## Outline

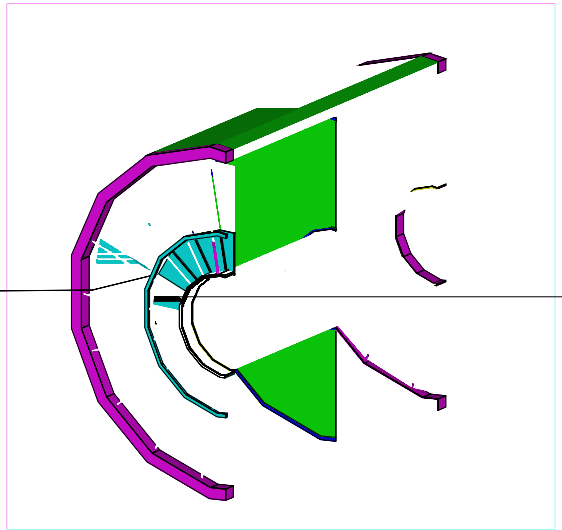
- TPC simulations
- Kalman filter: Advantages and shortcomings
- Cluster finding
- Track finding
- Definition of the tracking efficiency
- Present results & problems

# ALICE TPC reconstruction methods & status

## TPC simulations (Marek Kowalski & Marian Ivanov)

**Geometrical features:**

- $R_{in}/R_{out} \approx 87/252$ cm, $L \approx 250$ cm
- sector opening angle $20^0$
- pad shapes $75 \times 40$ and $100 \times 60$ mm$^2$



**Phyisical processes:**

- all GEANT processes
- diffusion
- gas gain fluctuations
- $E \times B$ effect
- responses in time and pad directions
- noise
- crosstalk

## Kalman filter: Advantages and shortcomings

**Advantages:**

- simultaneous track recognition and reconstruction
- matrices not more than $5 \times 5$
- natural way to take into account multiple scattering
- possibility to take into account mean energy losses (fluctuations as well ?)
- e cient way to match tracks between di erent detectors

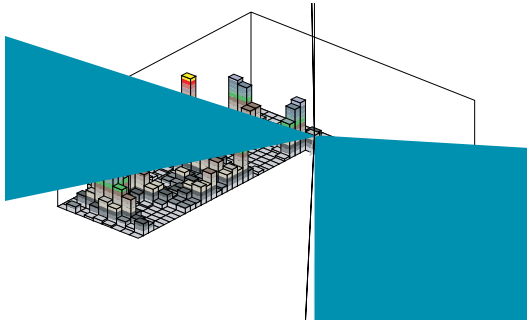
**Shortcomings:**

- track "seeds" have to be provided
- clusters have to be reconstructed **before** tracking
- "local" nature of the method (what if there are many clusters inside the "road" ?)
- sensitivity to p.d.f. of measured space points

## Cluster finding

**Occupancy:** $10 \div 40$ %

- search for groups of adjacent digits with signals above the zero suppression level (preclusters)
- for each precluster search for all its local maxima
- cut all the local maxima at the level of the nearest saddle point
- calculate center of gravity for each group of these cut digits (clusters)
- errors are assumed to be proportional to clusters' dispersions



## Track finding

**Track parametrisation:**

$$y(x) = y_0 - \frac{1}{C}\sqrt{1-(Cx-\eta)^2}$$

$$z(x) = z_0 - \frac{\tan\lambda}{C}\sin^{-1}(Cx-\eta)$$

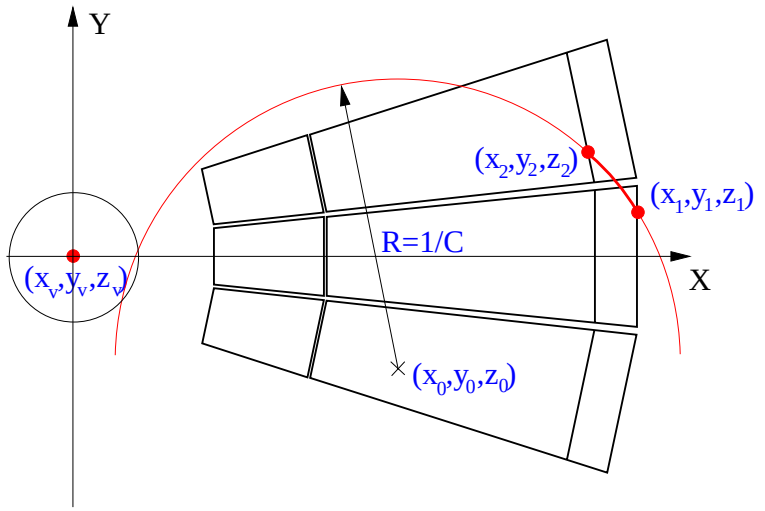
**"State vector":**

$$\mathbf{x}^T = (y,\ z,\ C,\ \tan\lambda,\ \eta),$$

where $\eta \equiv Cx_0$

**Seed finding:**

- for each pair $(x_1, y_1, z_1)$ $(x_2, y_2, z_2)$ and primary vertex $(x_v, y_v, z_v) \Rightarrow$ initial approximation of the "state vector".
- for each $(\Delta y_1, \Delta z_1)$ $(\Delta y_2, \Delta z_2)$ and the diameter of the beam pipe $\Rightarrow$ initial approximation of the covariance matrix.




Track propagation and assignment of clusters are done in a standard way. Multiple scattering and mean energy losses are taken into account during the track propagation.

## Definition of the tracking efficiency

**"Found good" track:**

- number of assigned clusters larger than 40 % of the total number of pad rows
- not more than 10 % of clusters are assigned incorrectly
- at least half of the innermost 10 % of clusters assigned correctly

**"Found fake" track:**

- a track with the su cient number, but incorrect assignment, of clusters

**"Generated good" track:**

- at least one digit on at least 40 % of pad rows
- at least one digit on the pad rows chosen for the seed-finding procedure

**Tracking efficiency:**

$$\epsilon_{\text{good}} = \frac{N_{\text{found good}}}{N_{\text{generated good}}}$$

**Probability to find "fake" tracks:**

$$\epsilon_{\text{fake}} = \frac{N_{\text{found fake}}}{N_{\text{generated good}}}$$

## Present results & problems

| $dN_{ch}/dy$ | $\epsilon_{good}(\epsilon_{fake})$, % | $\Delta p_t/p_t$(5 GeV/$c$), % | $dE/dx$ (max. digit), % |
|---|---|---|---|
| 1500 | 98 (0) | 1.6 (5.1) | 7.8 (7.0) |
| 8500 | 93 (3) | 2.0 (8.5, 4.5*) | 17.3 (9.0) |

* if the primary vertex is included in fit

**Computing resources per one simulated TPC event ($dN_{ch}/dy$ = 8300)**

| | CPU time, h** | RAM, Mb | Disk space, Mb |
|---|---|---|---|
| hit generation | 8.0 | 400 | 2500 (200 ?) |
| digitization | 13.5 | 750 | 400 |
| reconstruction | 0.5 | 550 | 5 |

** on 25 SpecINT95 machine

**And at long last:**

**HOW SHOULD WE UNFOLD CLUSTERS ???**