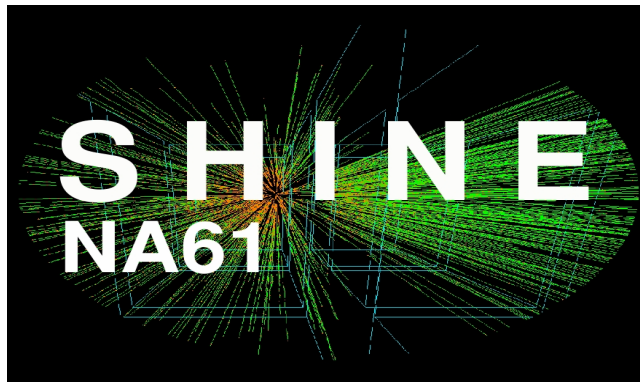


NA61 Status and Plans

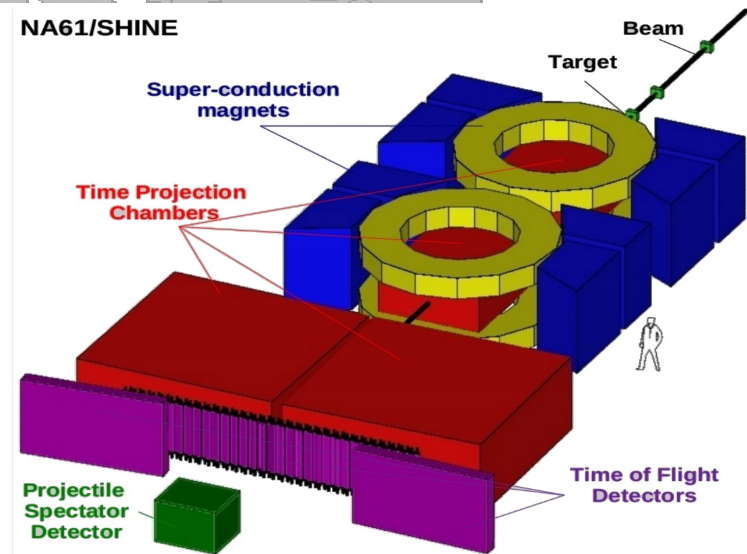
(report on September 2009 – September 2010 period)

András László (for the NA61/SHINE Collaboration)



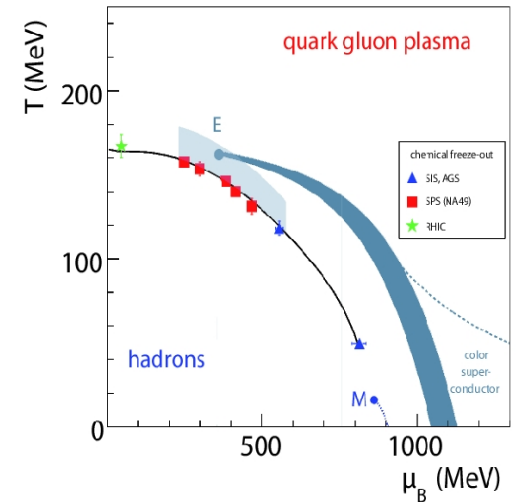
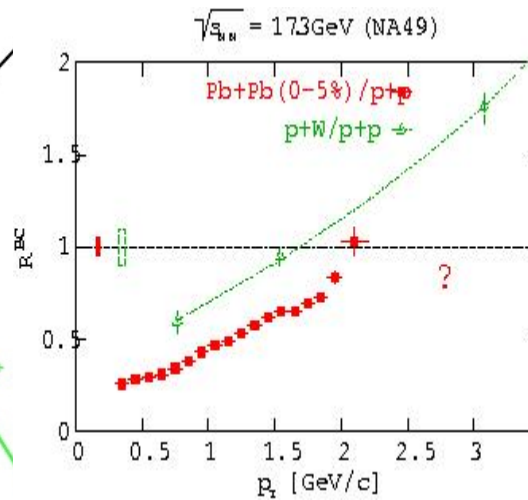
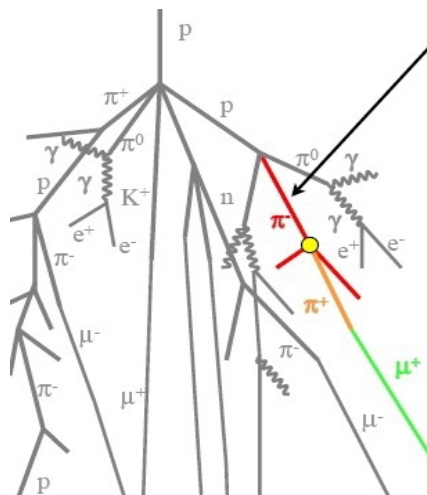
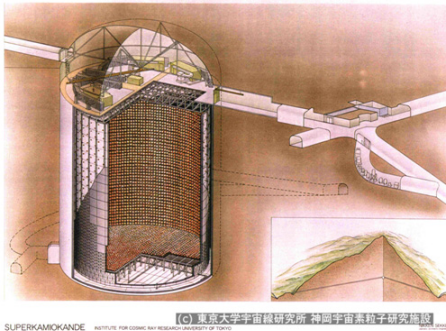
Outline

- Introduction
- Detector and beamline upgrades
- 2009 beam period
- 2010 beam period
- Software development
- Calibration of 2009 data
- Data analysis
- Data taking plans
- Summary



Introduction

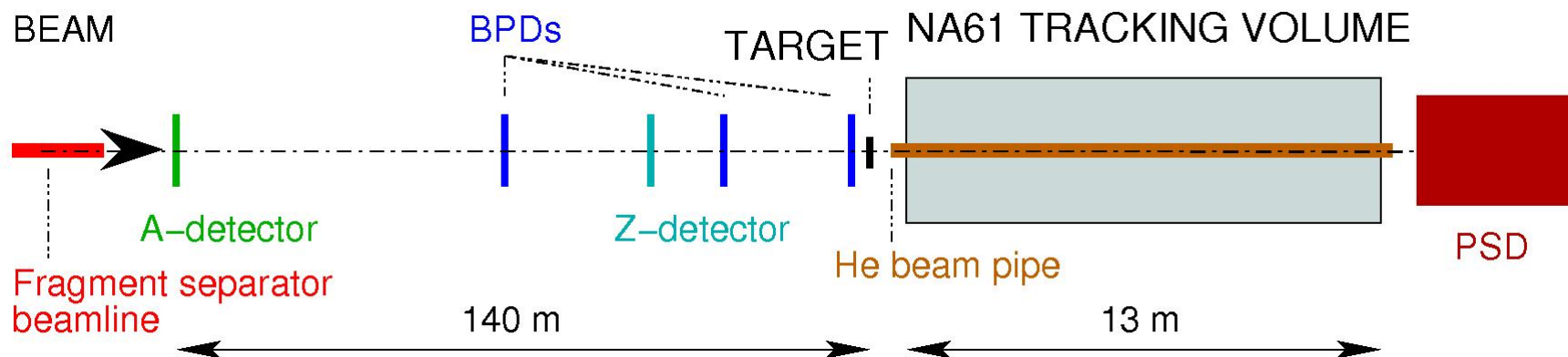
- NA61 is a large acceptance hadron spectrometer experiment.
- Main physics goals are to measure:
 - Reference hadron spectra in p+C for T2K experiment.
 - Reference hadron spectra in π^- +C for the Pierre Auger Obs.
 - High p_T physics in p+p, p+Pb.
 - Fluctuations in ion-ion for CP&OoD in strong interactions.



Detector and beamline upgrades

Recent upgrades are mainly motivated by ion runs.

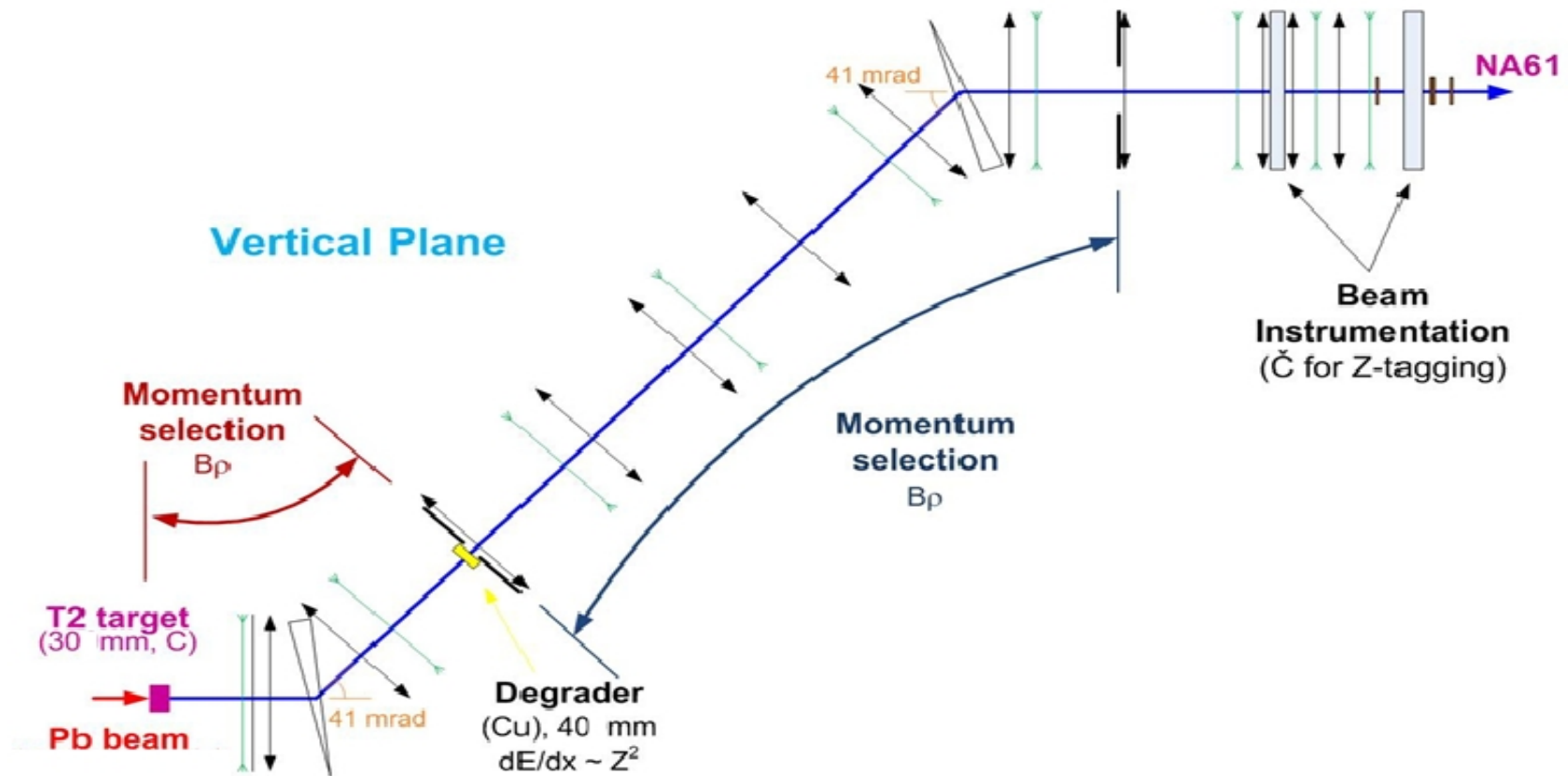
- New BPD-s and shapers to perform in higher intensity (done).
- A-detector (TOF) constructed for secondary beam diagnostic (done).
- Z-detector (Cherenkov) is developed for secondary ion trigger (2010).
- He beam pipe into TPC-s to reduce δ -electron contribution: design ready, model being tested at CERN. Installation in 2011.
- Projectile Spectator Detector (PSD) for ion runs: 16 modules for central part finished, assembly of the peripheral modules ongoing at CERN. Energy resolution of $55\%/\sqrt{E}$ confirmed by test beam. Full assembly foreseen in the beginning of 2011. FEE integrated into NA61 DAQ, in production.



Also upgrade of beamline is necessary.

- Change of H2 beamline to fragment separator (activity lead by Ilias Efthymiopoulos at CERN-EN-MEF, 2010).

H2 Beam Line for Fragmented Ion Beam

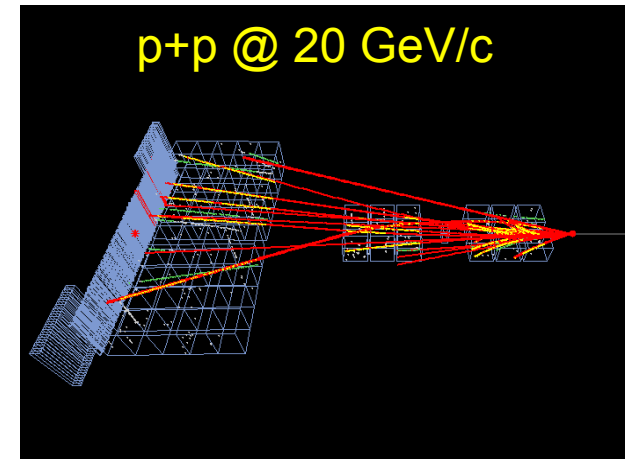
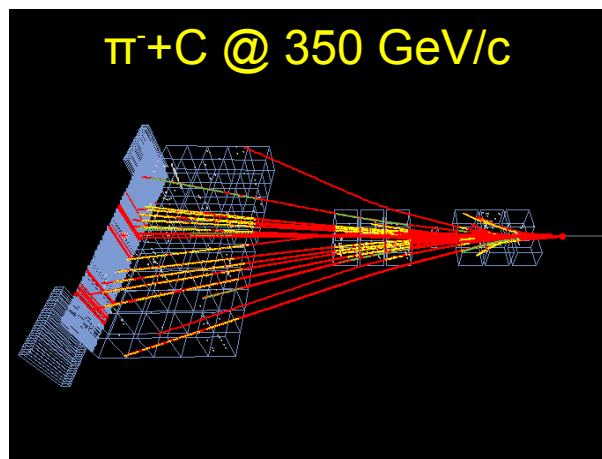
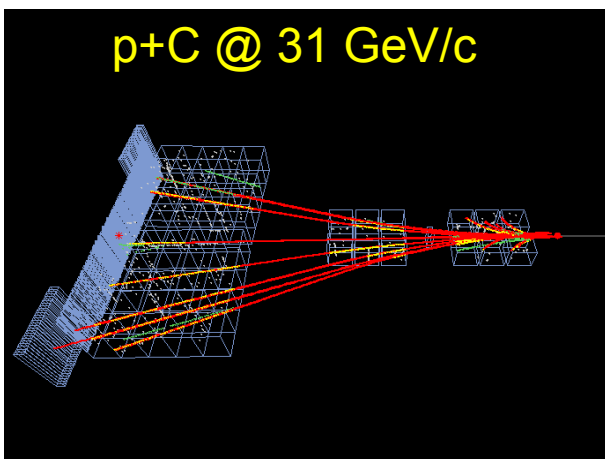


2009 beam period

(data taking period 16 July – 14 November 2009)

- T2K p+C and p+(T2K Replica Target) at 31 GeV/c.
- π^- +C at 158 and 350 GeV/c for the Pierre Auger Observatory.
- p+p at 20, 30, 40, 80 and 158 GeV/c for ion-program.
p+p at 10 GeV/c not recorded: poor stability and identification.

40M events recorded, for 3 physics programs.



2010 beam period

(data taking period 19 July – 25 October 2010)

- High statistics T2K p+(T2K RT) at 31 GeV/c (about 10M).
- Pilot p+p at 13 GeV/c for ion-program (better PID by CEDAR-W).
- p+p at 158 GeV/c being taken for high p_T physics (about 20M by September 17, about 45M is expected with extrapolation).

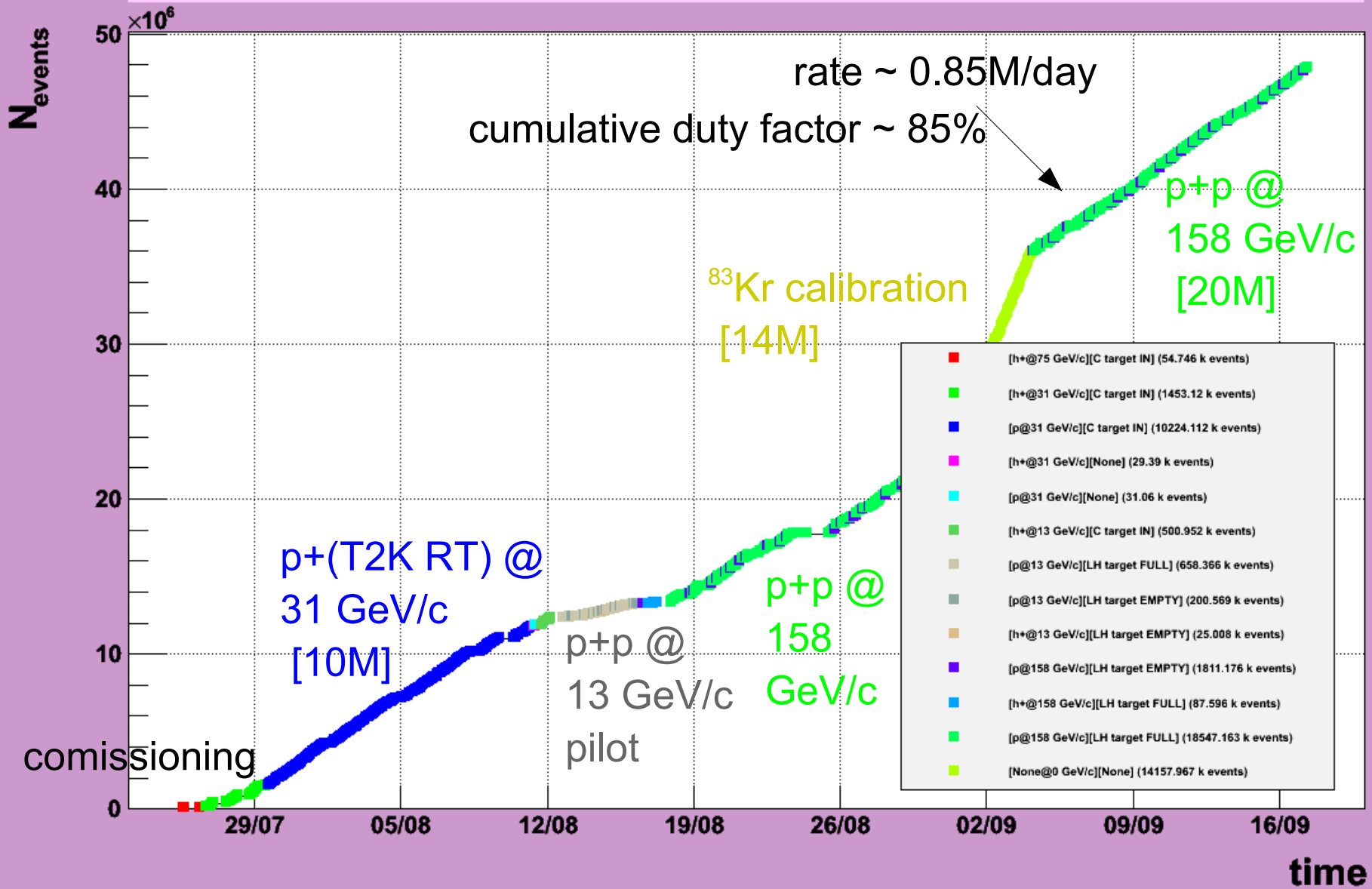
Additional data/tests:

- PSD testbeam at PS-T10.
- ^{83}Kr data was taken during MD for TPC calibration (about 14M).
- PSD beam test is planned for 19-21 November.
- Pb fragmentation beam test for 13, 20 and 80 GeV/c ^{11}B beam is planned for 22-28 November.

Data taking rate:

- Nominal 1.1M/day, effective 0.85M/day, Σ -ed duty factor 85%.
- Great thanks to accelerator and NA61 crew.

NA61 data statistics 2010



Software development

- Migration to the new CERN-supported SVN repository (done).
 - Migration to a new MySQL-based DB (done).
 - Migration of the software project to SLC5 platform (ongoing).
 - Virtualization of the NA61 software on CernVM (ongoing).
- Further development of the NA61 software/data preservation approved by PH, support of PH-SFT group was granted.
(1 Project Associate supported by CERN directorate.)

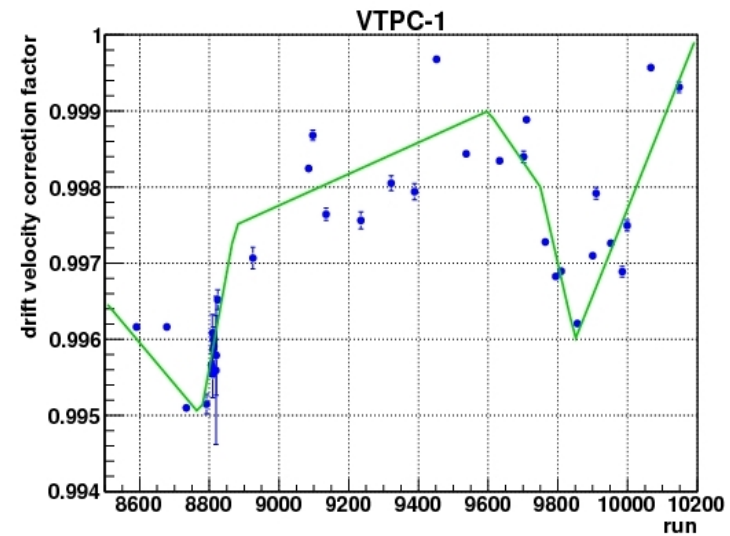
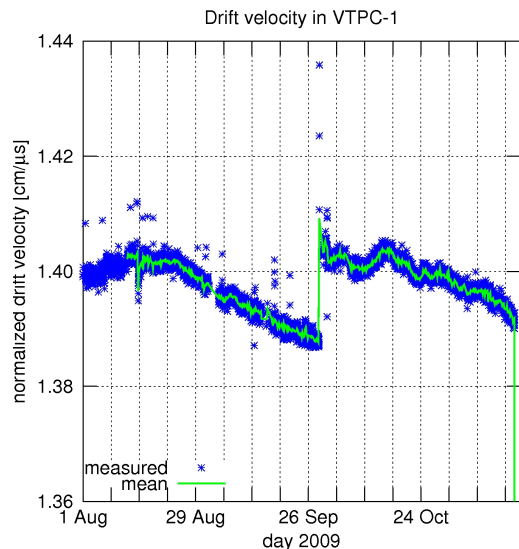


Calibration of 2009 data

2009: revised calibration strategy.

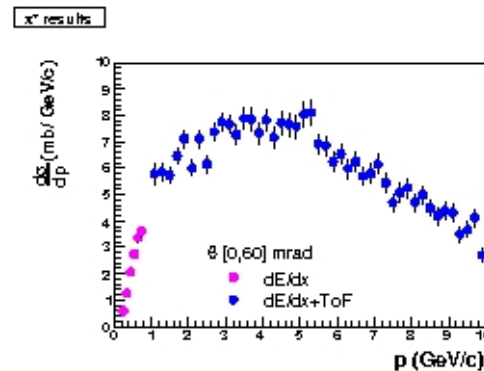
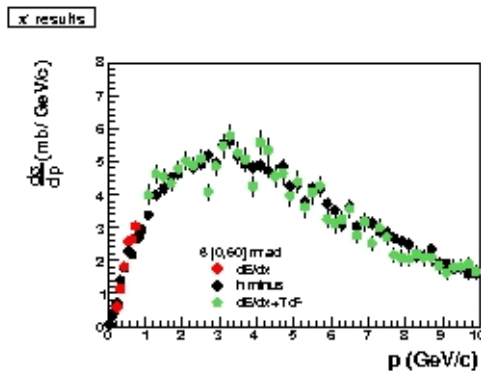
(Higher available statistics,
precision of drift velocity measurement is lower than required.)

- Drift velocity calibration (done).
- TPC time offsets correction (done).
- Detector positions measurements and correction (in progress).
- TPC ionization response correction (to be done).
- TOF calibration (to be done).

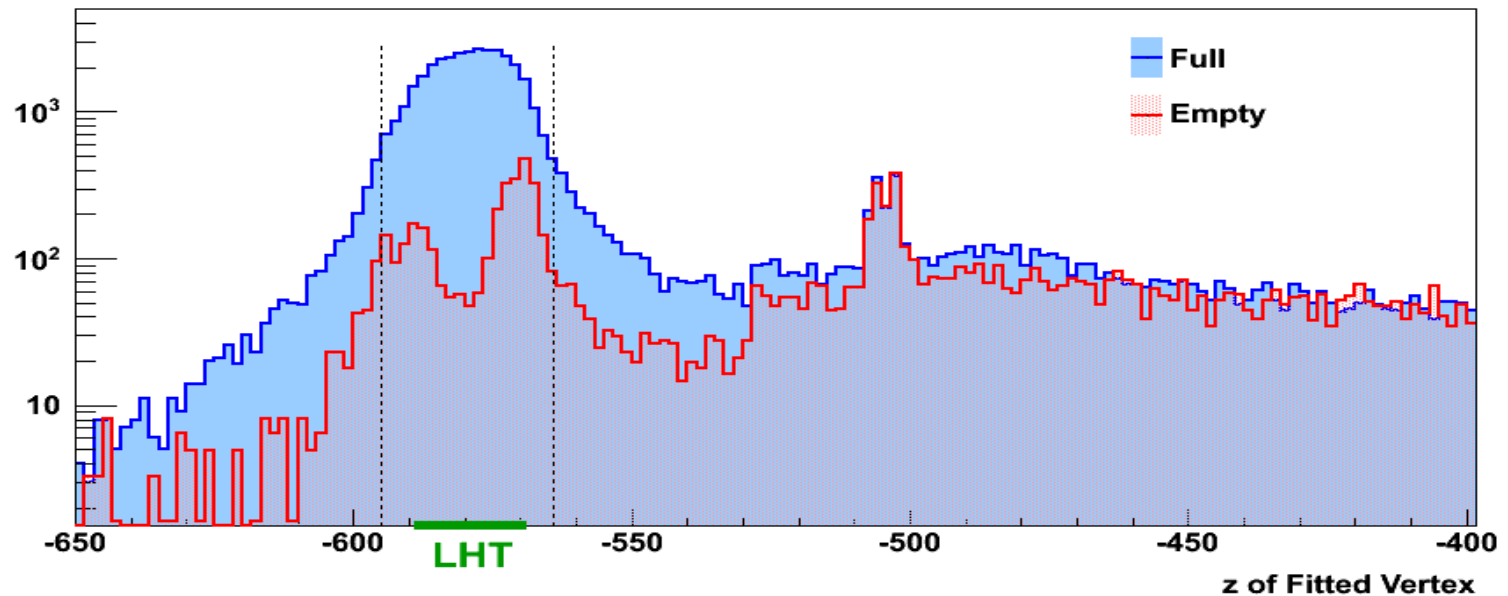


Data analysis

- Preliminary spectra of π^+ in p+C at 31 GeV/c released and reported at conferences in 2010. Data being used by T2K. Paper on π^\pm spectra foreseen by the end of 2010. (See: Alessandro Bravar's talk.)
- Methods to introduce p+C data in T2K and C.R. experiments simulation advanced. (See: Alessandro Bravar's talk.)



- Methods to correct event-by-event fluctuation data for various effects, in particular for non-target contribution has been developed. Tested on uncalibrated p+p at 20, 30, 40, 80 and 158 GeV/c.



- Full – empty target subtraction has to be done on the moments of event-by-event distributions. Tests on uncalibrated p+p show that this contribution is much smaller than fluctuations expected by presence of critical point.

Data taking plans

(preliminary: 2010 physics run not finished, November test not yet performed)

Stop of SPS beam in 2012 and considered reduction of duty cycle will have a negative impact on NA61.

To minimize this, NA61 proposes the following measures:

- Convert the second test of ^{11}B beam in 2011 to physics run with $^{11}\text{B}+\text{C}$ at 13, 20, 30, 40, 80 and 158 GeV/c. (60 days of Pb.)
(Discussed with Stephan Maury, CERN-BE.)
- Establish primary ion beam preparation schedule, which would allow 48 days Ar primary beam for physics in 2013 and 48 days Xe primary beam in 2014.
(Discussed with Stephan Maury, CERN-BE.)
- High p_{T} p+p at 158 GeV/c in 2011 should be completed (30 days of p).
- p+Pb at 158 GeV/c for high p_{T} may have to be shifted to 2013.

Impact on CP&OoD physics:

NA61 proposal (assuming 25% duty cycle etc.):

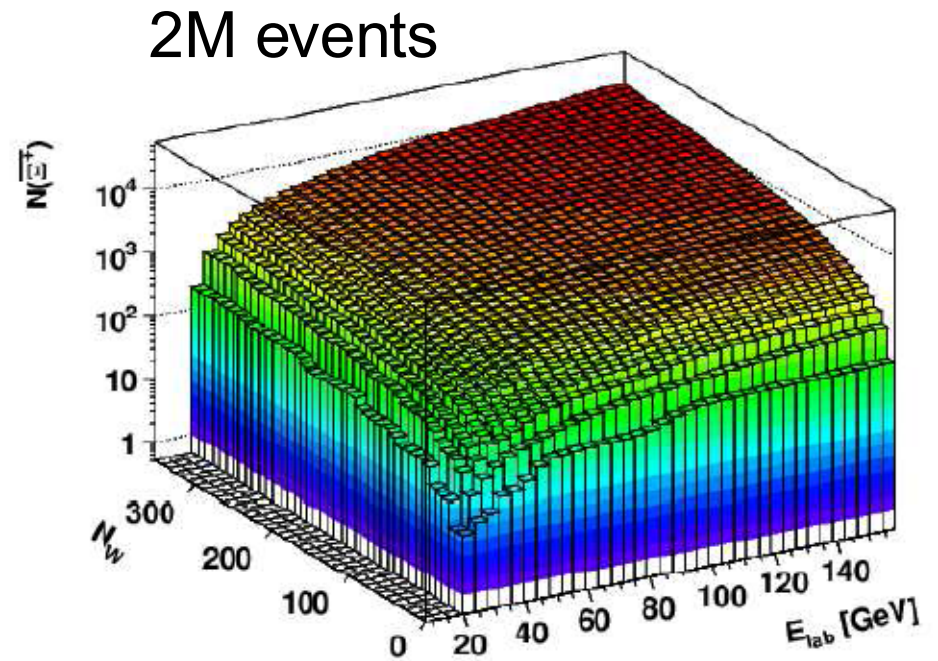
- 2M central events for multiplicity, p_T fluctuations; inclusive hadron yields & spectra; multistrange hadron yields.
- 4M minimum-bias events for elliptic flow; centrality dependence of multiplicity fluctuations.

September 2010 SPSC (assuming 5% duty cycle etc.):

- 1M central for multiplicity, p_T fluctuations; inclusive light hadron yields & spectra. Basic CP&OoD measurements can be still performed.
 - Negative impact: no measurements of elliptic flow, no centrality dependence of multiplicity fluctuations; *limited* measurements of heavy (e.g. multistrange) hadrons.

For 1M central events:

- Scaled variance of multiplicity distribution: 0.5% (stat), 3% (syst), 30% (CP effect).
- p_T fluctuations: 0.3 MeV/c (stat), 1 MeV/c (syst), 5 MeV/c (CP effect).
- Ξ^+ measurements very limited:



Primary beam	Secondary beam	Target	Energy [A GeV]	Year	Duration [days]	Physics
p			400			
	p	p	158	2011	30	High p_T
Pb	^{11}B	C	13,20,30,40,80,158 13,20,30,40,80,158	2011	6x10	CP&OoD
p			400			
	p	Pb	158	2013	77	High p_T
Ar		Ca	13,20,30,40,80,158	2013	6x8	CP&OoD
p			400			
	p	Pb	13,20,30,40,80,158	2014	6x7	CP&OoD
Xe		La	13,20,30,40,80,158	2014	6x8	CP&OoD

p+p @ 13 GeV/c is not yet in the schedule.

Also p+C @ 13 GeV/c is under discussion (to cross-check with HARP data).

Summary

- BPD upgrade, A-detector done. Z-detector, He beam pipe, PSD being done. Upgrade of H2 beamline ongoing.
- 2009: p+C @ 31 GeV/c for T2K, π^- +C @ 158, 350 GeV/c for CR.
p+p @ 20, 30, 40, 80, 158 GeV/c for CP&OoD.
- 2010: p+C @ 31 GeV/c for T2K. Pilot p+p @ 13 GeV/c for ions.
p+p @ 158 GeV/c for high p_T . Testbeams in November.
- Significant progress with software development, calibration of 2009 data and physics analysis.
- Due to 2012 stop at CERN: beam schedule needs to be revised.
Request of physics with ^{11}B (2011), Ar and Xe (2013, 2014).

Backup slides

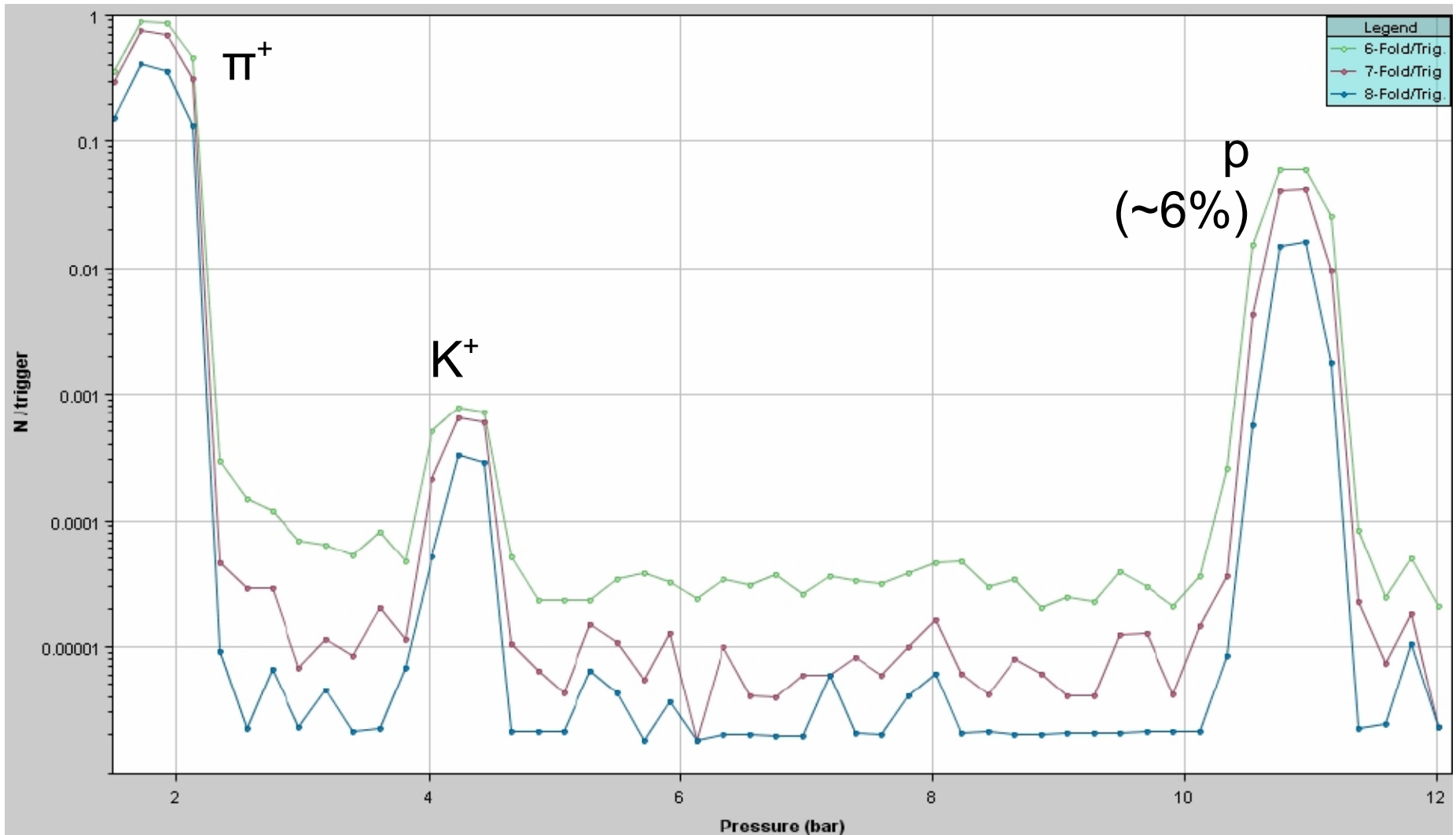
Calibration of 2009 data

The calibration of NA61 data goes with the following steps:

- Direct measurement of TPC drift velocities + smoothing. ✓
- Residual drift velocity calibration from data. ✓
- Direct measurement of TPC time offsets channel-by-channel. ✓
- Detector-wise time offset correction from data. ✓
- Direct measurement of detector positions. ✓
- Data based corrections to detector positions. ✓
- Residual correction to detector points from data.
- Residual correction to the magnetic field from data.
- Channel-by-channel measurement of TPC response.
- Data based corrections to TPC response (dE/dx calibration).
- Data based corrections to TOF response (ToF calibration).

✓: done for 2009 data

PID for p+p @ 13 GeV/c



Schedule from Addendum-5:

Primary beam	Secondary beam	Target	Energy [A GeV]	Year	Duration [days]	Physics	Status
p	p	Pb	400 158	2011	77	High p_T	<i>recommended</i>
Pb	¹¹ B	C	13,20,30,40,80,158 13,20,30,40,80,158	2011	20	FS-test2	<i>to be discussed</i>
p	p	Pb	400 13,20,30,40,80,158	2012	6x8	CP&OoD	<i>recommended</i>
Ar		Ca	13,20,30,40,80,158	2012	6x8	CP&OoD	<i>recommended</i>
Pb	¹¹ B	C	13,20,30,40,80,158 13,20,30,40,80,158	2013	6x10	CP&OoD	<i>to be discussed</i>
Xe		La	13,20,30,40,80,158	2014	6x8	CP&OoD	<i>to be discussed</i>

