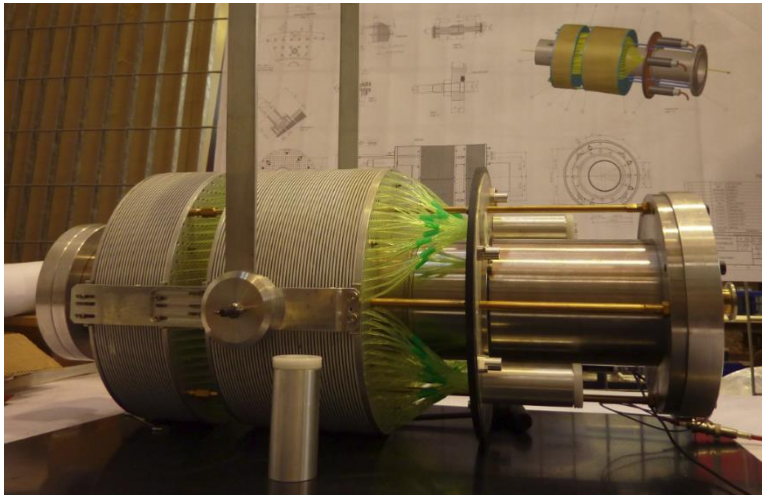
- Photons predicted in LAV match with reconstructed LAV clusters.
  - $K^+ \rightarrow \pi^+\pi^0$ reconstructed using straw spectrometer only.
  - 1 γ detected in the liquid Krypton calorimeter.
- LAVs' sensitive to muons



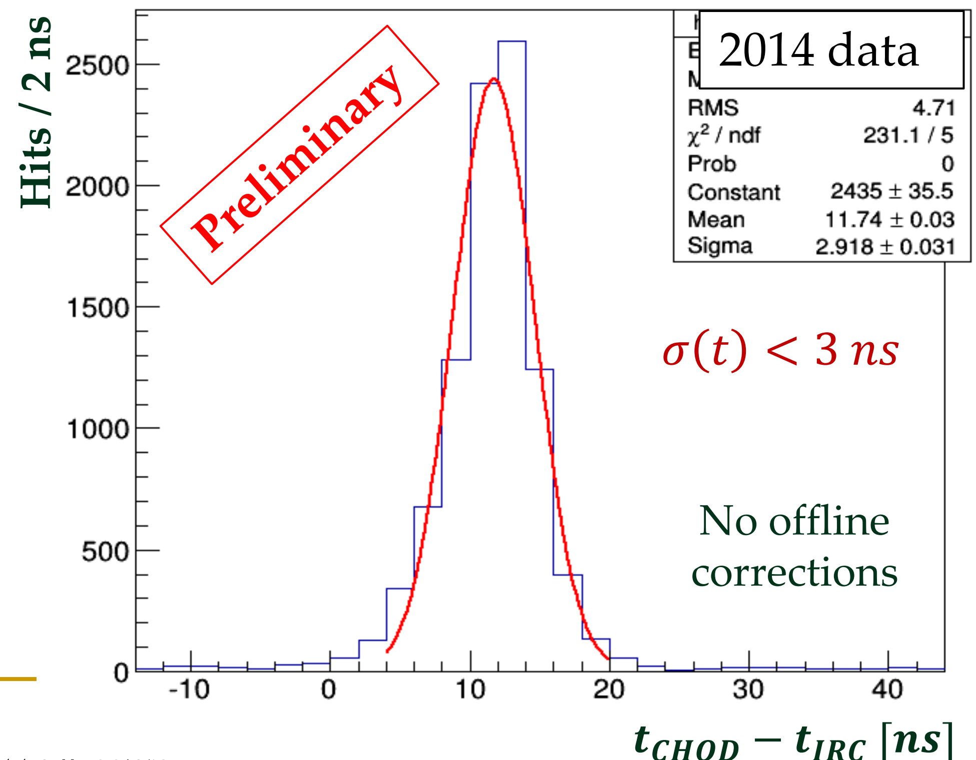
2014 data



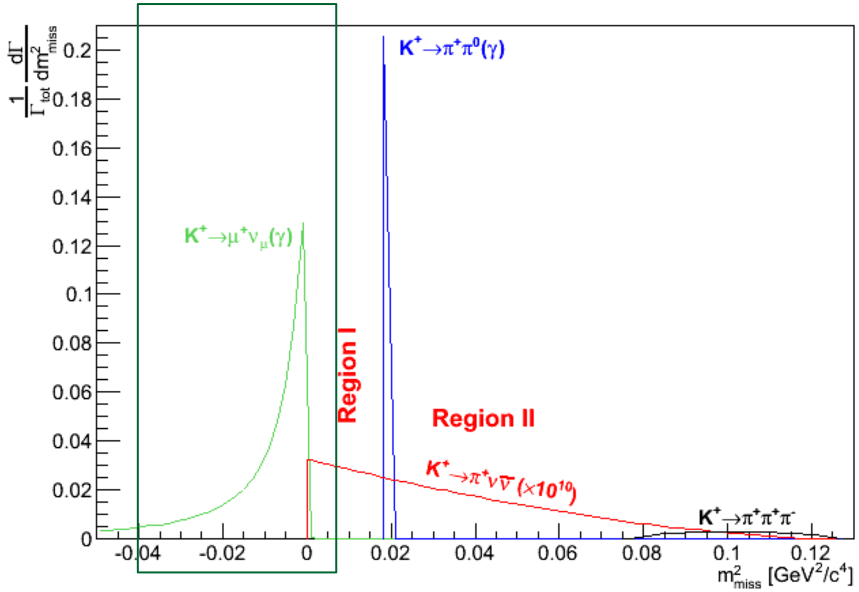
Photon Detectors: < 1 mrad region

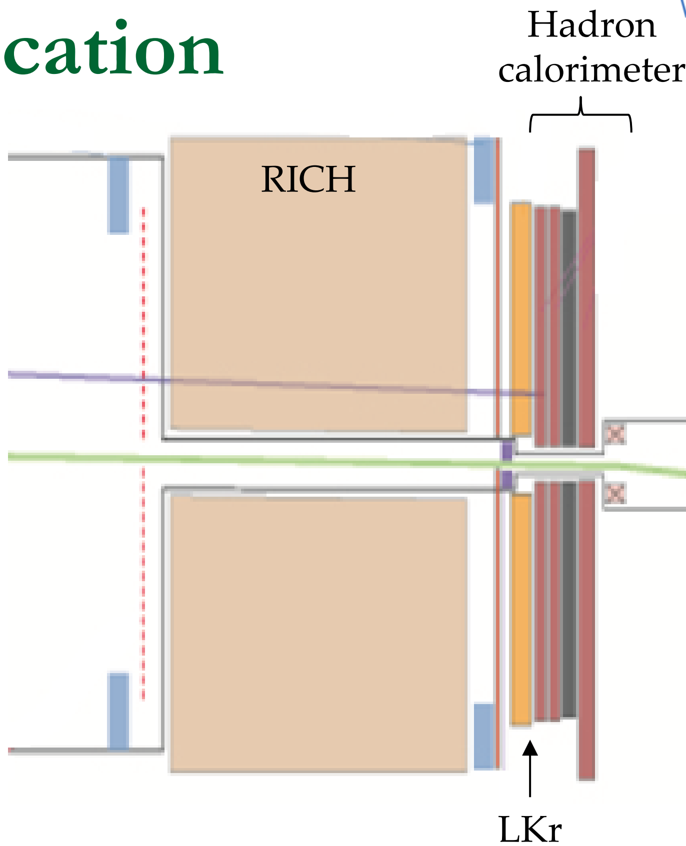


- Intermediate Ring (IRC) and Small Angle (SAC) calorimeters
- Shashlik technique (Iron and scintillating fibers)
- TDC readout
- 10^{-4} inefficiency for > 1 GeV photons
- Photon rate at full intensity < 1 MHz
- Commissioned in 2014



Particle Identification

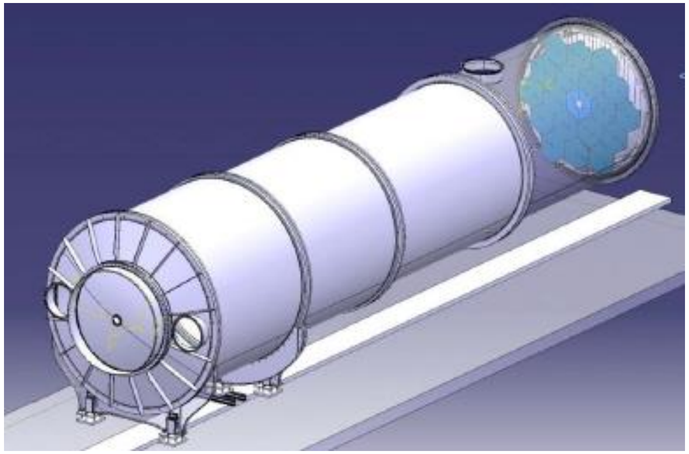




- Purpose: π/μ/e separation
- Main goal: O(10^7) μ/π separation
- Cerenkov and calorimetry techniques employed
- Analysis: $P_{\pi^+} < 35$ GeV/c to get the best μ/π separation using the Cerenkov technique

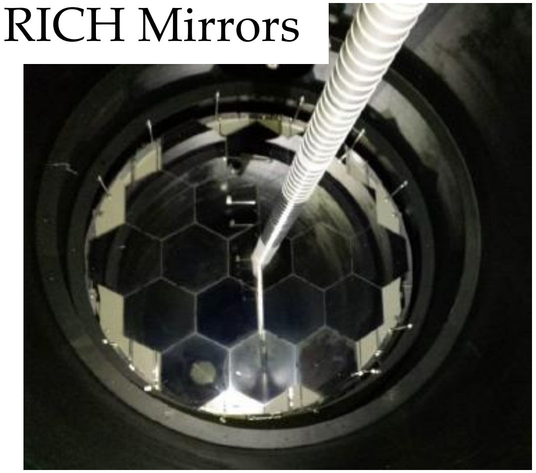
Particle ID Detectors: RICH

- 17 m, Ne @ 1 atm, 20 mirrors (17 m focal length)
- PMs arrays separated in two spots
- TDC readout (~2000 PMs)
- Track angle resolution ≤ 100 μrad
- Time resolution < 100 ps
- μ/π separation >10^2 measured on a prototype
- Rate at full intensity 10 MHz
- Commissioned in 2014



RICH Vessel

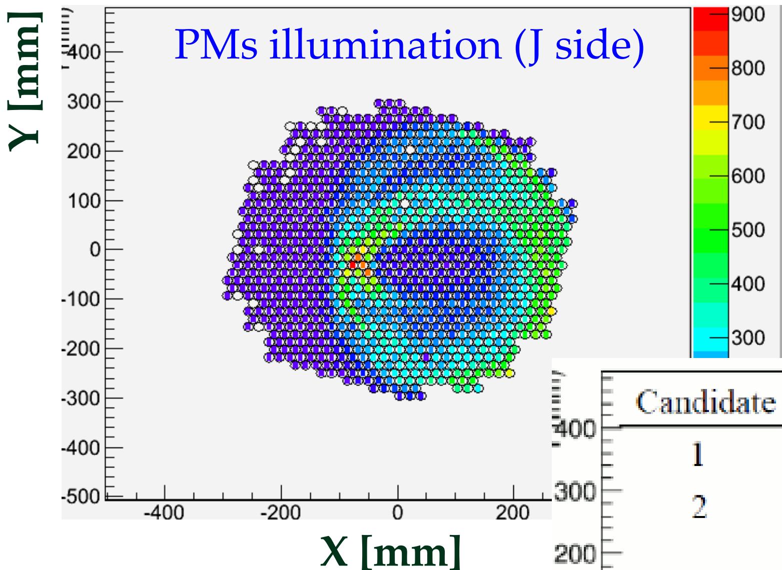
RICH Mirrors

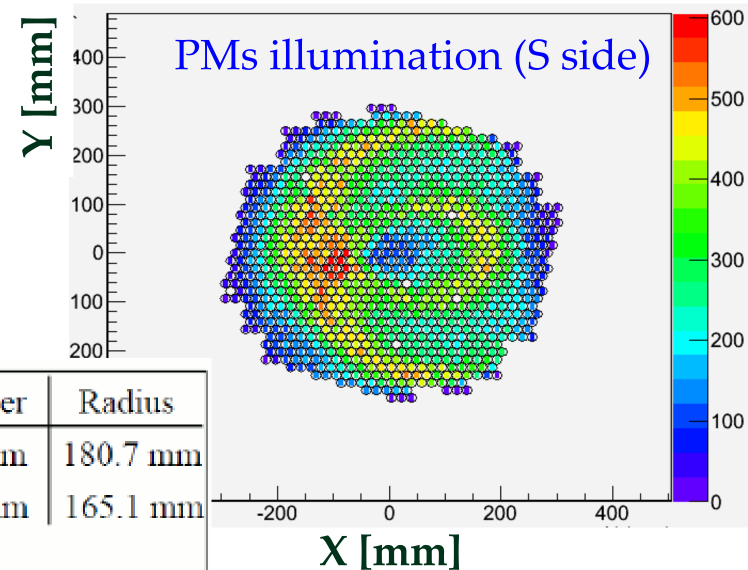


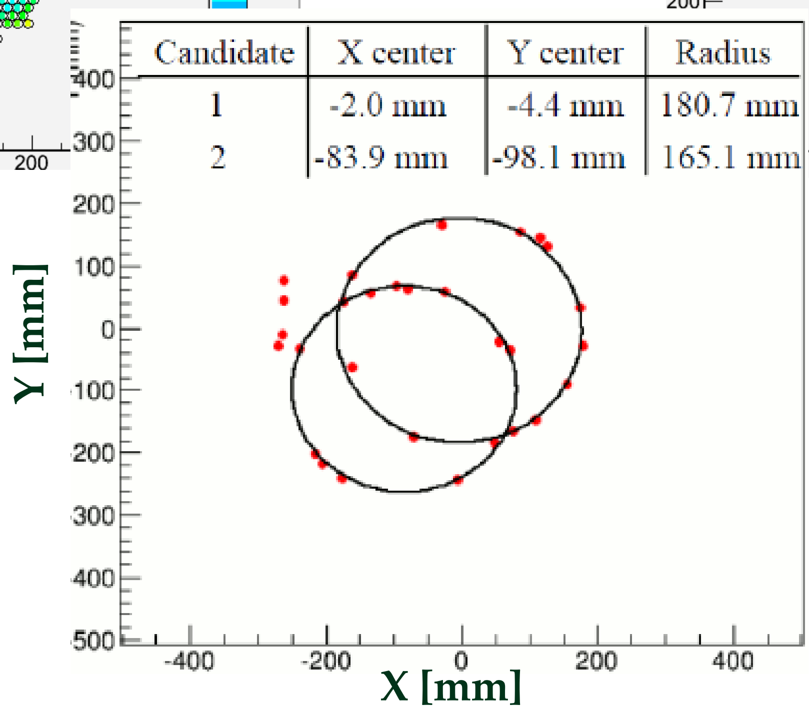
RICH PMs

RICH Illumination

2014 data



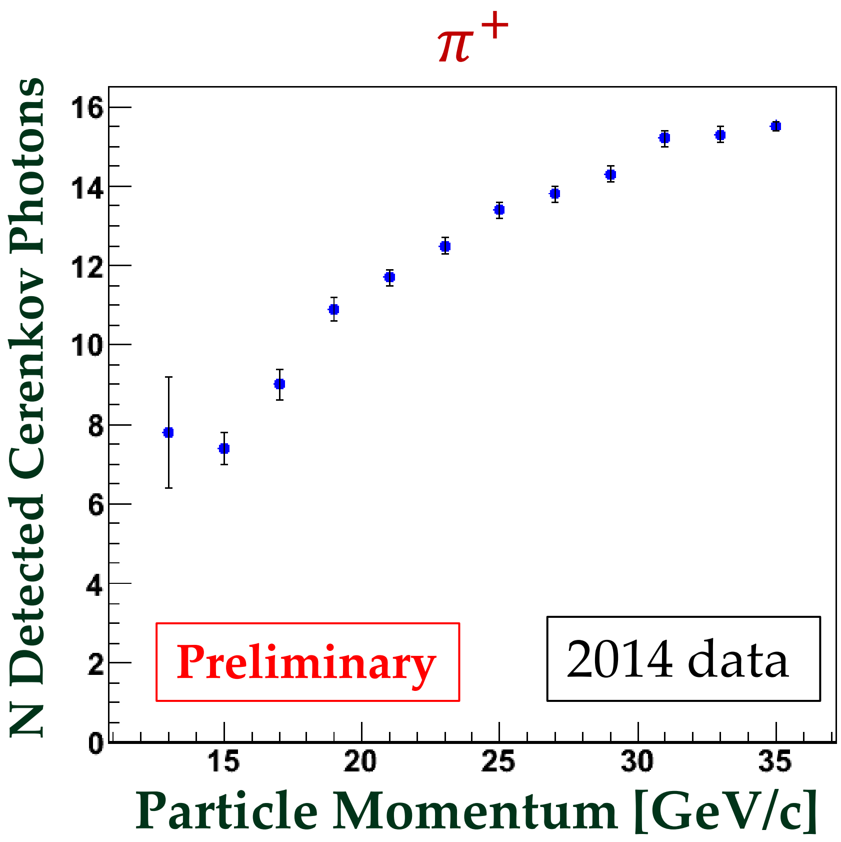


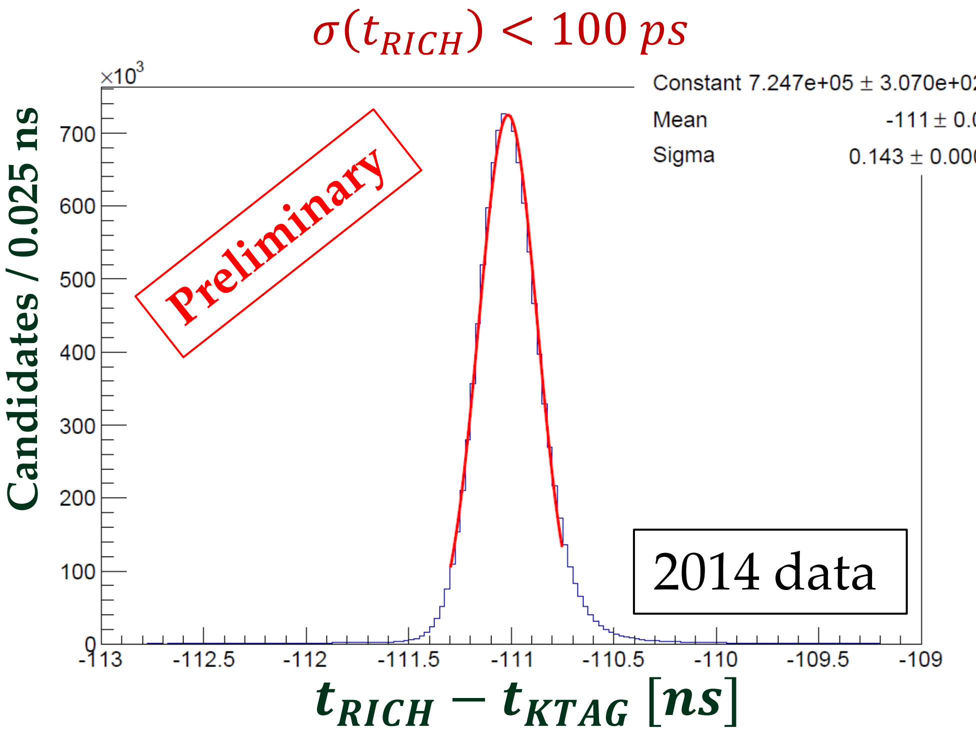


Candidate	X center	Y center	Radius
1	-2.0 mm	-4.4 mm	180.7 mm
2	-83.9 mm	-98.1 mm	165.1 mm

RICH Rings

- Preliminary ring reconstruction
- No offline corretions for mirror mis-alignment

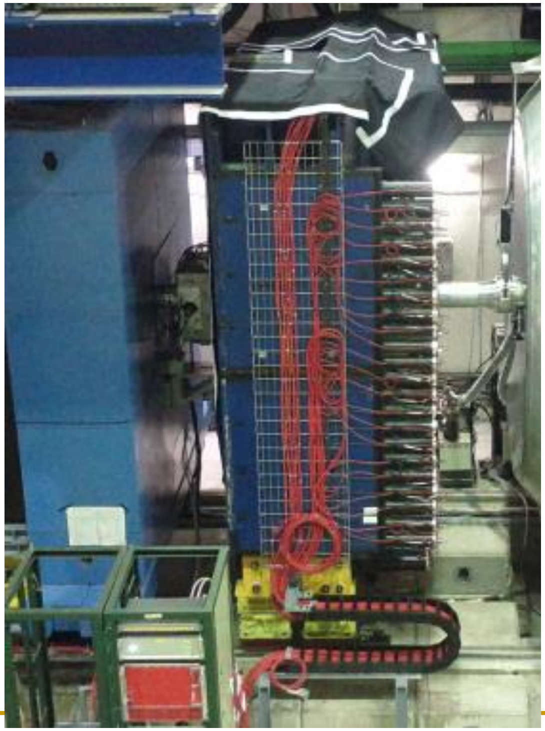




Particle ID Detectors: Calorimetry

- Hadron calorimeter
- 2 modules of iron-scintillator plates (64+128 channels)
- FADC readout
- 1 module commissioned in 2014

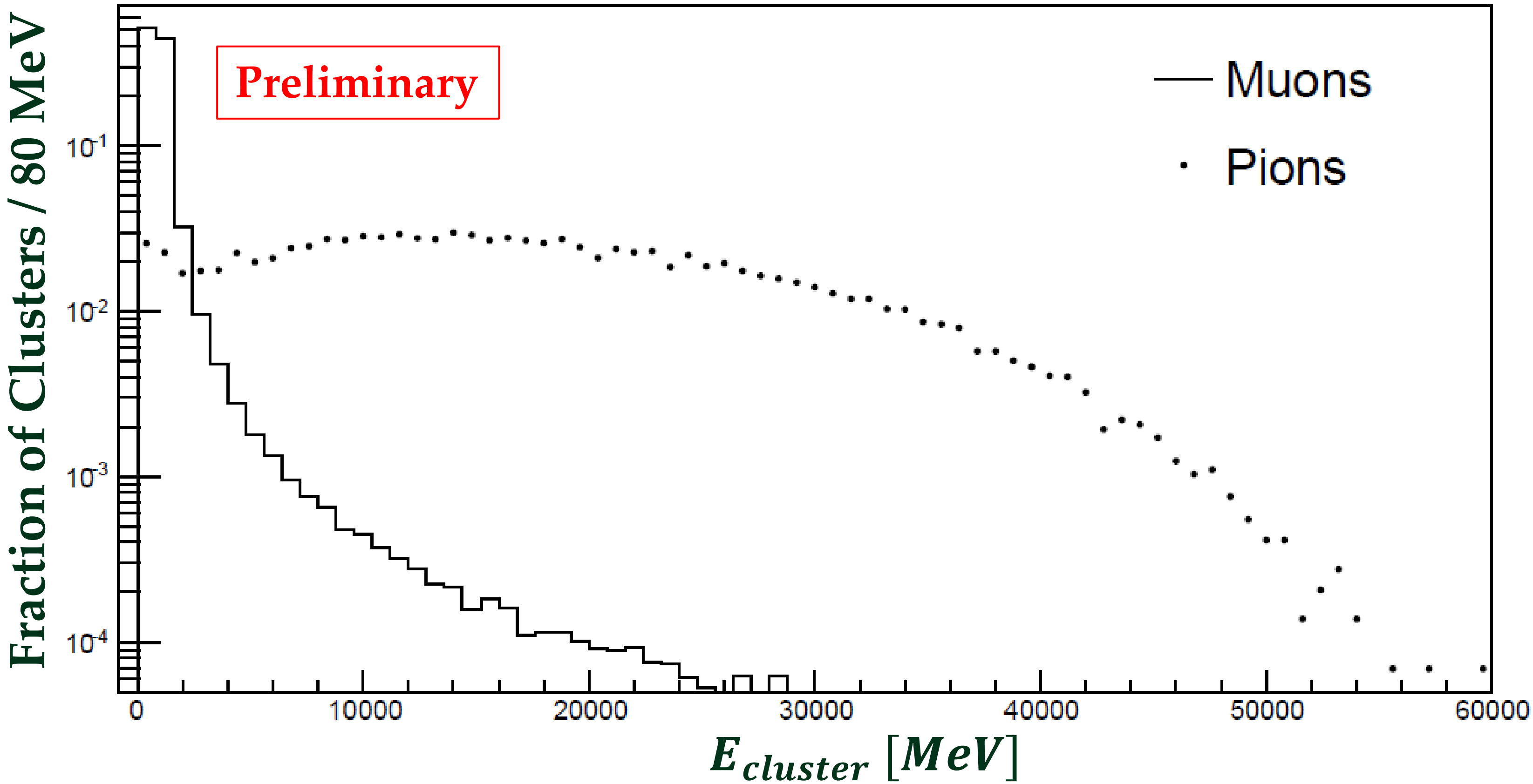
- Fast Muon Veto plane
- 148 Scintillator tiles (2 PMs per tile)
- CFD+TDC readout
- < 500 ps time resolution
- Commissioned in 2014



Energy in Hadron Calorimeter

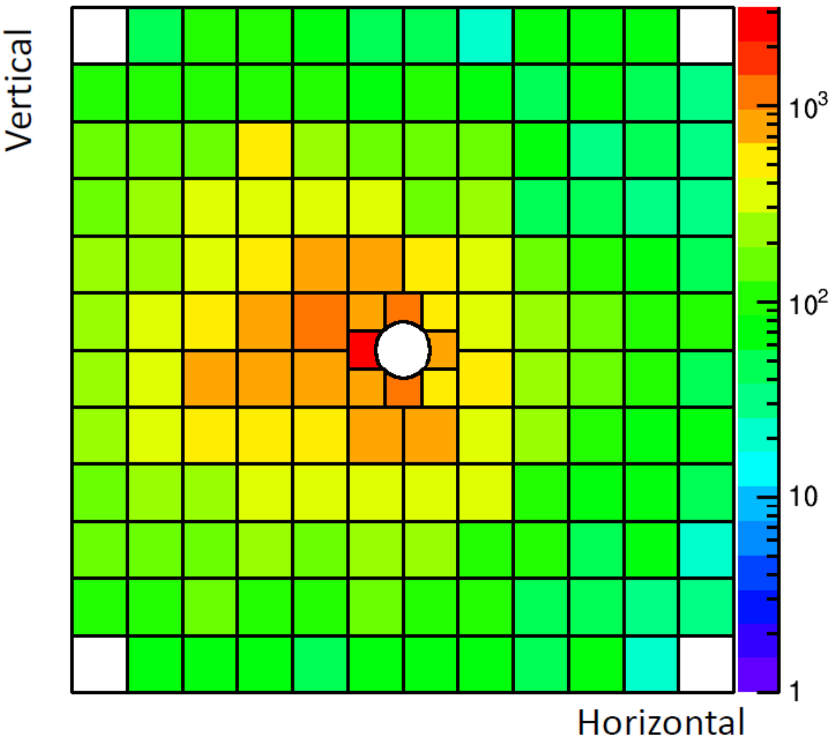
- Half of hadron calorimeter
- Prelimary cluster reconstruction

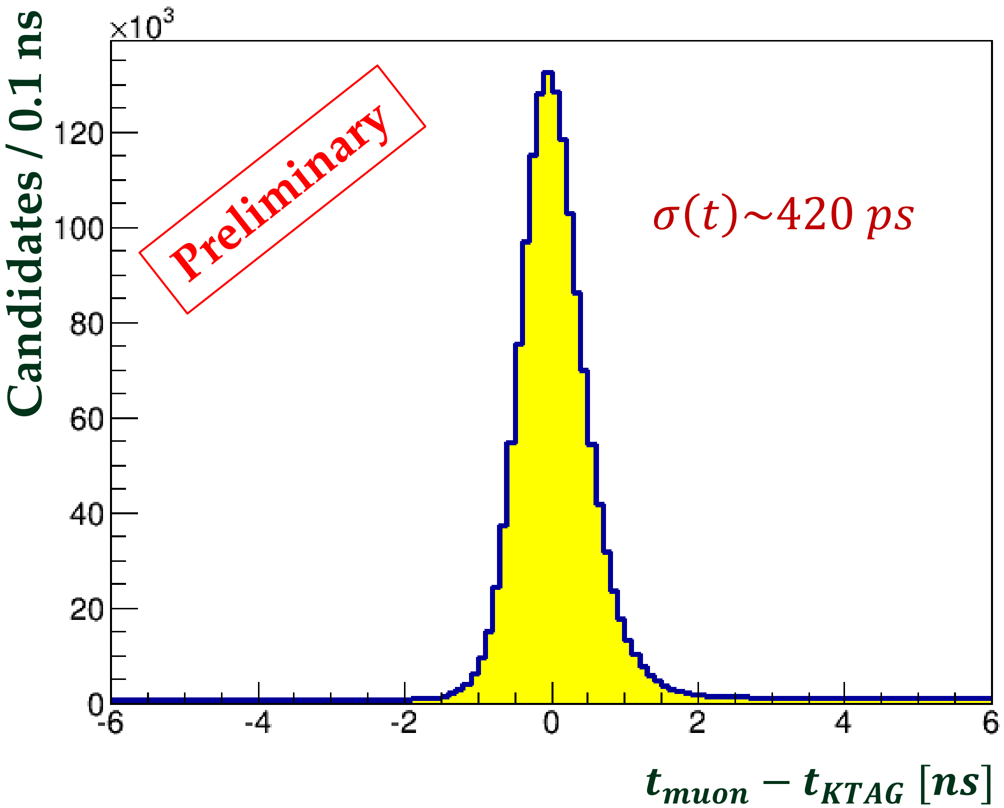
2014 data



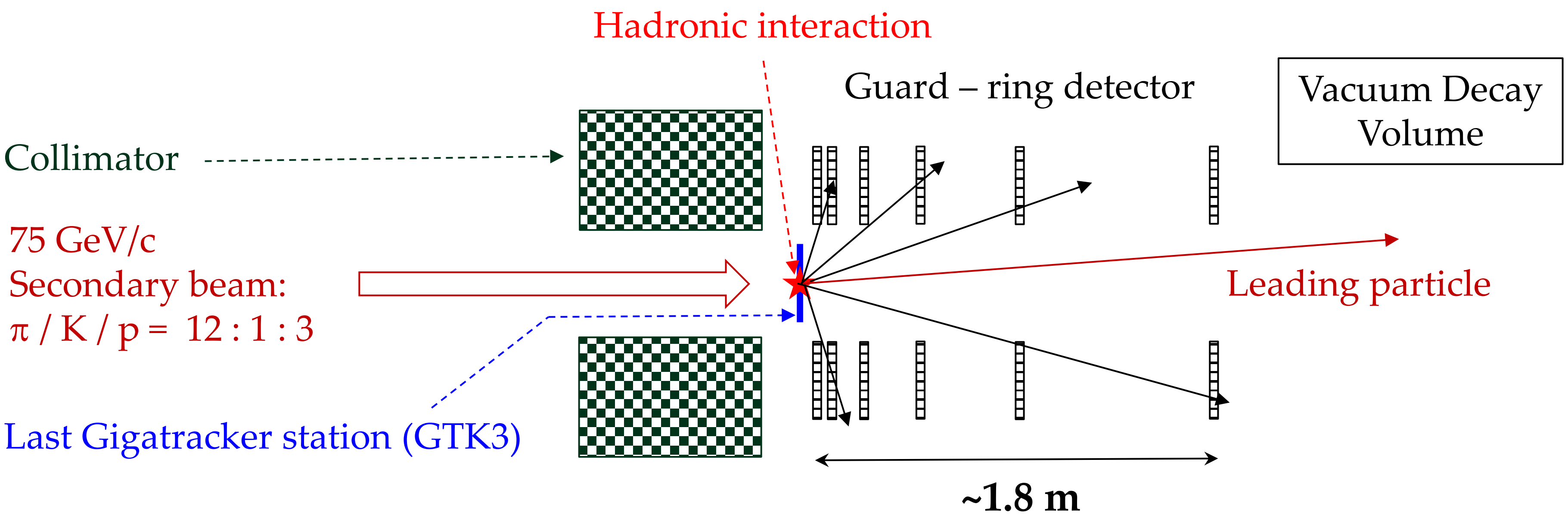
Fast Muon Veto Plane

2014 data





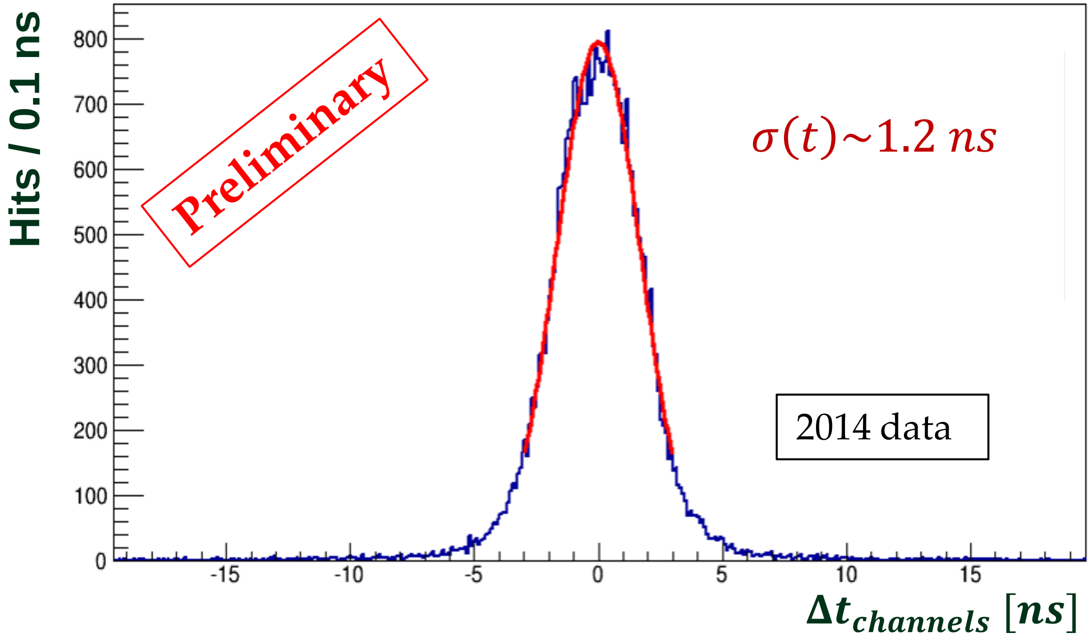
Non Kaon decay Background



- Goal: $O(10^8 - 10^9)$ suppression
- Identify Kaon: KTAG
- Detect low energy products: guard - ring detector
- Reconstruct the origin of the leading particle: tracking systems
- Keep high vacuum level to avoid beam interactions with residual gas

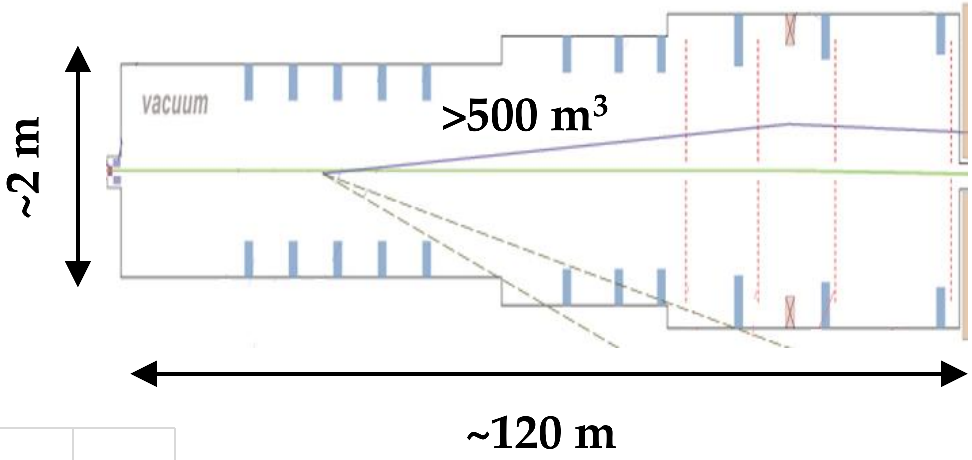
Guard – Ring detector: CHANTI

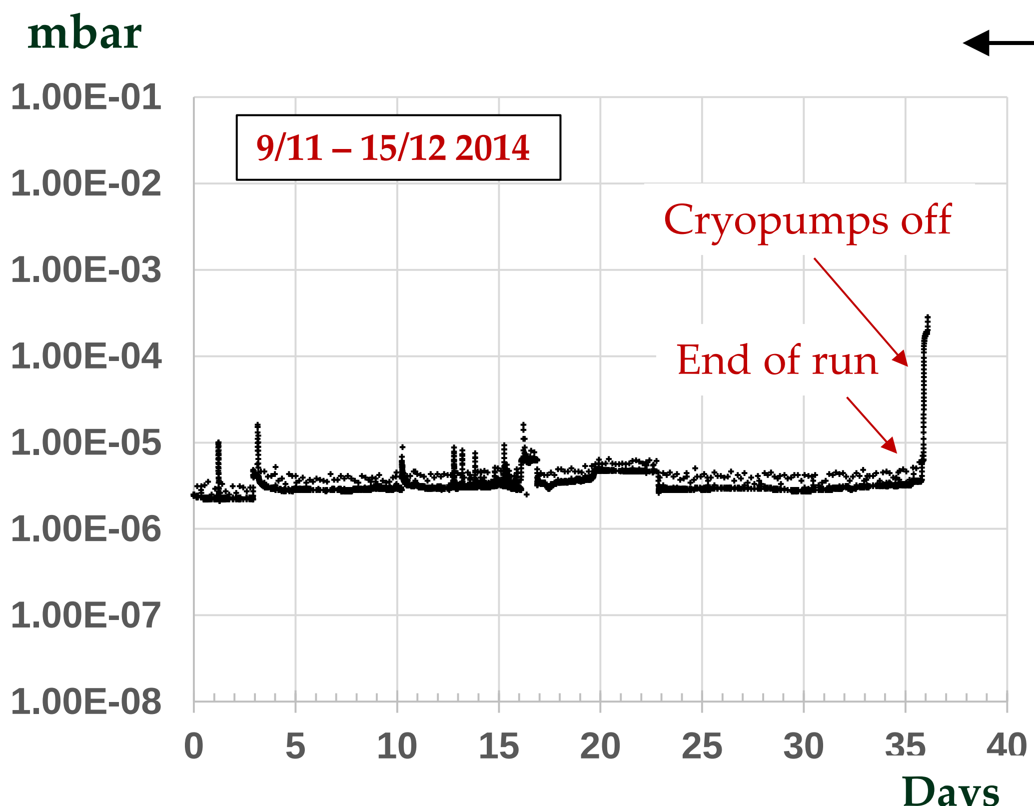
- 6 stations made by triangular scintillator bars
- Readout: WLS and SiPM (300 channels)
- <1% inefficiency > 50 mrad; ~1 ns time resolution
- Rate O(10-100 KHz)/channel
- Commissioned in 2014

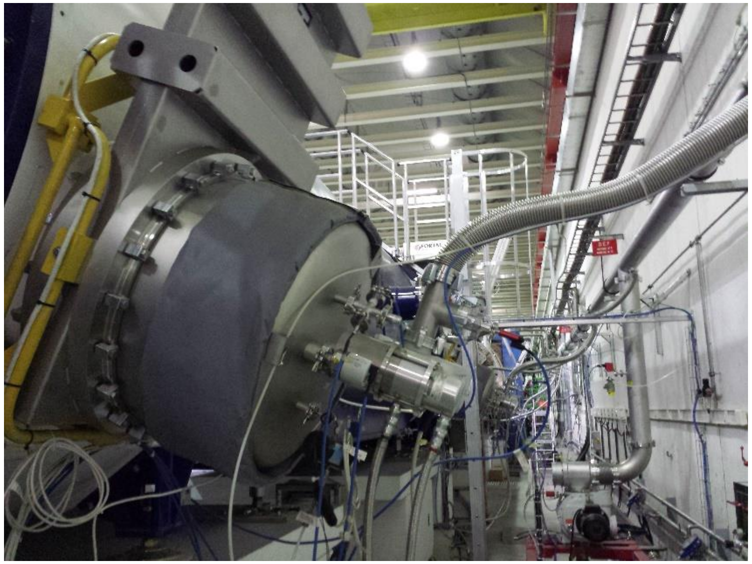


Vacuum

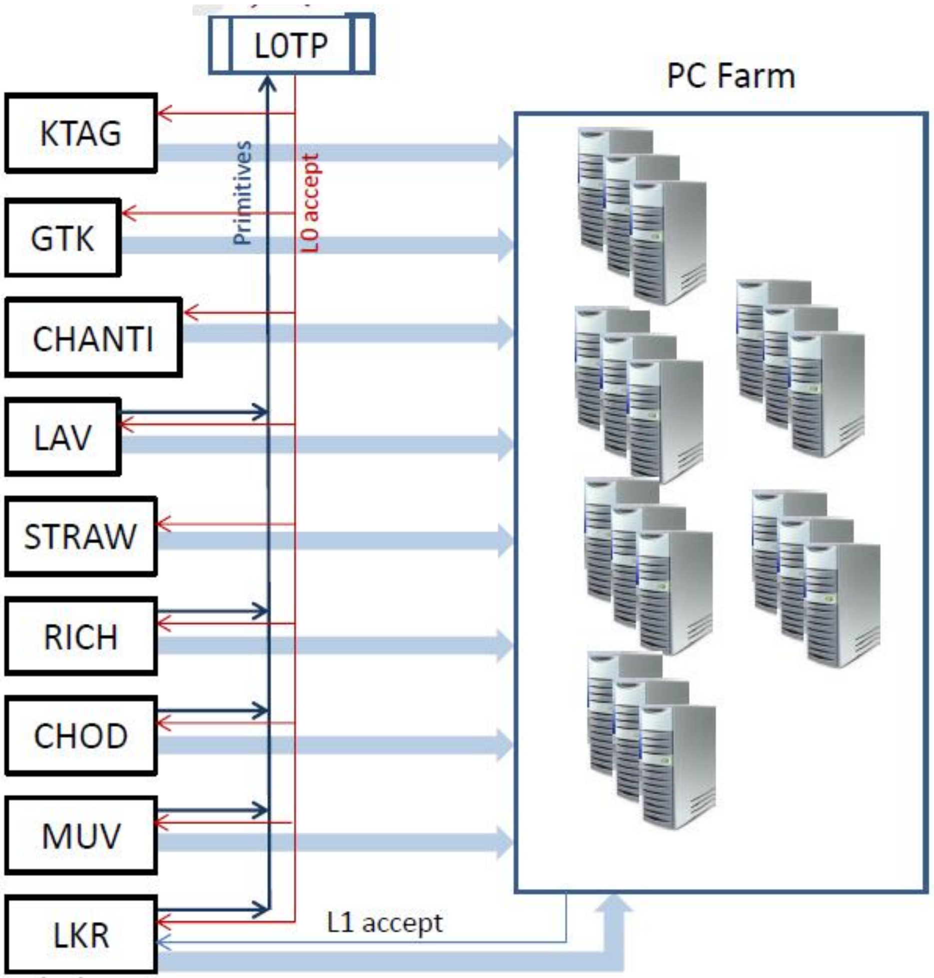
- O(10^{-6}) mbar vacuum guaranteed by a system of 7 cryopumps.
- Background from beam-gas interactions negligible.







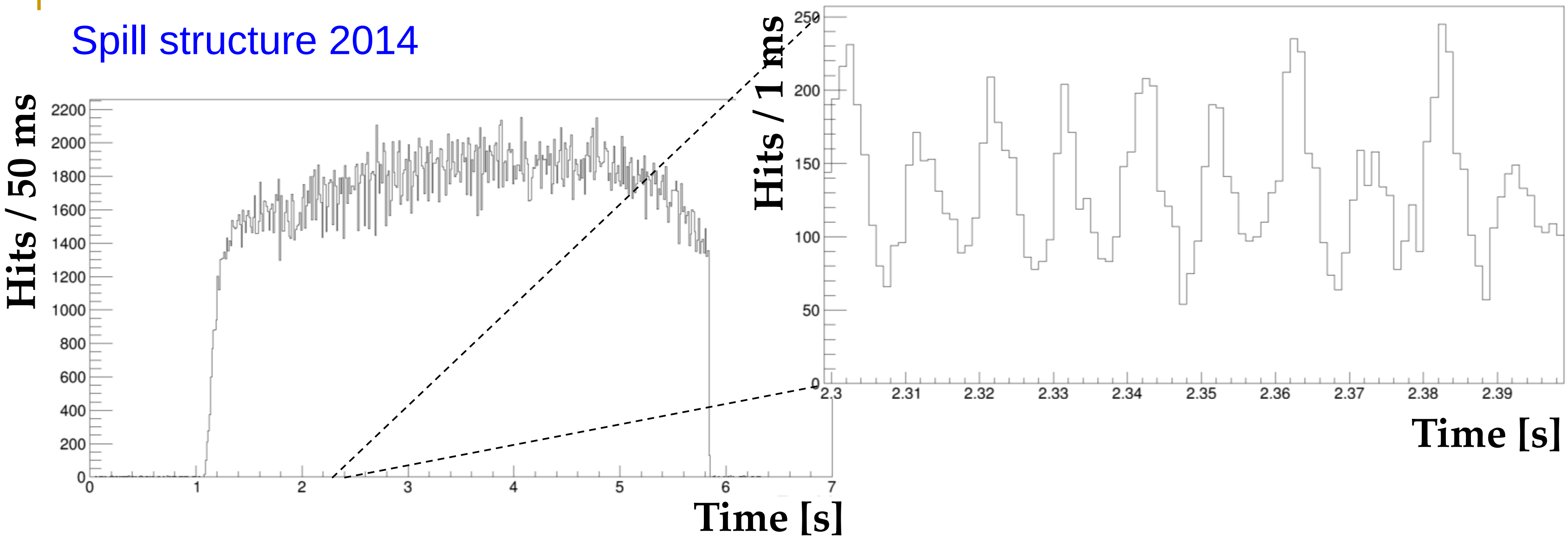
Trigger and DAQ



- Trigger:
  - L0 (hardware): 10 → 1 MHz
  - L1/L2 (software): 1 MHz → 20 KHz
- DAQ: 20 KHz
- L0 trigger for $K^+ \to \pi^+ \nu \bar{\nu}$:
  - Single charged particle topology
  - Energy in hadron calorimeter / no muons
  - No photons
- L0 Trigger partially commissioned in 2014 (no photon trigger).
- DAQ commissioned in 2014 at 5% of nominal intensity.

2014 Pilot Run Conditions

Spill structure 2014



- Duty cycle: 4.8/16.8 s spill
- 5% of the nominal beam intensity (most of the time)
- Data size: 20 Kbyte / event (~100 K events per spill)
- (last) 2 weeks of run dedicated to physics studies.
- Triggers:
  - $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ without photon rejection (most of the time)
  - Minimum bias (few hours).

First Look at 2014 Data Quality

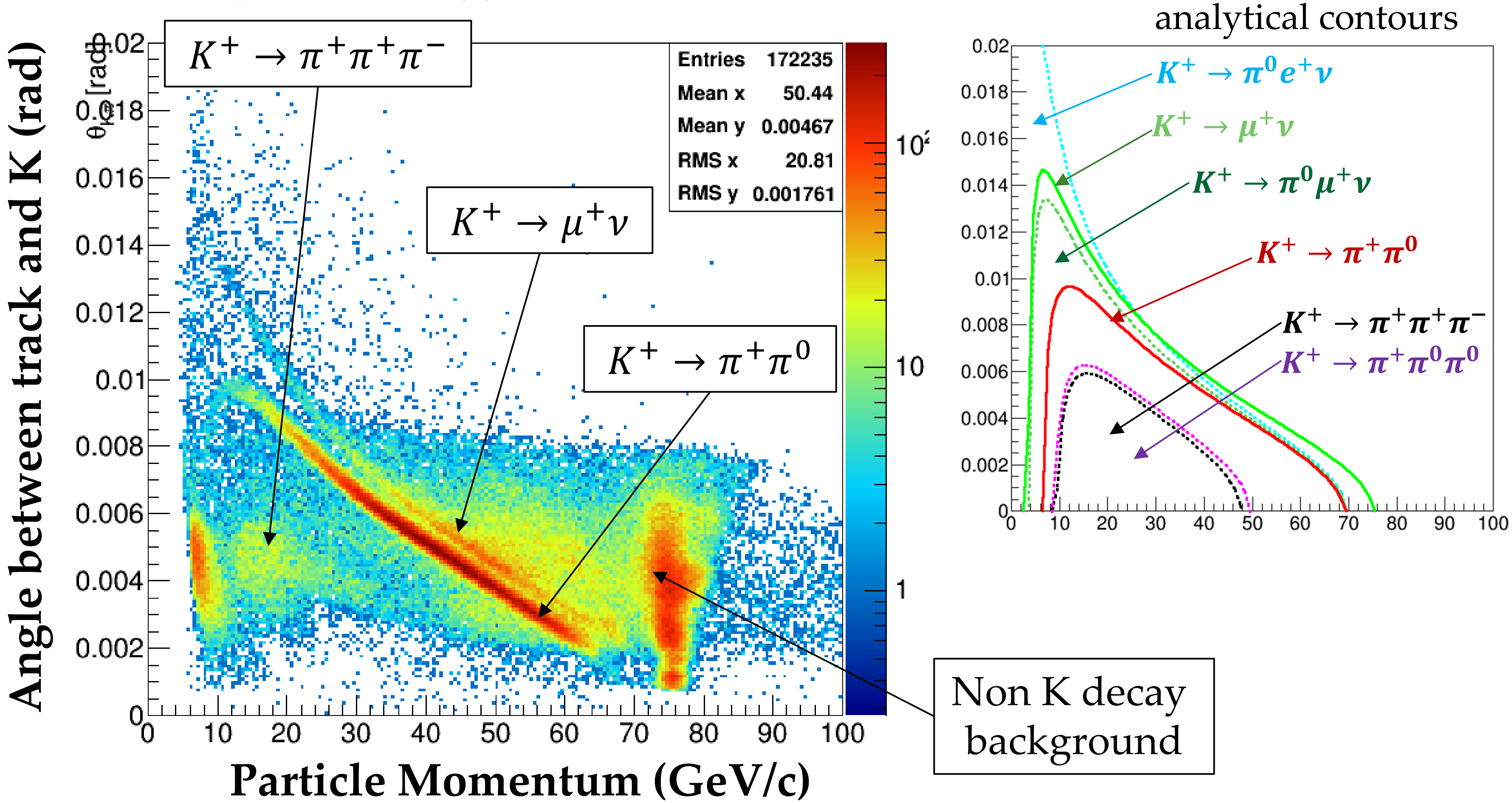
<1% of the total data with the $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ trigger studied

All the plots are very preliminary

- No Gigatracker. Kaon nominal momentum and direction assumed (factor 3 degradation of the missing mass resolution).
- Straw spectrometer: 3 chambers used; T0 applied; position measured using the R-T relation from simulation; no straw by straw alignment; preliminary track fit using a constant B field; (factor 2 degradation of the missing mass resolution).
- KTAG: preliminary time alignment.
- RICH: no offline mirror alignment.
- Liquid Krypton: preliminary calibration using a global energy scale only.
- No photon rejection exploited.
- Muon rejection: applied online by triggering on hadronic energy (inefficiency ~1%).

First Look at 2014 Data Quality

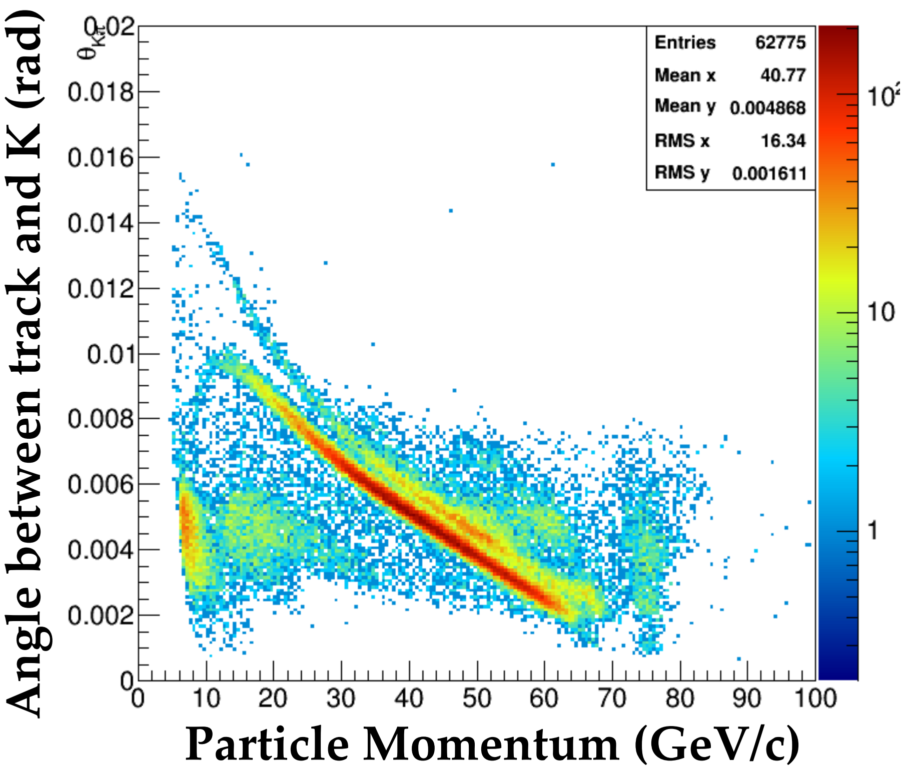
- Events with only 1 track in the spectrometer reconstructed (40 ns time window)
- 10^2 muon rejection at trigger level.



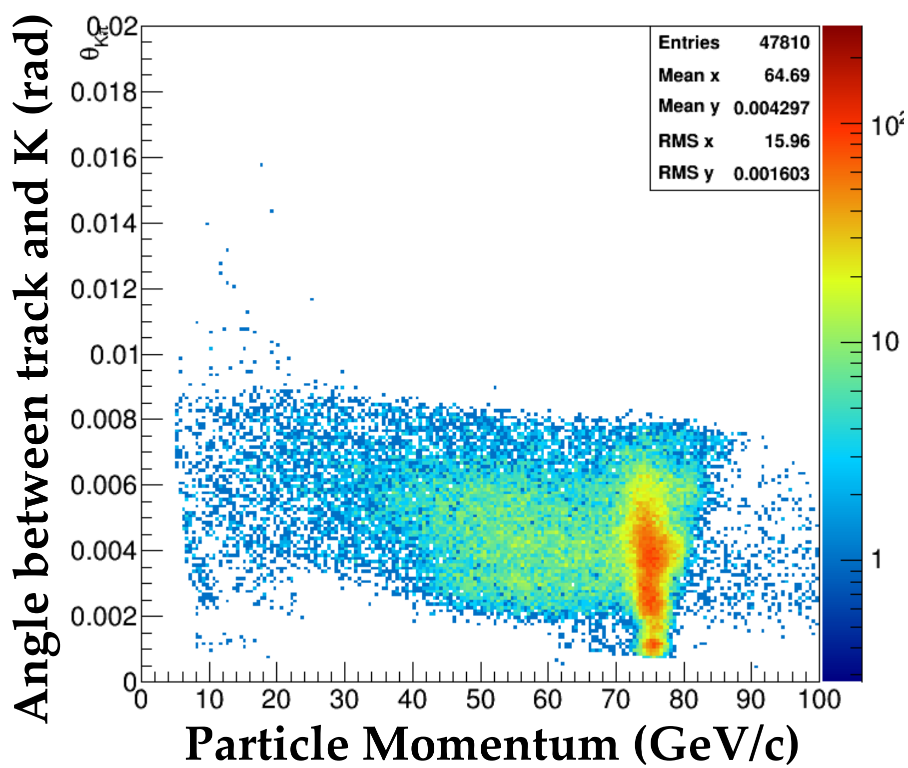
First Look at 2014 Data Quality

- Apply KTAG for K ID

K ID from KTAG in time with the track

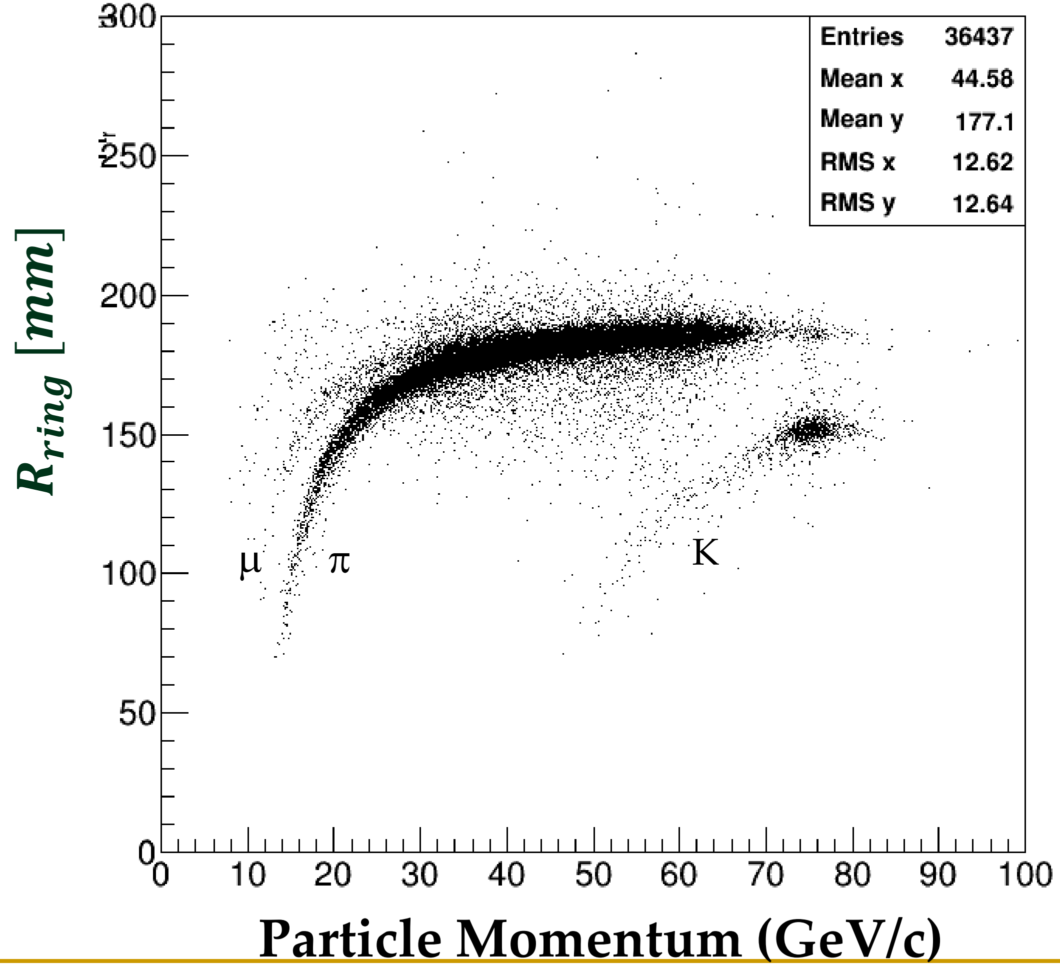


No K ID from KTAG



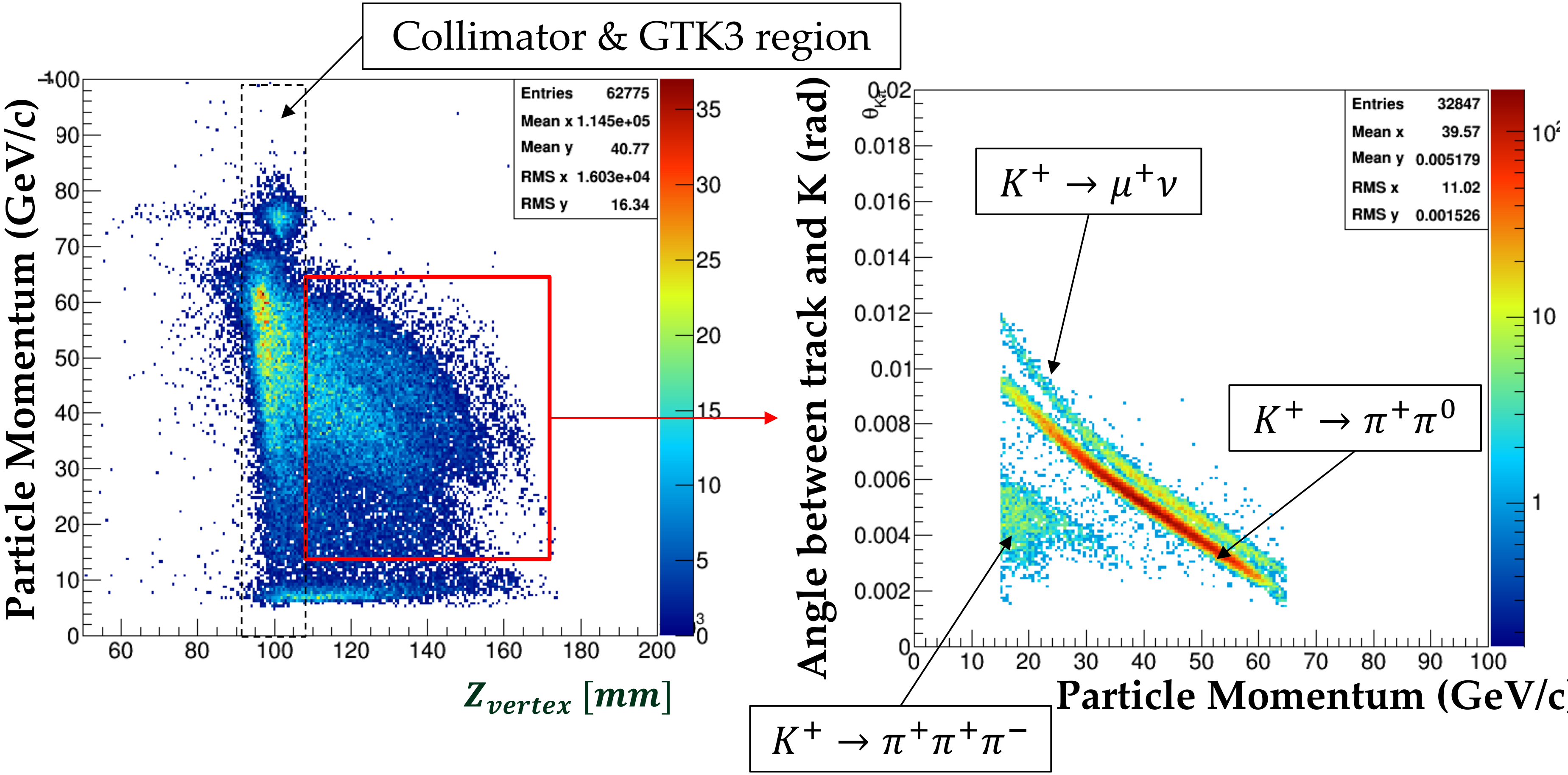
First Look at 2014 Data Quality

- Matching between track and RICH ring to study the particle content
- Positrons suppressed by the trigger



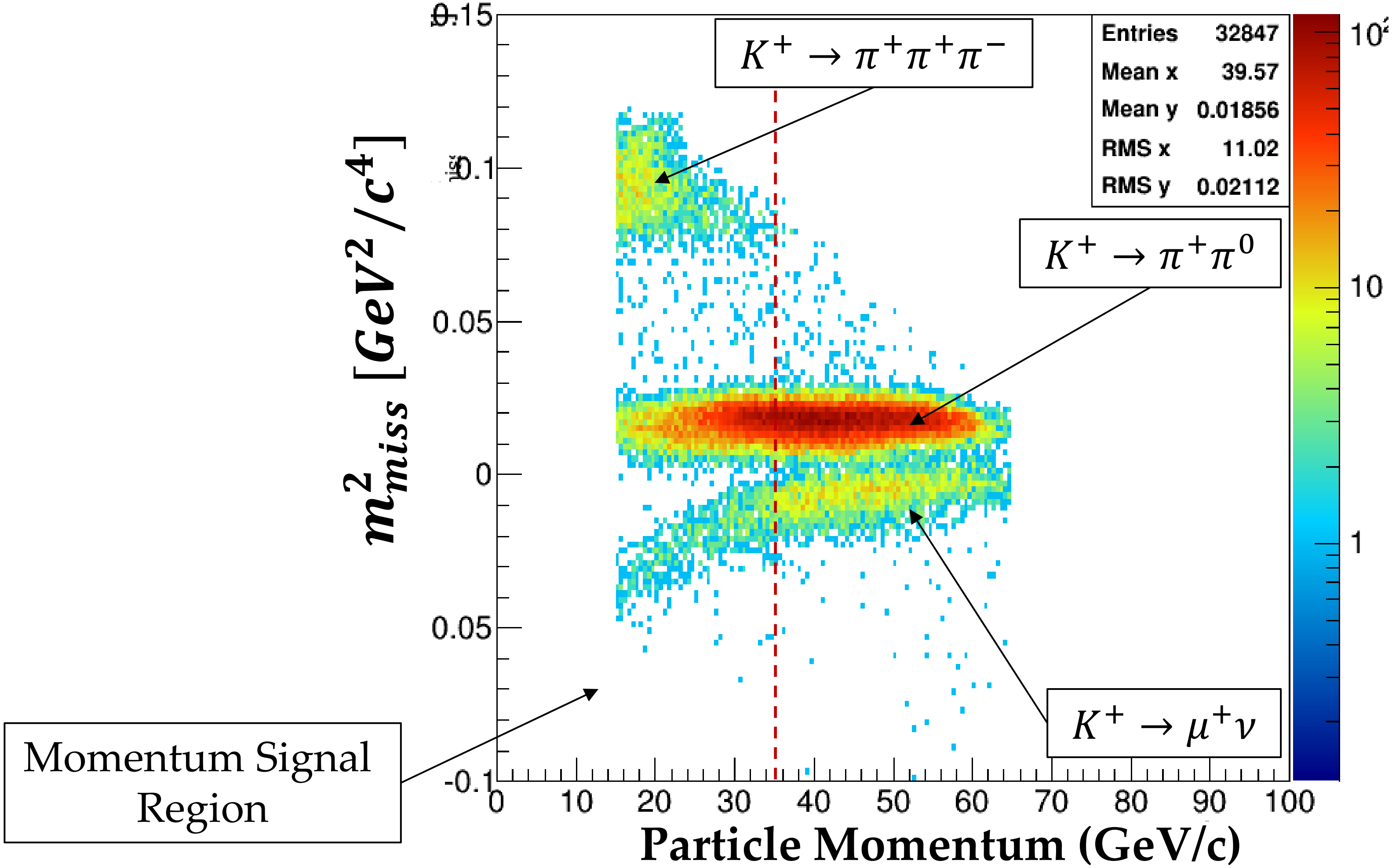
First Look at 2014 Data Quality

- Use track origin to suppress the background from kaon interactions
- Decay vertex from the intersection between the track and the nominal K direction



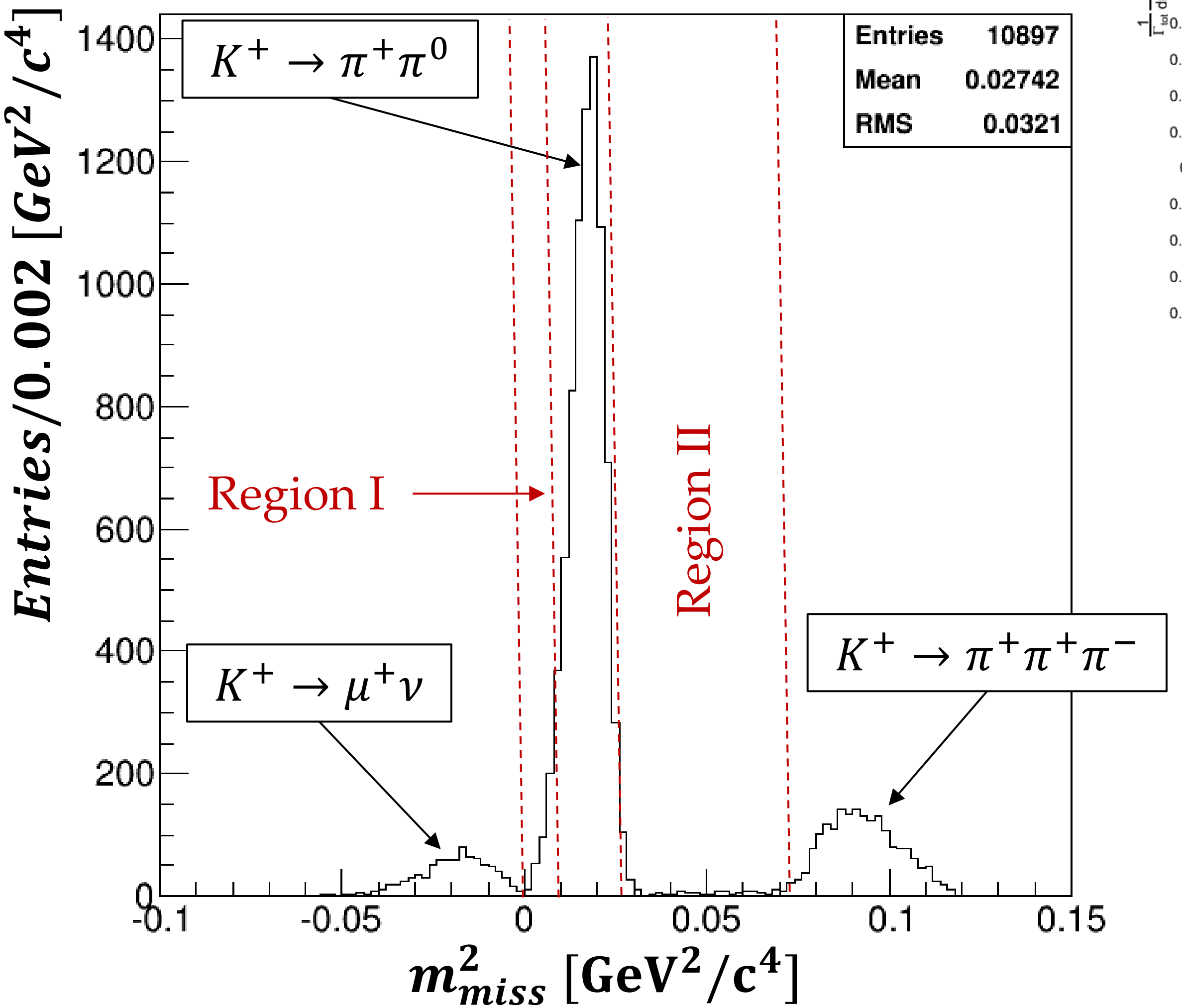
First Look at 2014 Data Quality

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

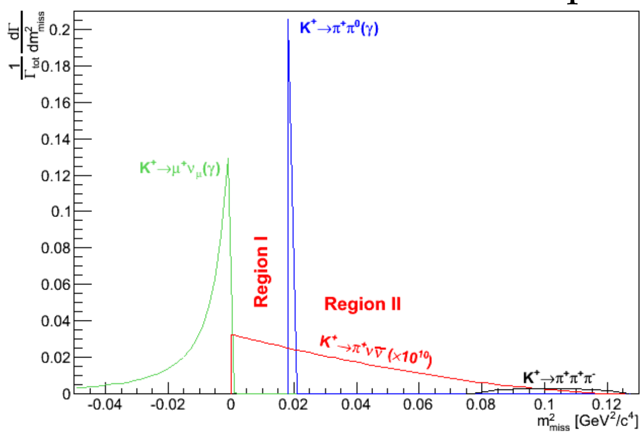


First Look at 2014 Data Quality

$P < 35\ GeV/c$

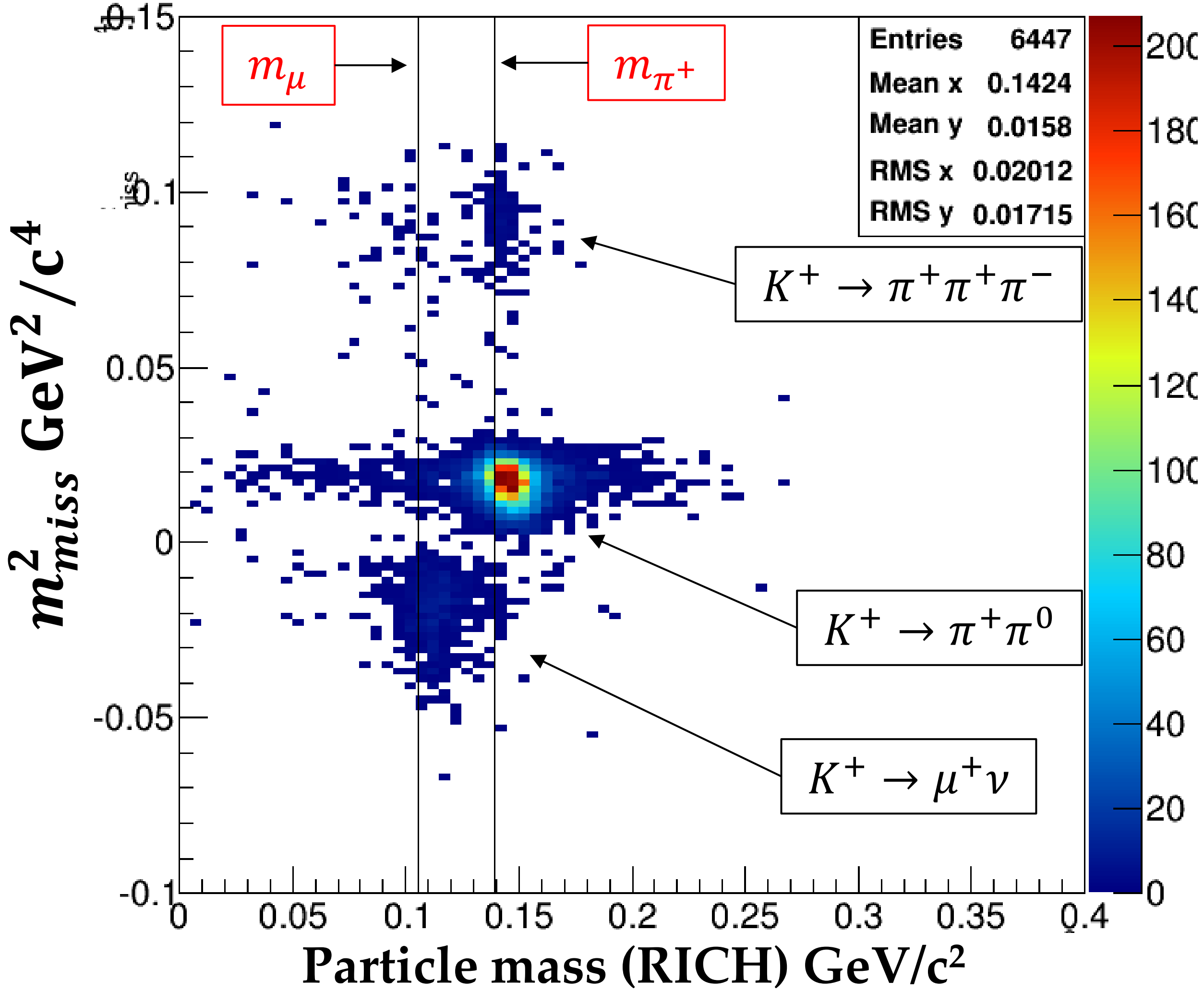


theoretical shapes



First Look at 2014 Data Quality

- Joining kinematics and particle ID

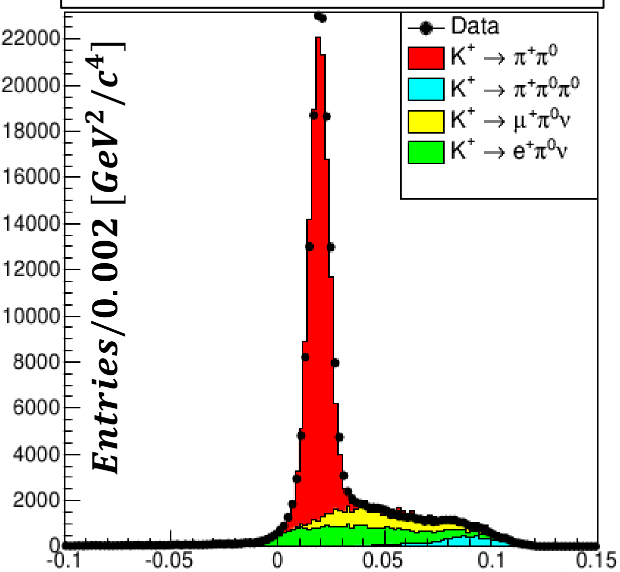


Examples of Control samples

- Kaon decay modes reconstructed with the liquid Krypton calorimeter only (from minimum bias data).
- Useful to measure the kinematic suppression factor, particle ID efficiency …

π^0 mass assumed

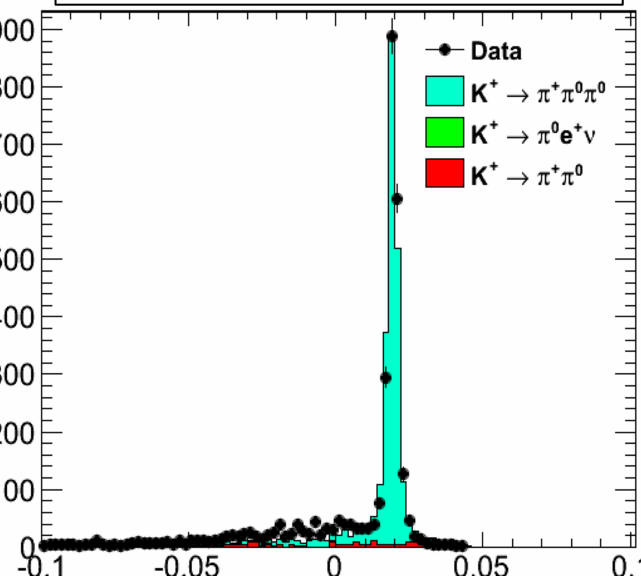
$K^+ \to \pi^+\pi^0$



$(P_K - P_{\pi^0})^2$ GeV^2/c^4

π^0 mass assumed

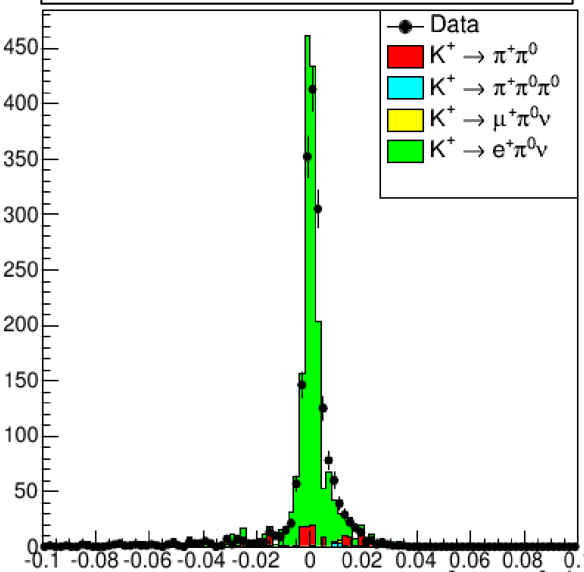
$K^+ \to \pi^+\pi^0\pi^0$



$\left(P_K - P_{\pi_1^0} - P_{\pi_2^0}\right)^2$ GeV^2/c^4

π^0 mass assumed and e^+ energy

$K^+ \to \pi^0 e^+ \nu$



$(P_K - P_{\pi^0} - P_{e^+})^2$ GeV^2/c^4

First Look to 2014 Data Quality

- Outstanding data quality, despite the very early stage of the reconstructions and calibrations used.
- The 2014 data reprocessing with the complete set of detector calibrations and reconstructions is on going.
- 2014 data crucial to set the present limit of the $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ sensitivity in view of the 2015 run.

2015 Run

- Scheduled from beginning of July to mid November.

- Commissioning of the remaining (part of) detectors
  - e.g. Full Gigatracker
- Increase of the intensity up to the nominal one.
- Exploit $K^+ \to \pi^+ \nu\bar{\nu}$ and further physics program.

Further NA62 K Physics Program

Decay	Physics	Present limit (90% C.L.) / Result	NA62
$\pi^+\mu^+e^-$	LFV	1.3×10^{-11}	0.7×10^{-12}
$\pi^+\mu^-e^+$	LFV	5.2×10^{-10}	0.7×10^{-12}
$\pi^-\mu^+e^+$	LNV	5.0×10^{-10}	0.7×10^{-12}
$\pi^-e^+e^+$	LNV	6.4×10^{-10}	2×10^{-12}
$\pi^-\mu^+\mu^+$	LNV	1.1×10^{-9}	0.4×10^{-12}
$\mu^-\nu e^+e^+$	LNV/LFV	2.0×10^{-8}	4×10^{-12}
$e^-\nu\mu^+\mu^+$	LNV	No data	10^{-12}
π^+X^0	New Particle	5.9×10^{-11} $m_{X^0} = 0$	10^{-12}
$\pi^+\chi\chi$	New Particle	$-$	10^{-12}
$\pi^+\pi^+e^-\nu$	$\Delta S \neq \Delta Q$	1.2×10^{-8}	10^{-11}
$\pi^+\pi^+\mu^-\nu$	$\Delta S \neq \Delta Q$	3.0×10^{-6}	10^{-11}
$\pi^+\gamma$	Angular Mom.	2.3×10^{-9}	10^{-12}
$\mu^+\nu_h, \nu_h \rightarrow \nu\gamma$	Heavy neutrino	Limits up to $m_{\nu_h} = 350\ MeV$	
R_K	LU	$(2.488 \pm 0.010) \times 10^{-5}$	>×2 better
$\pi^+\gamma\gamma$	χPT	< 500 events	10^5 events
$\pi^0\pi^0e^+\nu$	χPT	66000 events	$O(10^6)$
$\pi^0\pi^0\mu^+\nu$	χPT	-	$O(10^5)$

Conclusions

- Kaons are partner of LHC in the quest for physics beyond the Standard Model.
- NA62 carries on the bright tradition of Kaon Physics at CERN.
- The NA62 apparatus is almost fully commissoned.
- After 9 years from the proposal, NA62 collected data in a first pilot run at the end of 2014.
- NA62 is working and ready to do physics.