



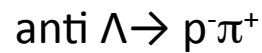
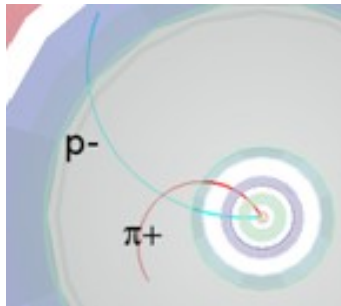
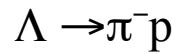
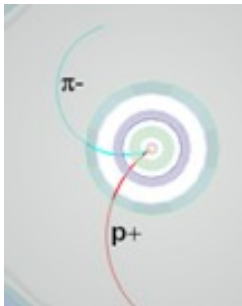
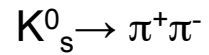
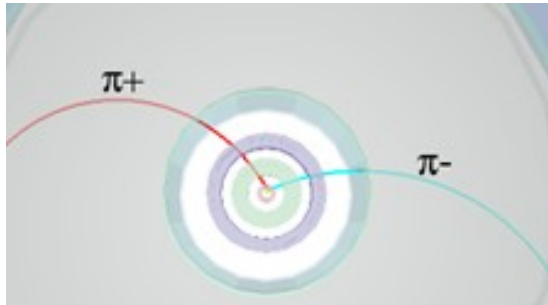
Search for strange particles

Physics Discussion of the ALICE Measurement

topic of the measurement, what should be combined/shown/discussed (and how)

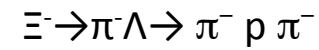
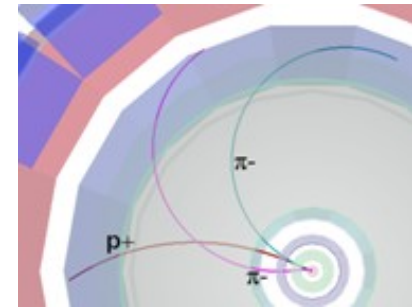
- the signature
V0 (and cascade) decays of strange hadrons (K_s^0 , Λ , anti- Λ , Ξ^-)
- the tools
Simplified ALICE event display based on ROOT
Combine visual analysis of small event sample with large statistics analysis
- The results

Visual identification of V0 decays

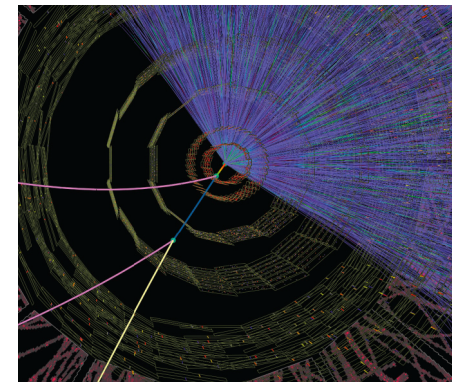


Two opposite tracks from a secondary vertex

and cascades



Bachelor (single track) and two opposite tracks coming from a secondary vertex



Monte Carlo Pb Pb event

The analysis tool : simplified ALICE event display based on ROOT

3 views of ALICE – 3D, $r\phi$, rz

V0 finder and cascade finder
Highlights V0 (cascade)

Recognise from decay pattern

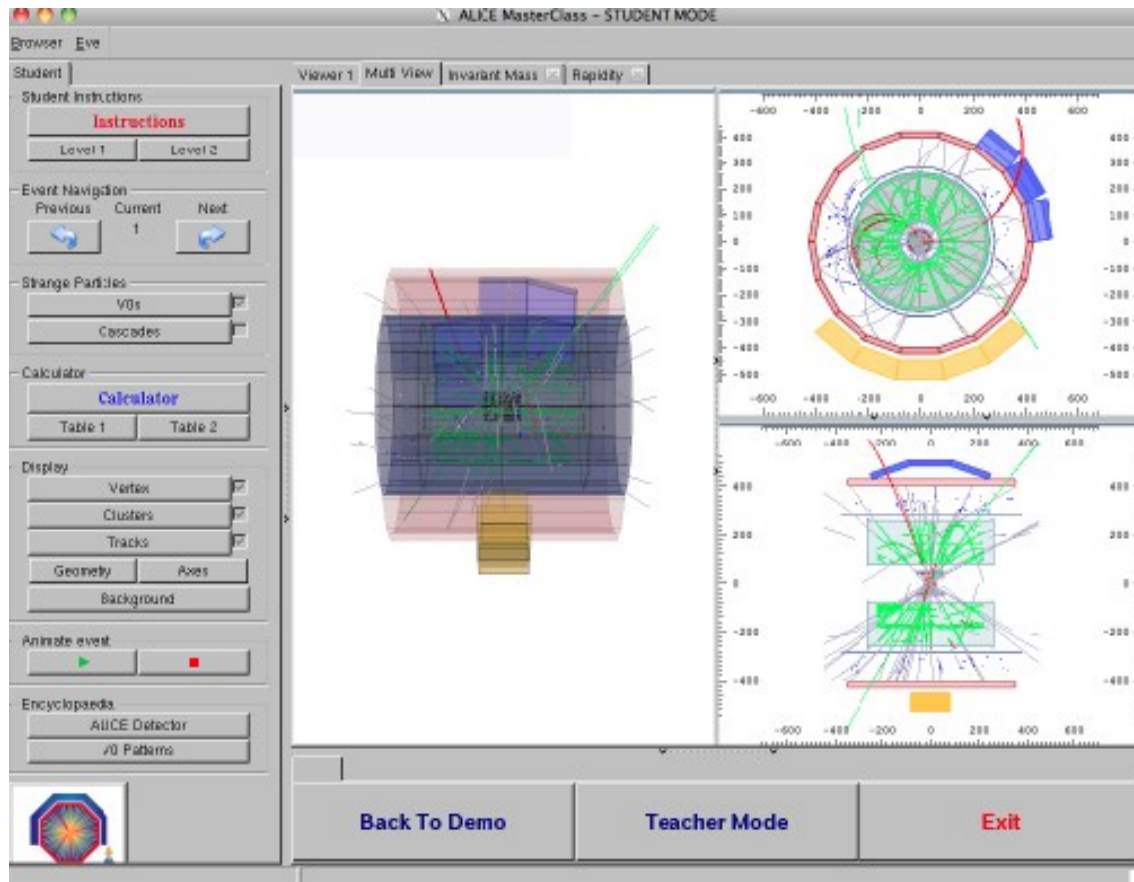
Calculate invariant mass

Classify according to mass

Fill tables

Fill histograms

Runs on LINUX, Ubuntu, MacOSX



MasterClass Application

The screenshot displays the ALICE MasterClass application interface. The central window shows a 3D visualization of the ALICE detector with a particle track highlighted in red. To the left, a 'Calculator' window is open, showing a table of particle masses and a calculator interface. Two 'Particle' pop-up windows are visible, displaying momentum and mass data for selected tracks.

Calculator Instructions

Instructions

Level 1 | Level 2

Navigation: Previous | Current | Next

1 / 1

Calculator

Particle type	Mass [GeV/c ²]
Electron	0.000511
Pion	0.139
Neutral Kaon	0.497
Proton	0.938
Lambda	1.115
Charged Xi	1.321

Calculator

	(-)	(+)	Bachelor
px	0	0	0
py	0	0	0
pz	0	0	0
mass	0	0	0

Invariant Mass

0

That's a Kaon!

That's a Lambda!

That's an Anti-Lambda!

That's a Xi!

Load

Save

Close

(-) Particle

MomentumX: [GeV/c] 0.309593

MomentumY: [GeV/c] -0.21867

MomentumZ: [GeV/c] -0.0303937

Mass: [GeV/c²] 0.13957

Copy to calculator

Close

(+) Particle

MomentumX: [GeV/c] -0

MomentumY: [GeV/c]

MomentumZ: [GeV/c] 0.176826

Mass: [GeV/c²] 0.13957

Copy to calculator

Close

I'm ready! Start Exercise

The calculator pops up for any track

ALICE MasterClass - DEMO MODE

Calculator

Calculator Instructions

Instructions

Particle Table

Particle type	Mass [GeV/c ²]
Electron	0.000511
Pion	0.139
Neutral Kaon	0.497
Proton	0.938
Lambda	1.115
Charged Xi	1.321

Calculator

	(-)	(+)	Bachelor
px	0.309593	-0.015456	0
py	-0.21867	-0.345743	0
pz	-0.030393	0.176326	0
mass	0.13957	0.13957	0

Invariant Mass

0.492339

That's a Kaon!

That's a Lambda!

That's an Anti-Lambda!

That's a Xi!

Load

Save

Close

Instructions

Level 1 | Level 2

Navigation

Previous | Current | Next

1 / 1

Selected Particles

V0s

Cascades

Calculator

Table 1 | Table 2

Vertex

Clusters

Tracks

Geometry | Axes

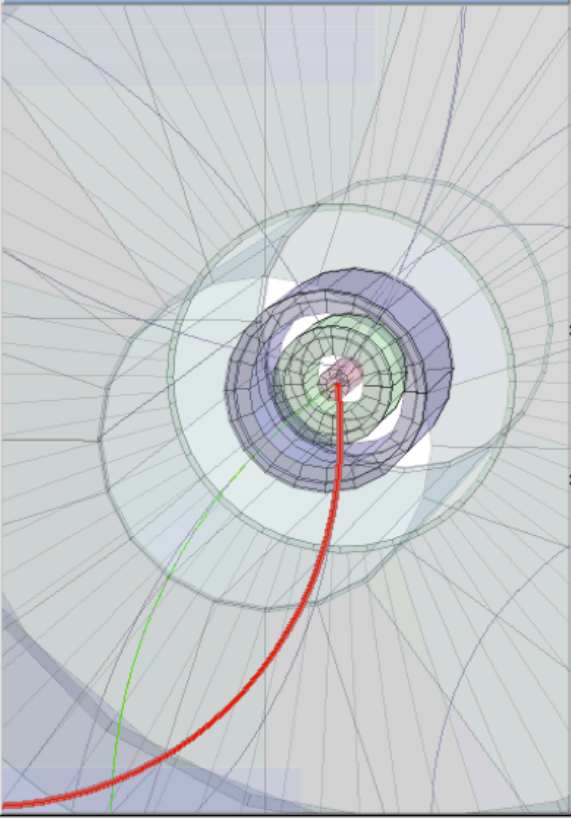
Background

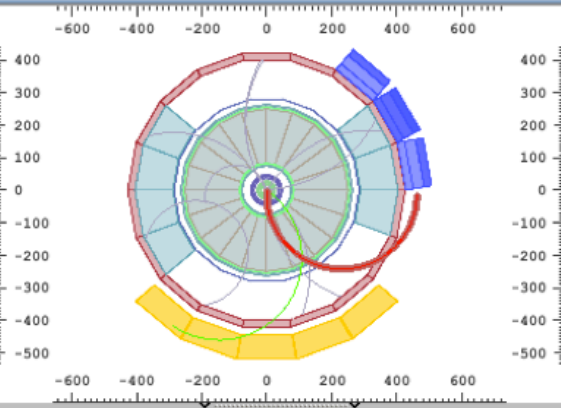
Helpopedia

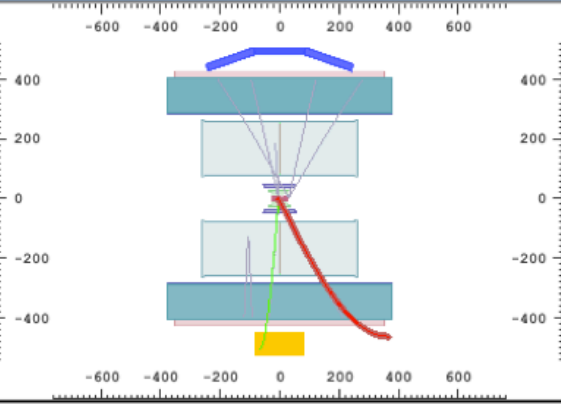
ALICE Detector

V0 Patterns

Viewer 1 | Multi View | Invariant Mass



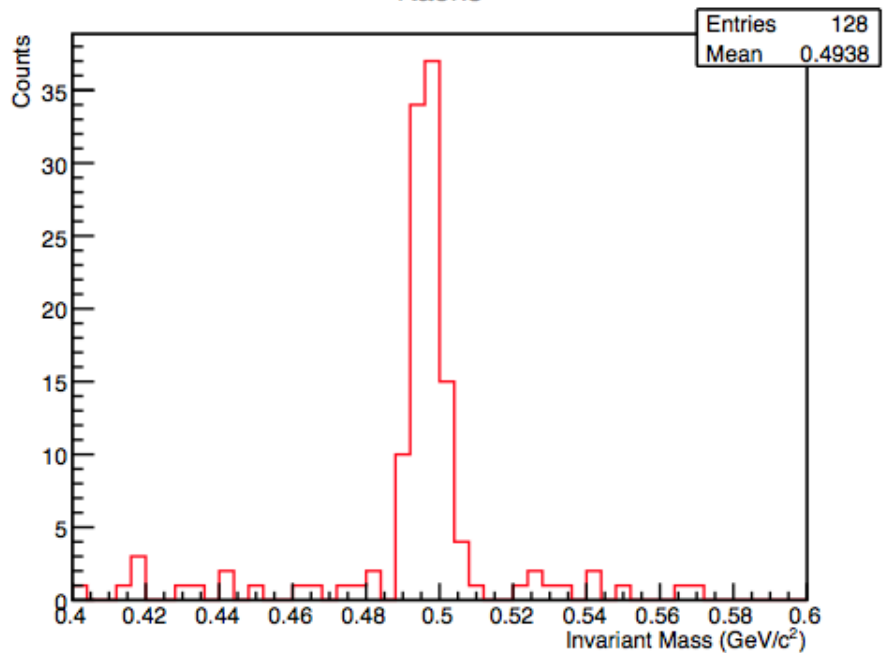




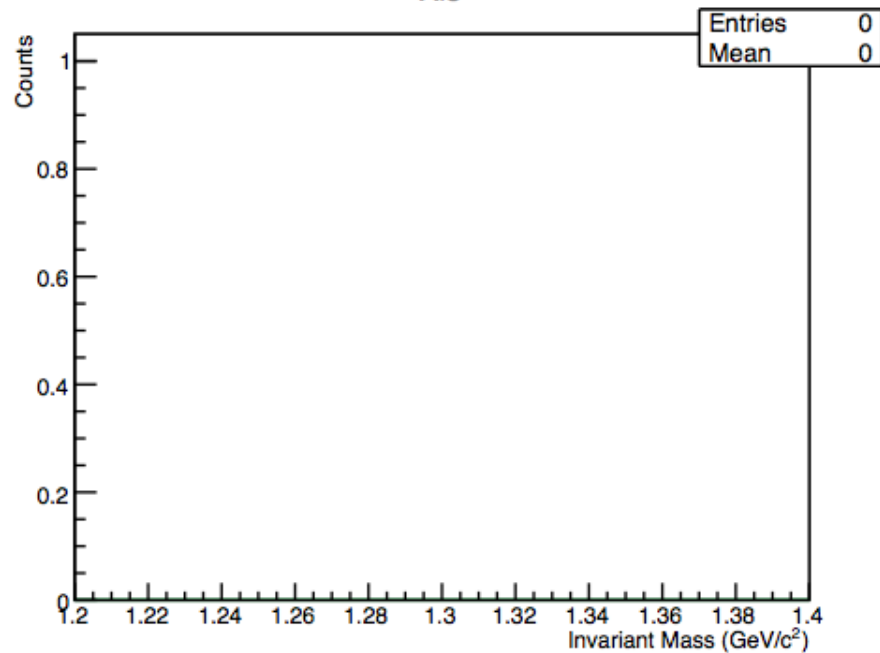
I'm ready! Start Exercise

Exit

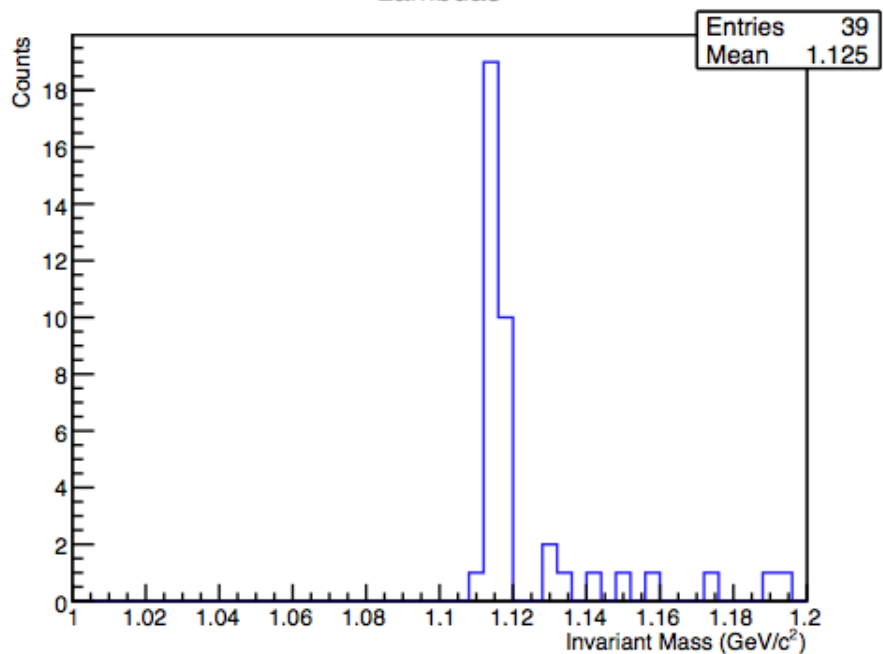
Kaons



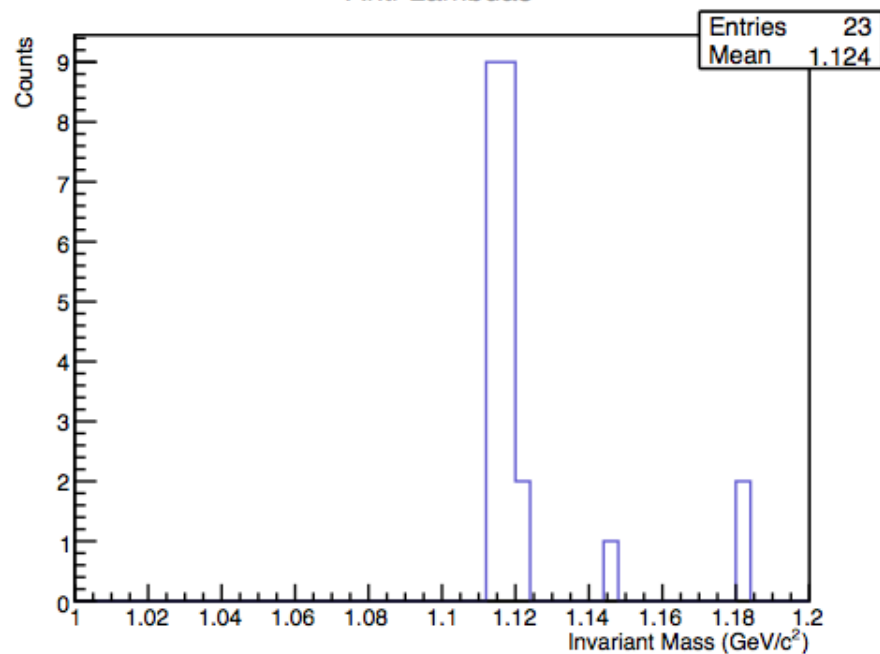
Xis



Lambdas



Anti-Lambdas



2nd part of exercise

- Analyse big event sample (2000 events)
- Invariant mass histograms for K_s , Λ , anti- Λ
- Fit 2nd degree polynomial to background
- Fit gaussian to peak
- Get number of K_s , Λ , anti- Λ after background subtraction

+ option to see combinatorial background
(without common secondary vertex requirement)

Teacher

Viewer 1 | Multi View | Invariant Mass Distribution

Teacher Instructions

Instructions

Animate event



Get Files

1	2	Lambda
3	4	Teacher

Fit

Fit background

Fit range

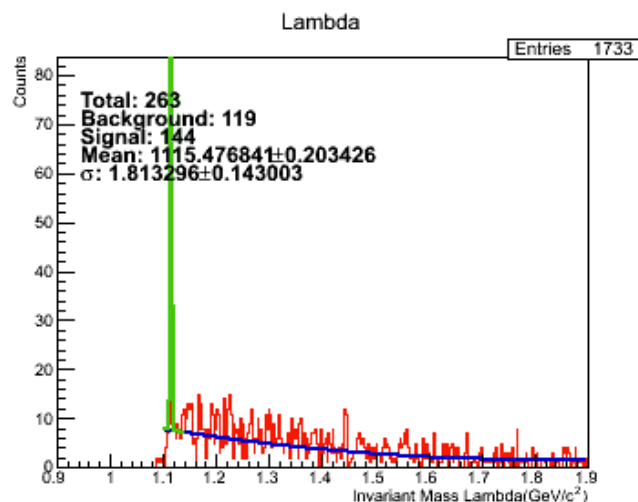
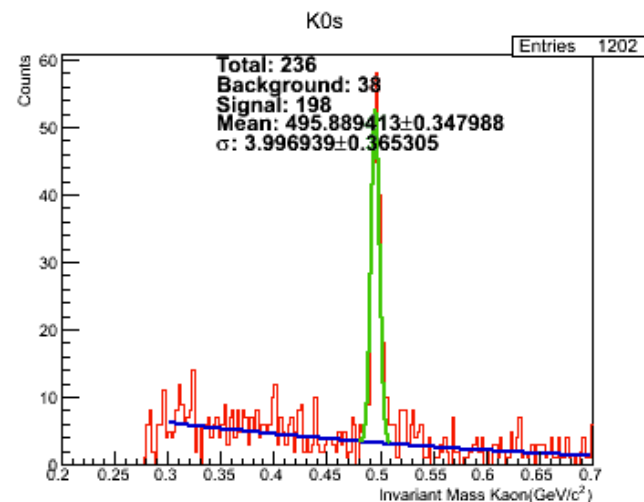
Fit signal+background

Fit range

Encyclopaedia

ALICE Detector

V0 Patterns



Student Mode

Exit

Outline of exercise

- **Students (each group):** Visual analysis of 30 events – tables + invariant mass histograms
- **Institute (all groups):** Add up numbers / merge histograms
30-event samples for visual analysis, 7 TeV proton-proton (6)
5-event sample Pb-Pb (1)
- **Students (each group):** Analysis of 2000 events - invariant mass histograms
- **Students (each group):** Try to fit background / peak / subtract -> find number of particles
- **Institute (all groups):** Merge histograms
- **Institute (all groups):** Fit background / peak / subtract -> find number of particles
2000 event samples 7 TeV proton-proton (7)
1500 event sample lead-lead
- Calculate yields of each particle type
(assumptions on **initial number of events** from which the sample has been extracted
correction factors for efficiency)

Goals

- Flavour of data analysis
- Concept of particle decays
- Concept of some conservation laws and invariant mass

Results

- Count numbers of particle species (K_s^0 , Λ , anti- Λ)
- Calculate yields of particles
- Compare with ALICE results
- Use particle ratios to calculate T (temperature of QGP)

For the institutes, if enough time...

- Strangeness enhancement : need to make ratio i.e. yield of Λ in pp / yield of Λ in Pb-Pb
- Show published strangeness enhancement plots from ALICE (+ other HI experiments)
- Explain on the plots what they would need to measure, in addition, to reproduce them

Proposal to institutes to use, for the collection of results, such a spreadsheet on

<http://www.editgrid.com/user/alice-masterclass/results-2012-example.csv>

Dataset	N(K0s)	N(Λ)	N(anti- Λ)	N(events)	error(K0)	error(Λ)	error(Λ bar)
1	19	6	0	1400	4.359	2.449	0.000
2	12	6	5	1400	3.464	2.449	2.236
3	20	3	8	1400	4.472	1.732	2.828
4	20	8	2	1400	4.472	2.828	1.414
5	18	3	2	1400	4.243	1.732	1.414
6	16	5	3	1400	4.000	2.236	1.732
total	105	31	20	8400	10.247	5.568	4.472
Yields	0.250	0.074	0.060		0.030	0.017	0.013
ALICE publ.	0.184	0.048	0.047		0.002	0.001	0.002
ALICE 7 TeV	0.276	0.072	0.0705				

Username alice-masterclass
Password alice

Proposal to moderators to use, for the collection of all results, such a spreadsheet on

<http://www.editgrid.com/user/alice-masterclass/results-2012-collection.csv>

Institute	N(K0s)	N			error(K0)	error(Λ)	error(Λ bar)
		N(Λ)	N(anti- Λ)	(events)			
1	105	31	20	8400	10.247	5.568	4.472
2	106	32	21	8400	10.296	5.657	4.583
3	104	30	20	8400	10.198	5.477	4.472
4	100	33	19	8400	10.000	5.745	4.359
5	99	31	20	8400	9.950	5.568	4.472
average	102.8	31.4	20	8400	10.139	5.604	4.472
Yields	0.245	0.075	0.060		0.030	0.017	0.013
ALICE pub	0.184	0.048	0.047		0.002	0.001	0.002

Username alice-masterclass
Password alice

Discussion

Compare results of different institutes

- with each other
- with ALICE results

Mention errors

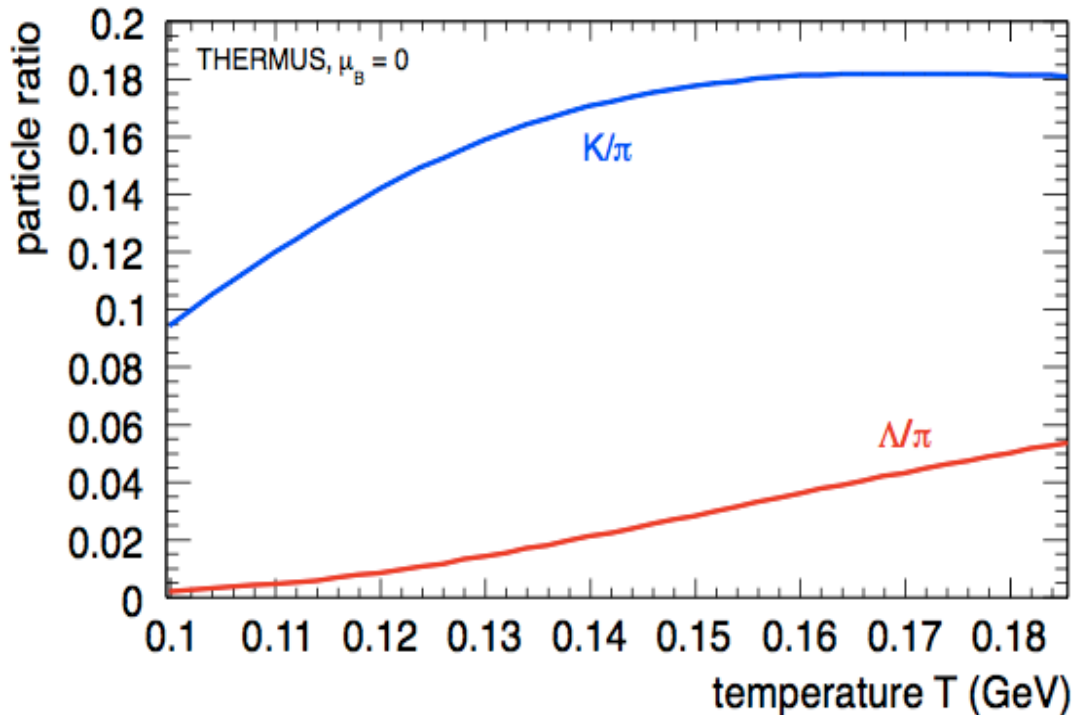
Physics discussion

Also in the proposal to the institutes to discuss locally

Calculation of the temperature of the Quark Gluon Plasma from particle ratios

Temperature calculation from particle ratios

The number of produced Kaons and Lambdas can be used as a *thermometer* of the matter produced in the collisions



$$N_{K0s} = 123.9 \pm 7$$

$$N_{\Lambda} = 28.8 \pm 3$$

$$N_{\pi^+} = 792.1 \pm 44.1$$

For central (0-5%) PbPb

$$N_{K0s} / N_{\pi^+} = 0.156 \pm 0.012$$

$$N_{\Lambda} / N_{\pi^+} = 0.036 \pm 0.004$$

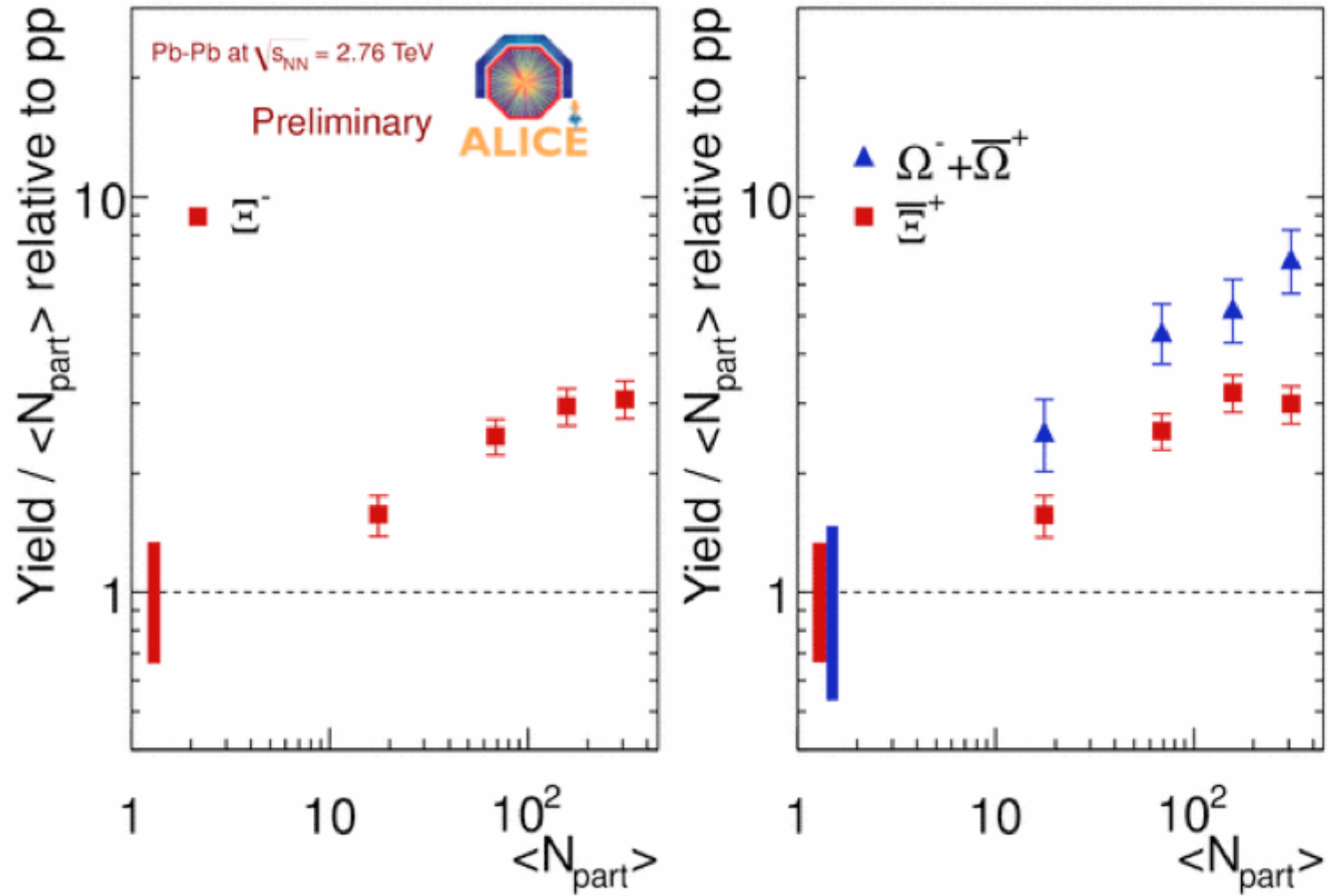
T = 120-180 MeV

Corresponds to
 $\sim 10^{12}$ K

Curves produced with thermal model.

Relates relative abundance of particles with temperatures in the fireball

Backup slide



ALI-PREL-11350