ALICE @ LHC

• ALICE Status

- ⇒ Detector
- ⇒ Performance (cosmics)
- ⇒ commissioning: S. Chaplain
- Early Physics Program
 - ⇒ first physics: JF Grosse Oetringhaus (Thursday)
 - → HI parallel talks Friday pm



















First TPC Tracks





















Tracking



- robust, redundant tracking from 100 MeV to 100 GeV
 - \Rightarrow modest soleniodal field (0.5 T) => easy pattern recognition
 - ⇒ long lever arm => good momentum resolution
 - \Rightarrow small material budget: ~ 10% X₀

 $(BL^2 : Alice \sim CMS > Atlas !)$

vertex -> end of TPC (r = 2.6 m)

• full GEANT simulation: central Pb-Pb, **dN**_{ch}/dy = 6000

 \Rightarrow very little dependence on dN_{ch}/dy up to 8000 (important for systematics !)





6.75

6.7

6.65

6.6

6.55^L

20

40

60

SDD: Drift speed calibration &

monitoring versus time

80 100 120 140 160 180 200 220

Event number







• stable hadrons (π , K, p):

⇒ dE/dx in silicon (ITS) and gas (TPC) + Time-of-Flight (TOF) + Cerenkov (HMPID)

- leptons (e, μ)
 - ➡ transition radiation (TRD), muon spectrometer
- photons, η, π^0
 - ⇒ e.m calorimeters (PHOS, EMCAL)
- decay topology (K⁰, K⁺, K⁻, Λ, D⁺, ..), secondary vertices (c,b)



Time of Flight









• Fully installed, 2/3 commissioned

⇒ L0 TOF trigger fully functional, noise rate factor 2 better than expected !

⇒ refurbishing of DC-DC converters not quite finished



Transition Radiation Detector



added 2000: 6 layer, fiber radiator, 715 m² drift chambers, r > 3mL1 (6.5 µs) tracking & trigger capability

<u>Status</u>

4/18 modules installed (problems with gas tightness being resolved) detector & trigger commissioned



High Momentum PID

PHOton Spectrometer

- Status: 3/5 constructed
 - ⇒ 2 more modules to be constructed
 - funding stretched to 2010
 - ⇒ only 1 installed & commissioned
 - condensation => improve insulation

Electromagnetic Jet Calorimeter

Construction start April 2008

- ⇒ approved & funded Dec 2008
 - US, Italy, France, Finland
- \Rightarrow ~ 20% to be installed early 2009
 - complete early 2010

44 m² Pb-Scint sampling calo, 20 X₀, 13 k FEE APD R/O $|\eta| < 0.7 \ \Delta \phi = 110^{\circ} \ r = 4.4 \ m$

Muon Spectrometer

Muon Arm Status

Online

- Continuous online operation since March (24/7)
 - ⇒ DAQ: 40% HW installed, stable operation up to 500 MB/s transfer, rates > 3 kHz
 - ⇒ DCS/ECS: essential functionality operational, continuous improvement
 - some problems encountered with scalability (mostly resolved)
 - CTP: some problems with spurious triggers resolved, running well
 - ➡ HLT: 500 CPU's, very successful operation (online reconstruction, data reduction)

Early Physics Program

• Physics of the first 'year'...

- \Rightarrow 'day 1' physics with pp:
 - requiring only subset of detectors, few 10,000 events
- \Rightarrow ' early pp physics'

global event properties (0.9/10/14 TeV ?)

detailed studies of pp

⇒ first heavy ion run

'at the end of the first long pp run'

QCD at 14 TeV

ALICE physics with pp

- ➡ Taking 'comparison data' for the heavy ion program
 - ${\boldsymbol \circ}$ eg: J/ ${\boldsymbol \Psi}$ suppression in AA requires measuring J/ ${\boldsymbol \Psi}$ production in pp
- Survey and characterization of typical ('Minimum Bias') events
 - \circ multiplicity, p_t distribution, particle composition,
 - > tuning of Monte Carlo generators (which differ widely)
 - => evaluate background & detect. performance
- Specific QCD measurements for which ALICE is particularly well suited
 - signals involving **PID** eg 'baryon transport: how are the beam protons decelerated'
 - ✤ low x-physics, charm & beauty production at low p_t,...

 Λ^*

 Ξ^{\pm}

Λ

Λ

 p^{\pm}

 \mathbf{p}^{\pm}

p[±]

0.5-5

1-8

0 25-2

0.5-11

0.15-0.9 / 5-50

1 - 5

0.45-4

Inv. mass reco.

Inv mass reco

HMPID TOF

Secondary vertex reco.

Secondary vertex reco.

dE/dx (ITS+TPC / Rel. rise)

The Particle Zoo

Table 6.16	: As for	Table 6.1	15, but	for meson
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Meson	Range (GeV/ c)	PID technique / sub-detector	Re	ference	Com	ments ⁽¹⁾	
Υ"	0-6	Inv. mass analysis	Section 6.6		$-4 < y < -2.5^{(2)}$		
Υ'	0-7	Inv. mass analysis	Sec	ction 6.6	$-4 < y < -2.5^{(2)}$		
r	0-13	Inv. mass analysis	Sec	ction 6.6	-4 < y	$-4 < y < -2.5^{(2)}$	
Ψ'	0-9	Inv. mass analysis	Sec	ction 6.6	-4 < y	$< -2.5^{(2)}$	
J/ψ	0-19	Inv. mass analysis	Sec	ction 6.6	-4 < y	$< -2.5^{(2)}$	
D ⁰	1-15	Secondary vertex reco.	Se	ction 6.5.4	n	mid-y	
φ	0.2-15	Inv. mass reco.	Sec	ction 6.2.5	n	aid-y	
K*	0.2-15	Inv. mass reco.	Sec	ction 6.2.6	n	mid-y	
ρ0	0.2-8	Inv. mass reco.	Sec	ction 6.2.4	mid-y, hadronic decay		
K _S ⁰	0.2-12	Secondary vertex reco.	Section 6.2.3.2		mid-y ⁽³⁾		
K±	0.3-13	Secondary vertex reco.	Section 6.2.2.6		mid-y		
K±	0.1-0.5 / 5-50	dE/dx (ITS+TPC / Rel. rise)	Section 5.4.1,2		mid-y (4)		
K±	1-3	HMPID	Section 5.4.5		mid-y ⁽⁴⁾		
K±	0.35-2.5	Time Of Flight	Section 5.4.4		mid-y ⁽⁴⁾		
π ⁰	0-100	PHOS	Section 6.2.2.4		mid-y (4)		
π^{\pm}	0.1-0.5 / 5-50	dE/dx (ITS+TPC / Rel. rise)	Section 5.4.1,2		mid-y ⁽⁴⁾		
π^{\pm}	1-3	HMPID	Section 5.4.5		mid-y ⁽⁴⁾		
π^{\pm}	0.3-2.5	Time Of Flight	Sec	Section 5.4.4 mid-y ⁽⁴⁾		d-y ⁽⁴⁾	
Table 0.17: As for Table 0.15, but for baryons.							
Baryon	ryon Range (GeV/c) PID technique / sub-detect			r Reference Comme		Comments ⁽¹	
Λ_c		Secondary vertex reco.		Under investigation		mid-y	
Ω^{\pm}	1.5-7	Secondary vertex reco.		Section 6.2	2.3.3	$mid-v^{(2)}$	

comprehensive survey
⇒ list still expanding
♥ η, D*, D+-,

\Rightarrow main topic for heavy ions:

 ${\odot}$ T, ${\mu},$ flow, recombination, HBT,...

- ⇒ fully characterize MB pp
 - in a depth not seen since ISR

	Table 6.18:	As for Table	6.15, but for	nuclear fragments
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Extrapolation

Extrapolation

Section 6.2.3.3

Section 6.2.3.2

Section 5.4.1.2

Section 5.4.5

Section 5.4.4

mid-y

 $md-v^{(2)}$

mid-v

mid-y⁽²⁾

mid-y⁽³⁾

mid-v⁽³⁾

mid-v (3)

Nuclear fragments	Range (GeV/c)	PID technique / sub-detector	Reference	Comments
d, t, ³ He, ⁴ He	0.5-10	dE/dx (ITS+TPC)	Section 6.2.2.5	mid-y (1)

Installation:

- ⇒ met all installation goals by mid 2008
- ➡ construction & installation not finished in ALICE (continuously upgrading !)
 - ✿ PMD (2008), DAQ/HLT(2009), TRD (2009), PHOS (2010/11), EMCAL (2010/11)
- Commissioning and initial calibration/alignment

went rather well, sometimes even better than expected
some (mostly minor) hickups / problems (noise, lost channels) / bug fixing

Detector performance
better – within - very close to specs

(at least as far as could be verified with cosmics and LHC injection tests)

