Considerations to the CBM Start Detector

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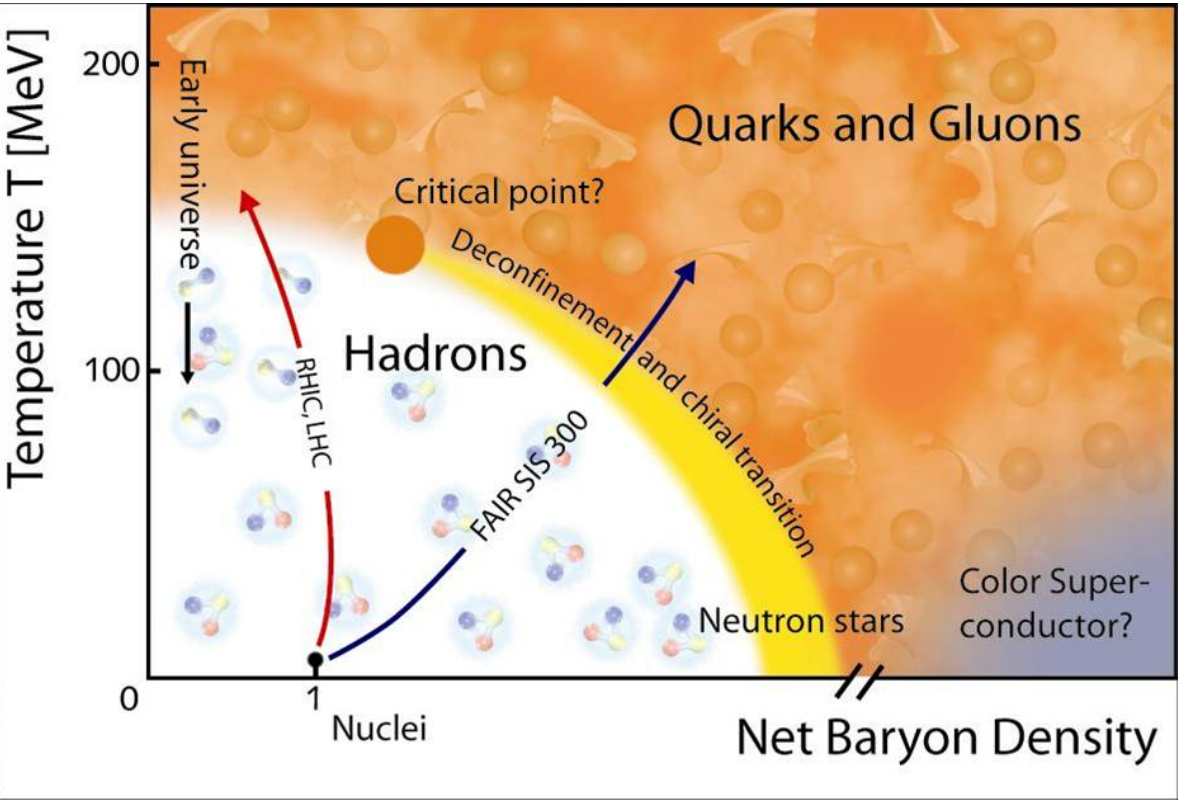
Compressed Baryonic Matter (CBM)



- Explore properties of matter at extreme baryon densities
- Search for the 1st order phase transition and critical end-point
- Equation-of-state of nuclear matter

The CBM experiment at FAIR

Physics observables:
- Open charm
- Charmonium (2 channels)
- Event-by-event fluctuations
- Low mass vector mesons (2 channels)
- Strangeness (multistrange hyperons)
- Bulk properties

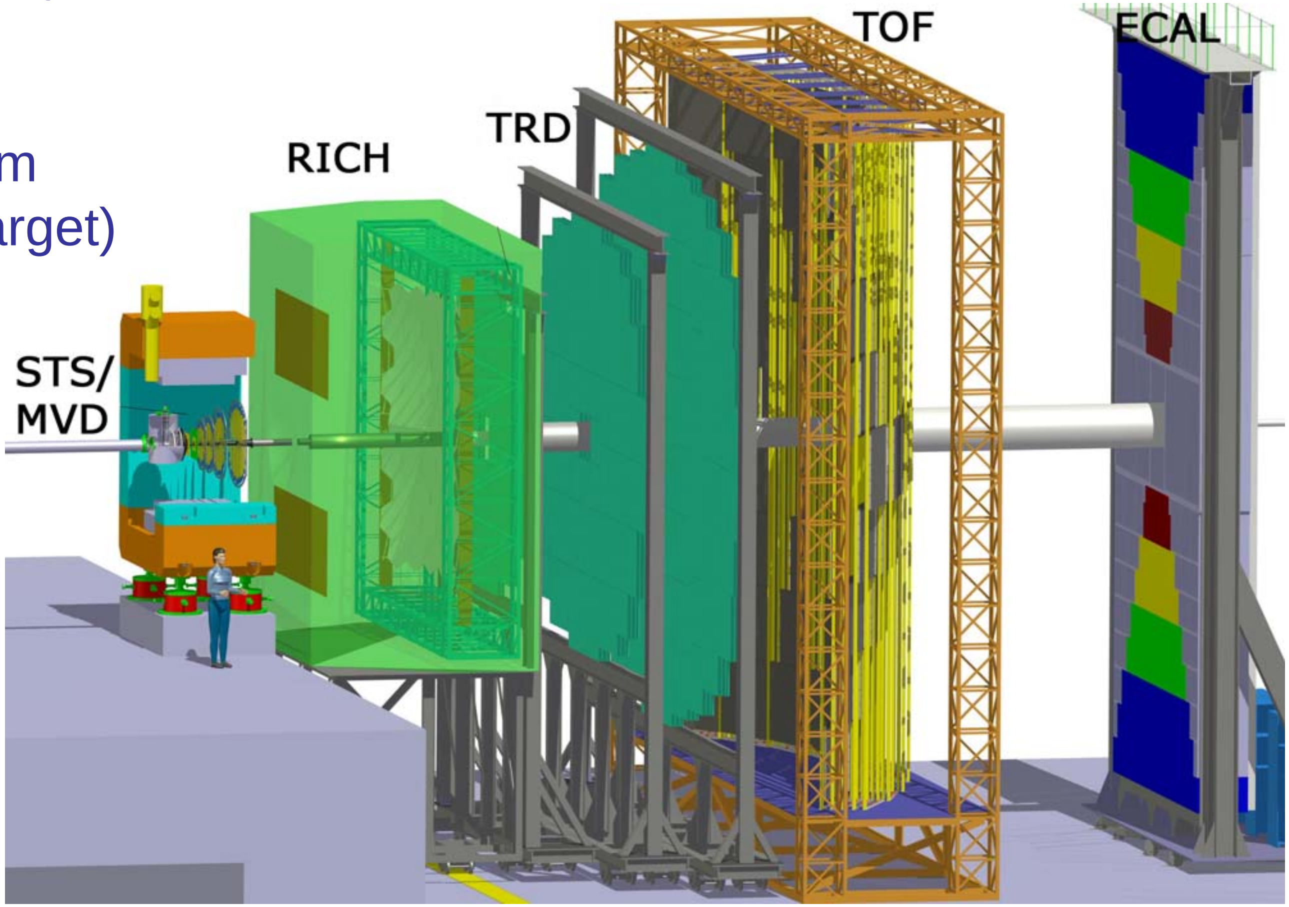
Extremely high interaction rates (10^7)
allow measurement of rare probes

Challenges:
- Fast on-line reconstruction
- Radiation hardness of the detectors

The CBM Experiment at FAIR

Hadron Identification by momentum and TOF measurements (TOF-stop wall at 10m downstream of the target)

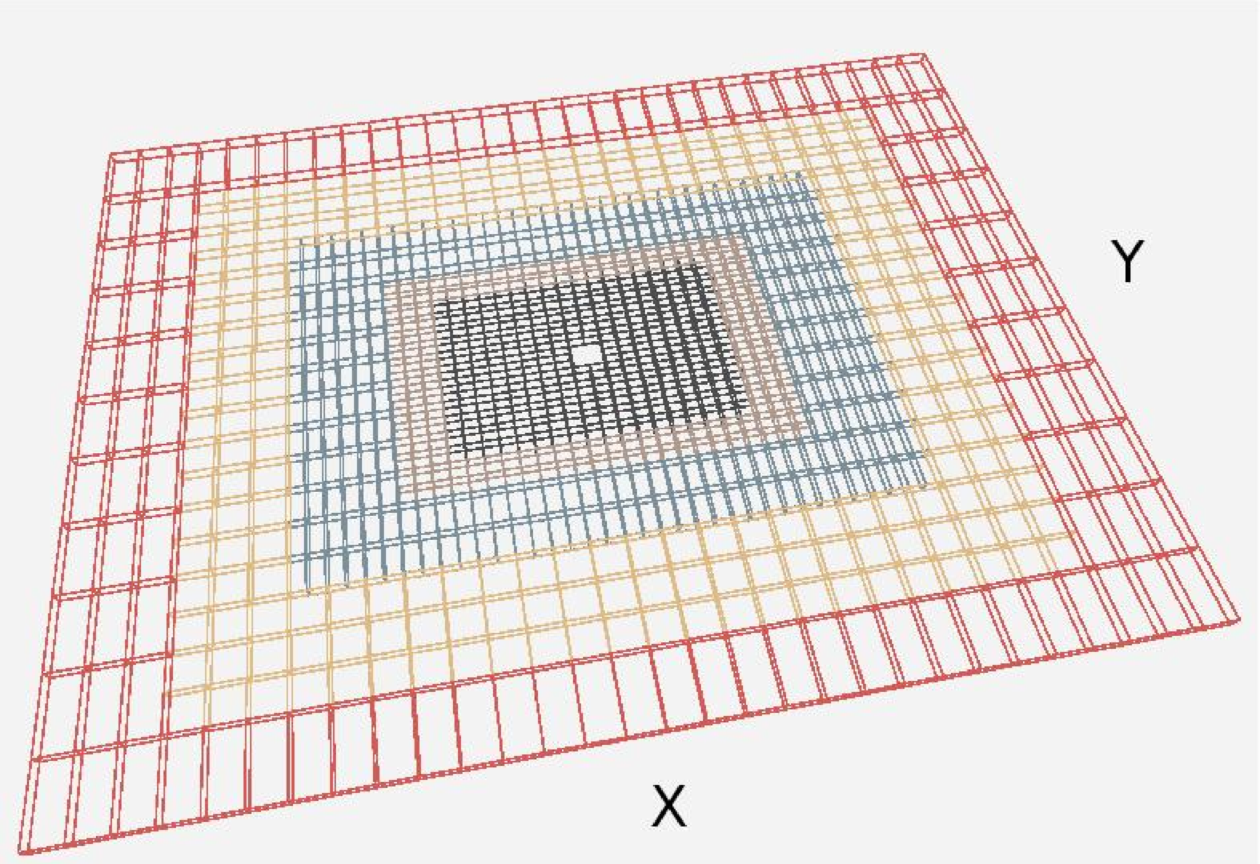
Check feasibility of measurements with respect to time resolution using Monte Carlo engines (Geant3)



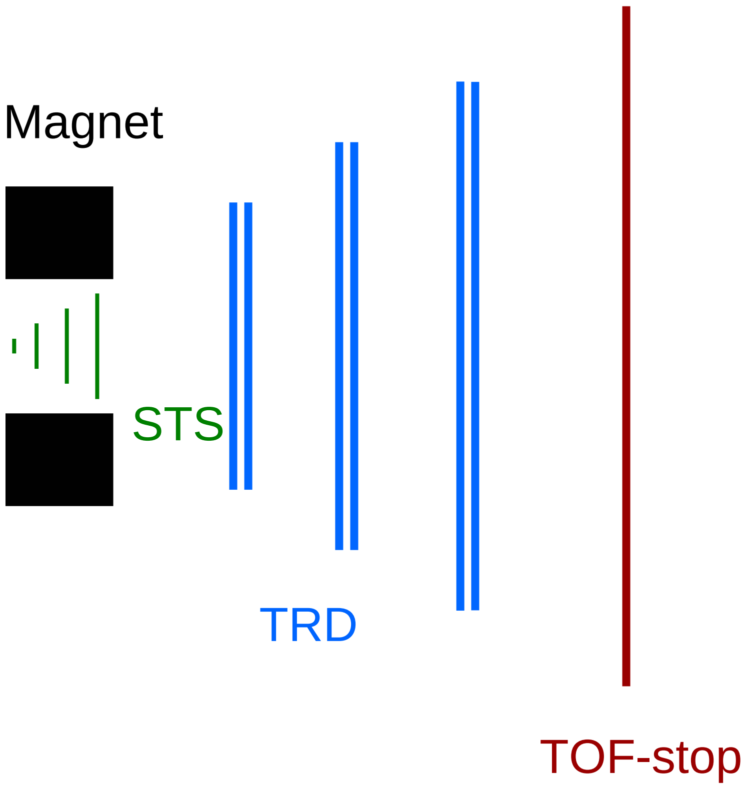
Feasibility study

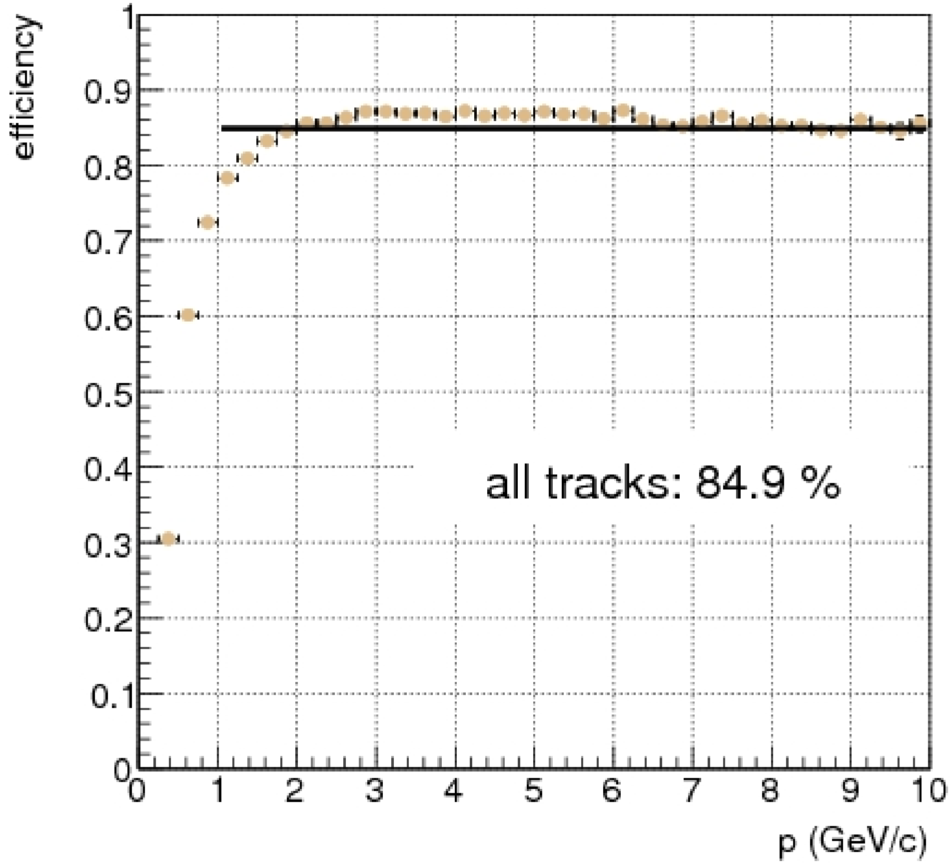
TOF-stop wall in simulation

- Area 12 x 10 m^2
- Granular geometry
- Double hits
- Smearing of time measurement (σ = 80 ps)



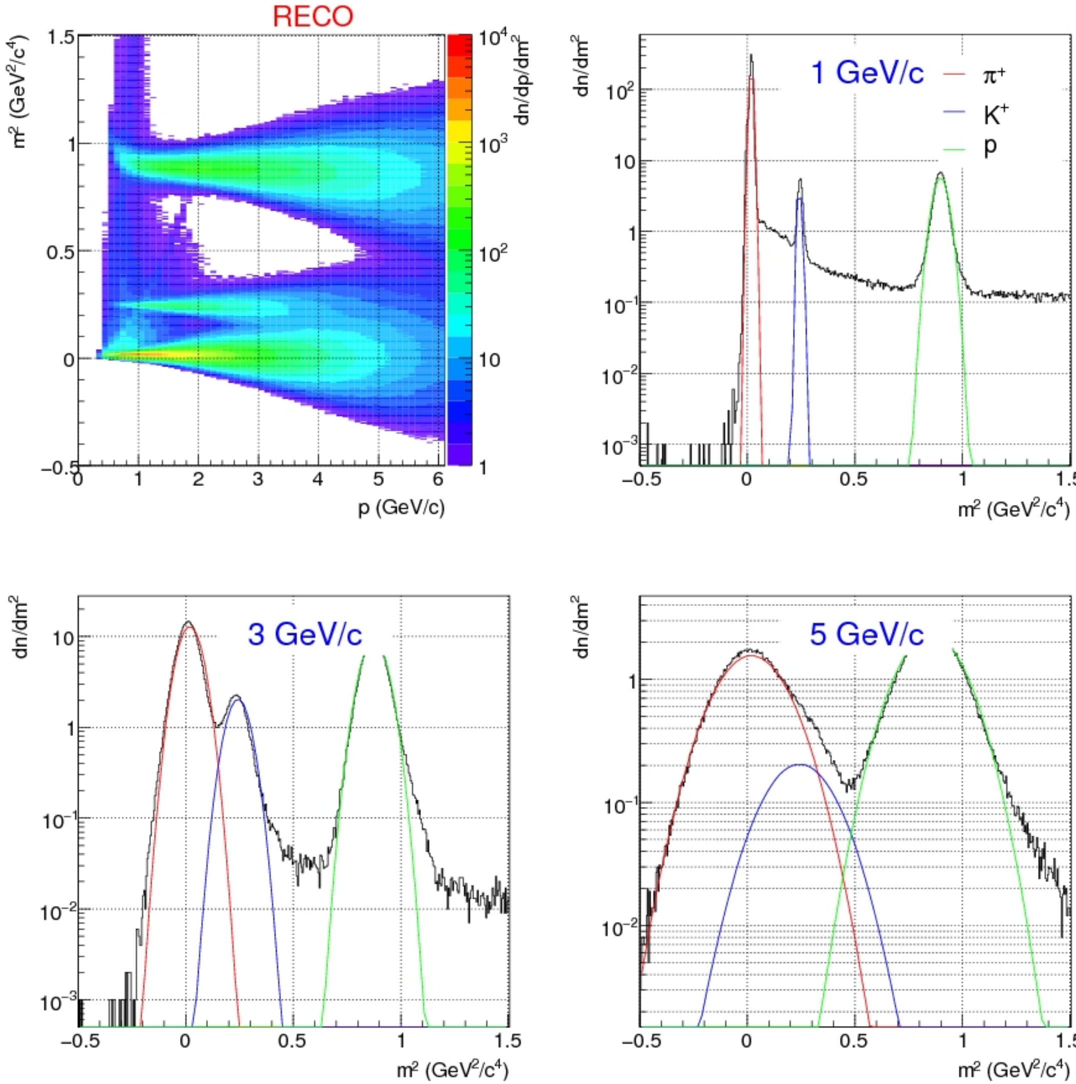
Global Tracking



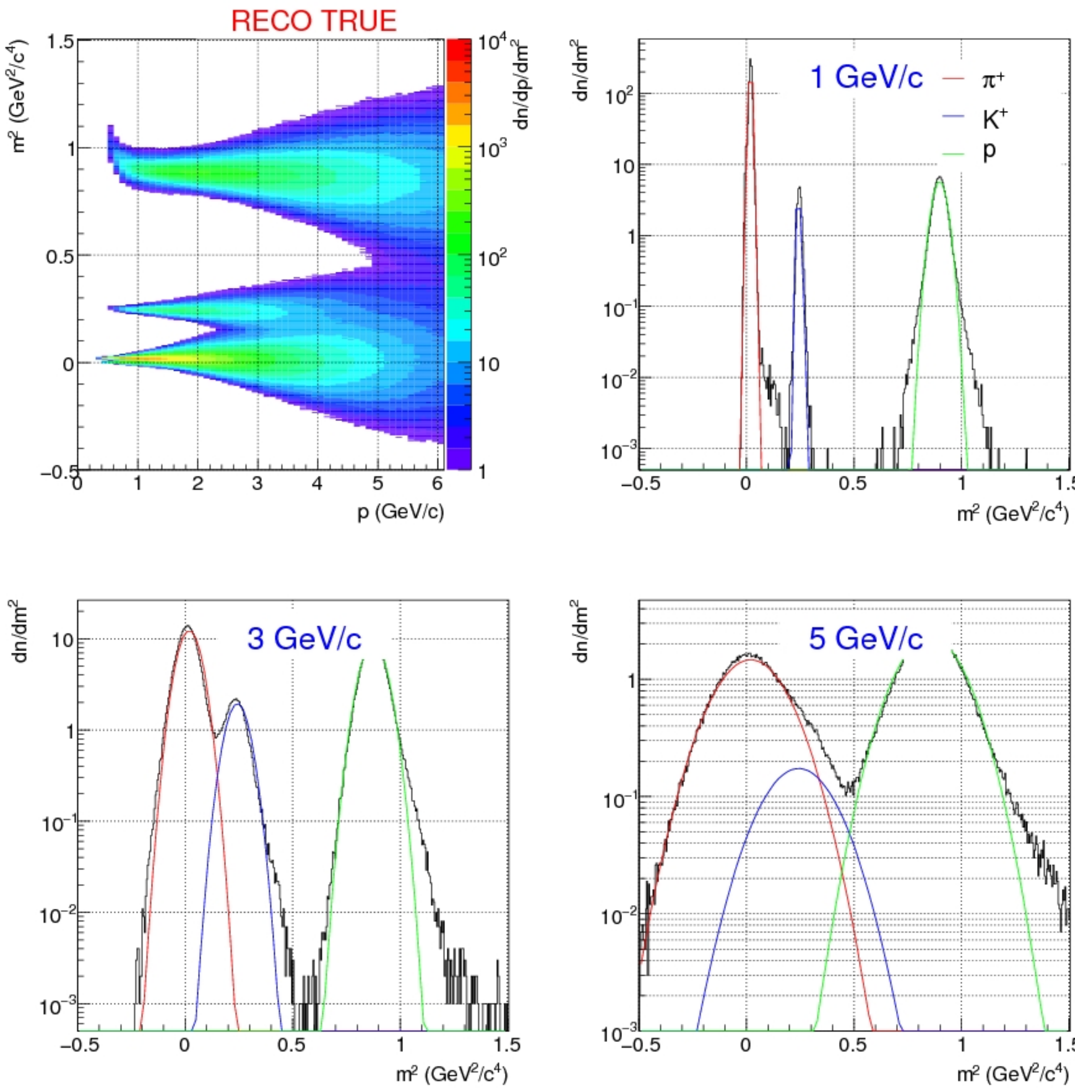


Squared Mass Spectra

$$m^2 = p^2\left(\frac{c^2t^2}{L^2} - 1\right)$$



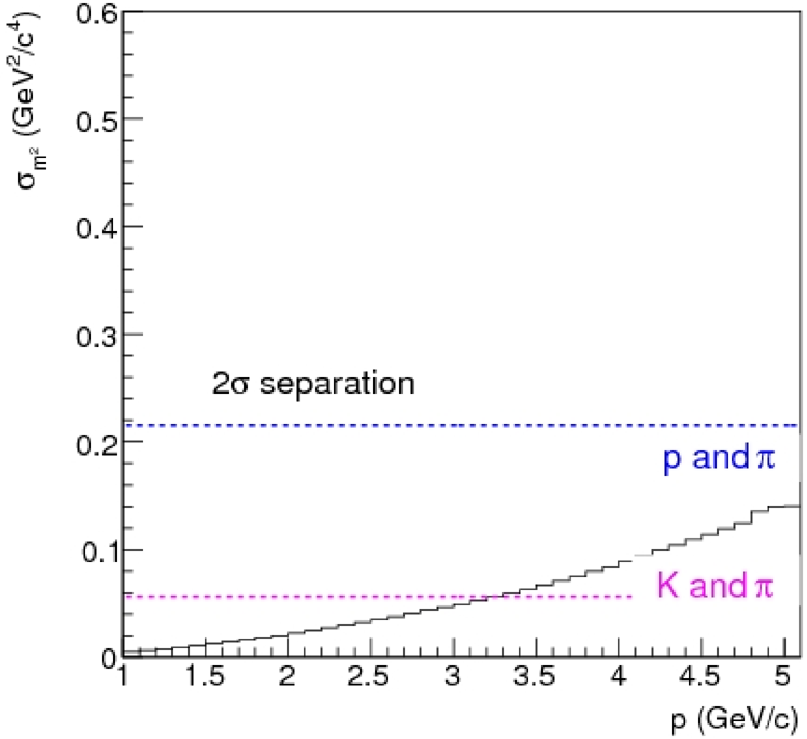
Correctly Reconstructed Tracks

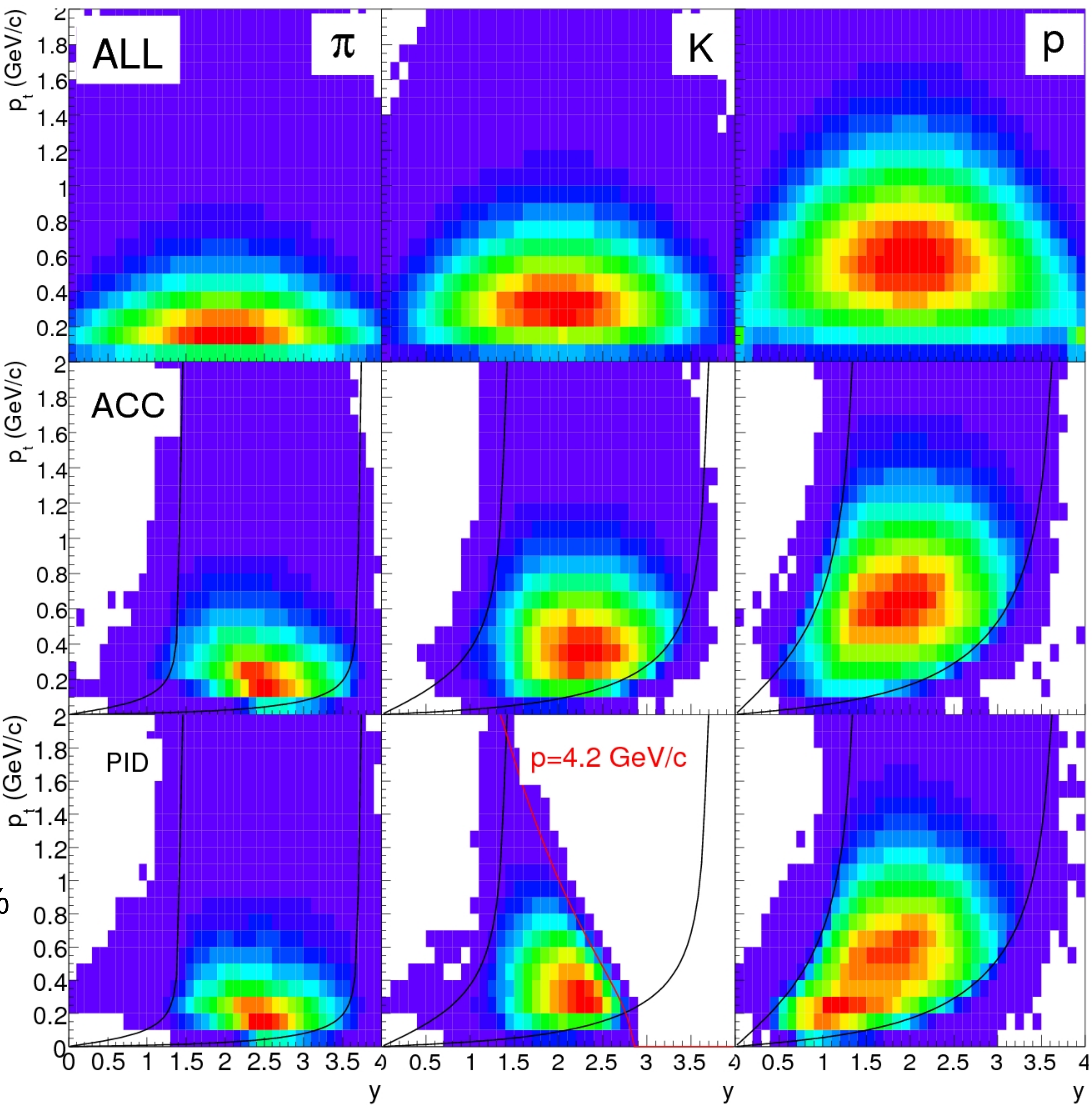


Squared Mass Resolution

$$\sigma_{m^2} = 2\sqrt{\left(m^2 \frac{\sigma_p}{p}\right)^2 + \left(\frac{p^2}{\beta^2}\frac{\sigma_t}{t}\right)^2}$$

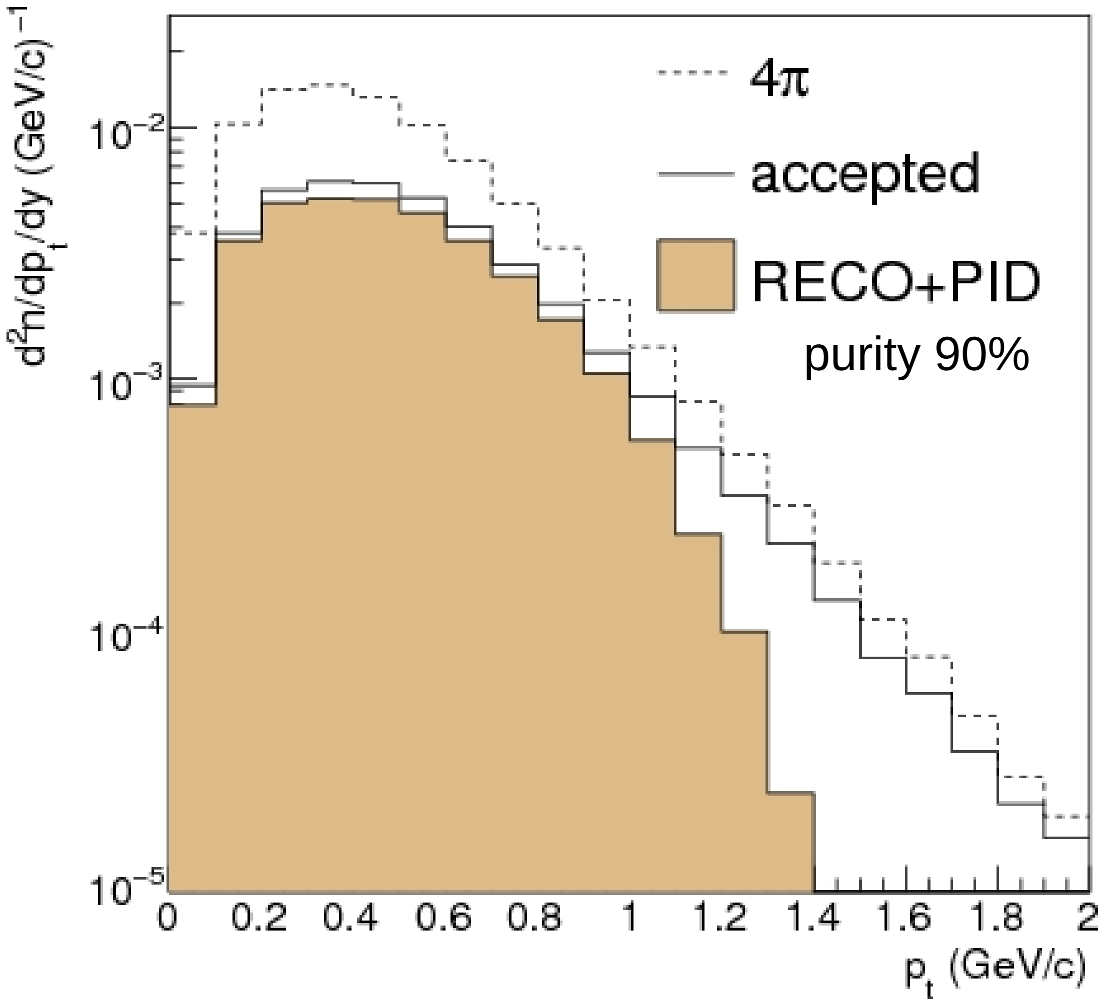
Time resolution dominates uncertainties in the m^2 measurement





purity 90 %

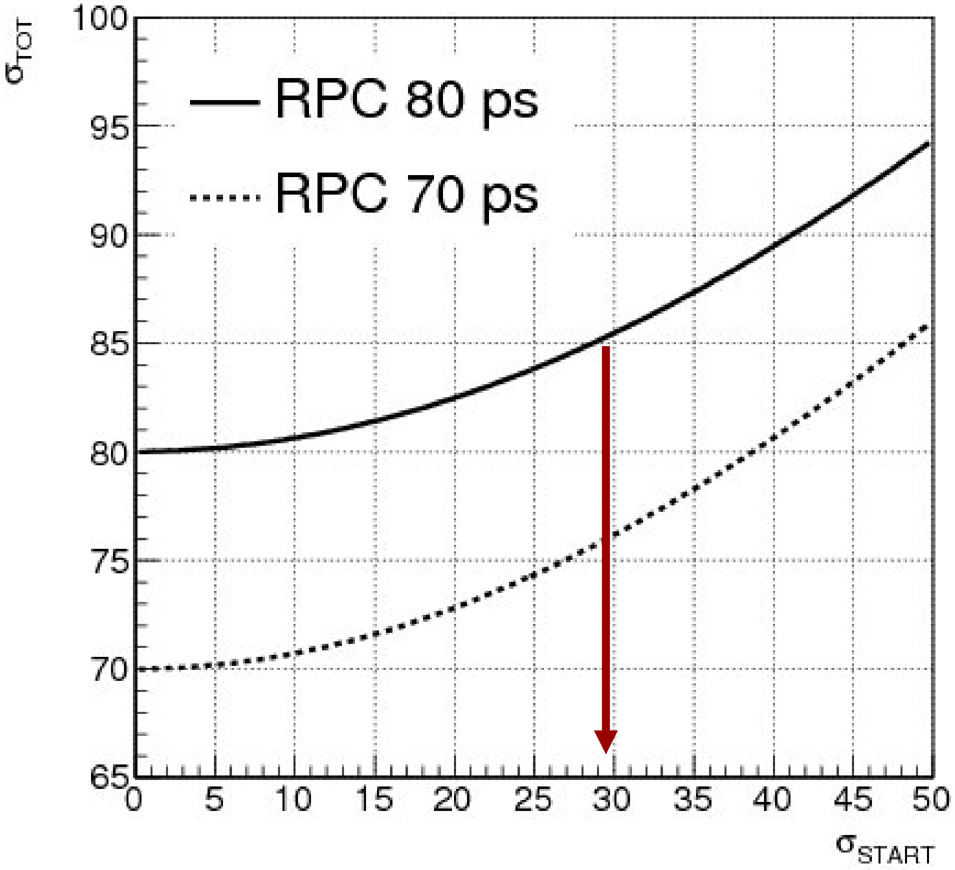
Kaon p_t at midrapidity



Requirements to the CBM start detector

Time resolution

$$\sigma_{TOT} = \sqrt{\sigma_{RPC}^2 + \sigma_{START}^2}$$



Time resolution

$$\sigma = \sqrt{\sigma_{RPC}^2 + \sigma_{START}^2}$$

RPC time resolution $\sigma_{RPC} = 80\,ps$

Resolution of start detector $\sigma_{START} < 30\,ps$

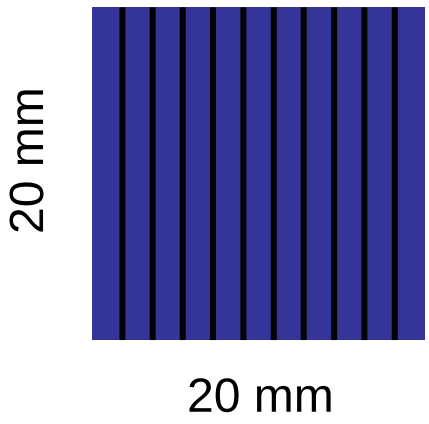
Total resolution of < 85 ps

Granularity, size and positioning

Beam rate at SIS300
up to 10^9 ions per second

Pulse length of Di 1 ns

CBM start detector should consist
out of more than **100 pixels** or **100 micro strips**
in order to have rate of 10^7 per pixel and pile-up of 1%



Possible solution:
1 mm^2 pixels or
100 μm strip pitch

Placed ~ 1 m
in front of the target

Conclusion

- Feasibility study of hadron identification in the CBM experiment with TOF wall was performed
- Rather clean (90% purity) kaon identification is possible with TOF resolution in the order of 80 ps
- Due to high timing resolution and low pulse width, Diamond detectors are well suited for the needs of the CBM Start Detector