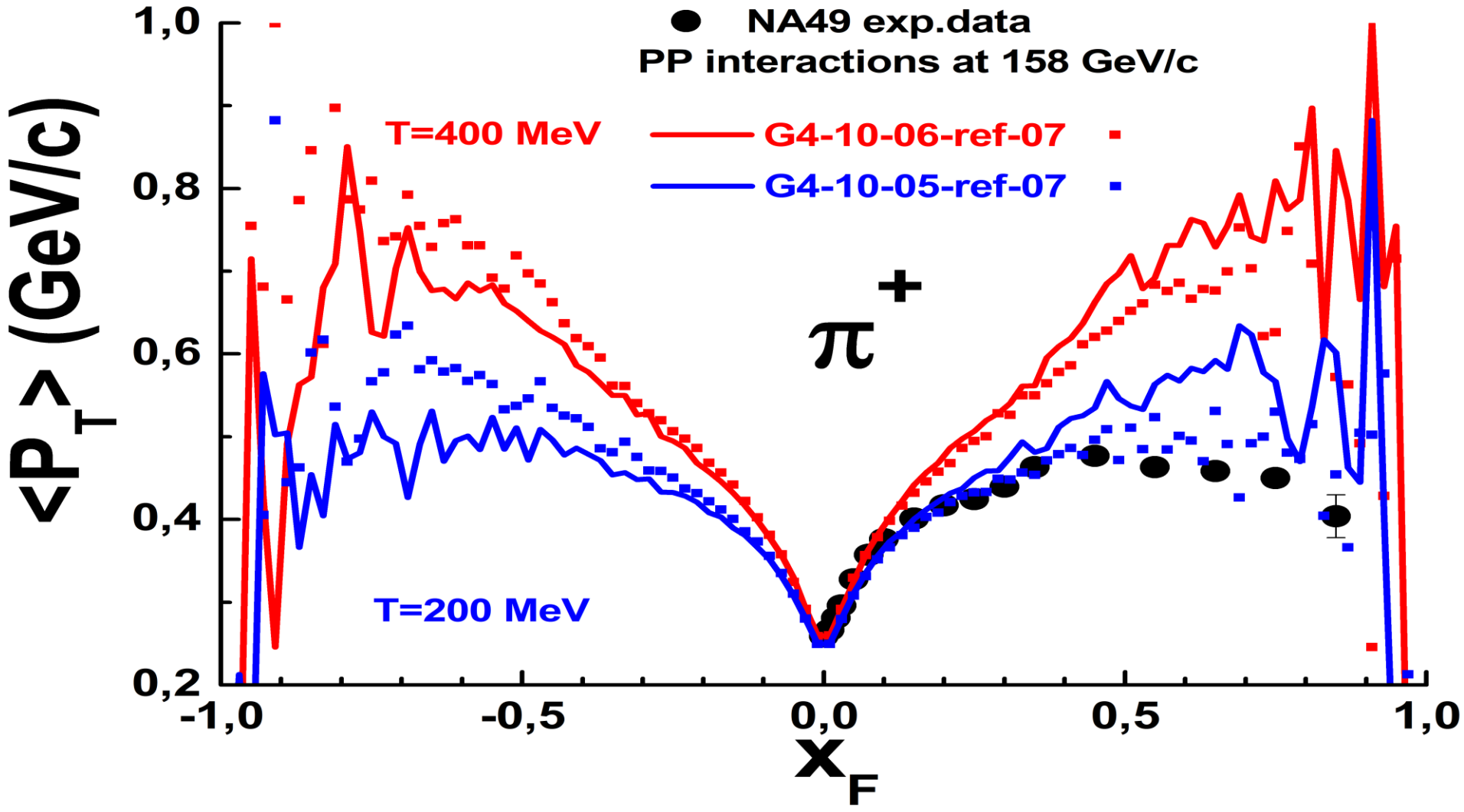
Struggle for Pt-Xf correlations in FTF

V. Uzhinsky, 16 Sept.

Problem!



What to do?

What to do?

Divide and rule!

FTF

1. Choose a process
2. Calculate string masses
3. Calculate Pt
4. Create strings

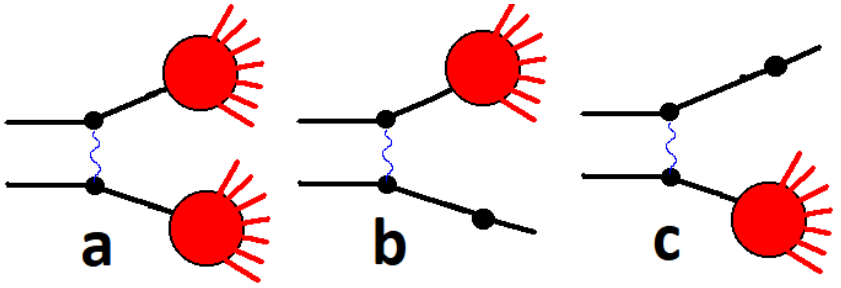
LUND hadronization

1. Transform to aligned string CMS
2. Choose produced hadron
3. Calculate hadron Pt
4. Calculate z-fraction
5. Calculate hadron momentum
6. Repeat steps 2 – 5 needed times
7. Transform back

FTF model : basic assumptions

B.Andersson et al. Nucl. Phys. B281 289 (1987)
B.Nilsson-Almquist, E.Stenlund, Comp. Phys. Comm. 43 387 (1987).

Processes of string's creations considered in the FTF model.

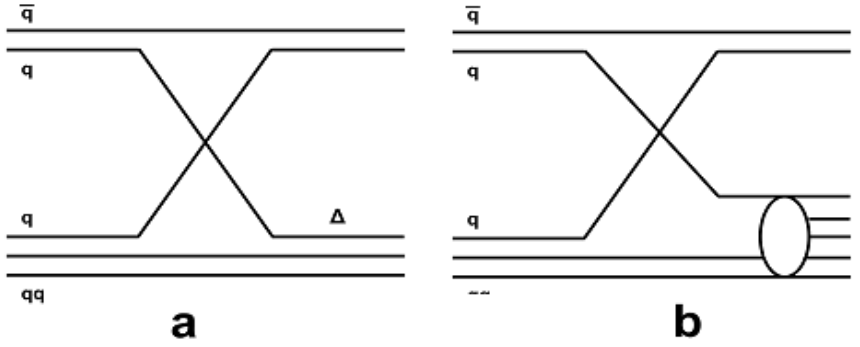


String mass distribution

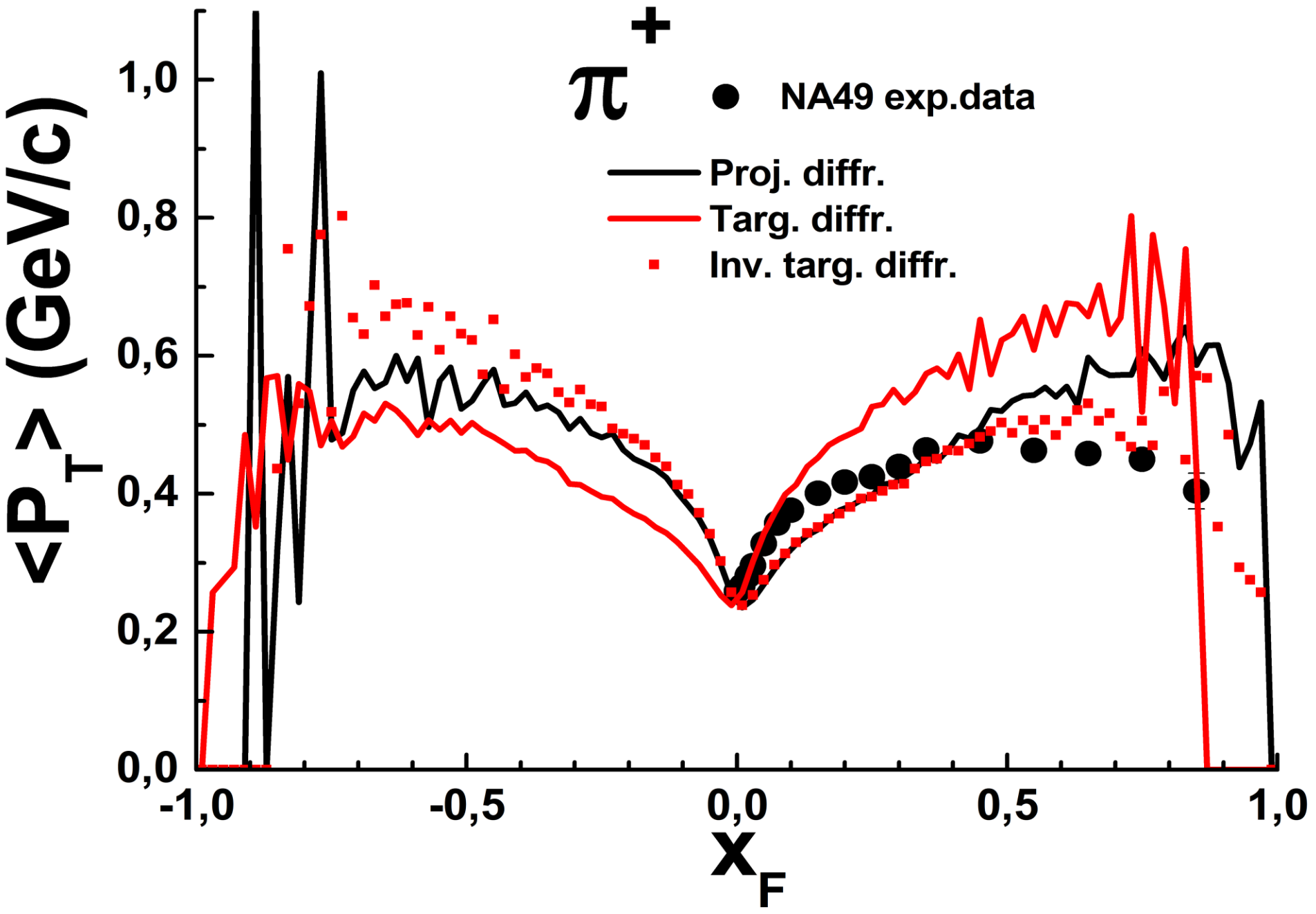
$$dW/dP^- = (1-f)\frac{1}{\ln\left(P^-_{max}/P^-_{min}\right)}\,1/P^- + f\frac{1}{P^-_{max}-P^-_{min}},\quad f=0.55$$

$$P^- = \sqrt{M^2+P_T^2+P_z^2}-P_z \simeq (M^2+P_T^2)/2\,P_z\;(P_z\to\infty)$$

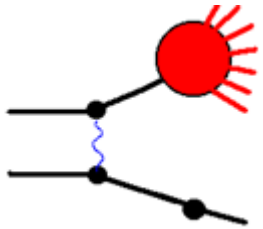
Additional quark exchange processes in the FTF model.

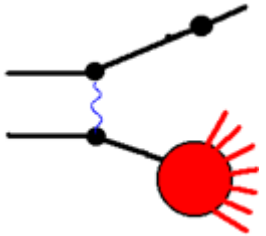


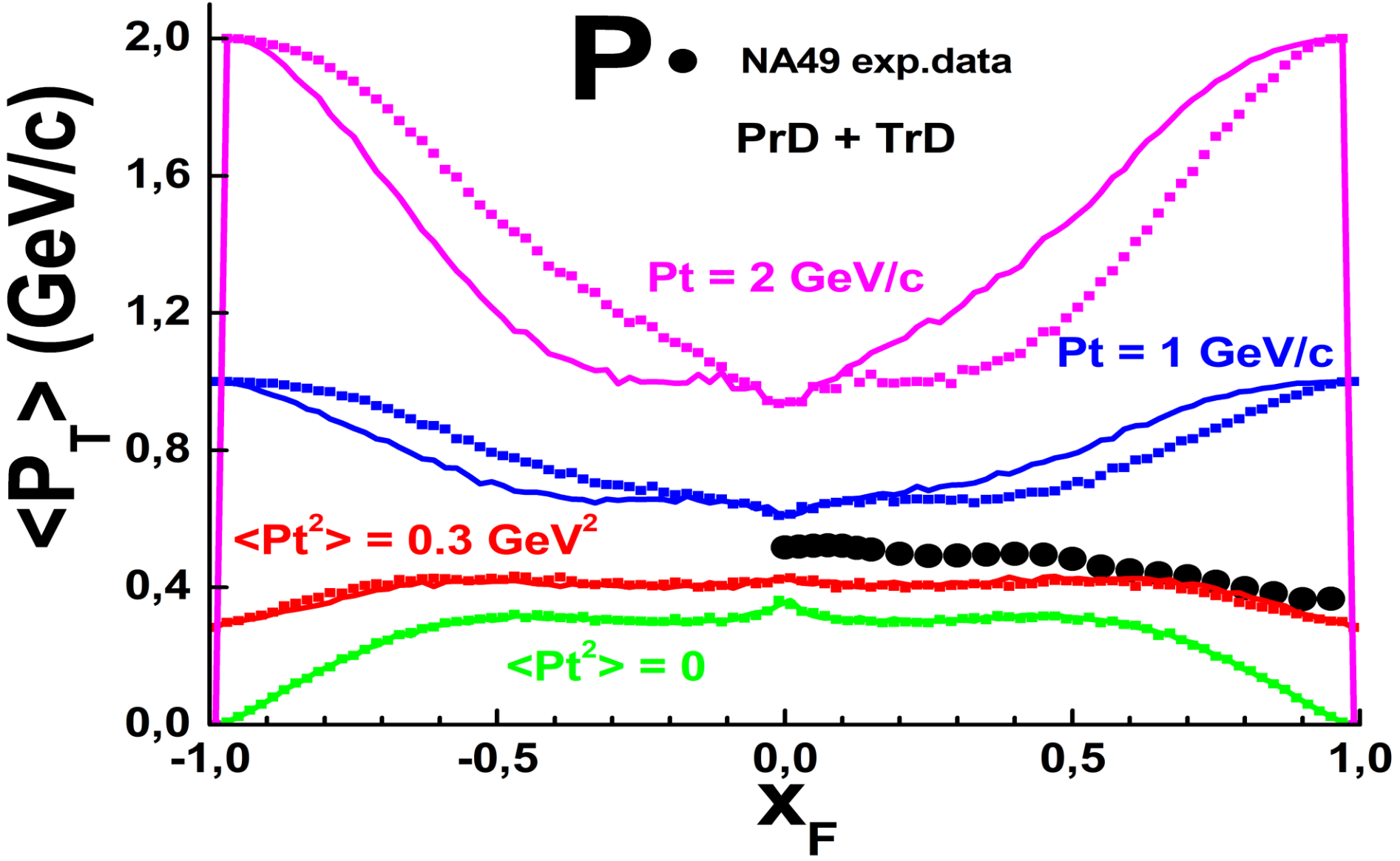
Projectile and target diffractions



Projectile and target diffractions
Extremal condition







The asymmetry is increased with Pt!

LUND string fragmentation
A String direction is not used!?

A string direction: +1 or -1

+1 projectile like string, q—qq, - 1 target like string, qq – q

Now there is:

G4bool G4LundStringFragmentation::Loop_toFragmentString

```
G4int sign = 1;
if( theString.GetDirection() < 0 ) sign = -1;
for(unsigned int hadronI=0; hadronI < LeftVector->size(); hadronI++) {
  G4LorentzVector Tmp = LeftVector->operator[](hadronI)->Get4Momentum();
  Tmp.setZ(sign*Tmp.getZ());
  Tmp *=toObserverFrameI;
  LeftVector->operator[](hadronI)->Set4Momentum(Tmp);
}
for(unsigned int hadronI=0; hadronI < RightVector->size(); hadronI++) {
  G4LorentzVector Tmp = RightVector->operator[](hadronI)->Get4Momentum();
  Tmp.setZ(sign*Tmp.getZ());
  Tmp *=toObserverFrameI;
  RightVector->operator[](hadronI)->Set4Momentum(Tmp);
}
```

It helped, but not too much!

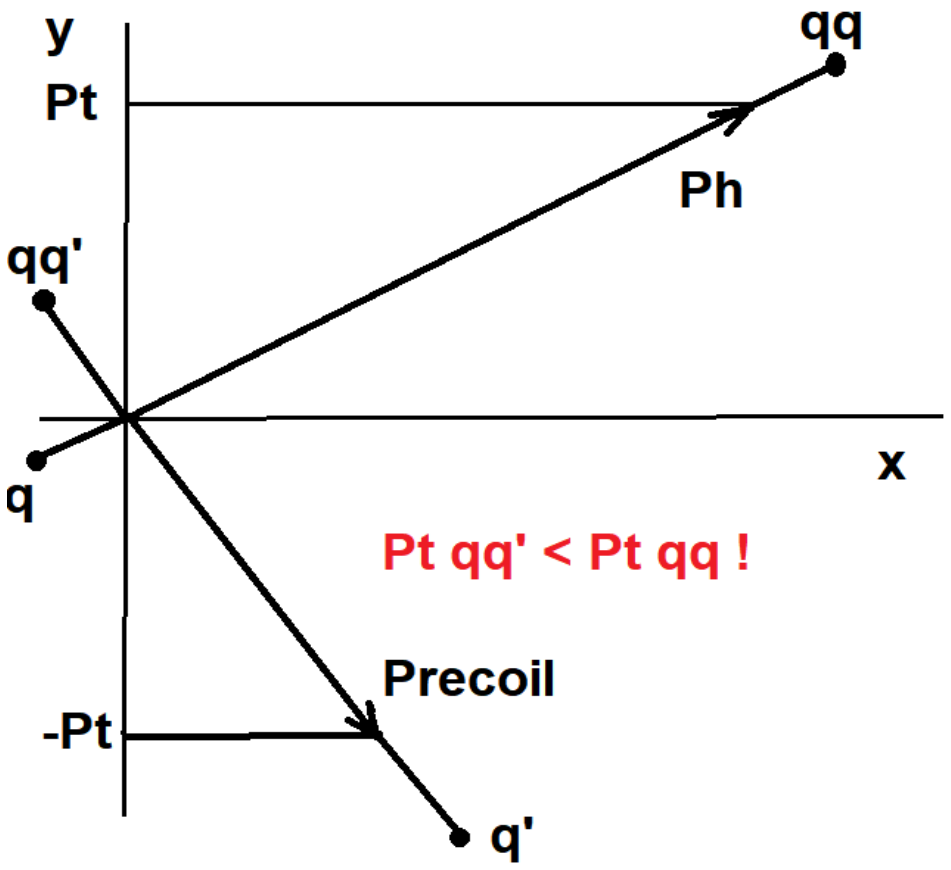
FTF model : Create strings

FTF

1. Choose a process
2. Calculate string masses V
3. Calculate Pt V
4. Create strings ?

The question is:
How to subdivide a hadron into quark and di-quark?

Algorithm implemented in Geant4

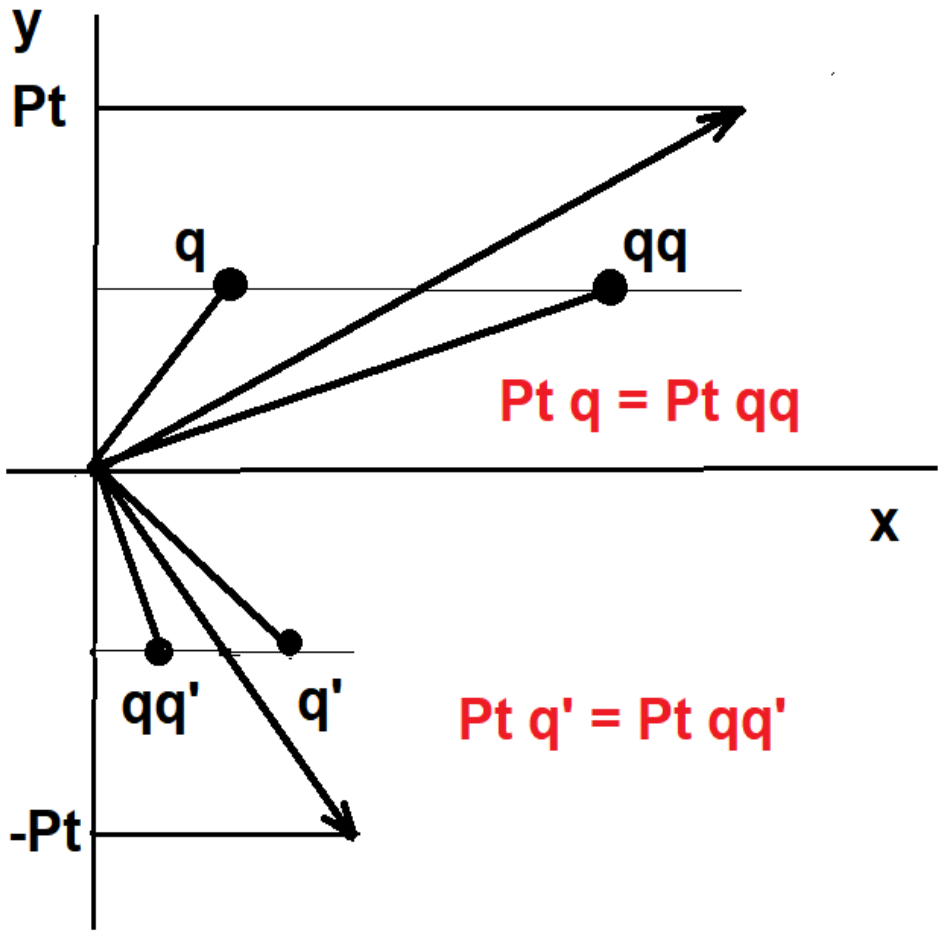


Massless q and qq!
Collinear Pq, Pqq and Ph

$$E_h = P_{qq} + |P_q|$$
$$P_h = P_{qq} - |P_q|$$

$$P_{qq} = (E_h + P_h)/2$$
$$P_q = (E_h - P_h)/2$$

Algorithm now implemented in Geant4 (invented by me)

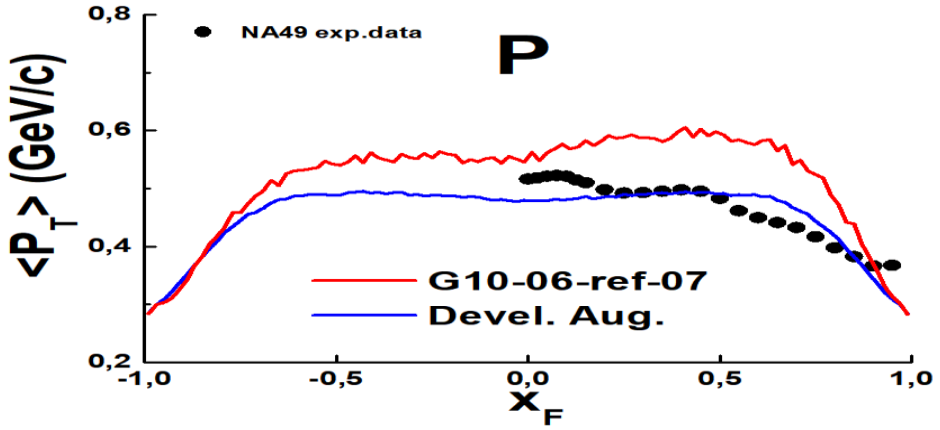


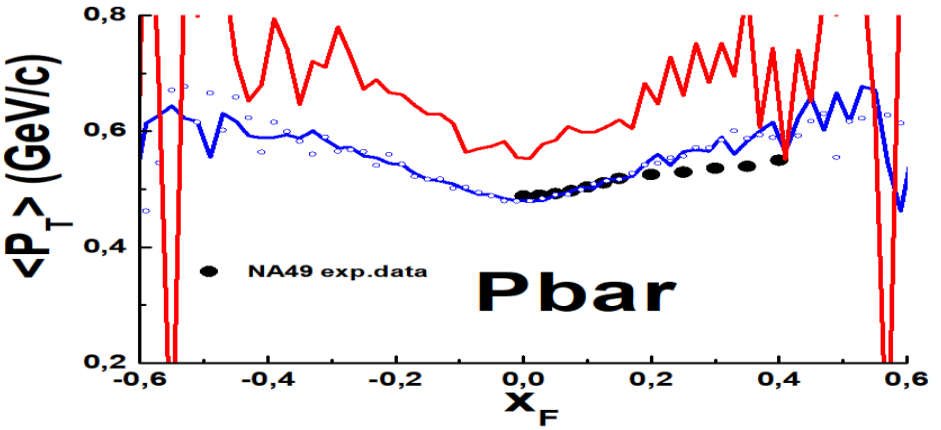
Massless q and qq!

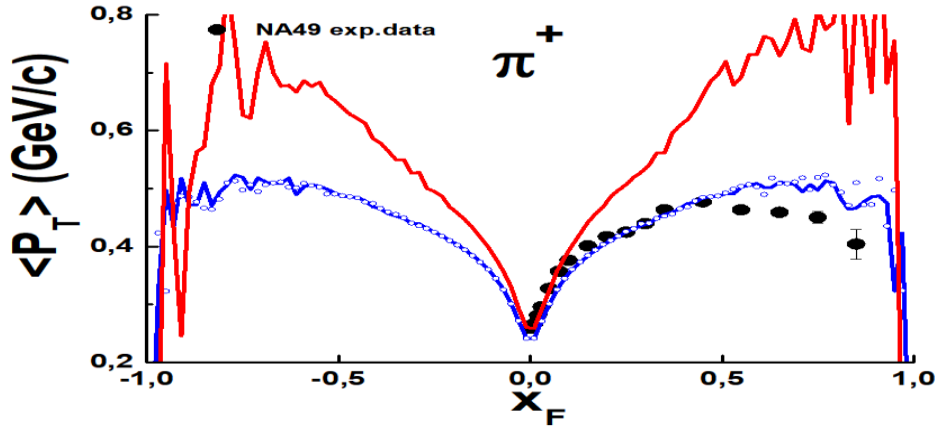
$$\vec{P}_h = \vec{P}_q + \vec{P}_{qq}$$
$$\vec{P}_q = \vec{P}_{qq} = \vec{P}_h/2$$

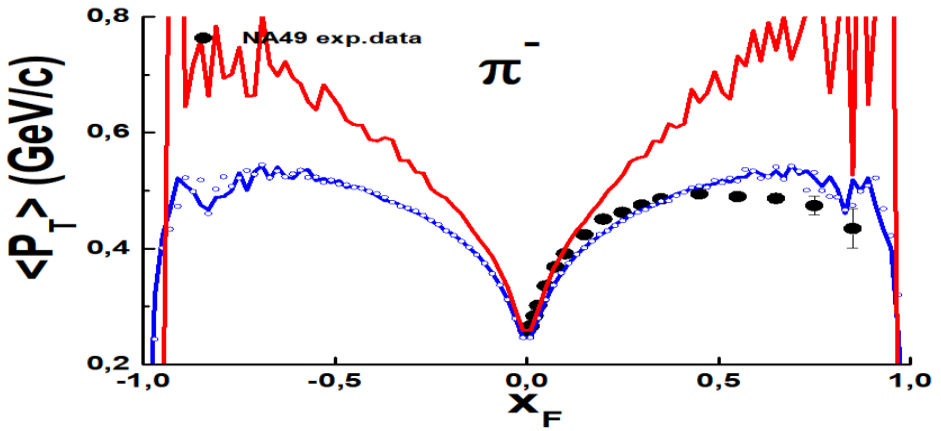
$$P_{z,q/qq} = P_{z,h}/2 \pm \pm \frac{1}{2}\sqrt{P_{z,h}^2 + \left[m_{T,h}^4 - 4\,E_h^2\,(P_{T,h}/2)^2\right]/m_{T,h}^2}$$

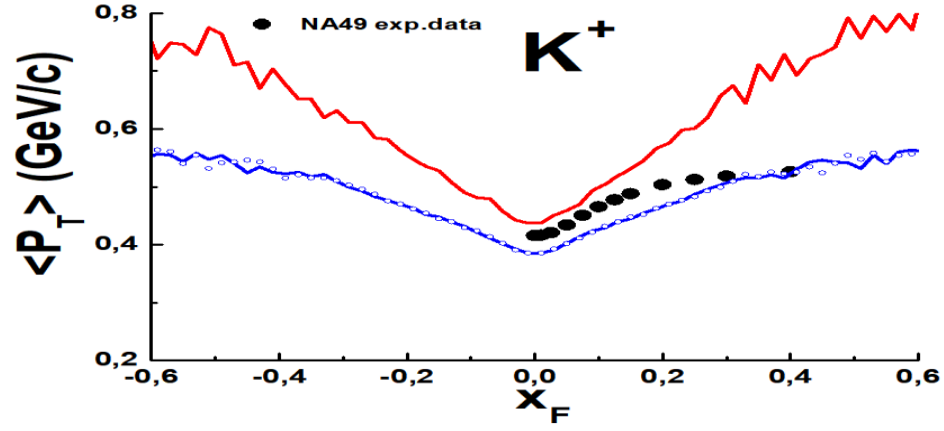
Final Pt – Xf correlations

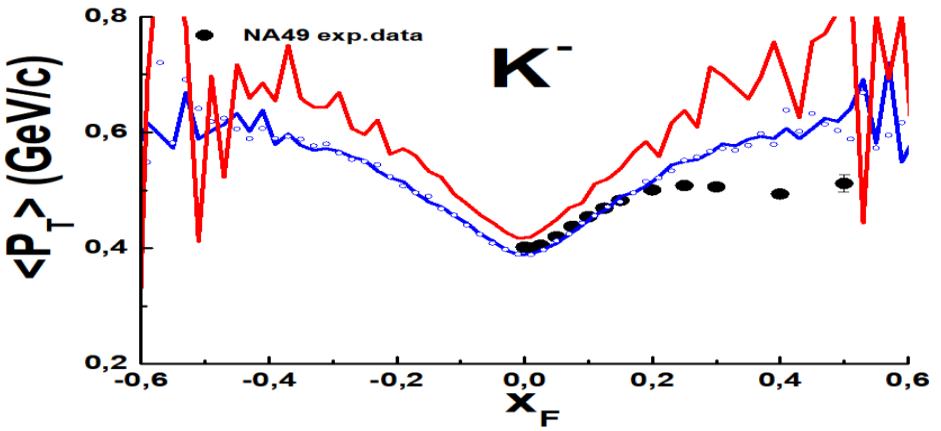








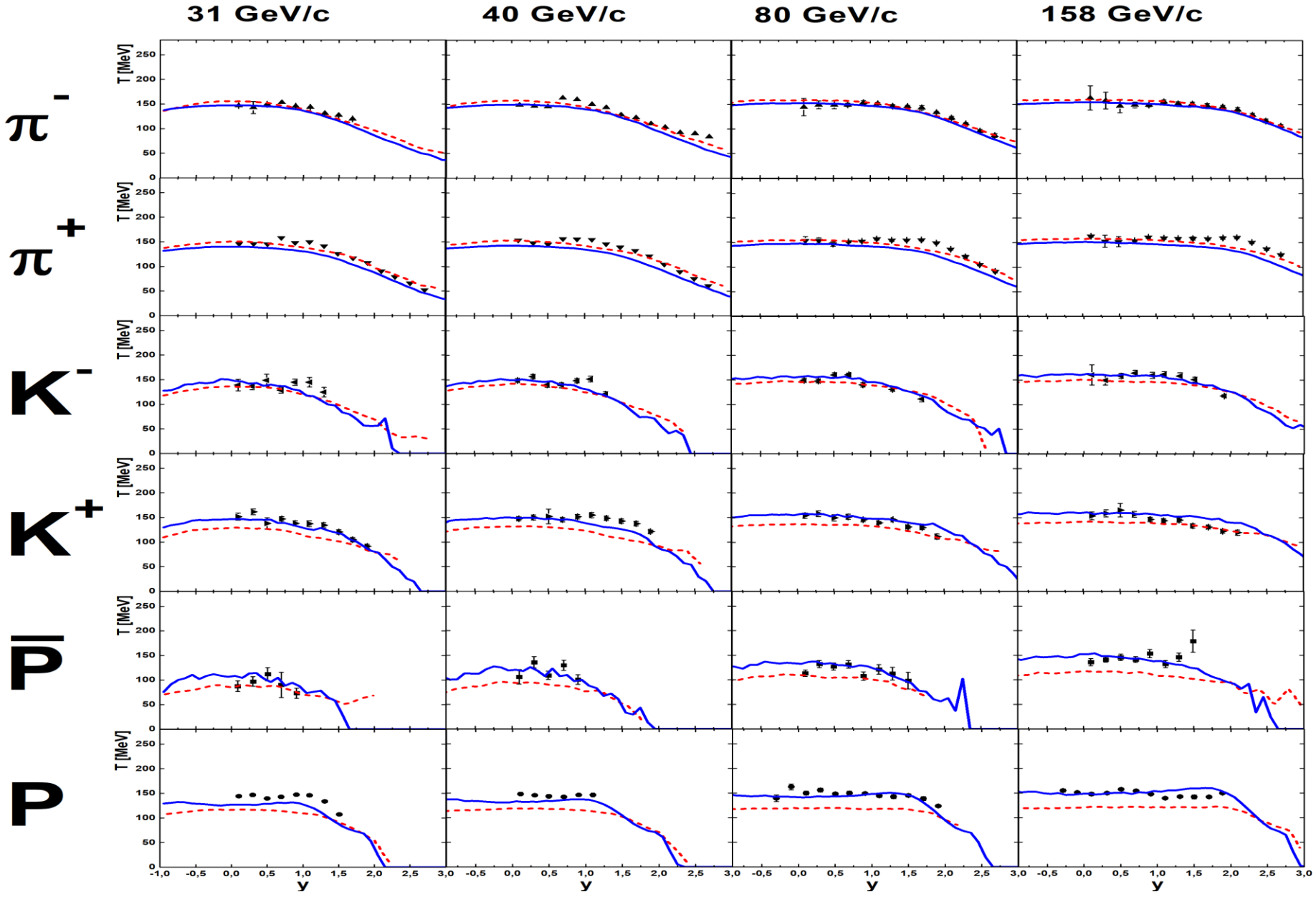




Check of FTF using NA61/SHINE pp data on “Temperature”

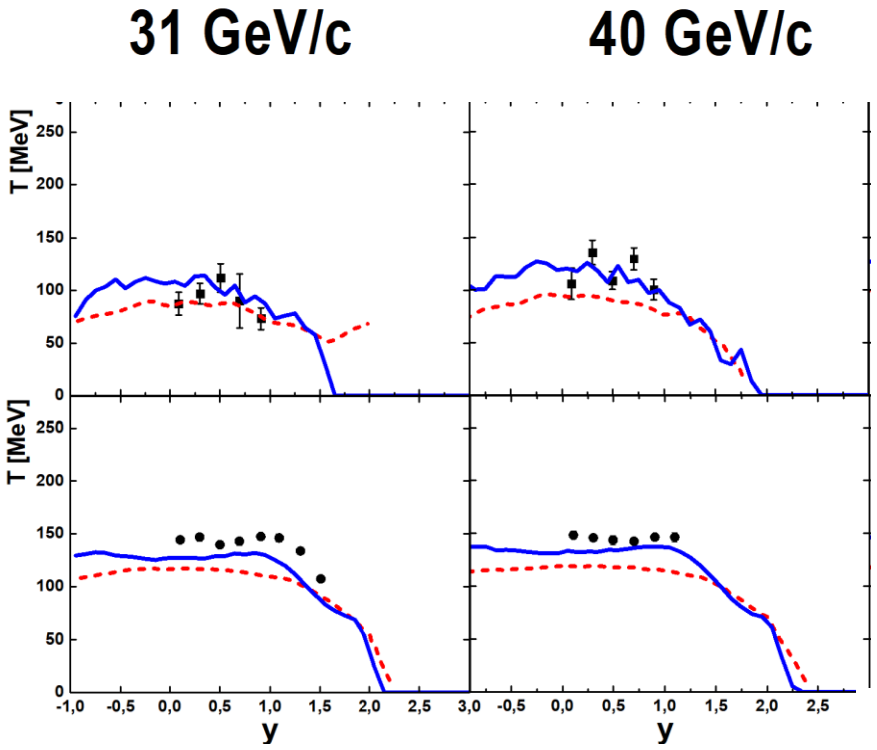
Eur. Phys. J. C (2017) 77

$$\frac{d^2n}{dp_T dy} = \frac{S\,c^2 p_T}{T^2 + m\,T} \exp(-(m_T - m)/T)$$



Blue lines – FTF, Red dashed lines Epos

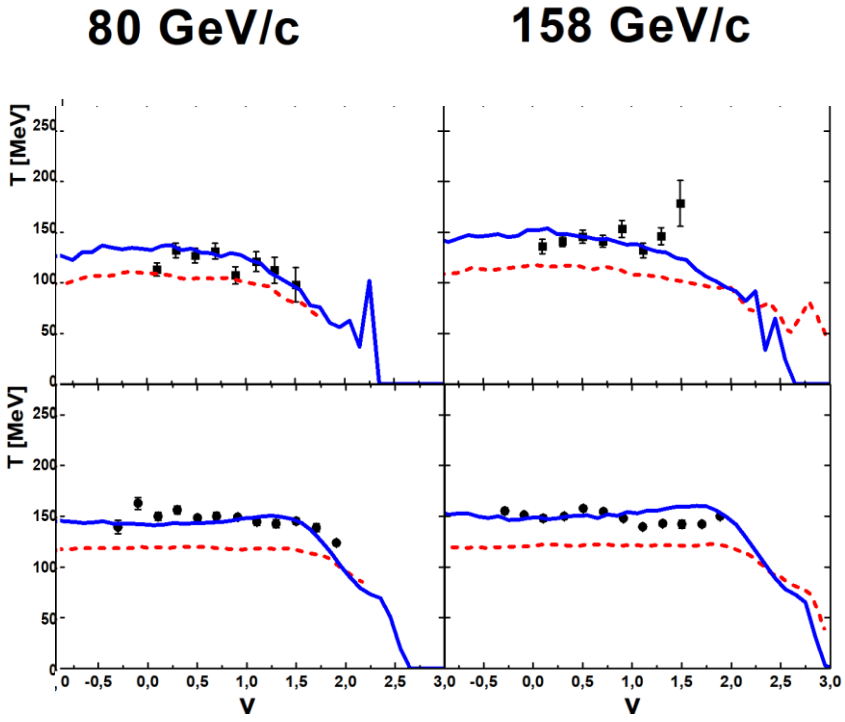
Check of FTF using NA61/SHINE pp data on “Temperature”



$\bar{p}$

p

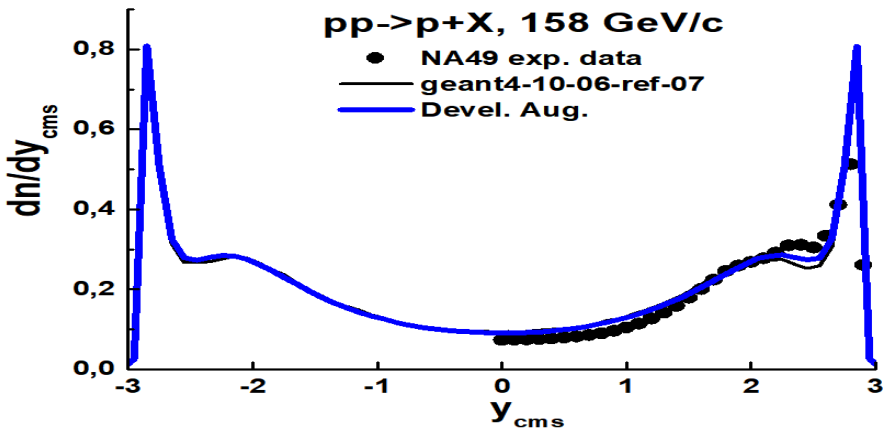
Blue lines – FTF,
Red dashed lines Epos

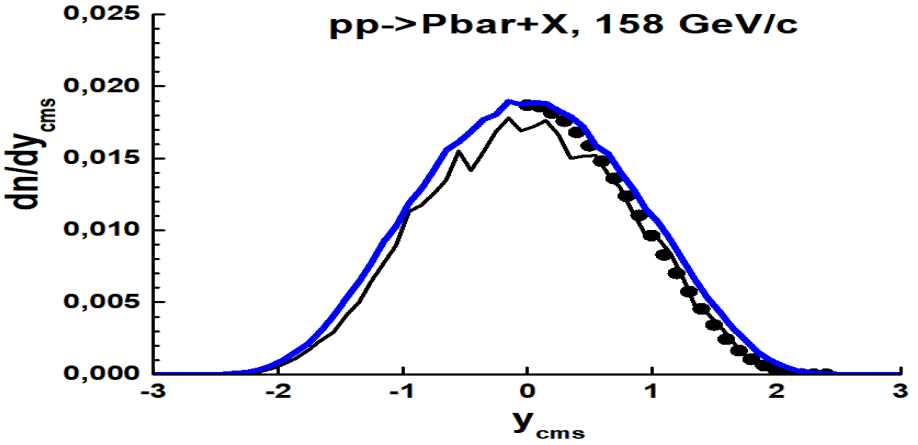


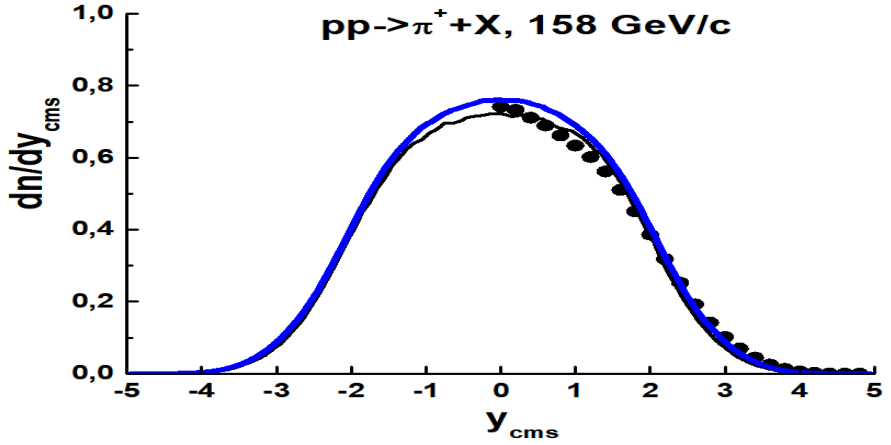
$\bar{p}$

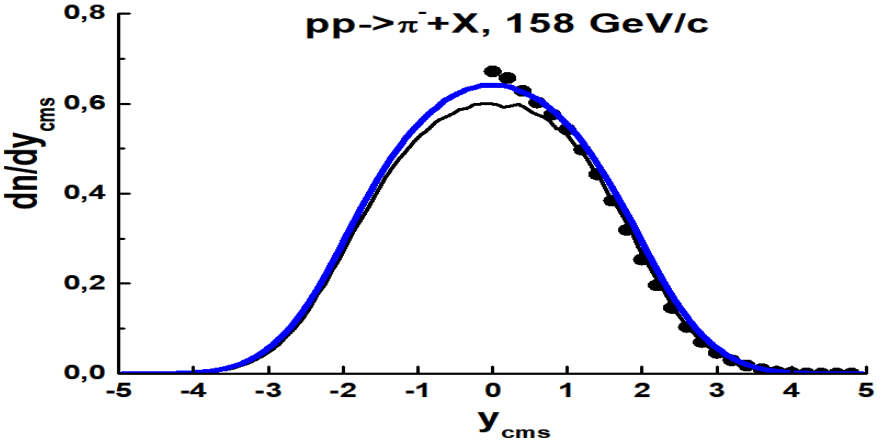
p

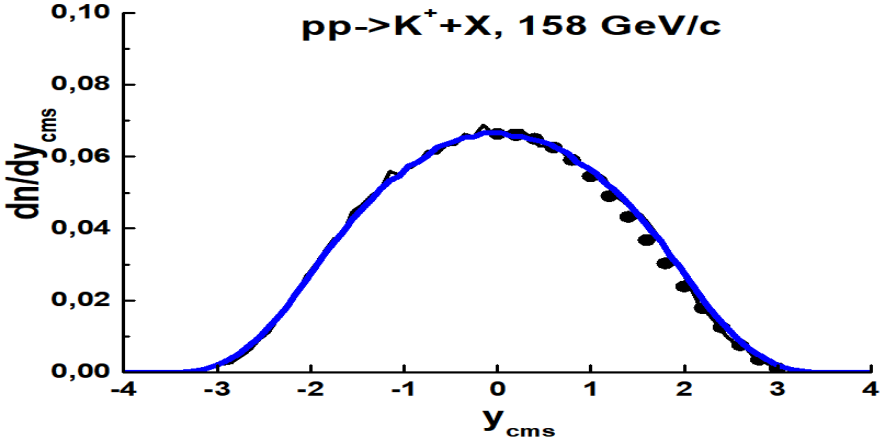
Check of FTF using NA49 data on rapidity distr.

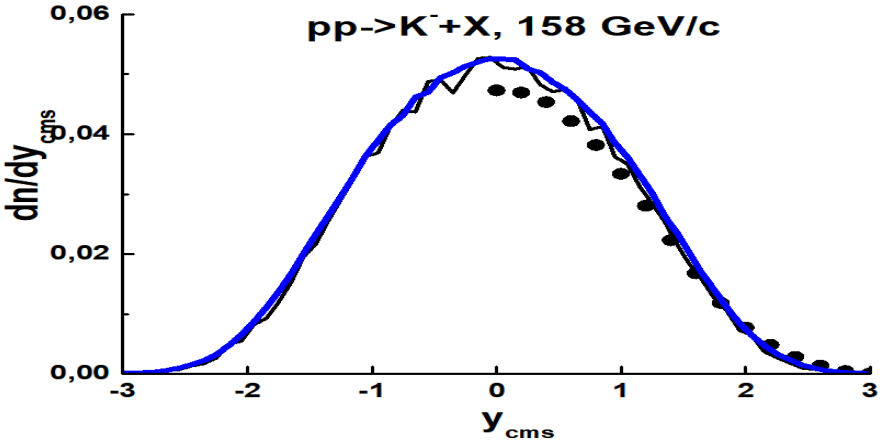












Summary

1. New hadron splitting algorithm is implemented in the core of FTF model.

2. Problem of asymmetry of Pt – Xf correlations is solved.

3. Good description of NA49 and NA61/SHINE exp. data on pp interactions is reached.

Future task:

Validate FTF for h+A interactions.
Extend the approach on QGS model!
Validate FTF for heavy meson production.