Verification of pp elastic scatterin in Geant4.

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Jan 25, 2006

1. **Approximation of differential cross sections (preliminary).**
2. **Approximation of total elastic cross-sections (preliminary).**
3. **Conclusion.**

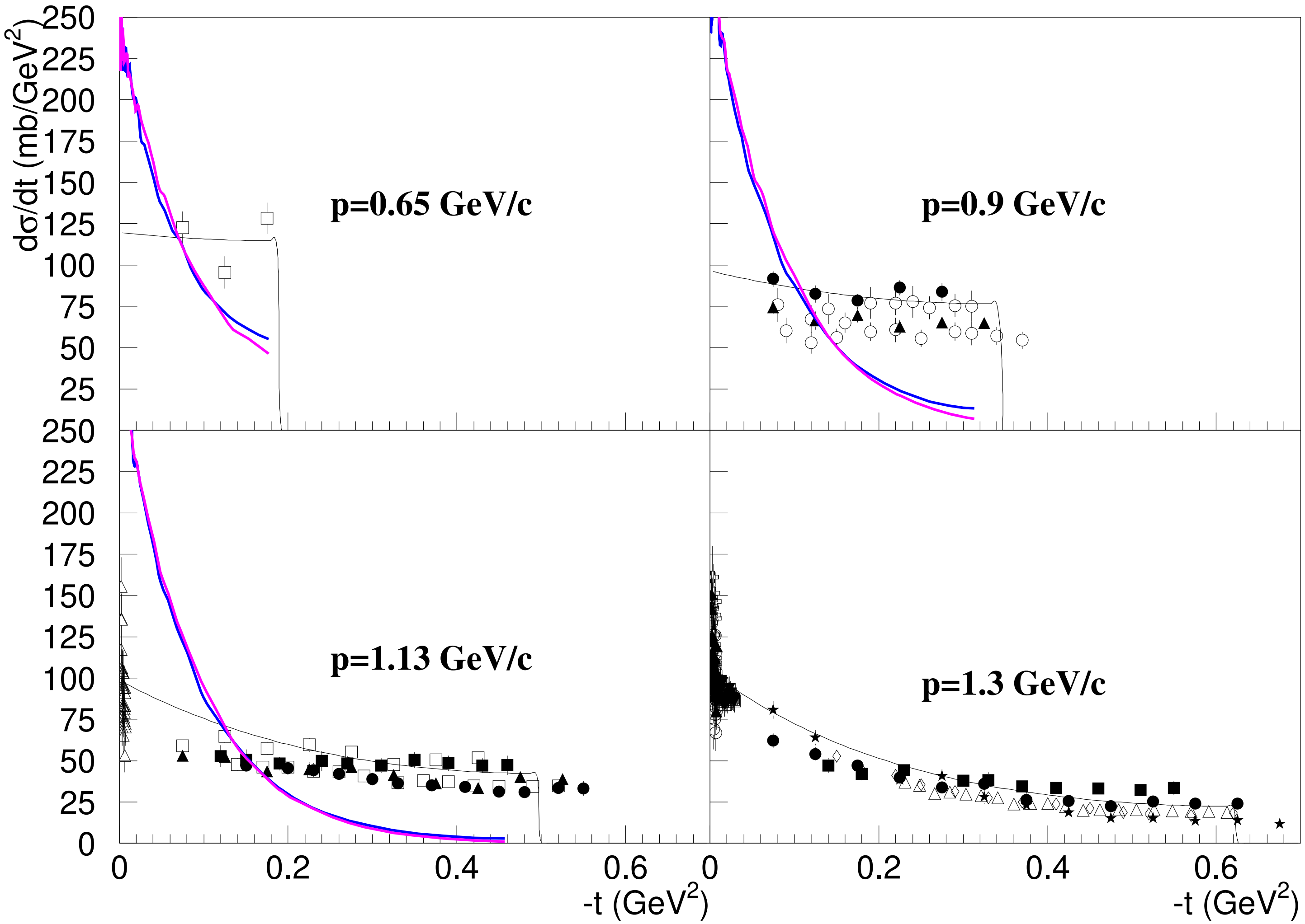
Four exponents approach in CHIPS

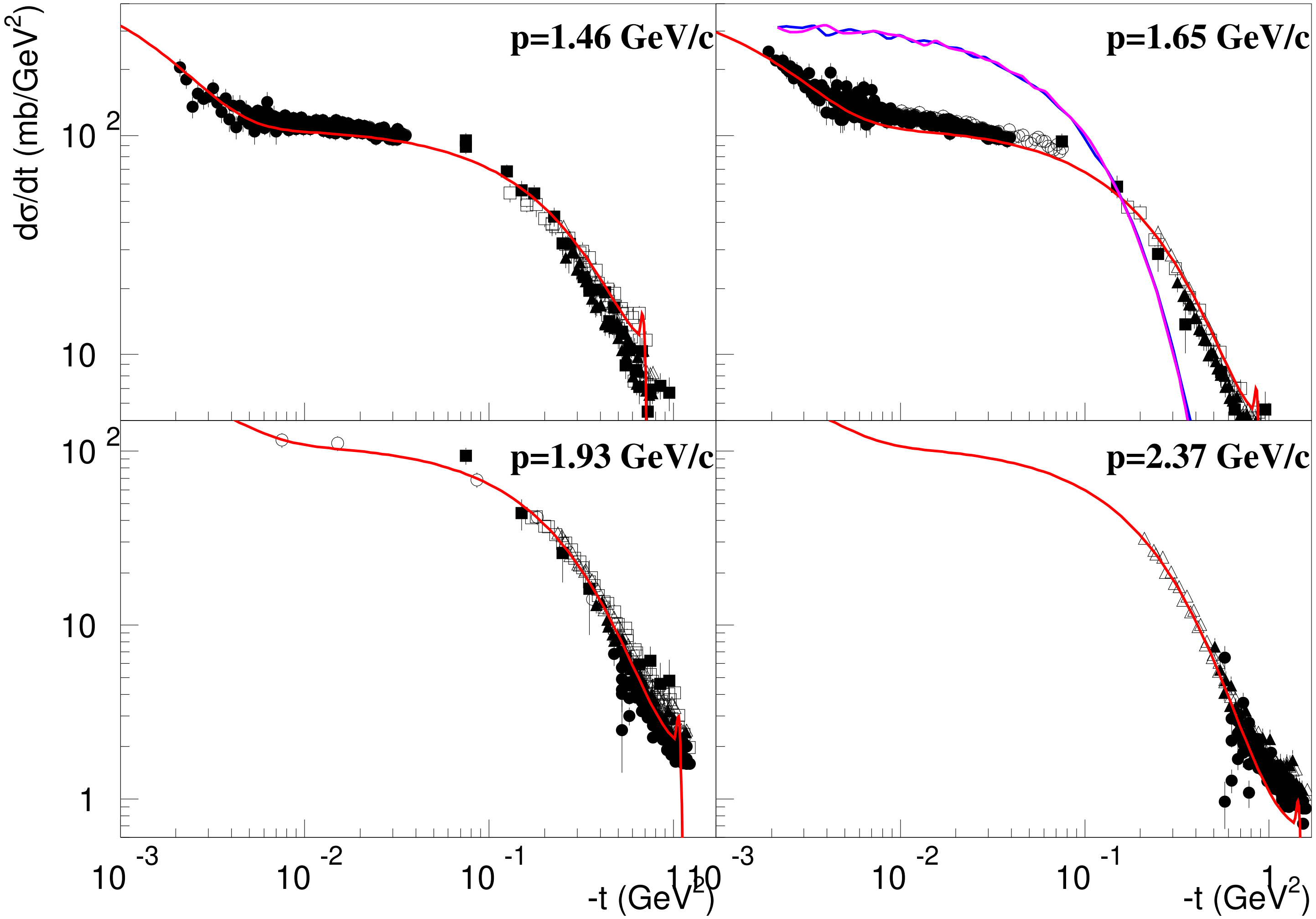
$$\frac{\mathbf{d}\sigma}{\mathbf{dt}} = \mathbf{A_1} \cdot \mathbf{e}^{\mathbf{B_1 t}} + \mathbf{A_2} \cdot \mathbf{e}^{\mathbf{B_2 t}} + \mathbf{A_3} \cdot \mathbf{e}^{\mathbf{B_3 t}} + \mathbf{A_4} \cdot \mathbf{e}^{\mathbf{B_4 t}}$$

1. Interference with electromagnetic scattering.
2. Diffraction on the nucleon.
3. Quark-diquark interaction.
4. Interaction of gluons.

Usually the interference term is not included in the elastic cross section.

The red line approximation is CHIPS, pink is G4LElastic, blue is G4LElasticB (conserves energy). The last two are practically coinciding.


p=0.65 GeV/c
p=0.9 GeV/c
p=1.13 GeV/c
p=1.3 GeV/c
dσ/dt (mb/GeV²)
-t (GeV²)
-t (GeV²)


p=1.46 GeV/c
p=1.65 GeV/c
p=1.93 GeV/c
p=2.37 GeV/c
dσ/dt (mb/GeV^2)
-t (GeV^2)
-t (GeV^2)
10^2
10
1
10^{-3}
10^{-2}
10^{-1}
1

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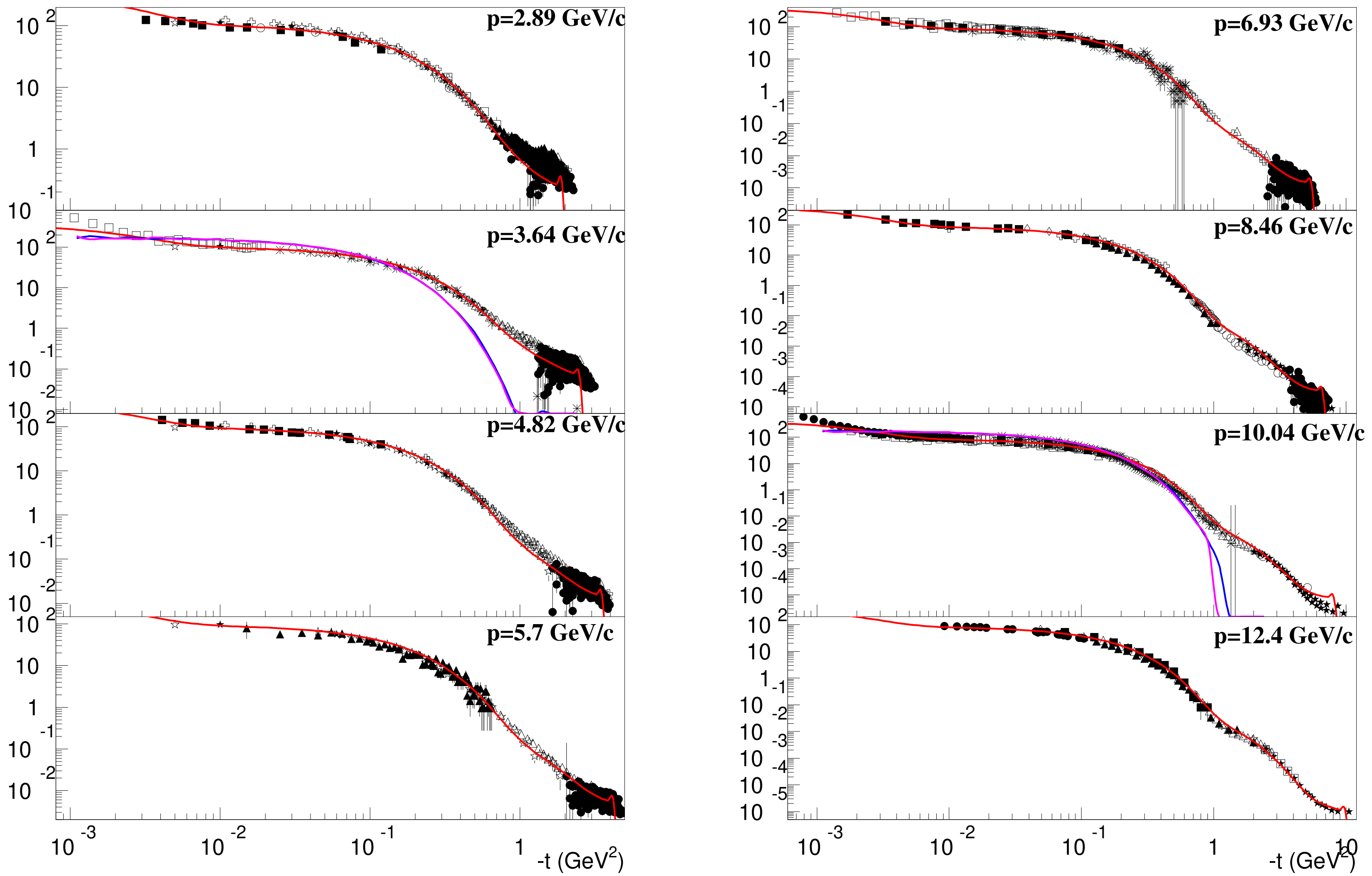

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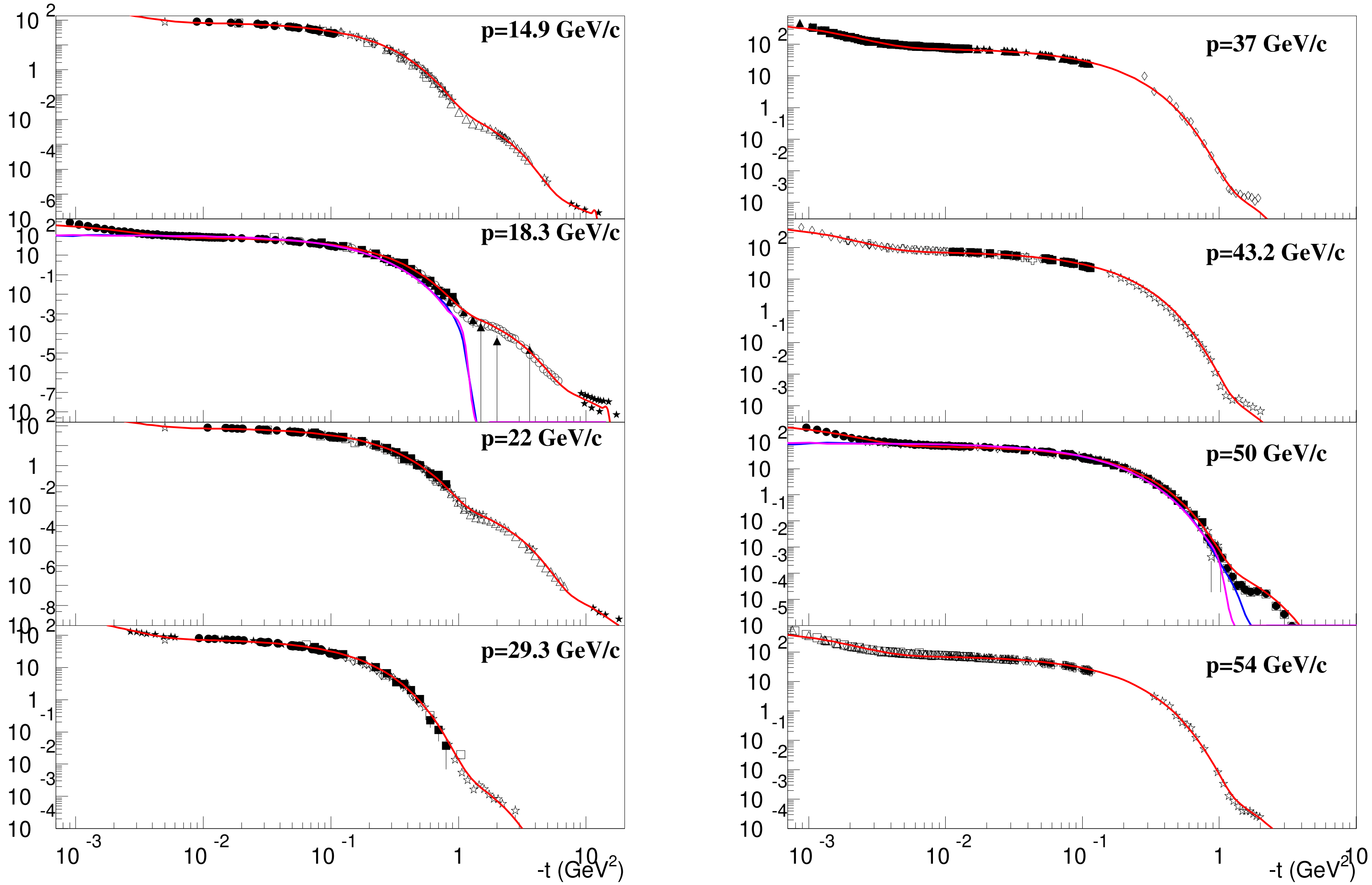

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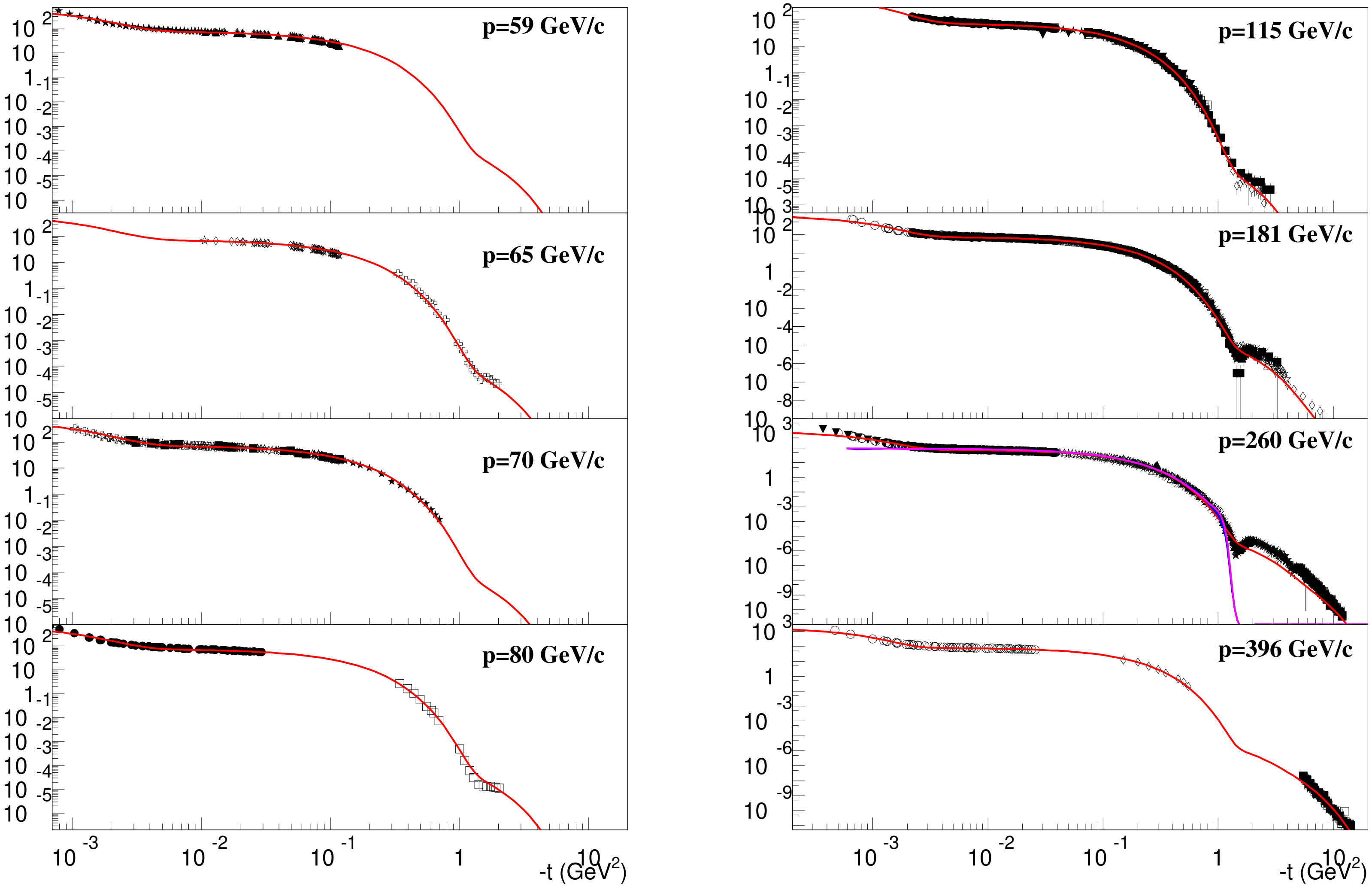
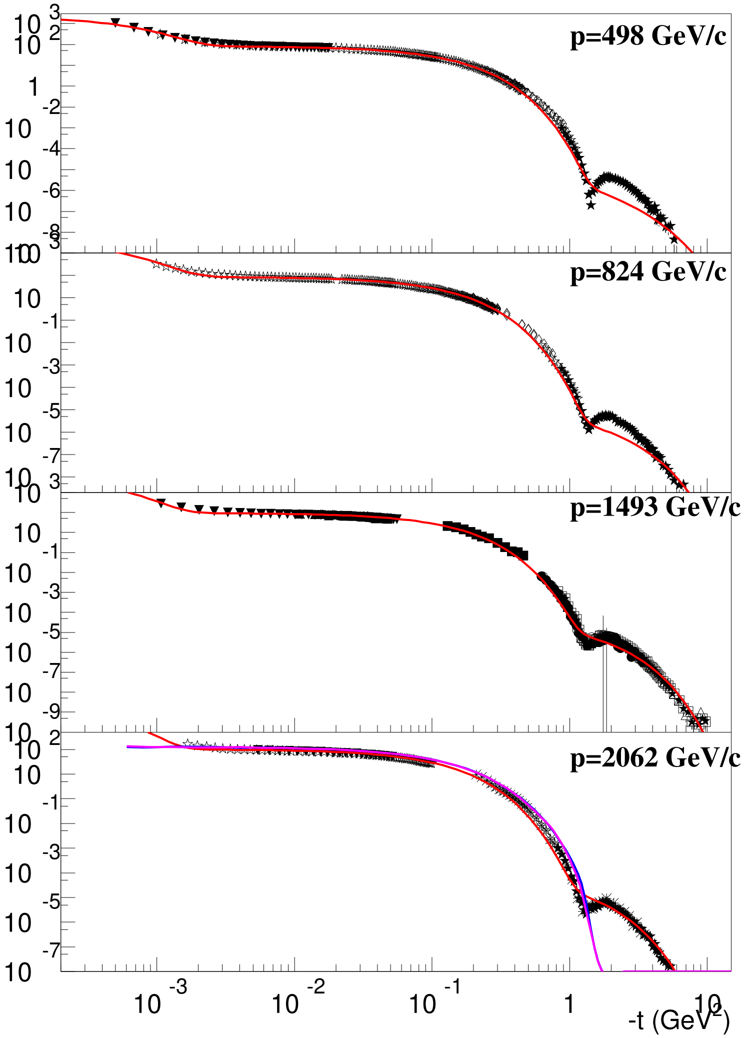
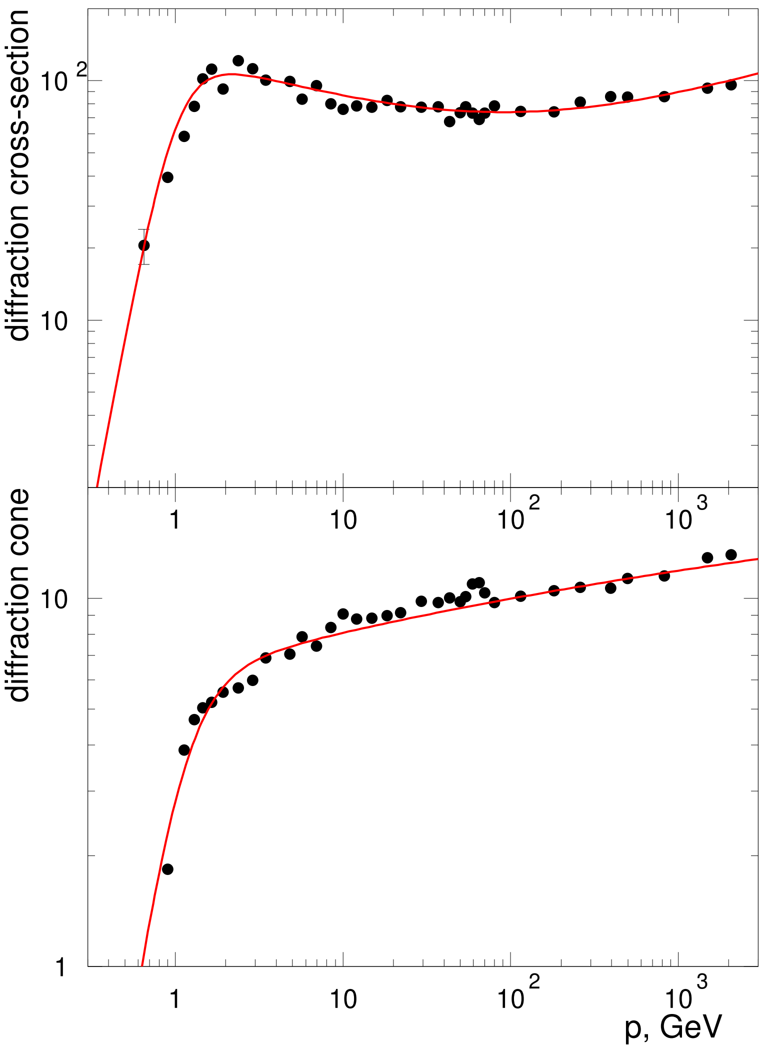
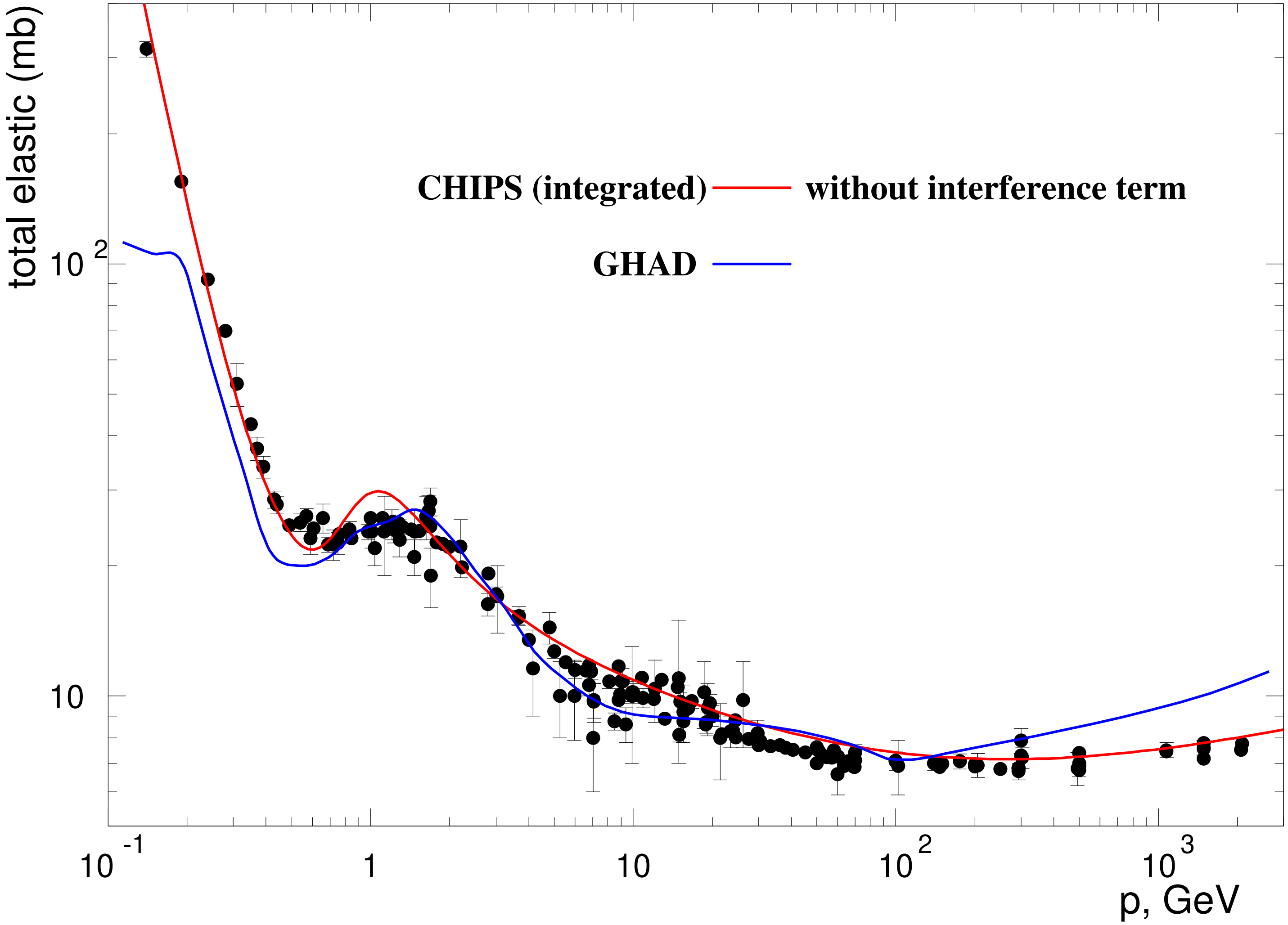



p=498 GeV/c
p=824 GeV/c
p=1493 GeV/c
p=2062 GeV/c
-t (GeV^2)


diffraction cross-section
diffraction cone
p, GeV



CHIPS (integrated)
without interference term
GHAD
total elastic (mb)
10 2
10
10 -1
1
10
10 2
10 3
p, GeV

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Conclusion

- The CHIPS algorithm gives a detailed approximation of the existing data;
- The existing GHAD (G4LElastic) approximation is bad at low energies and at very high energies;
- Development of the elastic scattering code can be important for low energy proton therapy;