The ITS role in the spectra analysis

The strategy
- the 3 Gaussian fit and the dE/dX
- the cuts and the two tracks samples

The results
- identified spectra from pp data @ 900 GeV
- particle ratios
The ITS role in the Particle Identification

- low momentum: crucial for comparison with the models
- low contamination from secondaries (impact parameter resolution)
- other details in the A. Dainese presentation of yesterday

↓

ITS standalone tracks
- not using of TPC or TOF information
- low momentum reached
- recovering the tracks lose by the TPC
(E. Biolcati)

ITS+TPC tracks
- better resolution in pt
- important for the matching with TPC points
- cross check for global analysis
(M. Chojnacki)
The 3 Gaussian method

1. Event selection
2. All tracks
3. General cuts on tracks
4. Assuming mass
5. Cuts for DCA & η

Calculating $\log(dE/dx) - \log(dE/dx_{BB})$ in pt bins for each particle type

Area below peak center in zero is a yield which we are looking for.

Other peaks are background.
The main cuts

**ITS standalone**

On the events
1. Physics selection + Background rejection
2. SPD vertex with at least 1 contributor
3. Z vertex position < 10 cm
4. Dispersion on Z vertex < 0.03 cm

On the tracks
1. kITSrefit & kITSpureSA
2. Pseudo-rapidity range: [-0.9,0.9]
3. Rapidity range: [-0.5,0.5]
4. At least one point in the pixel layers
5. At least 3 points in strip or drift layers
6. $\chi^2/($# ITS clusters$) < 1$

**ITS + TPC**

On the events
1. Physics selection + Background rejection
2. SPD vertex with at least 1 contributor
3. Z vertex position < 10 cm

On the tracks
1. kITSrefit & kTPCrefit
2. No kink daughters
3. Rapidity range: [-0.5,0.5]
4. At least one point in the pixel layers
5. At least 3 points in strip or drift layers
6. Minimum # TPC clusters = 70
7. $\chi^2/($# TPC clusters$) < 4$
8. ITS cluster charge > 50 keV (under investigation)
The cuts on DCA for ITS standalone tracks

\[ \sigma_{\text{d0xy}} = [p0] + [p1]/pt^2[p2] \]

\[ \sigma_{\text{d0Z}} = [p0] + [p1]/pt^2[p2] \]

7 \( \sigma \) cut as a function of pt both in XY plane and in Z direction
The cuts on DCA for ITS + TPC tracks

Secondaries not well reproduced by the Monte Carlo simulation

method to extract the secondary fraction from data only

Selecting clean proton (pions) sample and making for it DCA distribution.

Tuning the dca cut and evaluating contamination on data.
The dE/dx calculation

dE/dx given by the truncated mean of the SSD/SDD signals:
- on 4 clusters: cut the 2 highest values
- on 3 clusters: cut the highest value, put a weight of 0.5 to the middle one, 1 to the lowest one

Distribution directly in pt bins of

\[ \log(\text{dE/dx})_{\text{calculated}} - \log(\text{dE/dx})_{\text{expected}} \]

where expected is the value calculated by the BetheBloch formula, using an ad hoc parametrization:

\[
\frac{dE}{dX}(\beta\gamma) = p_0 \frac{p_1 + 2 \log \gamma - \beta^2}{\beta^2} \xi
\]

with

\[
\xi = \begin{cases} 
  p_4 + (\beta\gamma - p_3)^2 & \text{for } \beta\gamma < p_2 \\
  p_4 + (p_2 - p_3)^2 & \text{for } \beta\gamma > p_2 
\end{cases}
\]

with different parameters for the two samples of tracks
The Bethe-Bloch parametrization

The Bethe-Bloch function for ITS standalone tracks

The Bethe-Bloch function for ITS + TPC tracks
The $dE/dx$ distribution in $pt$ bins

Cut on the minimum $dE/dx$ value (e.g. 50 keV) \\
“more Gaussian” shape in the left \\
probably noisy clusters cut
The calibration for drift and strip

The dE/dx calculation, obtained by the cluster charge in the 4 ITS outer layers, are calibrated to the same Most Probable Value.
Improving calibration on DATA for pp @ 7 TeV

For SSD: using 7 TeV high statistics, a new calibration on module level was put to the Offline Condition DataBase (OCDB)

For SDD: the fine tuning was performed using 900 GeV data
The global efficiency takes into account all the effect to correct via MonteCarlo simulation:

- geometric acceptance
- dead channels
- tracking efficiency
- 3 Gaussian fit efficiency
The corrected spectra for pp @ 900 GeV

The corrected spectra extracted from the two samples of tracks will be shown in the M. Floris presentation.

DATA for pp @ 900 GeV
open marker: ITS+TPC
close marker: ITS standalone

the final matching with the points of TOF and TPC ones will be shown in the M. Floris presentation
The positive-negative particle ratios

- preliminary plots -

π⁺/π⁻, K⁺/K⁻, p/\bar{p}

DATA for pp @ 900 GeV
open marker: ITS+TPC
close marker: ITS standalone

Errors over-estimated → under study
The different particle ratios

- preliminary plots -

\[ \frac{K^+}{\pi^+} \]
\[ \frac{K^-}{\pi^-} \]
\[ \frac{p}{\pi^+} \]
\[ \frac{\bar{p}}{\pi^-} \]
\[ \frac{p}{K^+} \]
\[ \frac{\bar{p}}{K^-} \]

Data for pp @ 900 GeV
open marker: ITS + TPC
close marker: ITS standalone
The conclusions

About the ITS Particle Identification:
- for ITS standalone and ITS+TPC tracks analysis framework has been done
- Bethe-Bloch parametrizations are fine tuned
- dE/dx calculation is optimized
- strip & drift charge calibration is under control

About the results:
- the pt spectra (900 GeV) have been extracted and corrected
- the preliminary ratios between particles have been extracted
- the low momentum points are used for the comparison with the theoretical models

About the future:
- repeat the analysis for pp @ 7 TeV
- estimation of the systematics
- check and fine tune of the particle ratios
- finalization of the d0 cuts

that’s all, thanks for the attention
backup slides
Secondaries/primaries d0xy cut - Protons

\[ P_t \text{ integrated [0.3, 1] w/o 7\sigma cut} \quad P_t \text{ integrated [0.3, 1] with 7\sigma cut} \]

- \( P_t \text{ integrated [0.3, 1] w/o 7\sigma cut} \)
  - sec/prim: 0.187223
  - sec from mat/prim: 0.019391
  - sec from s/prim: 0.167833

- \( P_t \text{ integrated [0.3, 1] with 7\sigma cut} \)
  - sec/prim: 0.084447
  - sec from mat/prim: 0.003304
  - sec from s/prim: 0.081143
Systematics:
- peak shape of the $dE/dx$ distribution in $pt$ bins
- common track cuts ($\chi^2$, cut value on the vertex, etc)
- $d0$ and contamination from secondaries (material, strangeness)
- tracking efficiency in low momentum region

Checks:
- number of clusters in strip & drift layers
- different MonteCarlo simulation used to correct