p→Be (400GeV/c)

G4 v7.0 exercise
Physical case: see M. Bonesini et al.
hep-ph/0101163 published in EPJC

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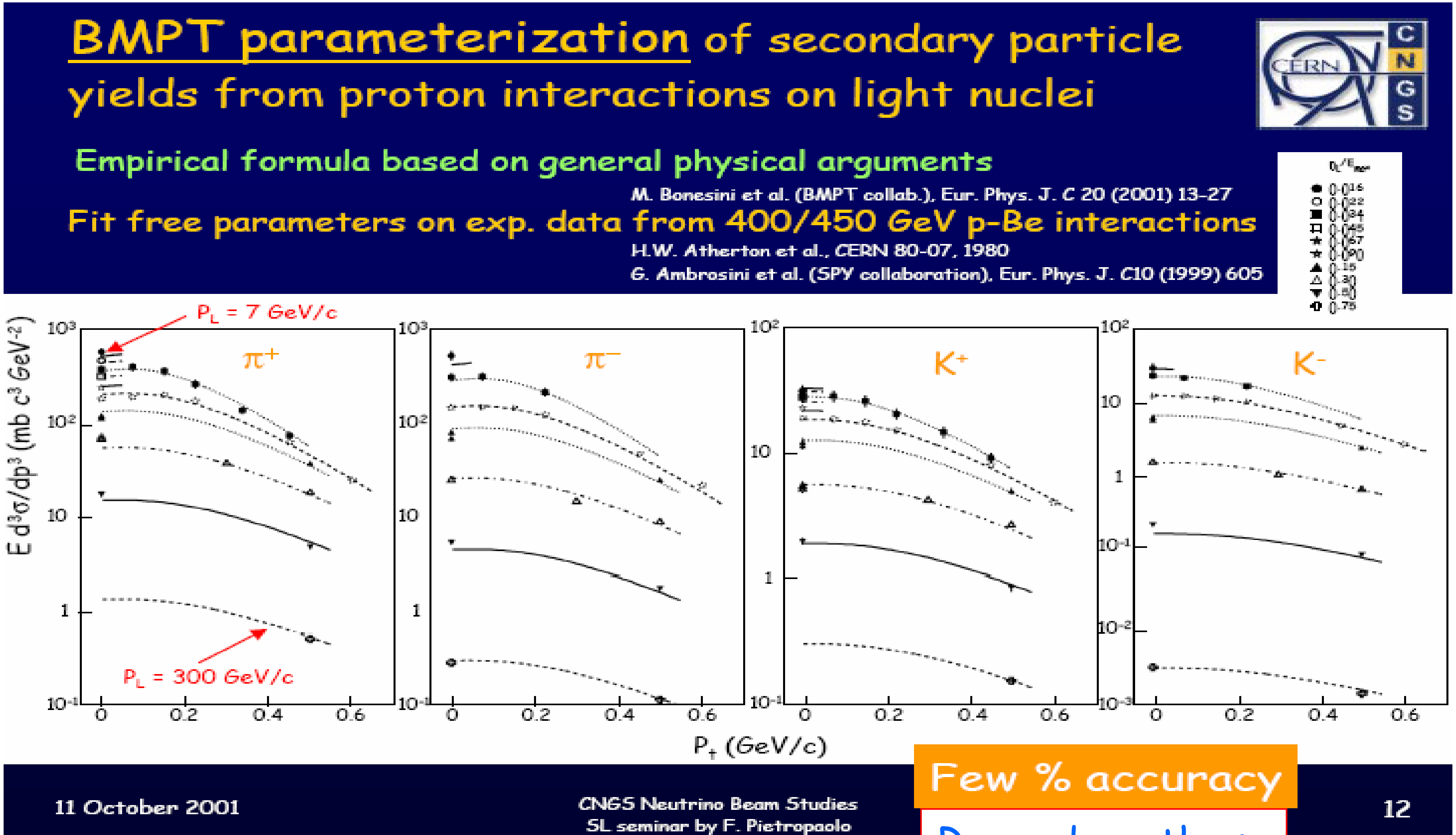
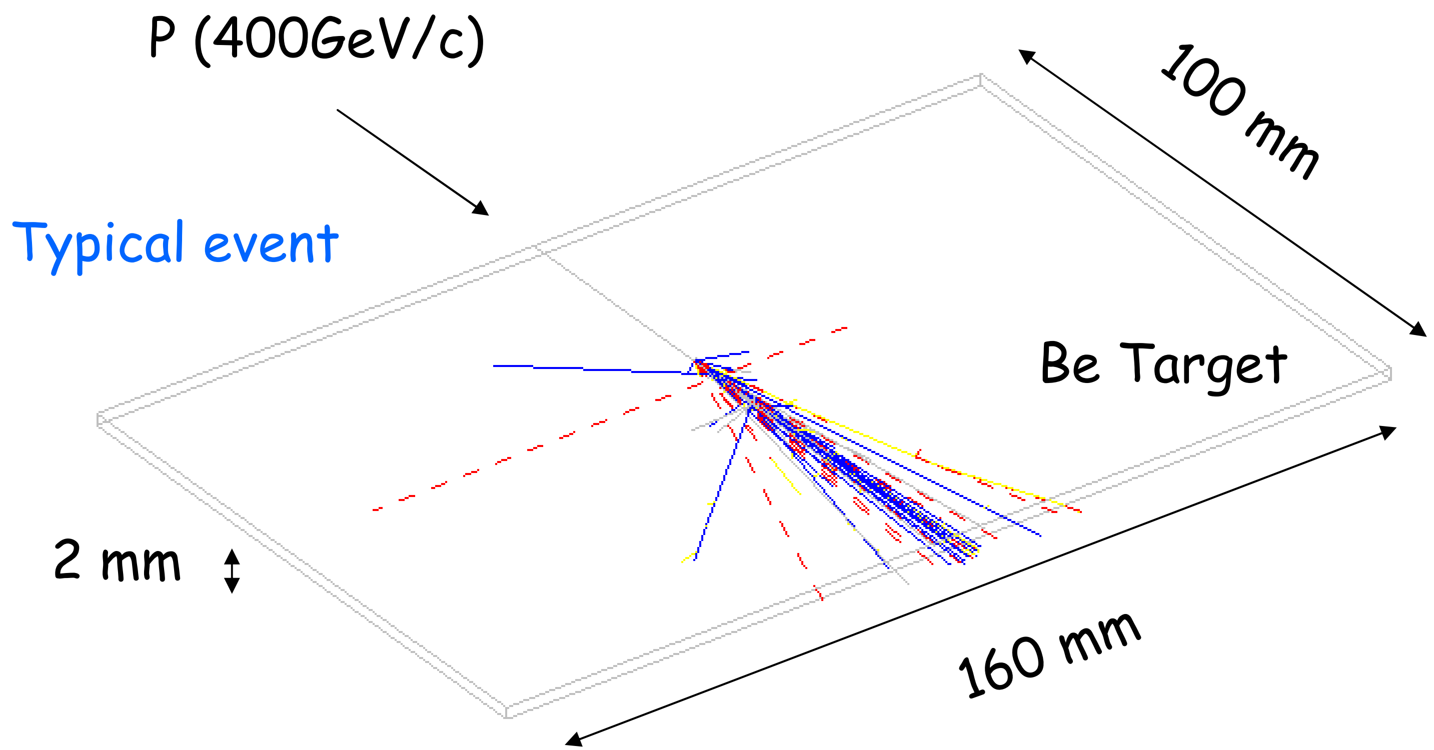
The goal: from F. Pietropaolo SL seminar



Reproduce these distributions

The target & beam

OpenScientist viz.



QGSP physics list (cf. Hans-Peter Wellisch)
http://www.geant4.com/hadronics/GHAD/HomePage/

Analysis (simple)

Run $N_{pot}=10^6$ protons mono-energetic and pencil-like beam on target

Register $\pi^{\pm}, K^{\pm}$ particles that exit the target

Compute the production cross-section:

Assume symmetry around the beam axis

Number of particles at i^{th} p_T bin and j^{th} p_L bin

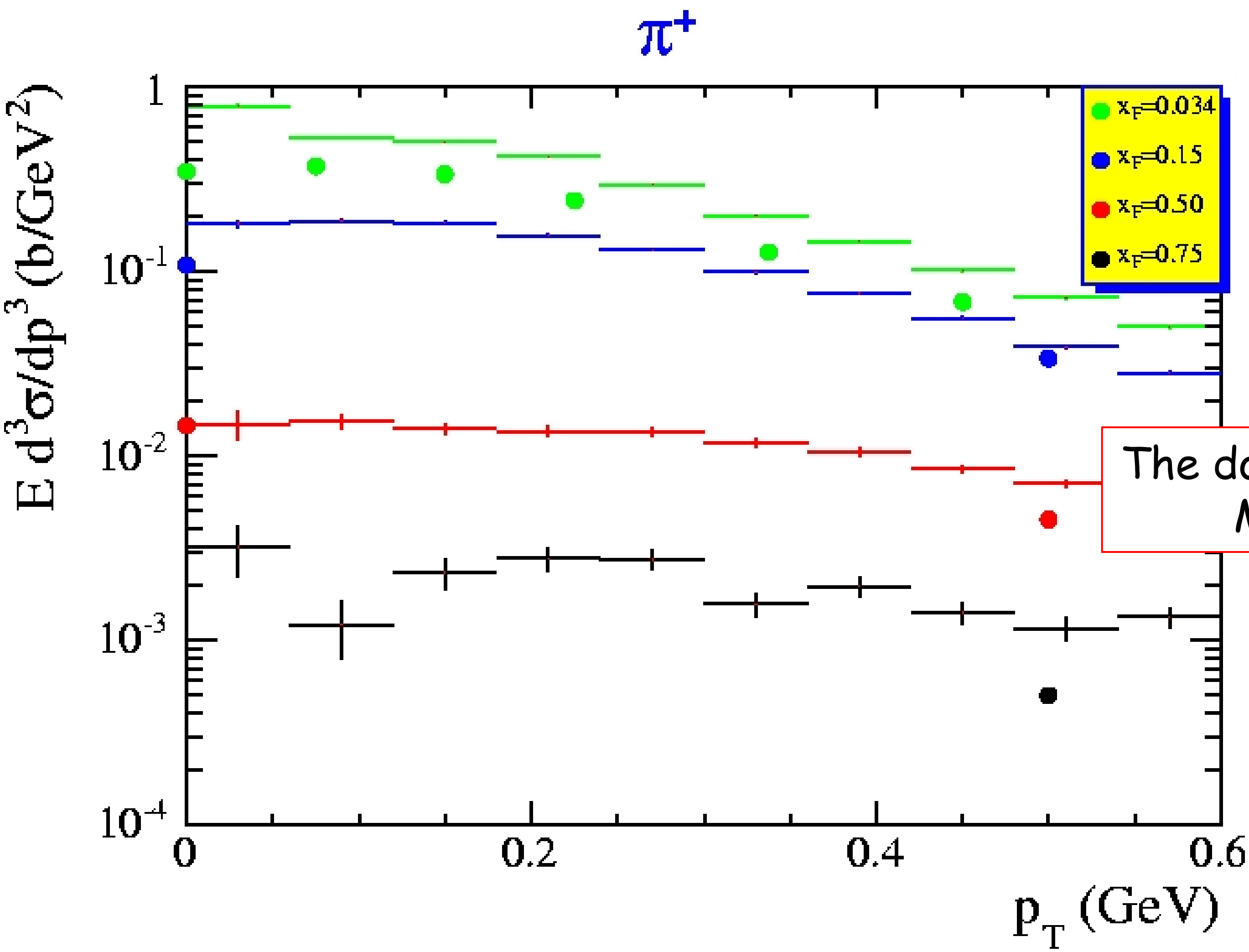
$$E\frac{d^3\sigma}{dp^3} = \frac{1}{2\pi}\frac{E}{p_T}\frac{A}{N_{pot}\,\rho N_A L_{equ}}\frac{n_{ij}}{(\Delta p_{T_i})(\Delta p_{L_j})}$$

Bin widths

For Beryllium: A = 9g/mol, $\rho = 1.85$ g/cm^3, N_A = 6 10^{23}/mol

$L_{equ} = \lambda_p f(L=100mm)$ = 82mm with f(L) Eq.7 Ambrosini et al. CERN-EP/99-19

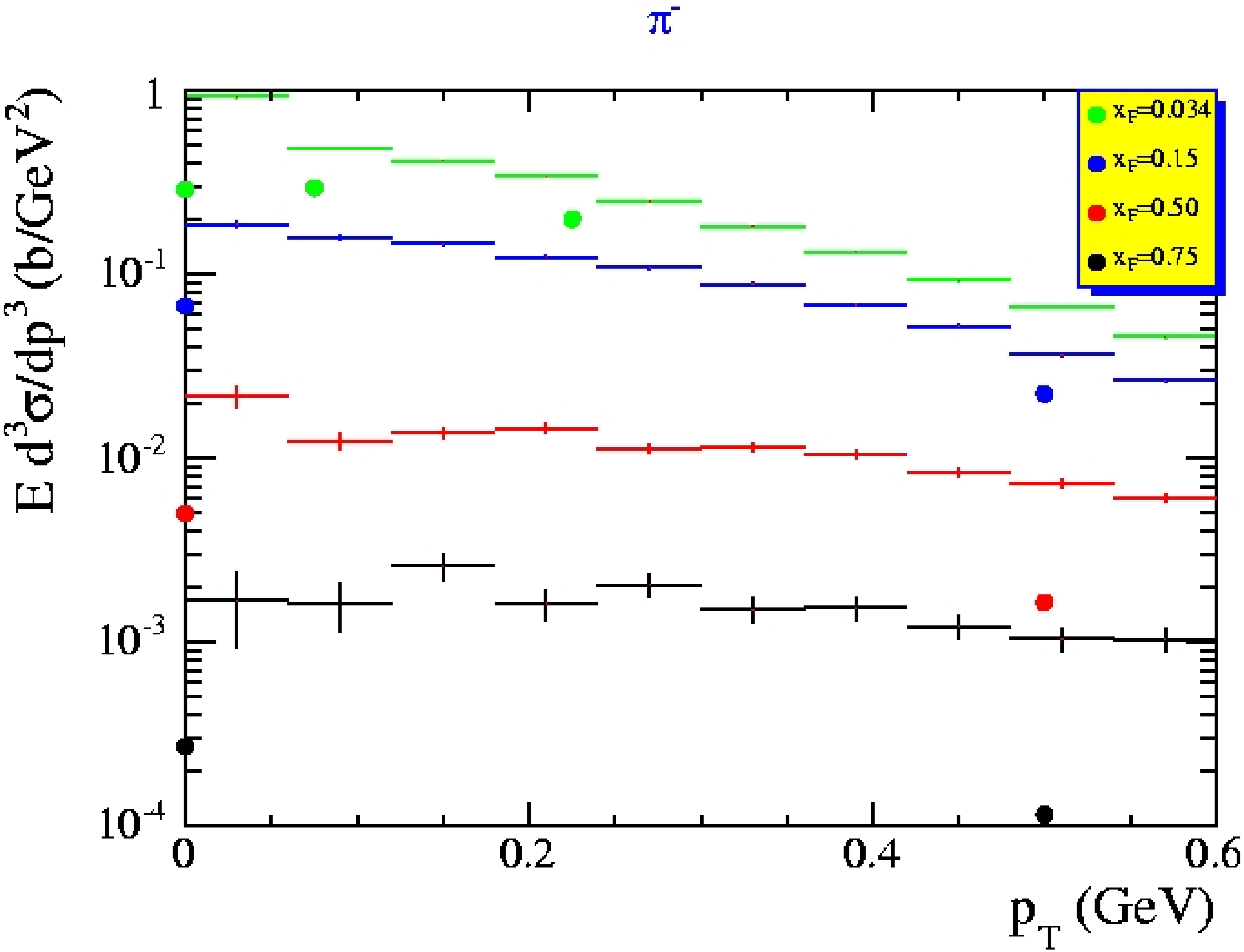
Results (1/4)



$x_F = p_L/p_{Beam}$

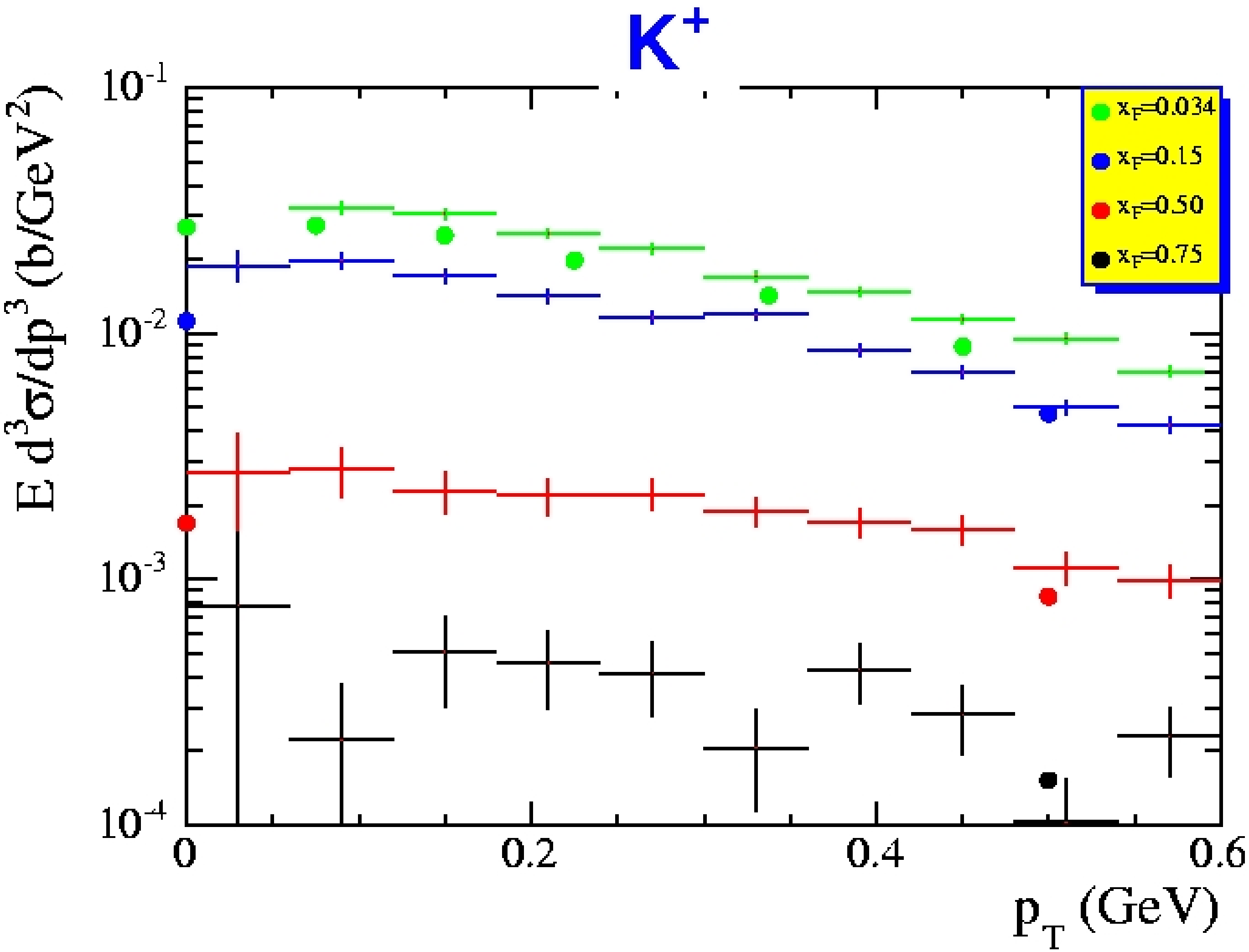
The dots are from Tab. 1 of M. Bonesini et al.

Results (2/4)



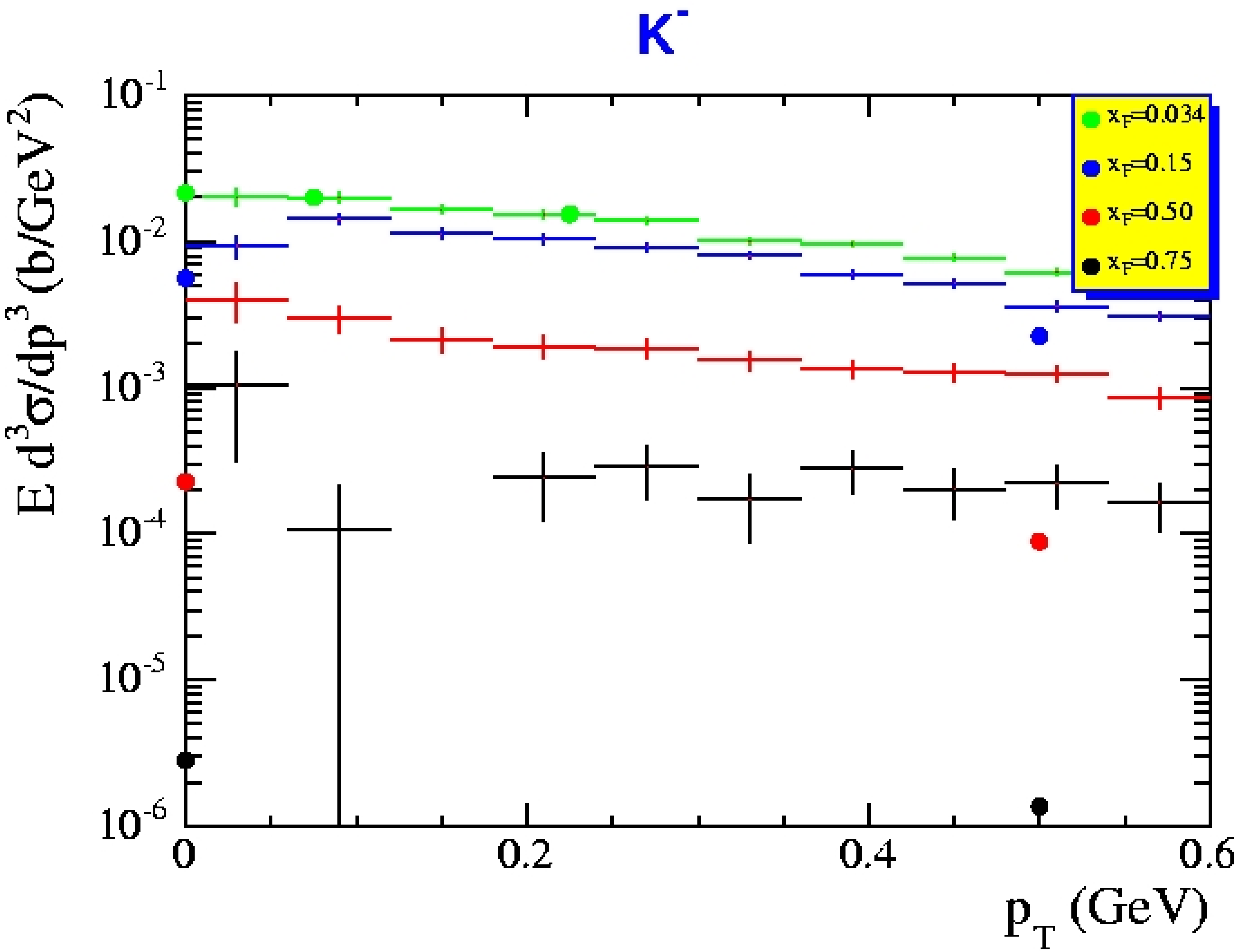
π^-
$E\, d^3\sigma/dp^3$ (b/GeV^2)
p_T (GeV)
x_F=0.034
x_F=0.15
x_F=0.50
x_F=0.75
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
0
0.2
0.4
0.6

Results (3/4)



K+
10-1
10-2
10-3
10-4
E d3σ/dp3 (b/GeV2)
0
0.2
0.4
0.6
pT (GeV)
xF=0.034
xF=0.15
xF=0.50
xF=0.75

Results (4/4)


K-
10-1
10-2
10-3
10-4
10-5
10-6
E d3σ/dp3 (b/GeV2)
0
0.2
0.4
0.6
pT (GeV)
xF=0.034
xF=0.15
xF=0.50
xF=0.75

Other trials

As a blind user, I have also tried QGSP_XYZ flavours included in the physics_lists/hadronic directory: the results are the same as QGSP (except QGSP_HP which seems not to be used for this use case)

I also tried QGSC but the results are worse.