Status of the swiss T2K collaboration

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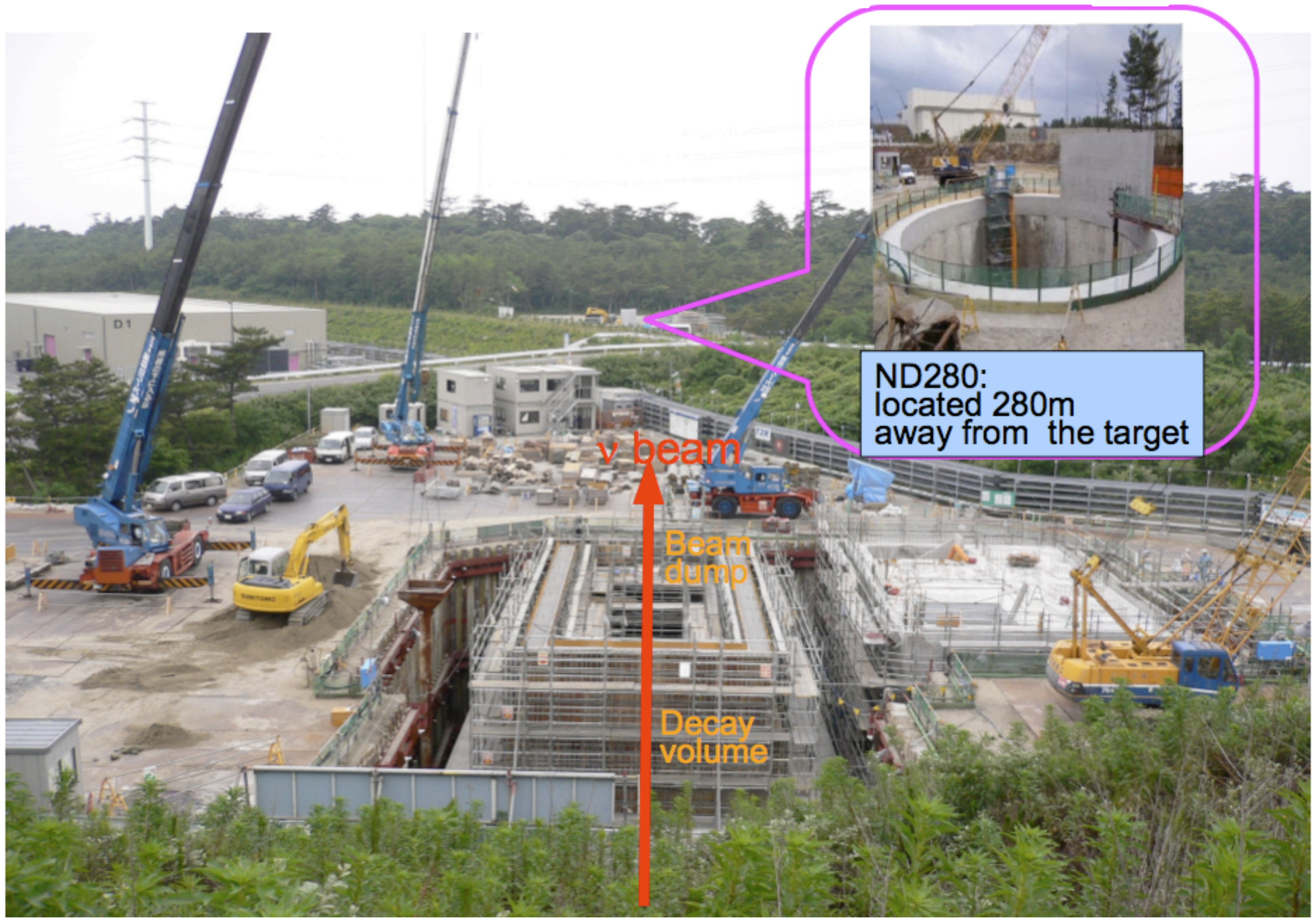
Outline

1. T2K experiment
2. Na61
3. Near Detector
4. Magnet
5. T2K-TPC
6. MicroMegas Calibration
7. Magnetic Field measurement



Primary Goal of T2K (phase-1)

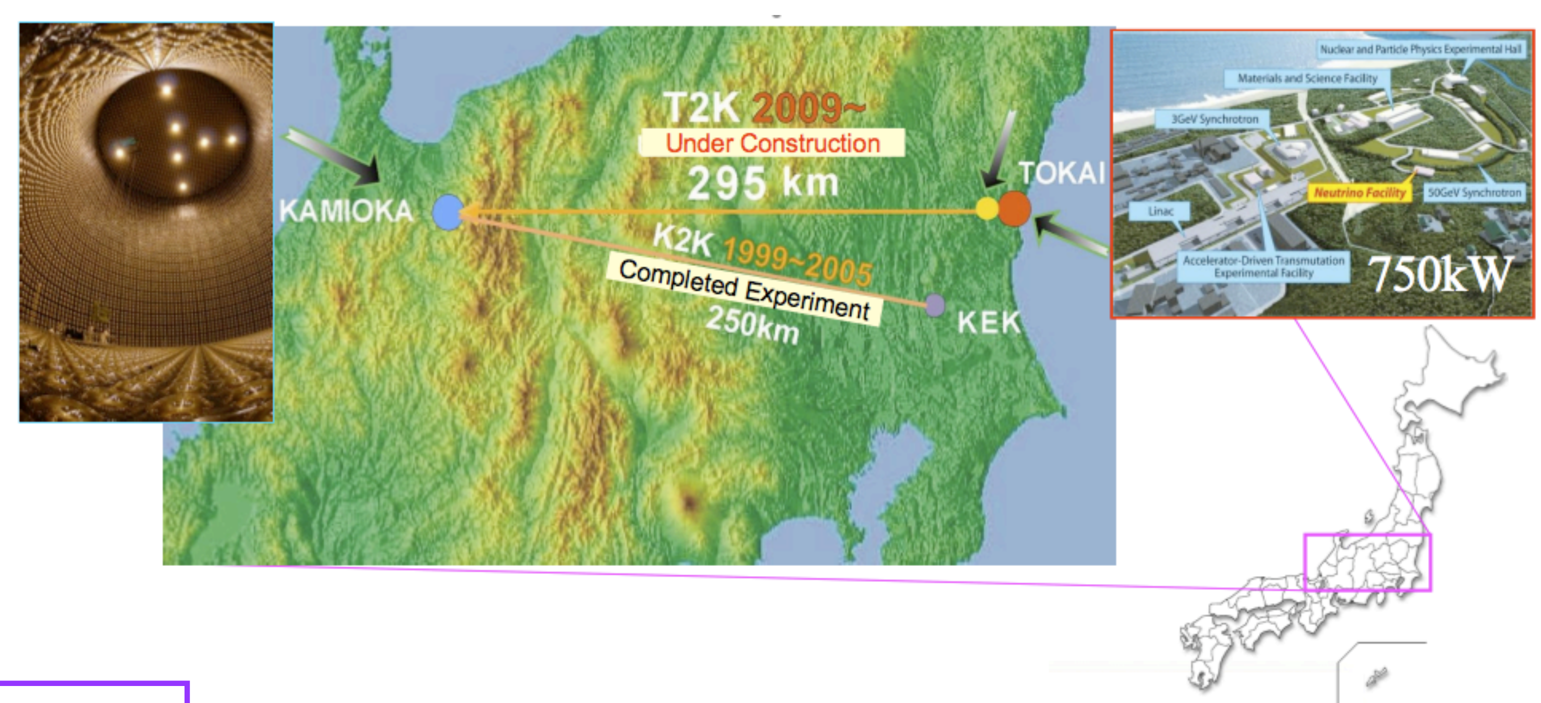
✳ MEASURE ν_μ DISAPPEARANCE

more accurate determination of the "atmospheric" parameters θ_{23} and Δm_{23}

$\delta(\sin^2 2\theta_{23}) \approx 0.01$

$\delta(\Delta m^2_{23}) \approx 3 \times 10^{-5}$ eV

c.f. : $\delta(\sin^2 2\theta_{23}) \approx 0.04$ $\delta(\Delta m^2_{23}) \approx 2 - 3 \times 10^{-4}$ eV^2 — **SK, K2K, MINOS**

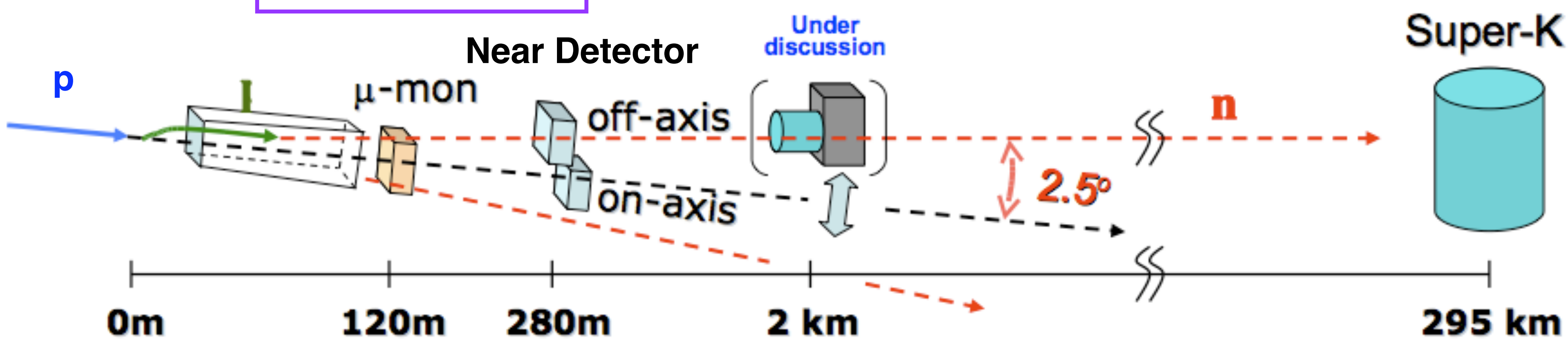


✳ SEARCH FOR $\nu_\mu \rightarrow \nu_e$ APPEARANCE

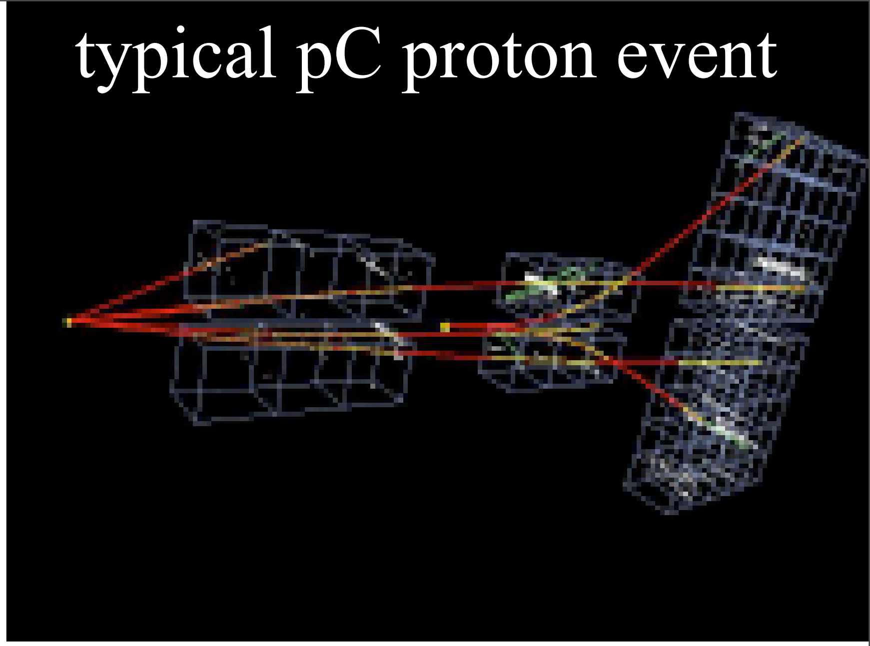
measurement of θ_{13} with a better sensitivity

$\sin^2 2\theta_{13} \sim 0.008$ (90%CL)

c.f.: $\sin^2 2\theta_{13} < 0.14$ (90%CL) — **CHOOZ + atm + LBL solar + KamLAND**



T2K requirement for Na61



- SK observables depend on the ν_μ and ν_e fluxes at SK
- These fluxes are predicted via the **F/N ratio (R_i)**:

$$\Phi^{SK}_{\mu,e}(E_\nu) = R_{\mu,e}(E_\nu) \times \Phi^{ND}_{\mu,e}(E_\nu)$$

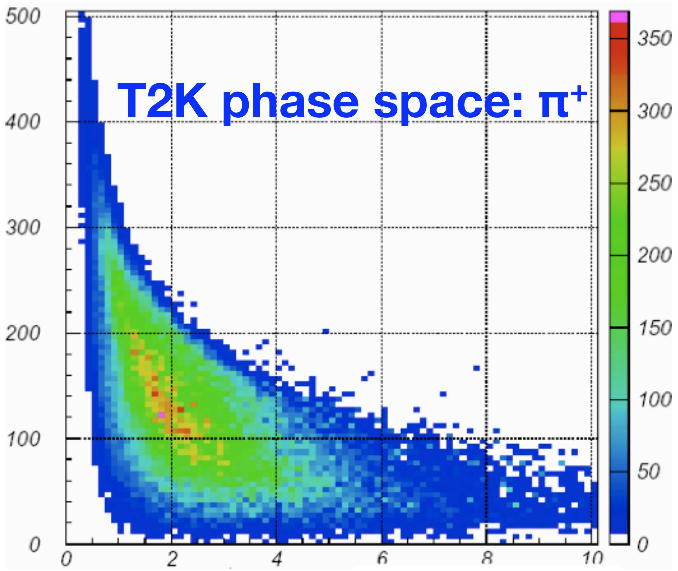
measured at the near detector

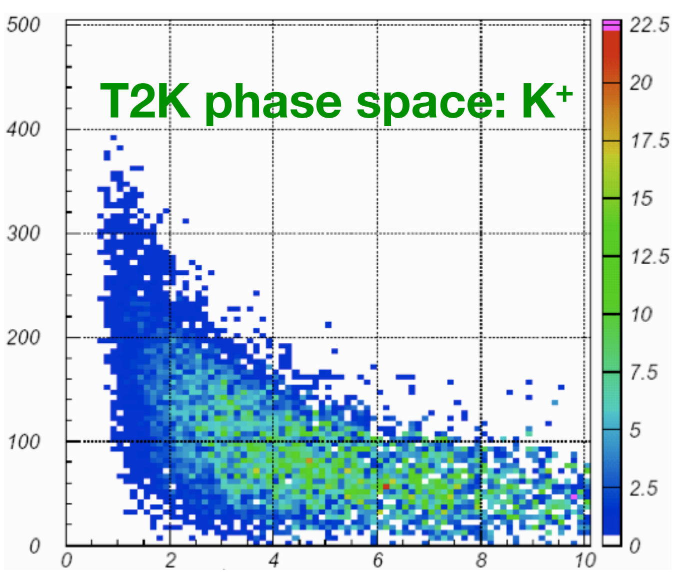
- Due to the finite size of the source, F/N is energy dependent and determined by:
  - **the relative rate(p) of π, K and μ at production**
  - **the geometry of the source**

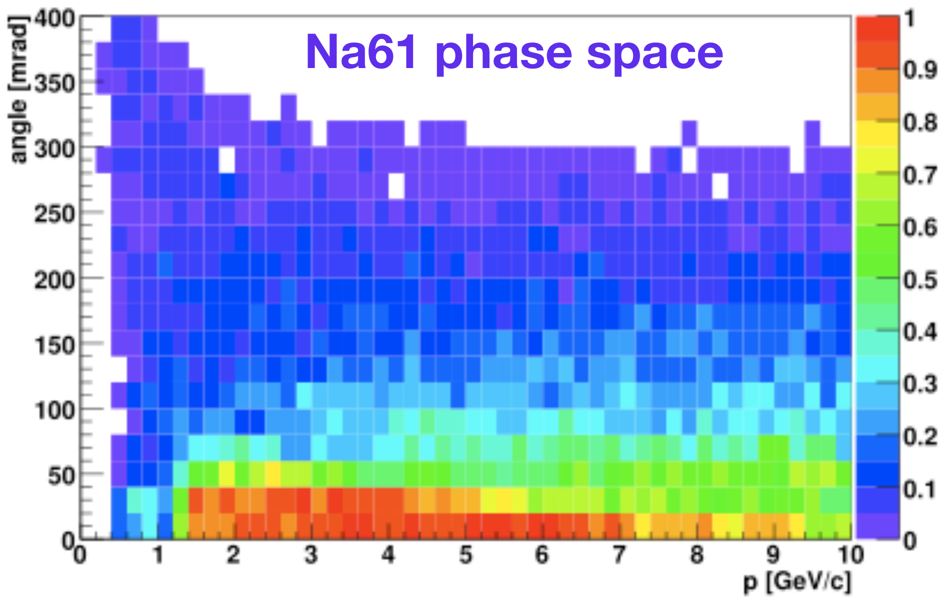
A detailed information on the pion and kaon production off the T2K target is needed → Na61

- To achieve the goal of T2K the precision on the F/N is required to be **δR = 2 - 3%** over 1-10 GeV

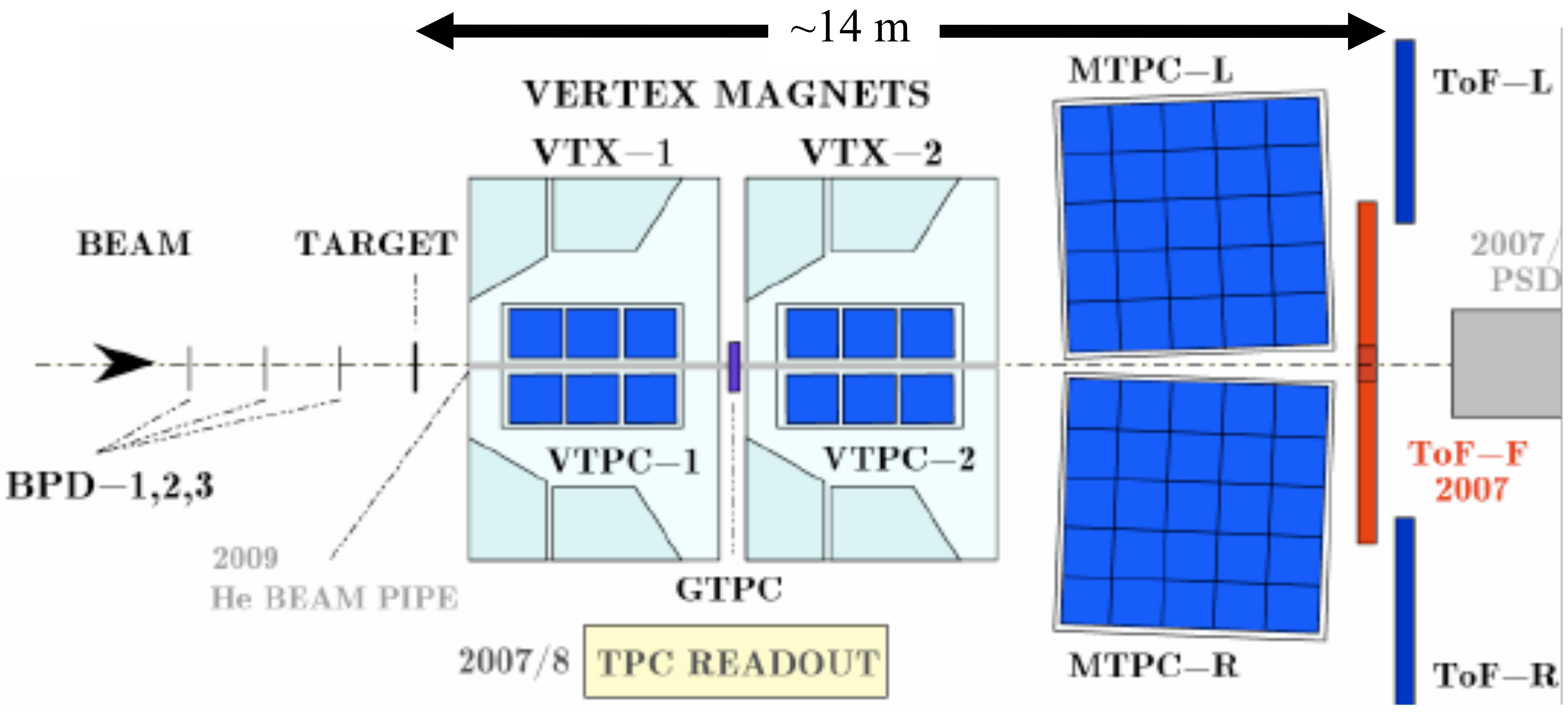
Need to measure the ratio in the region: $1 < p < 10$ GeV/c, $0 < \theta < 250$ mrad with **10% accuracy**:





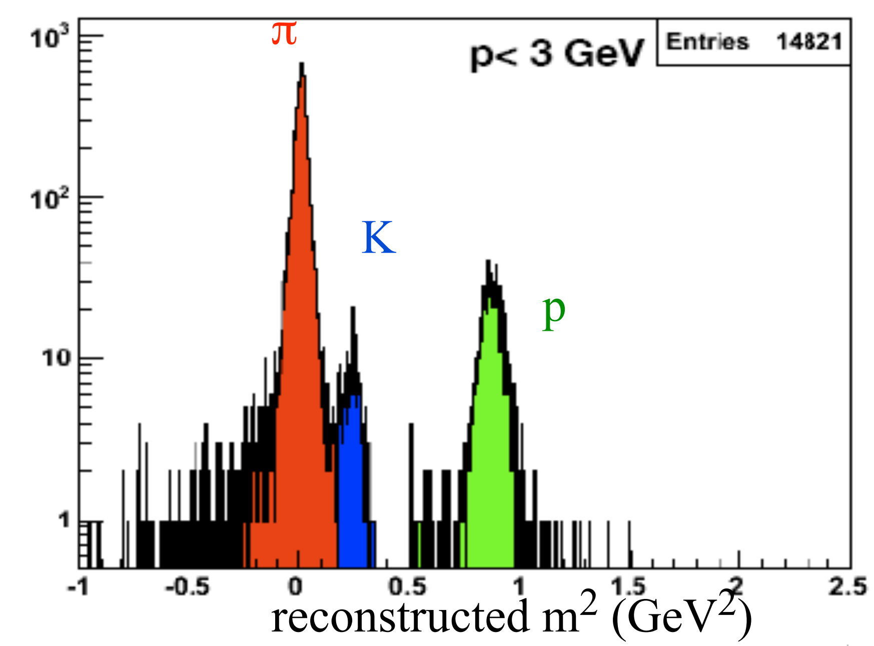


The NA61 Detector & PID

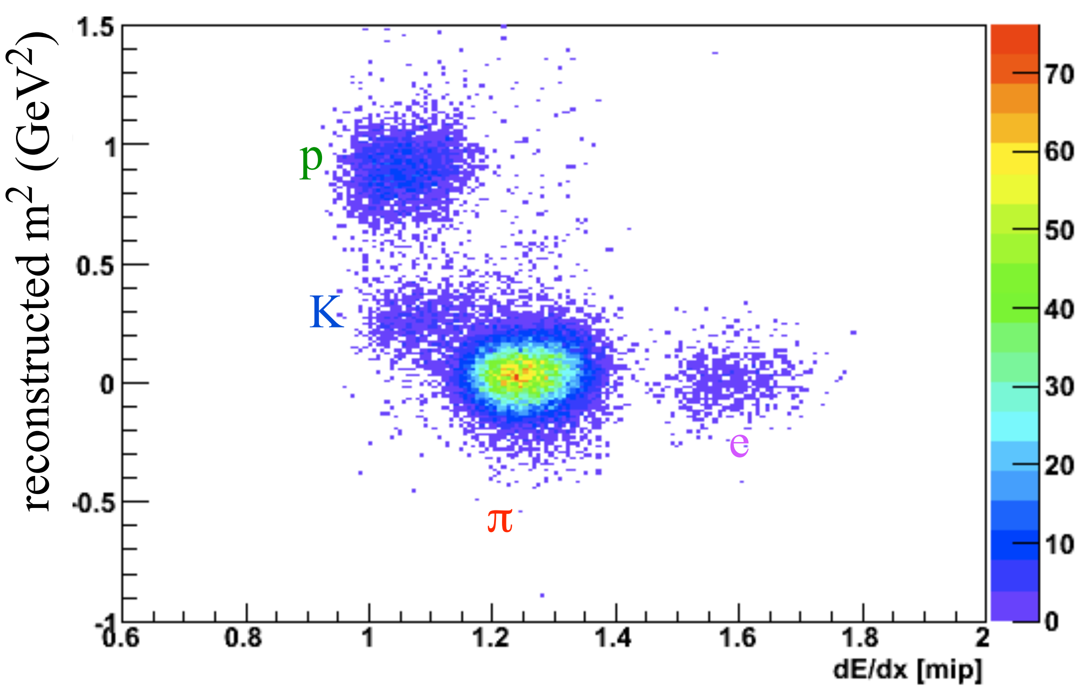


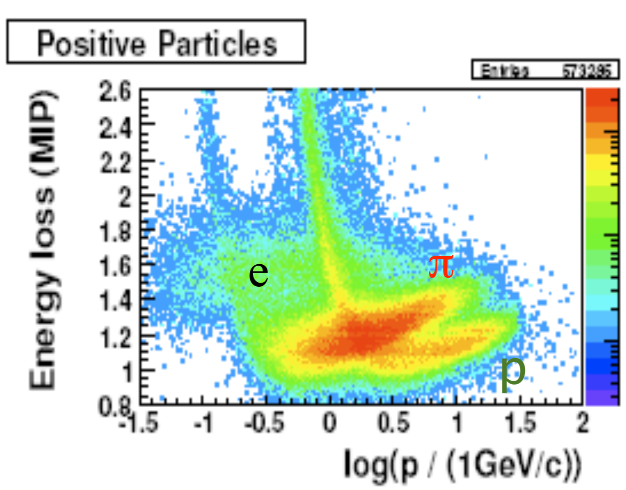
Tracking: 4 large volume TPCs: $\Delta p/p^2 \sim 10^{-4}$ (GeV/c)$^{-1}$

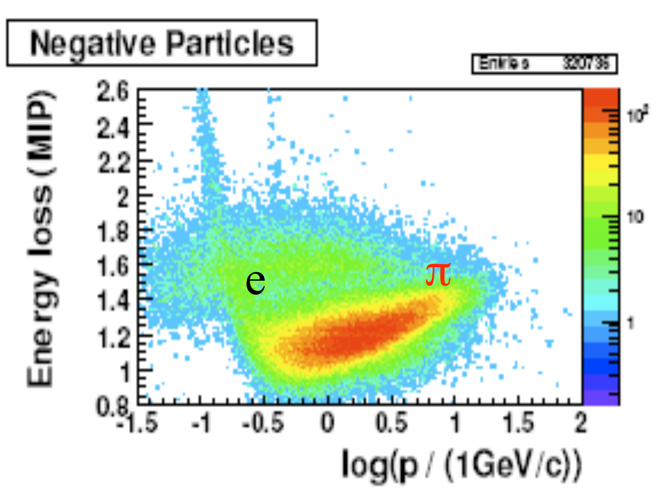
Particle Identification: Time of Flight (3 walls) + dE/dx in TPCs
ToF resolution: < 120 ps; σ(dE/dx)/<dE/dx> ~ 0.04 with preliminary calibration



PID is based on
- dE/dx energy loss in TPCs
- ToF measurements:
  1 forward-ToF wall, 5 σ π/K separation up to 4 GeV/c
  2 large angle higly segmented detector (σ < 70 ps)

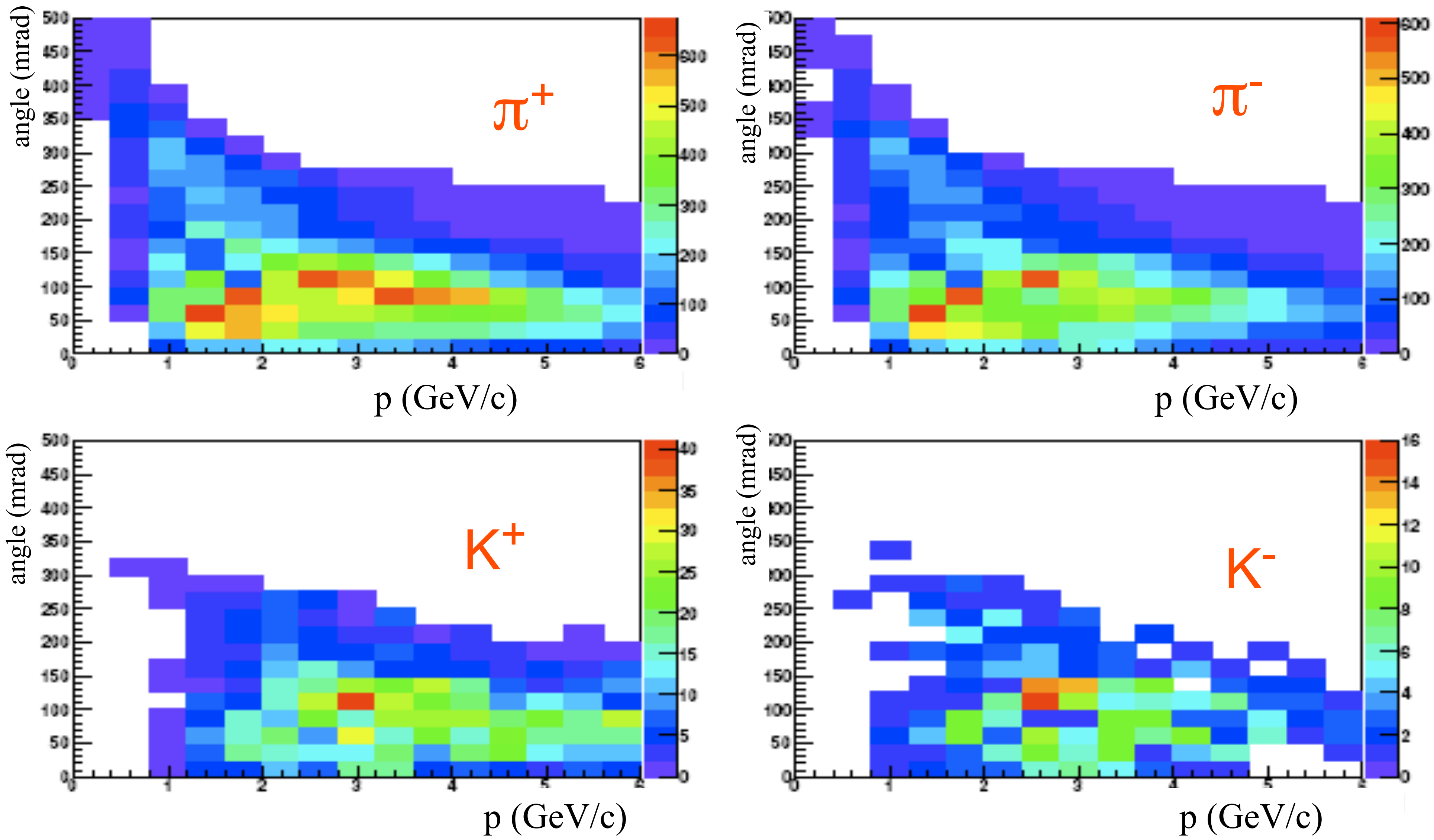






First Data

production angle versus momentum



Run 2007:
- 2cm carbon target
- collected about 1 M triggers

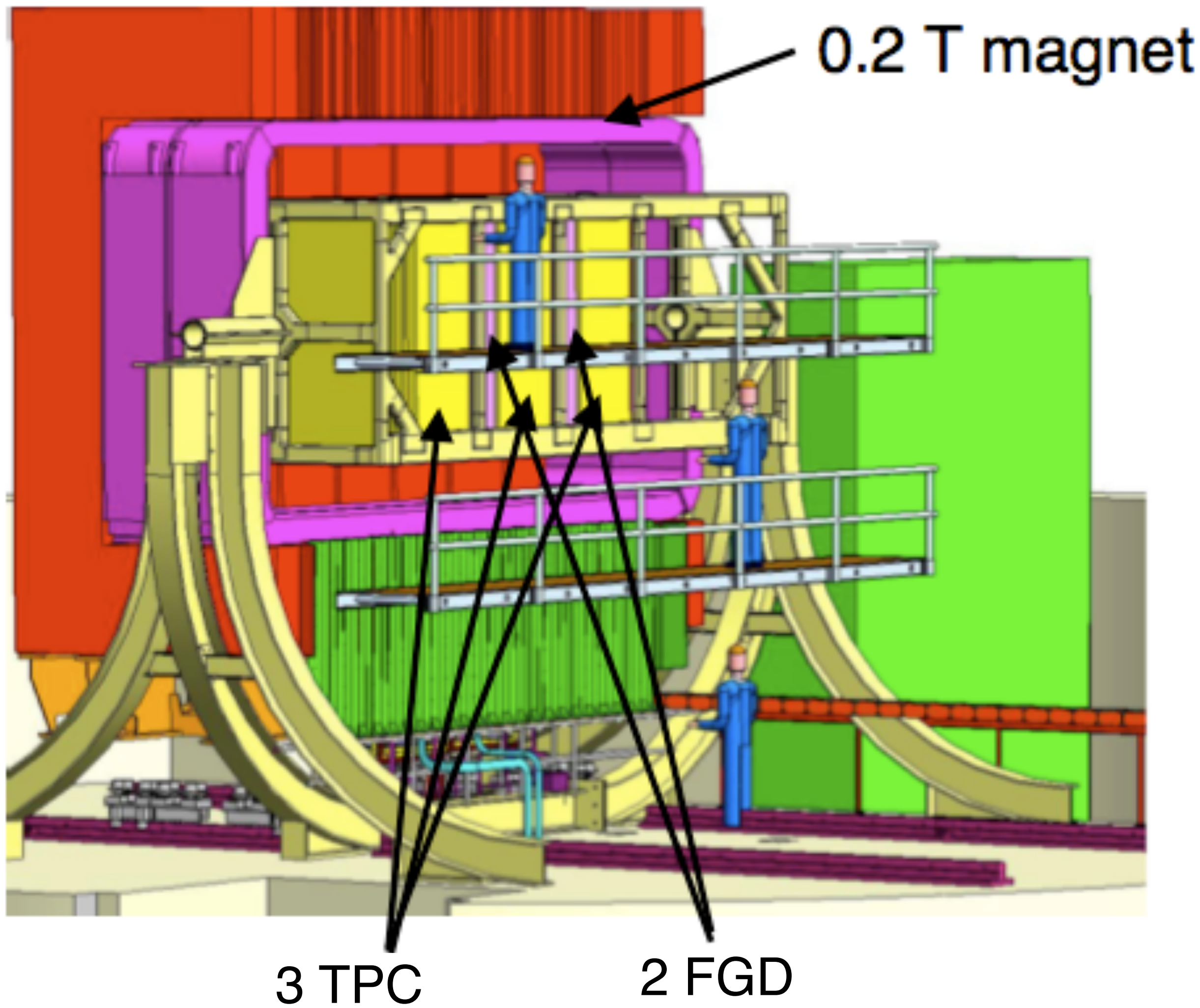
October 2008 and 2009:
- Upgrade of the electronic
- 2cm carbon target + T2K replica target
- expected about 10 M triggers

Raw spectra: no corrections for acceptances nor trigger normalization

Particles are required to cross and be measured in the TPCs and to reach the ToF walls for identification

NA61 has full coverage of the T2K hadron beam phase space with PID

The Near off-axis Detector



Off- Axis Detector

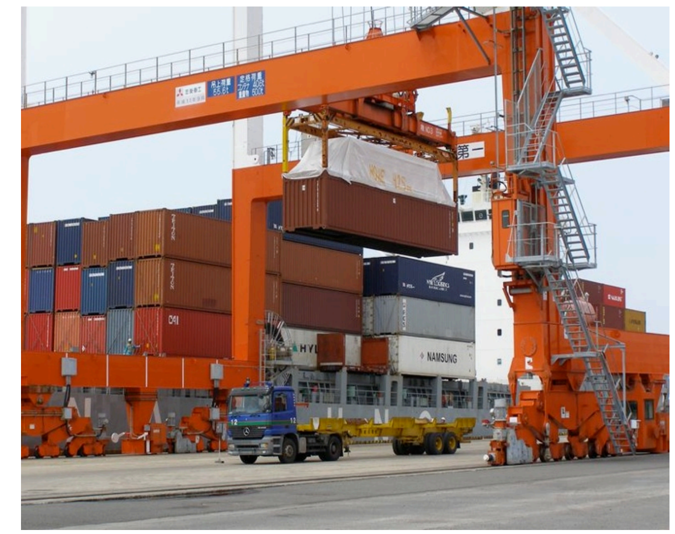
- Overall normalization
- Cross sections
- Beam fluxes
- Background processes

TPC

T2K-ND280 Magnet

- Re-use conventional donated CERN UA1/NOMAD magnet
- Provide bending field for TPC
- Magnetic field strength B=0.2 T, I=3300 A
- Project leadership ETHZ (since Nov 2006)

On the way from CERN to J-PARC...

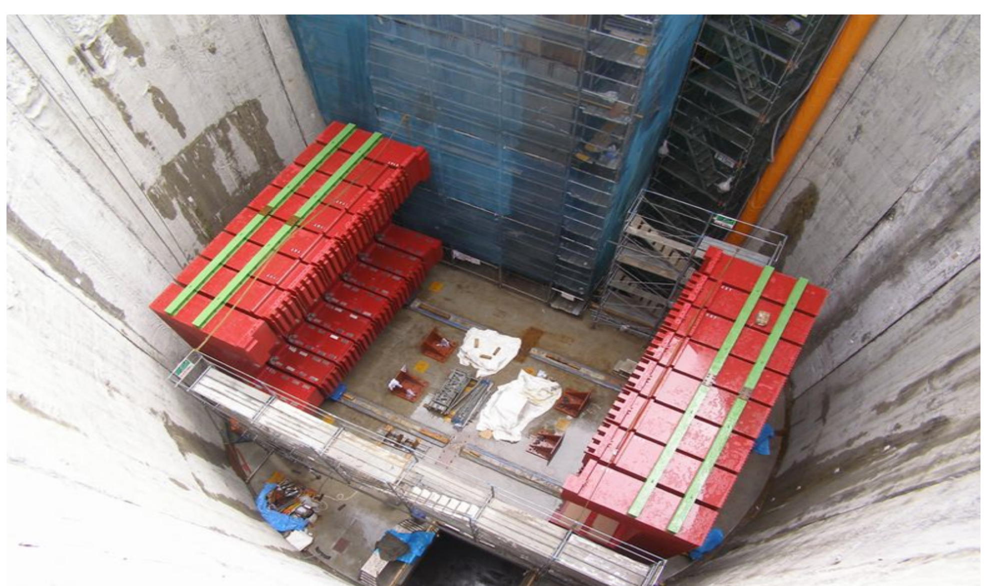


In total 42 ISO 40-foot containers (949,834 kg)

The largest long-distance transport ever organized by CERN

...At J-PARC

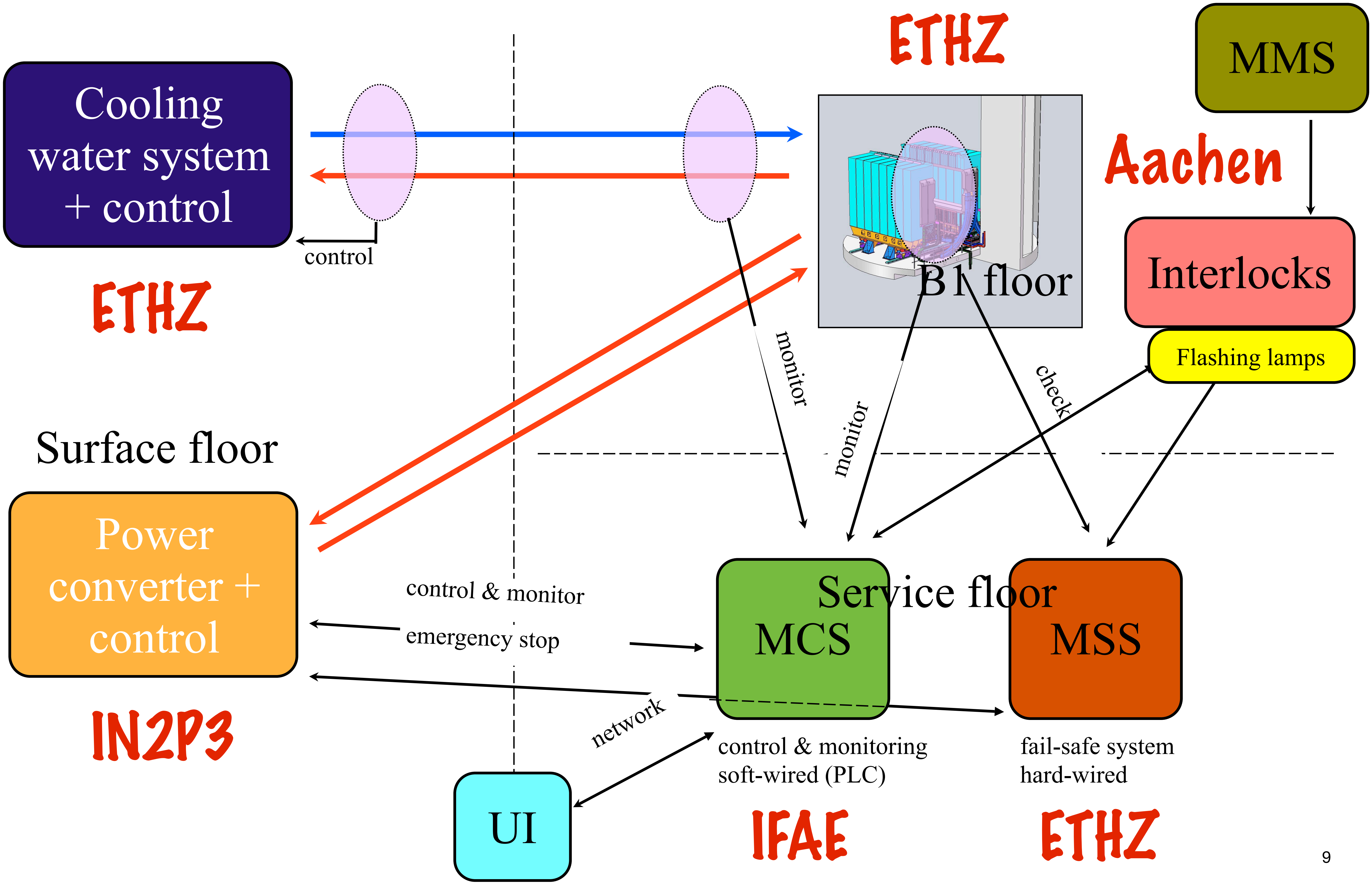
Yoke re-assembly



Yokes installation (open position)

Coils installation

Magnet responsibilities



T2K TPC: GOALS

- Obtain neutrino spectrum from charged lepton momentum via $\nu_\mu n \rightarrow \mu^- p$ (CCQE) process.

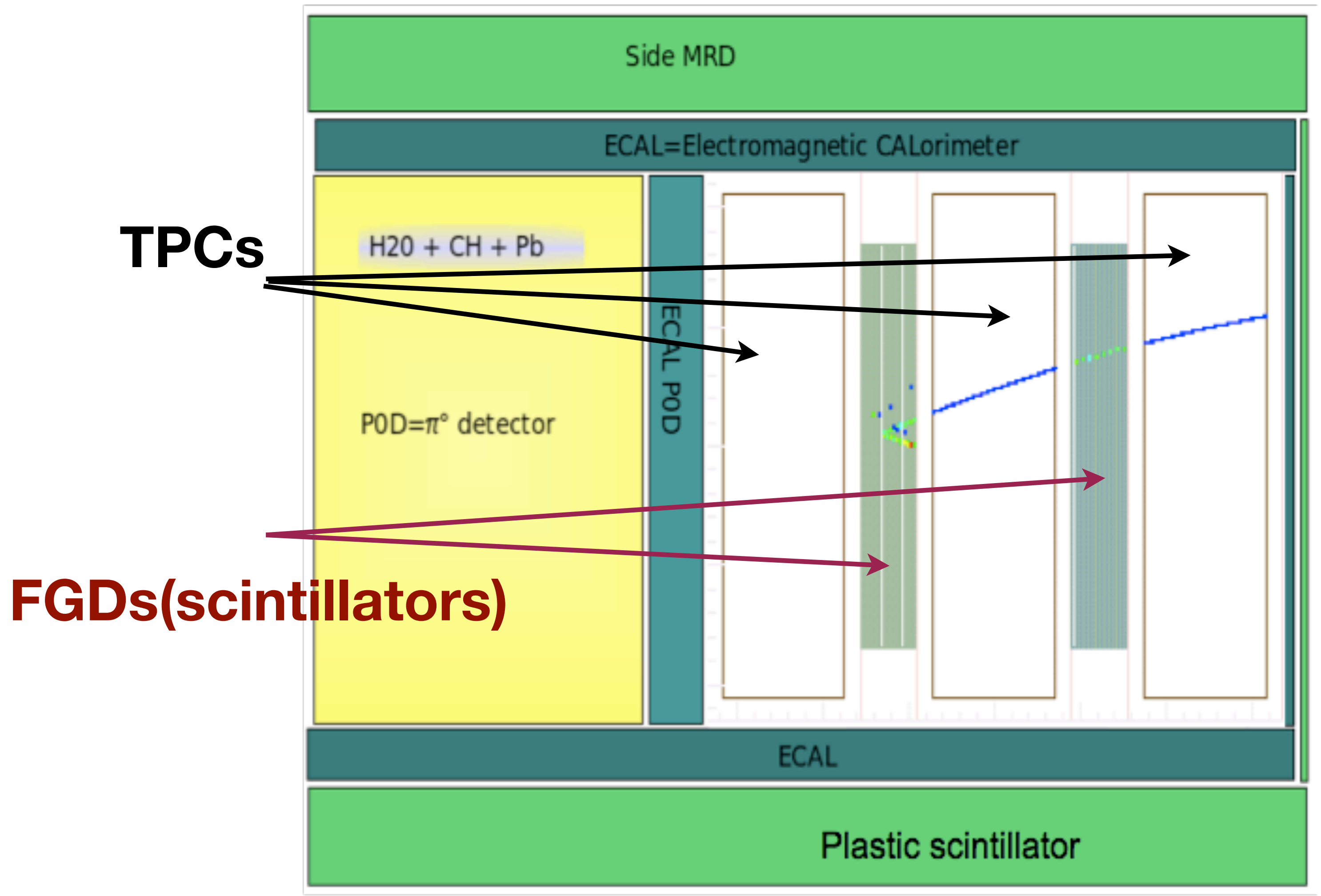
- PID is made with dE/dx. For 3σ e/μ separation in the interesting energy range of 0.5 to 1 GeV, the energy resolution of the detector should be <10%.
  Readout (MM) CALIBRATION NEEDED

- Momentum resolution < 10% at 1 GeV muon which requires a point resolution of ~ 400μm for a magnetic field of 0.2 T

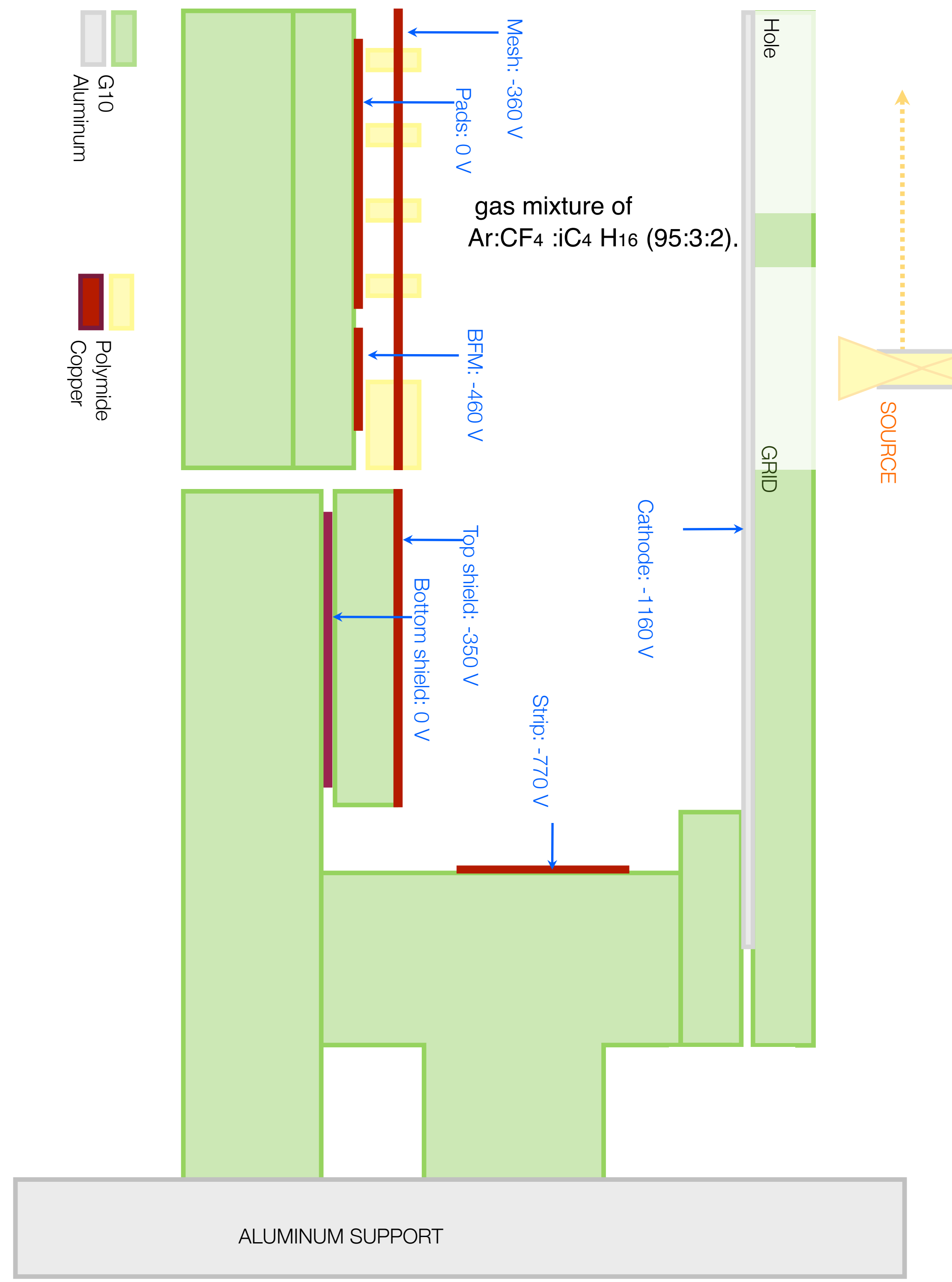
- The energy scale has to be known at the 2% level. This can be achieved by an excellent control of magnetic and electric field distortions and using a physical signal for the absolute momentum calibration

- Installation in ND280 Aug. 2009; first run Dec. 2009

ccqe event



Test-bench at CERN

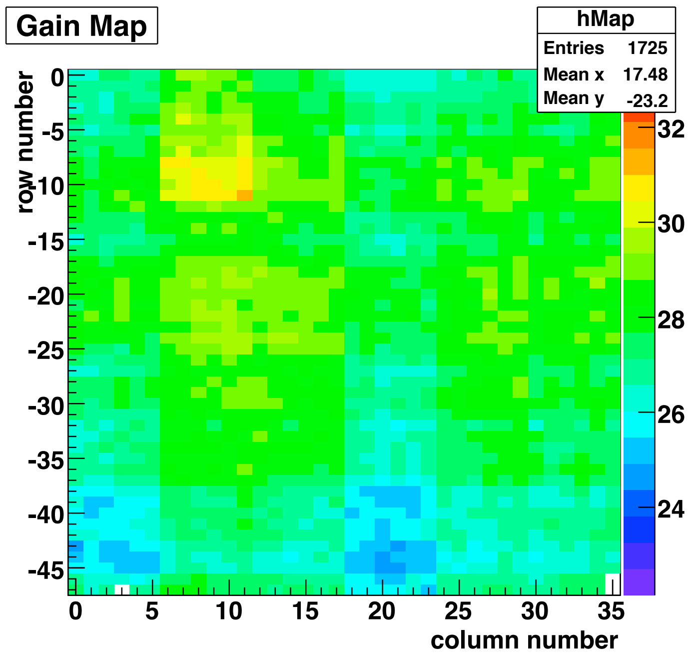


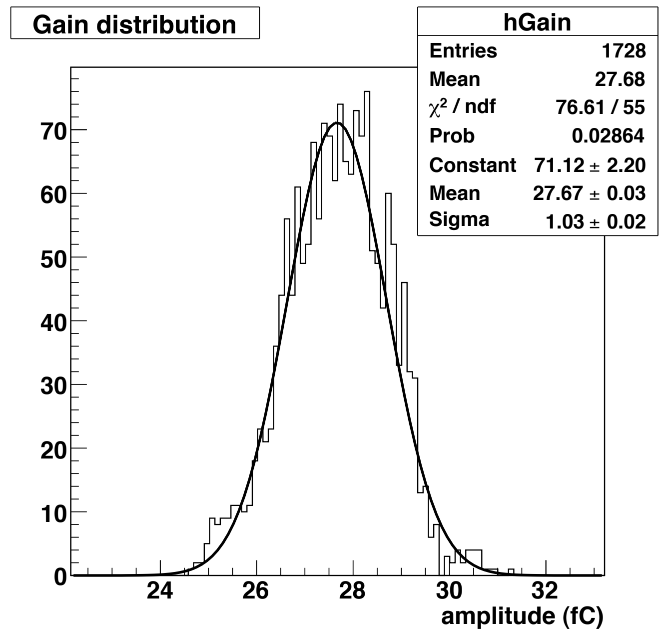
The ^{55}Fe source is moved by X-Y stages => good pad per pad analysis

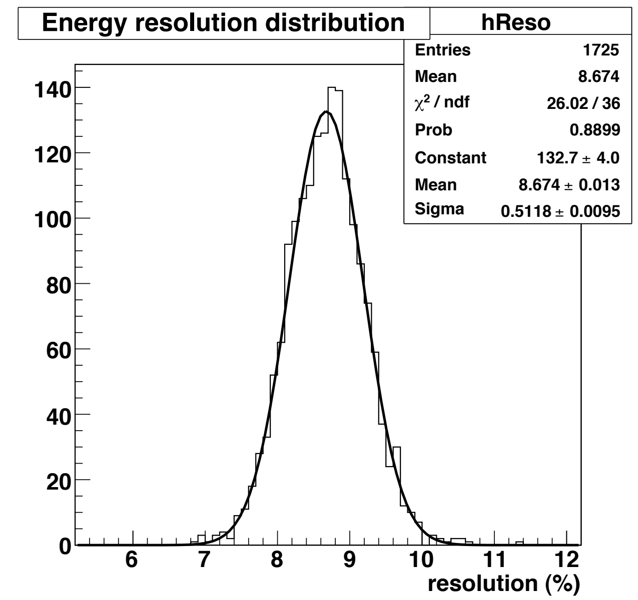
To maximize the gain the calibration box is filled with $ArCF_4iC_4H_{10}$ (95:2:3)

The Test Bench will calibrate 80 MM modules.

MicroMegas performances from Test Bench



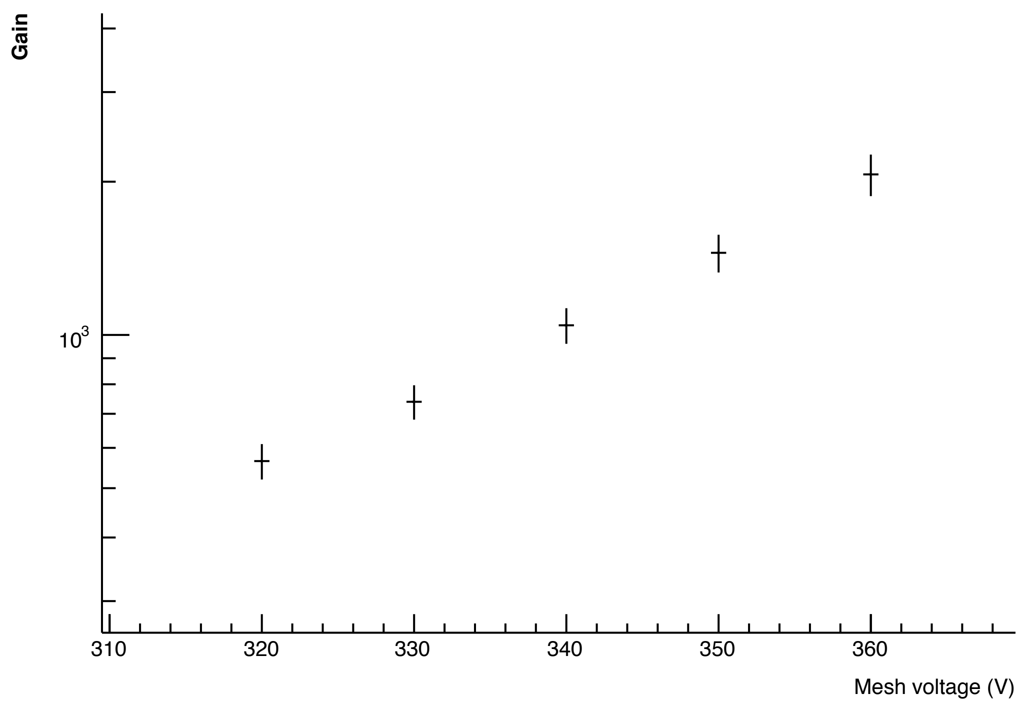


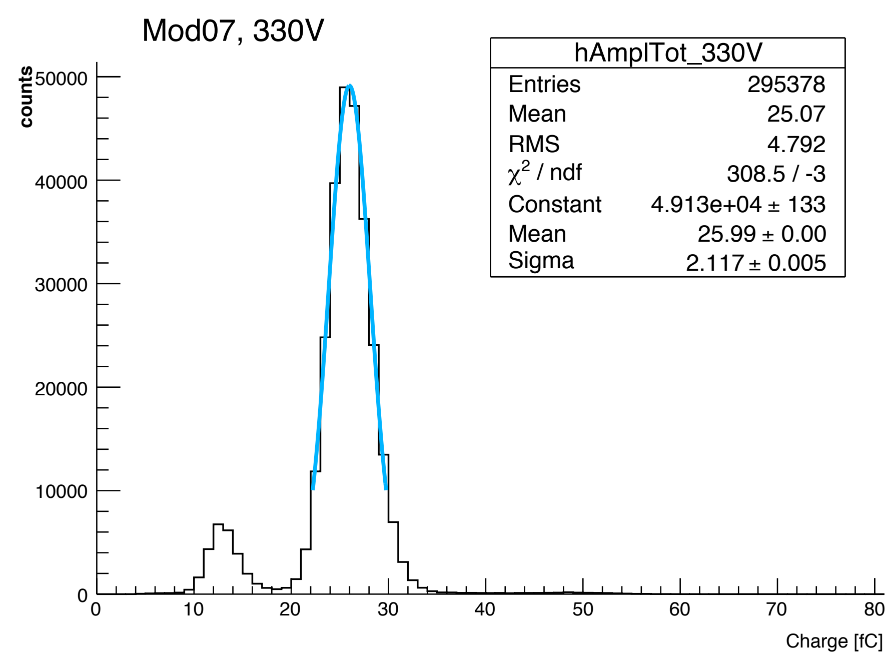


Gain uniformity: 3%

Energy resolution: 8.6 %

Mod07, gain vs. mesh voltage



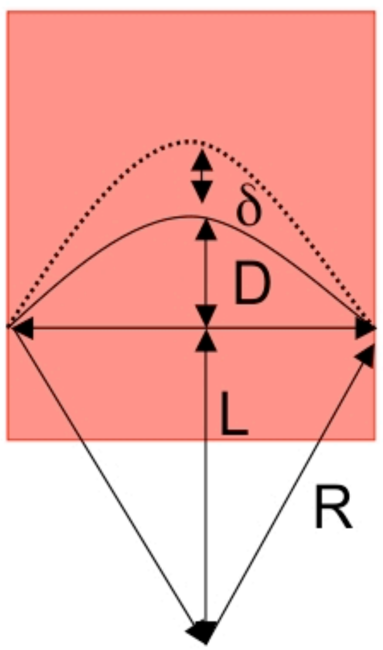


7^{th} MicroMegas module of the production

Magnetic Field Measurement

How well we need to measure the field map?
Given a track distortion δ due to a $B_\perp$ the measured momentum is:

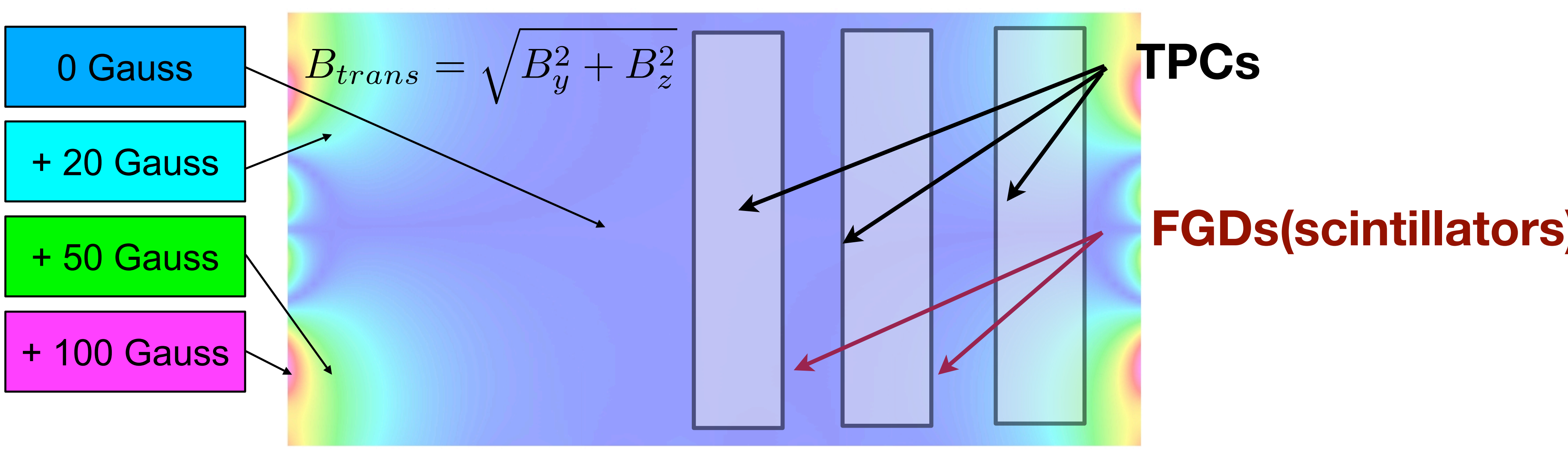
$$p = 0.3B\frac{L^2}{8(D+\delta)}$$



For δp~2%, δ~0.08 mm

⇒ δB_{trans}~1-2 %

This implies a required accuracy on the B mapping from 0.6 and 1.6 Gauss

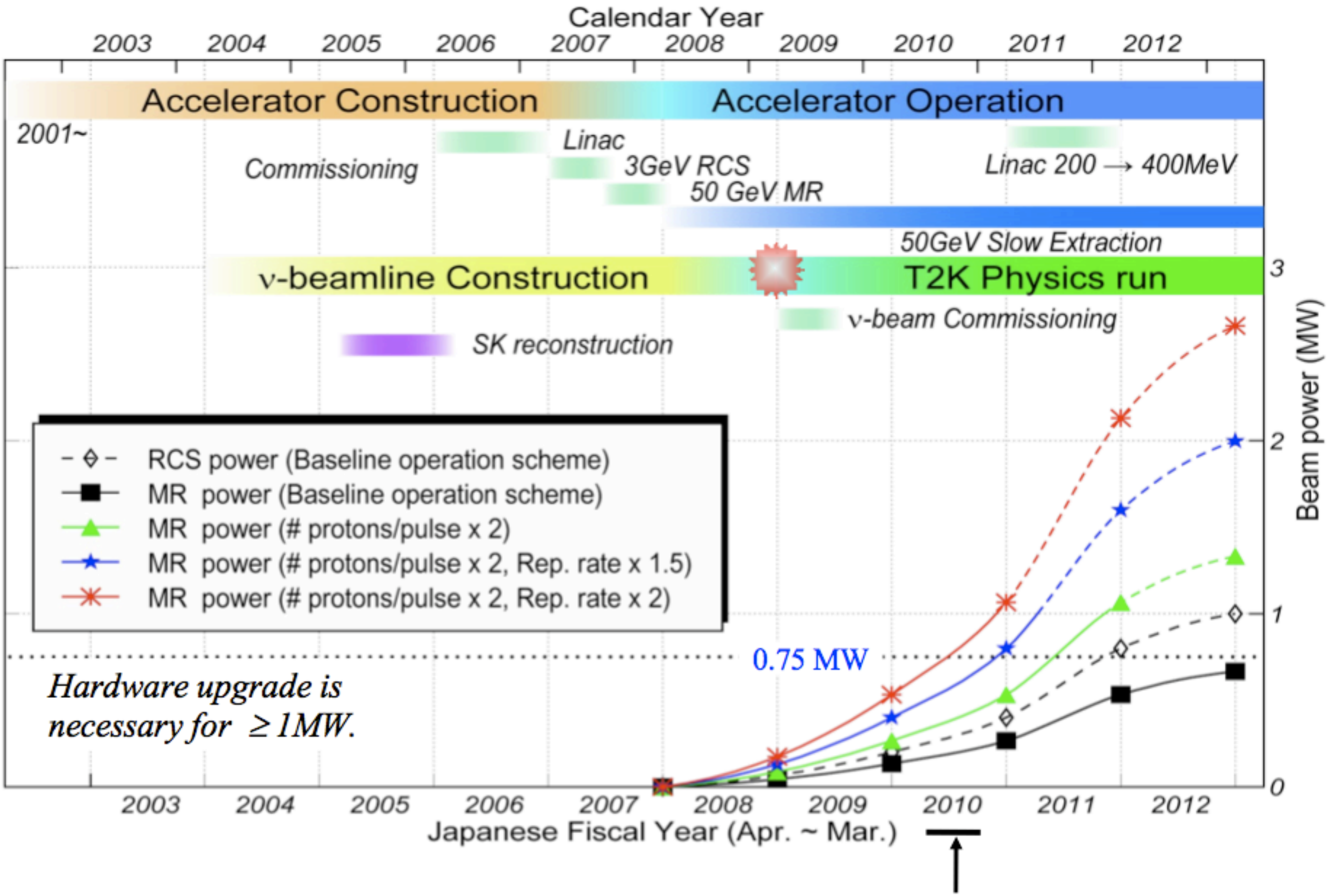


an example: transverse B-Field of ND280 (top view)

Magnetic Field Measurement

- Already installed at CERN:
– almost everything, e.g.
  - 3 arms for probes
  - all 3 pneumatic motors
  - motion control
  - etc.
- Coming soon:
  - set of readout cards with 3D Hall probes
  - full test in ND280 basket

T2K initial schedule



Goal at initial stage: T2K Physics run with 100kW beam × 10^7 sec by 2010 summer.

Conclusion

- Swiss groups play an important role in T2K: Na61, Magnet, TPC.
- We also have leading role in the global analysis but we need more people.
- 1st beam in 2009.
- First oscillation results for summer conference 2010 with maybe a first value of θ_{13}
- The value of θ_{13} is a fundamental milestone for neutrino physics to define future neutrino roadmap

BACK UP SLIDES...

schedule

B field mapping device time schedule	2008											
	1	2	3	4	5	6	7	8	9	10	11	12
3D card production												
3D card calibration												
Blank assembly												
Basket ready at CERN												
Full test device												
Packing of the mappper and basket												
Shipping to J-PARC												

B field mapping device time schedule	2009											
	1	2	3	4	5	6	7	8	9	10	11	12
Shipping to J-PARC												
Unpacking												
Installation, prepartion at ND280												
Measurement at ND280												

Magnet	2008											
	1	2	3	4	5	6	7	8	9	10	11	12
Award contract for cooling system												

Magnet	2009											
	1	2	3	4	5	6	7	8	9	10	11	12
Install. of magnet services + safety system												
Magnet commissioning												
Magnetic field measurement												

T2K-ND280 time line

- Nov 2006-July 2007: recovery equipment, refurbishing, magnet design improvements (new slow control instrumentation, seismic reinforcement, new moving system, ...), transport planning, procedure for assembly @ J-PARC
- August 2007-December 07: yokes dismantling, award contracts for shipment & for installation @ J-PARC (Japanese company)
- January 08-March 08: shipment from CERN to J-PARC
- April-May-June 08: installation of magnet @ J-PARC
- September 08: award contract for magnet cooling system (CERN)
- Feb-April 09: installation of magnet services + safety system
- May-June 09: magnet commissioning
- July 09: magnetic field map measurement

Magnetic Field Measurement

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Schedule