Verification and development of pA elastic scattering.

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1. **Proton-proton and proton-deuteron elastic scattering**
2. **Proton-helium and proton-beryllium elastic scattering**
3. **Conclusion.**

Approximation of pp elastic scattering

$$\frac{\mathbf{d}\sigma}{\mathbf{dt}} = \left(\mathbf{A_1} \cdot \frac{\mathbf{e}^{-\mathbf{B_1}|\mathbf{t}|^{1/2}}}{|\mathbf{t}|^{1/2}} \right) + \mathbf{A_2} \cdot \mathbf{e}^{\mathbf{B_2 t}} + \mathbf{A_3} \cdot \mathbf{e}^{\mathbf{B_3 t}} + \mathbf{A_4} \cdot \mathbf{e}^{\mathbf{B_4 t}}$$

1. Interference with electromagnetic scattering.
2. Diffraction on a nucleon.
3. Diffraction on quarks.
4. Diffraction on gluons.

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

Low energy is usually parameterized by SAID (phase analysis) model.

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

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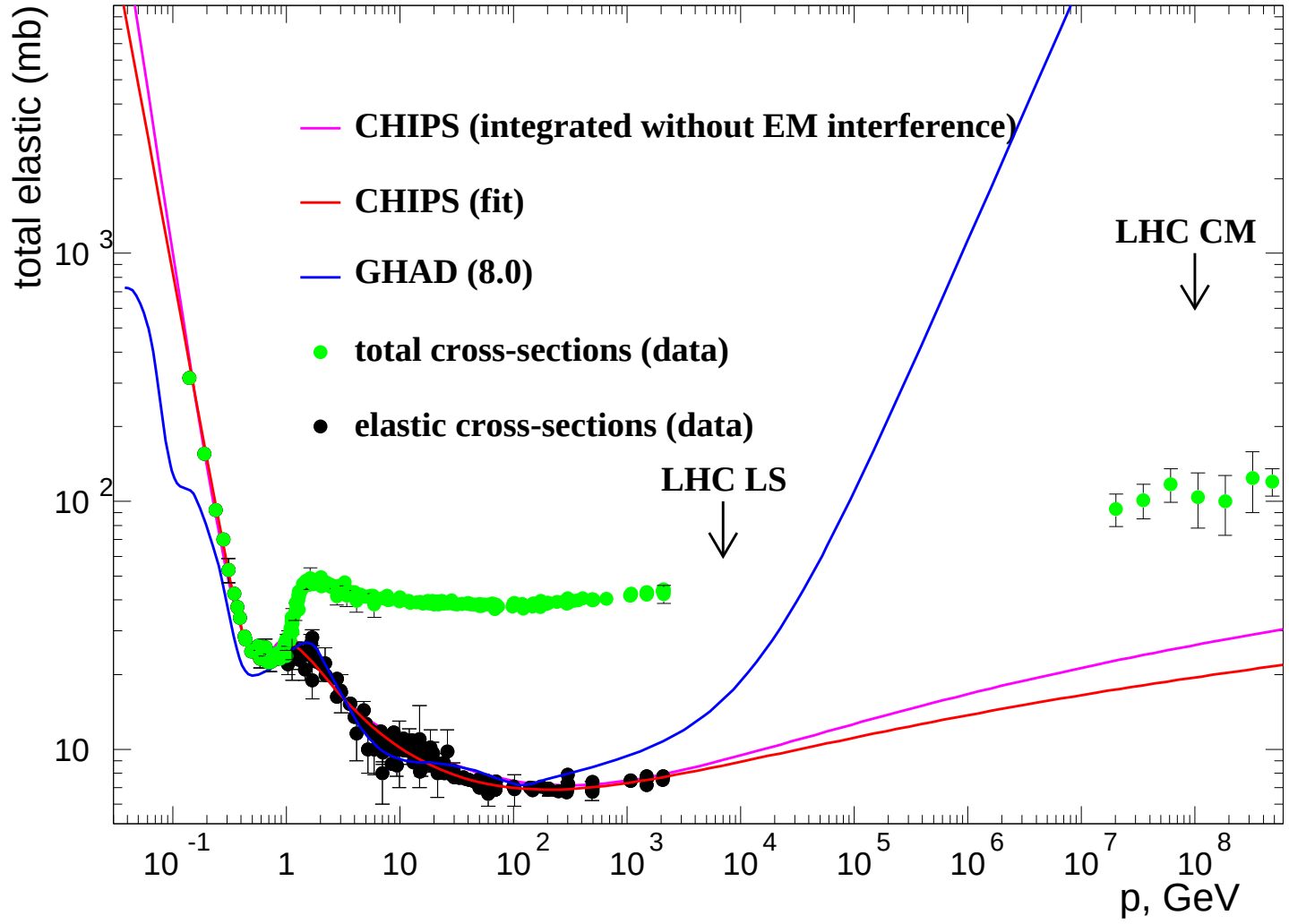

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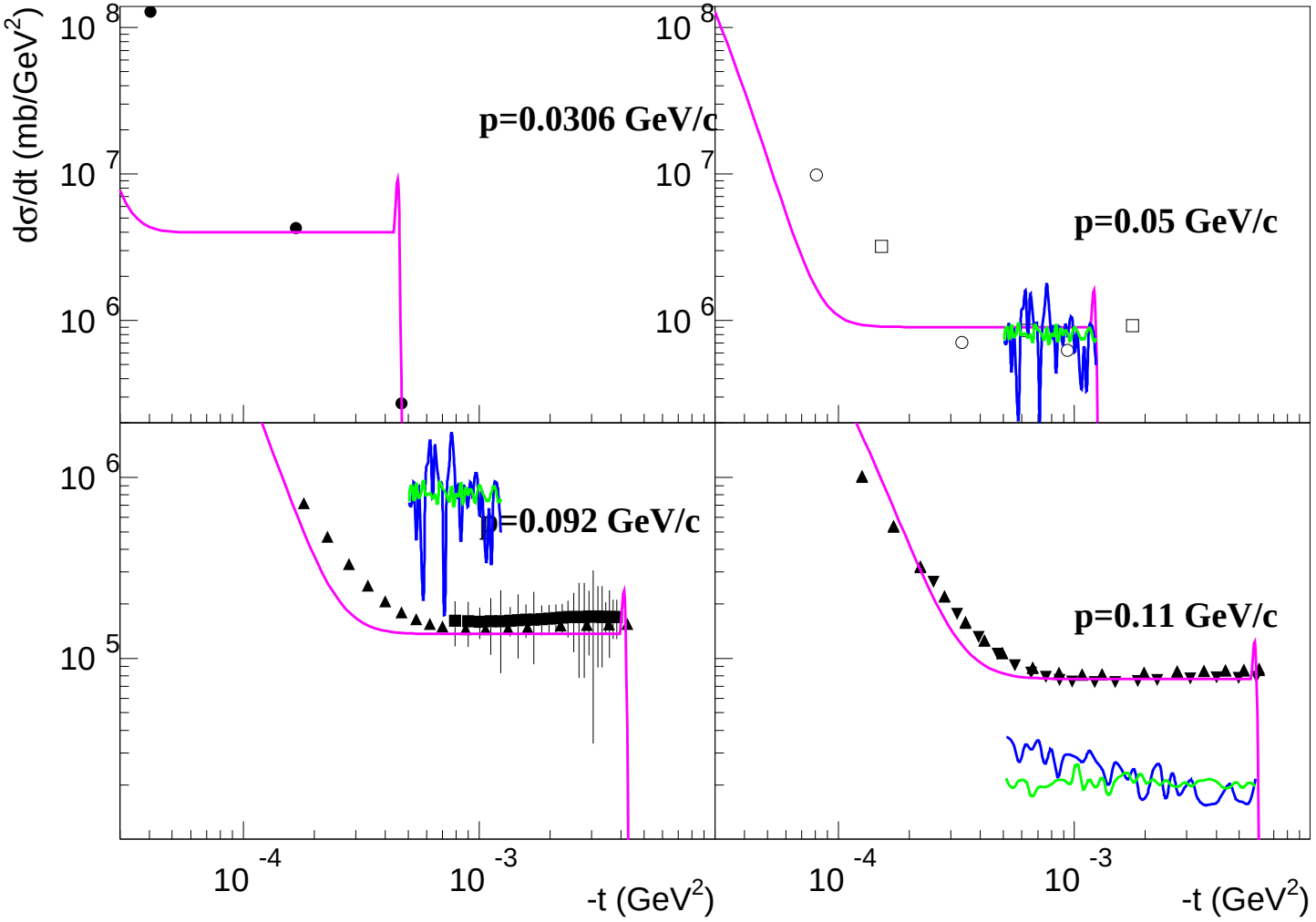

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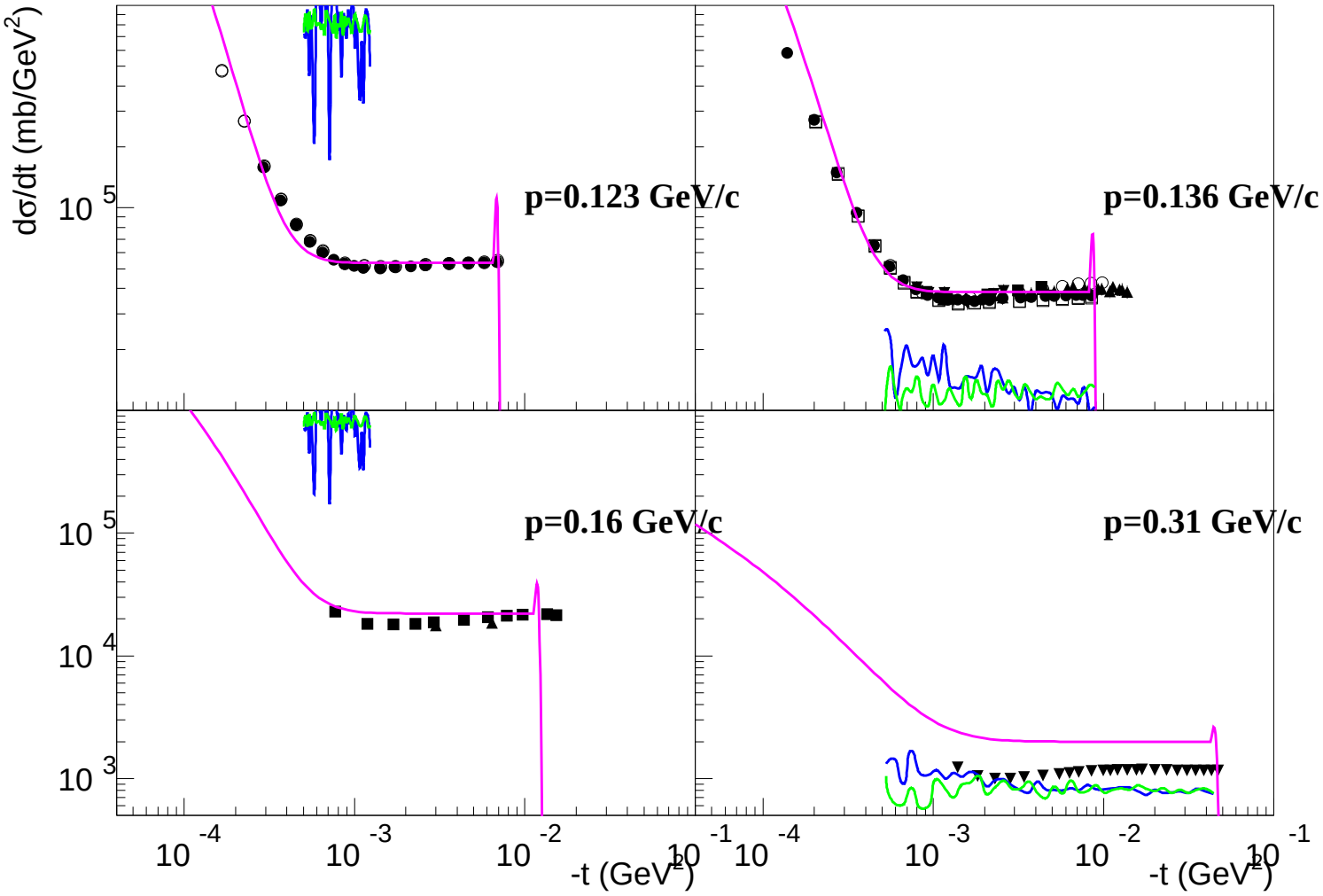

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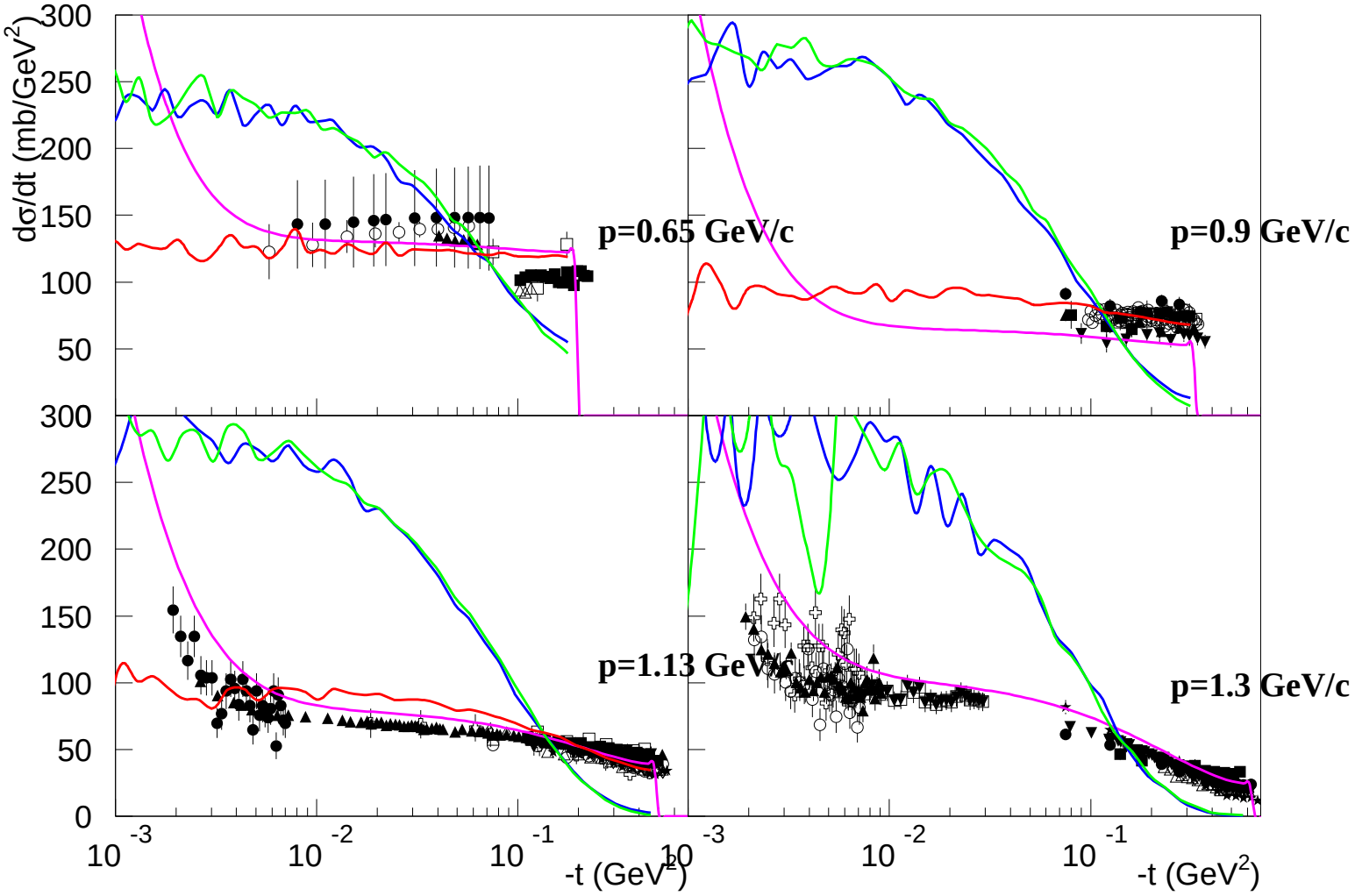

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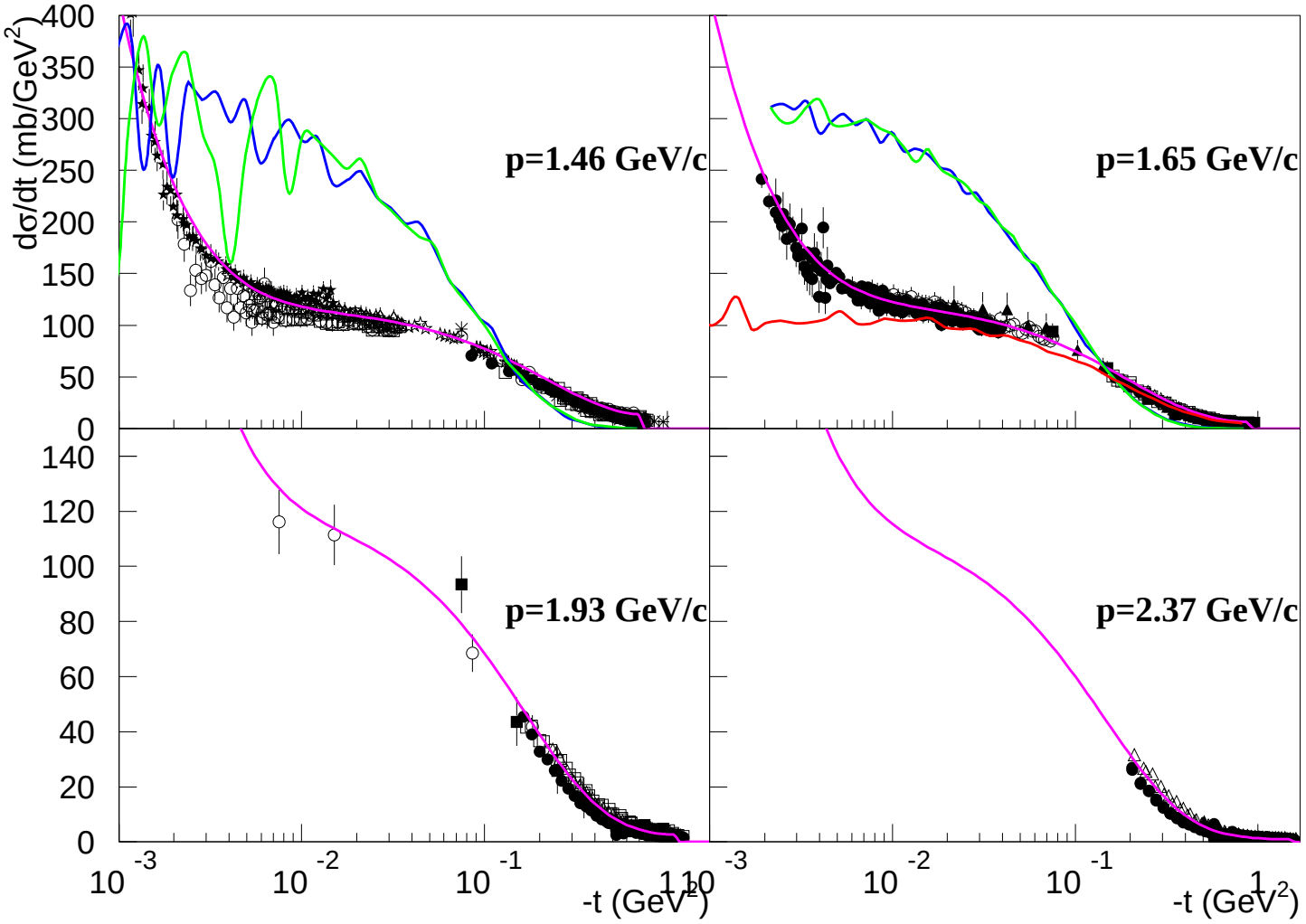

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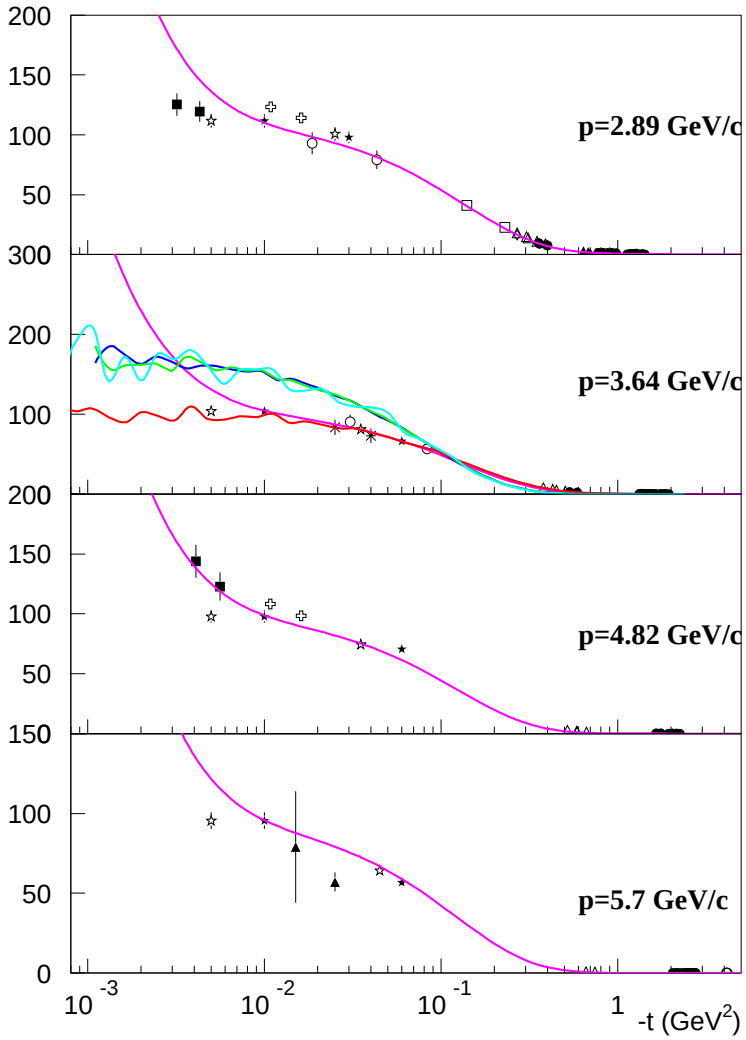

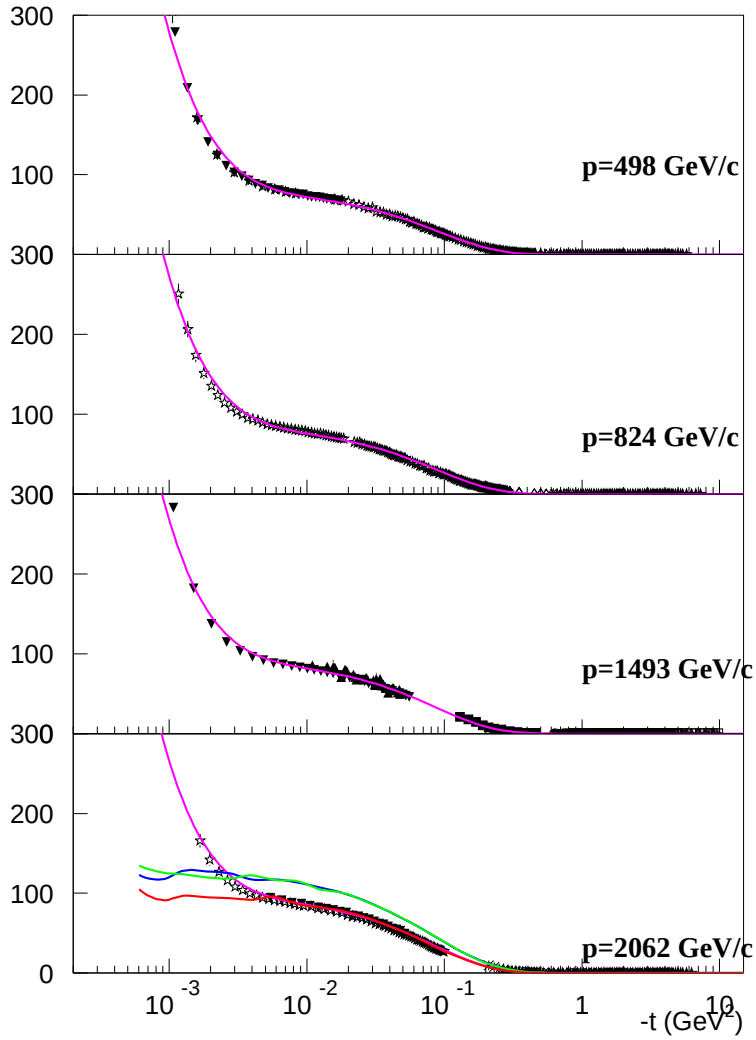

Approximation of pd elastic scattering

$$\frac{d\sigma}{dt} = A_1 \frac{e^{-B_1|t|^{1/2}}}{|t|^{1/2}} + A_2(B_2 - 2C_2 t)e^{(B_2 - C_2 t)\cdot t} + A_3 e^{B_3 t} + A_4 e^{B_4 u}$$

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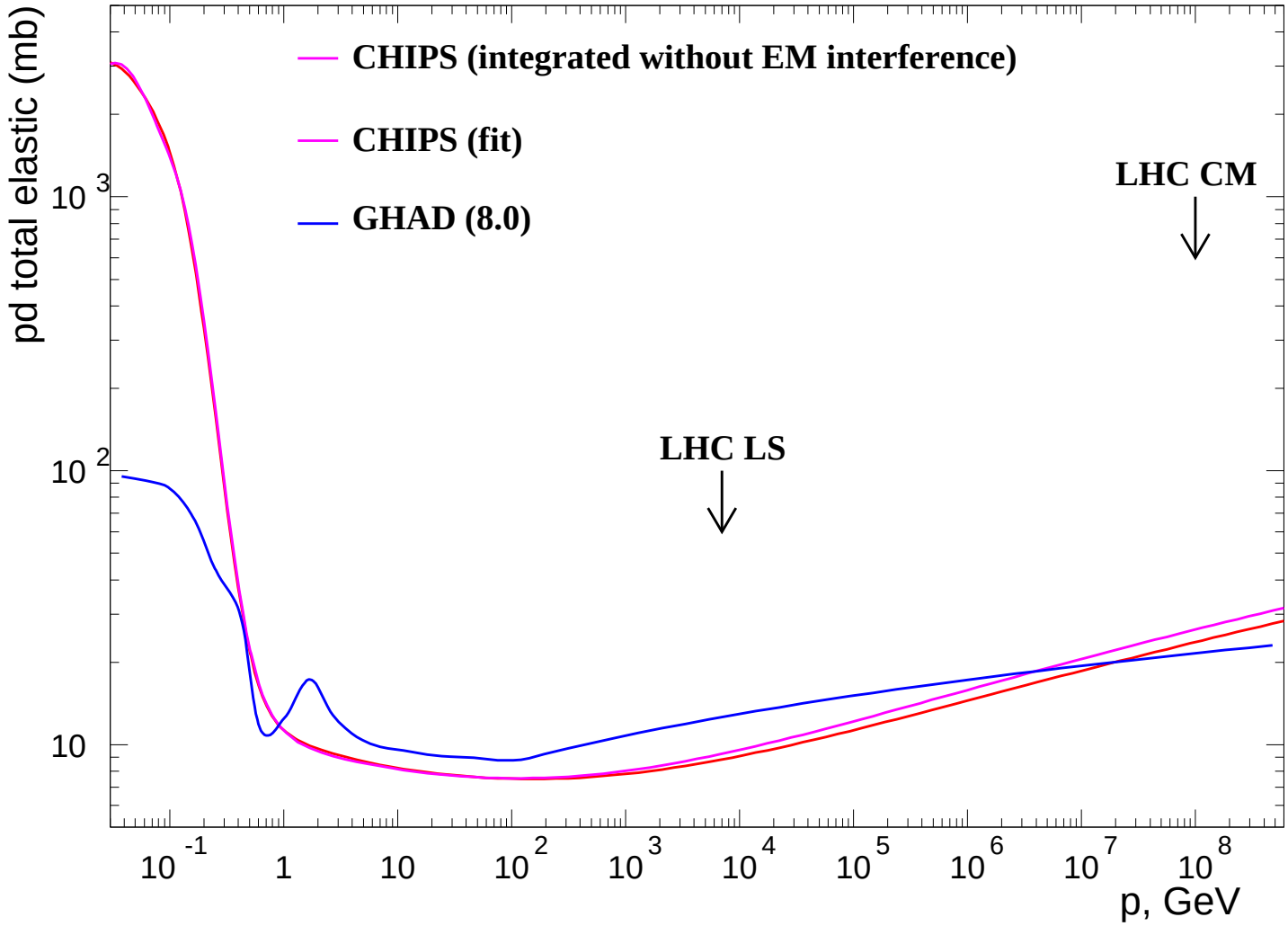

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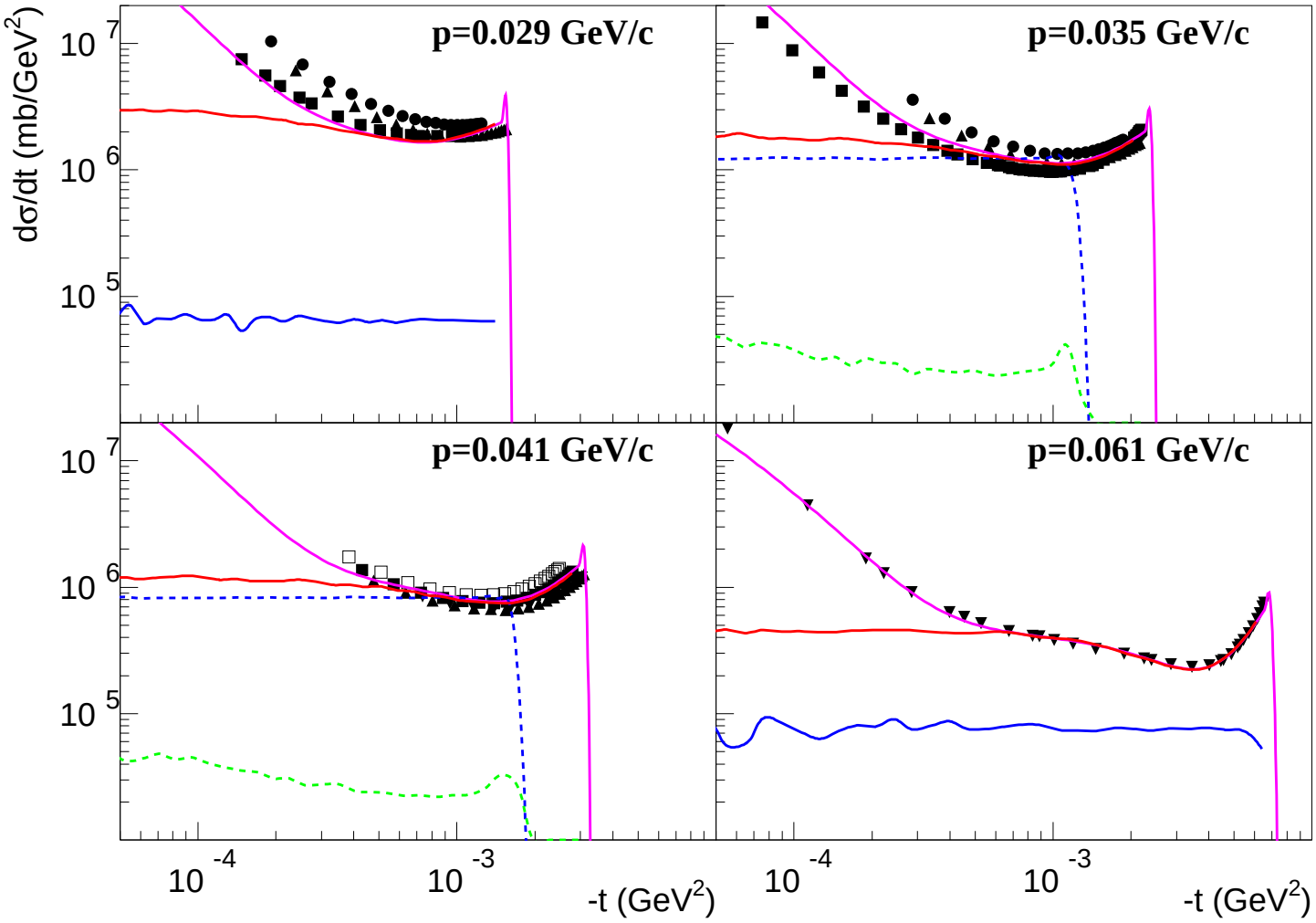

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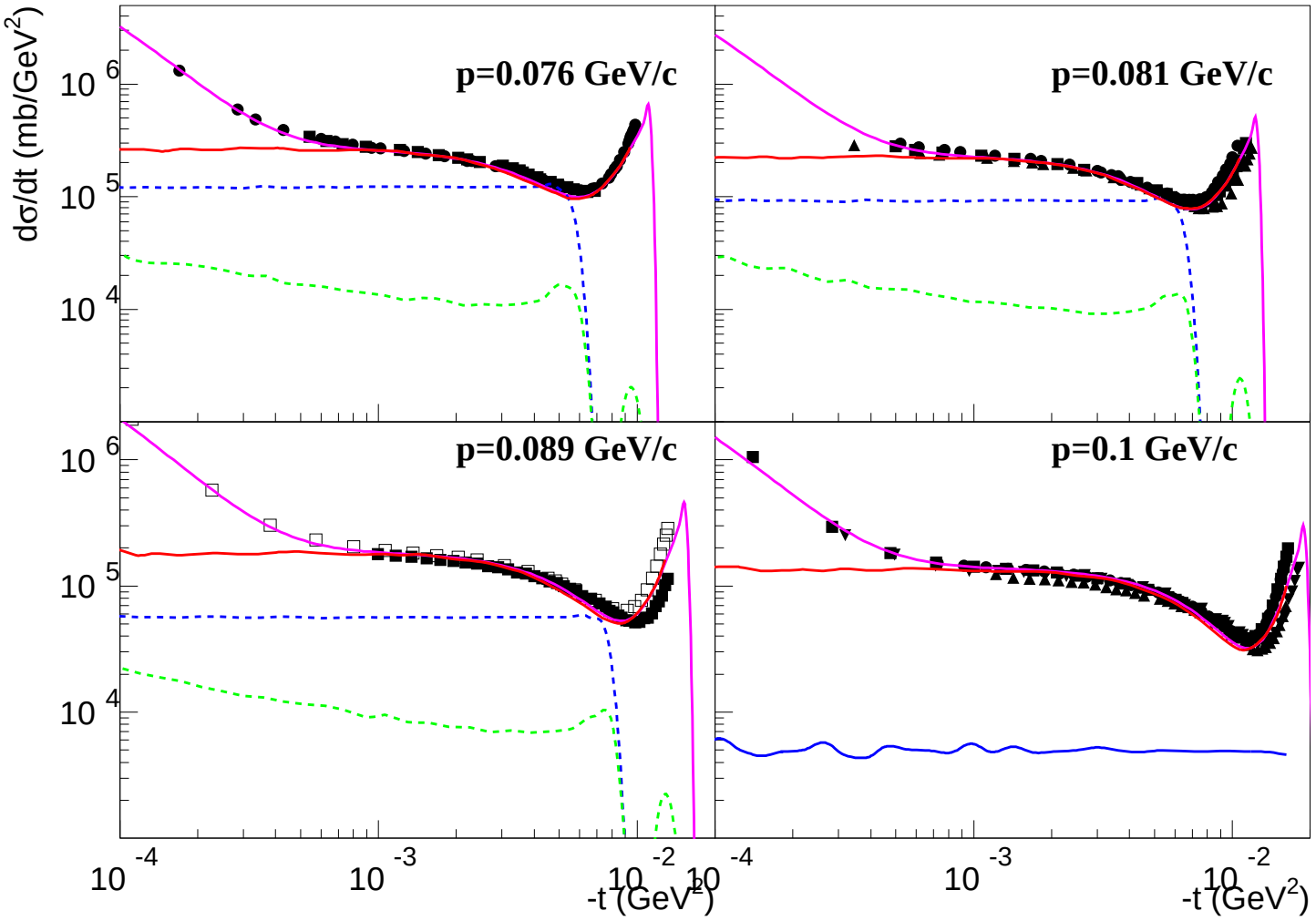

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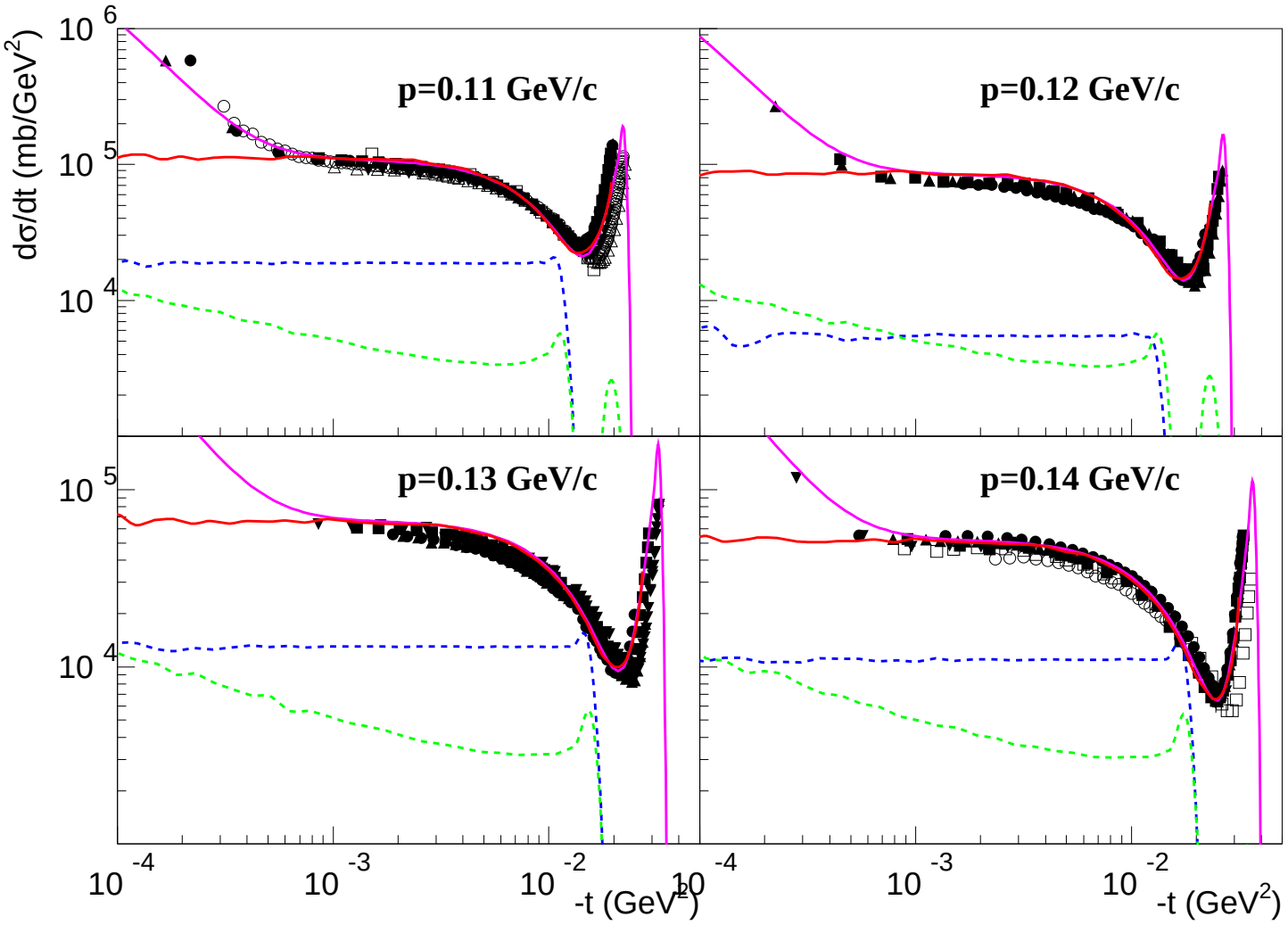

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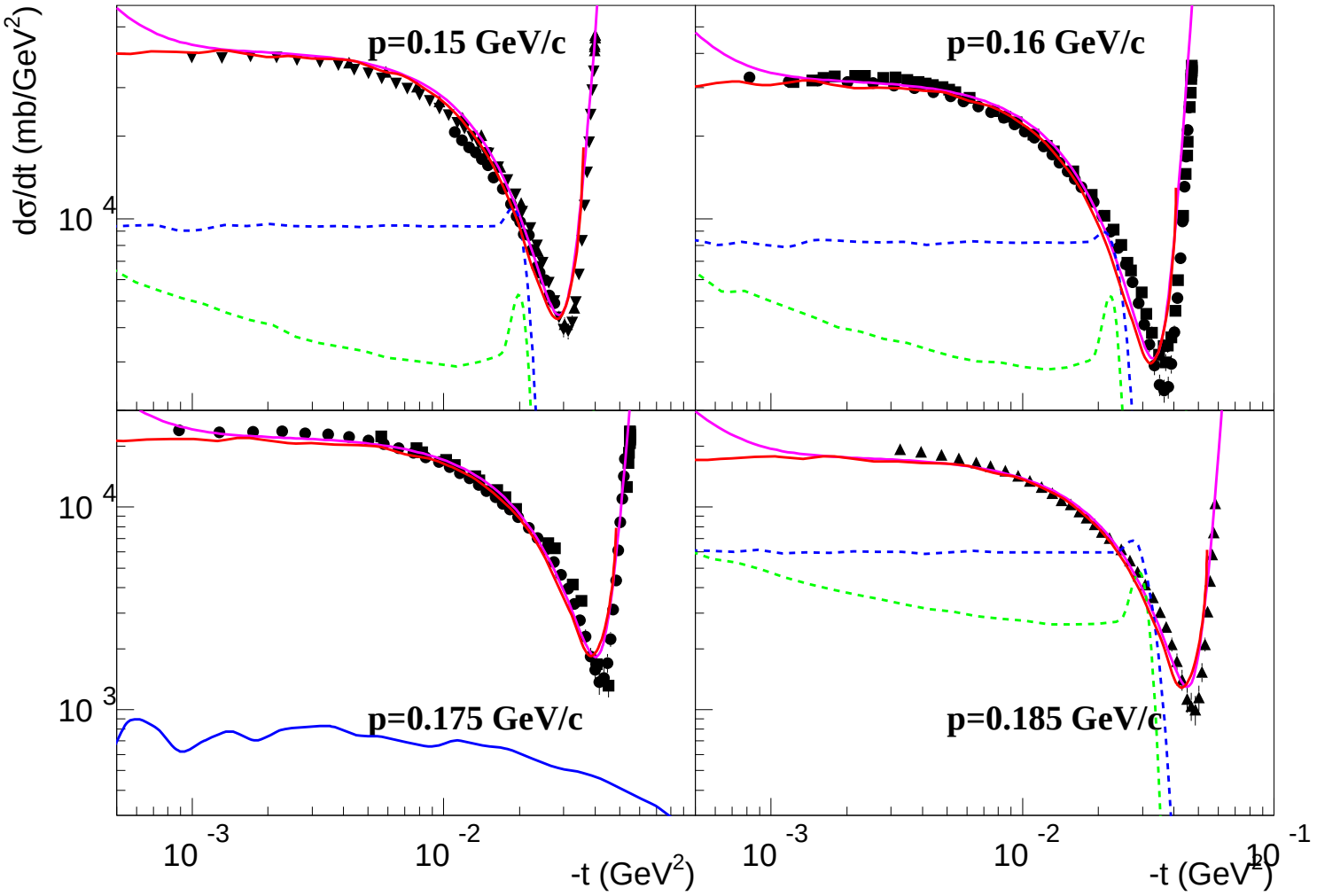

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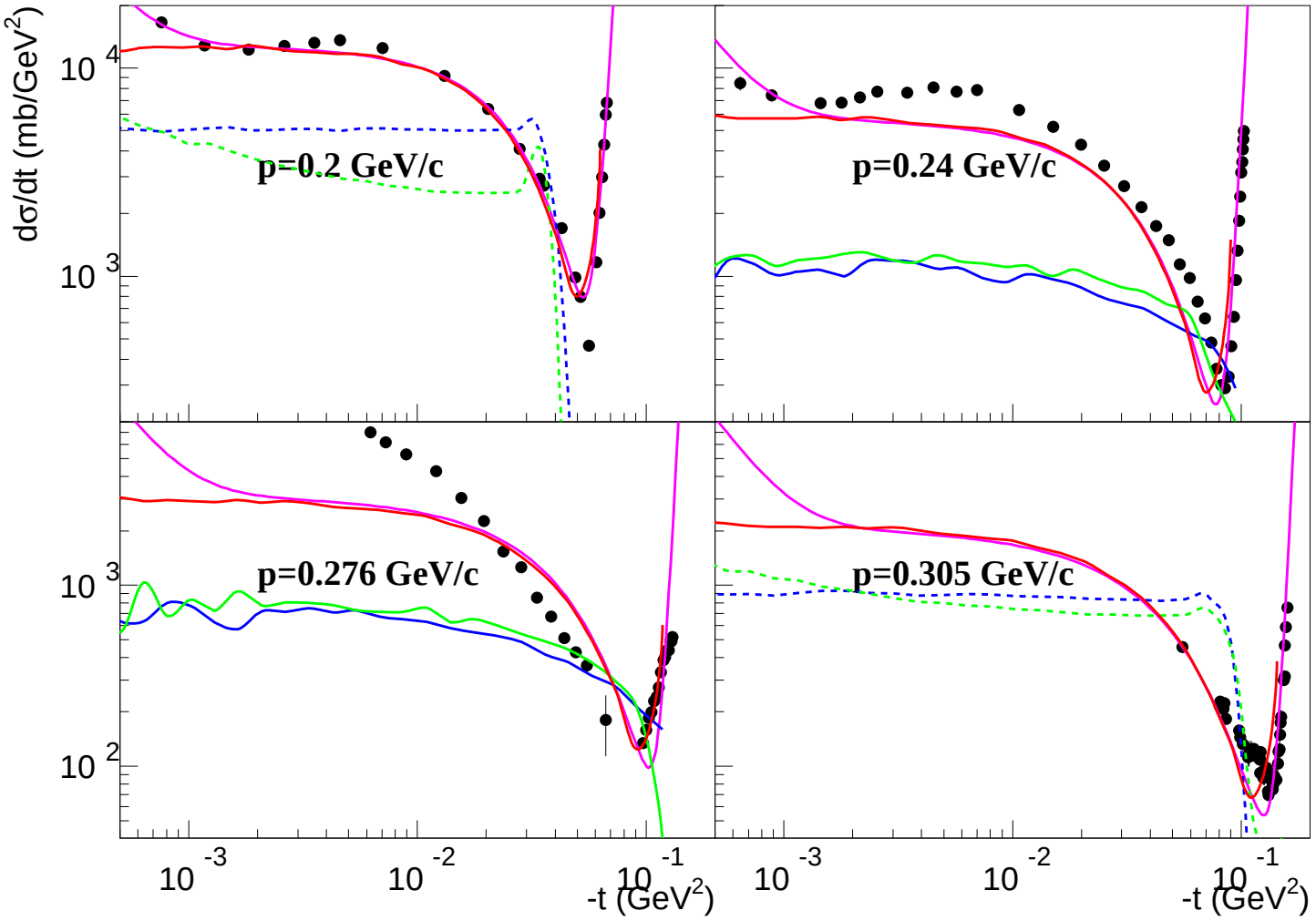

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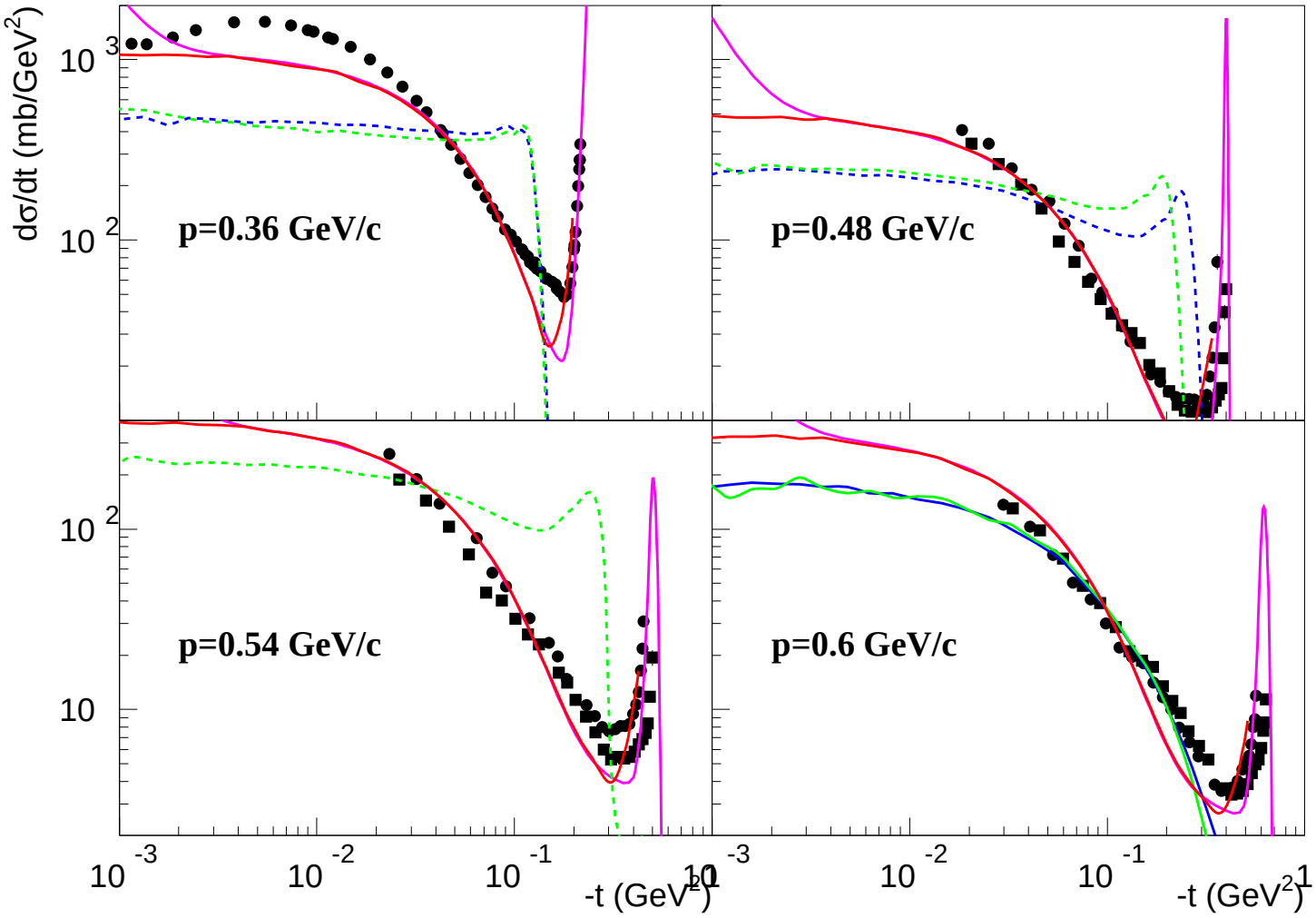

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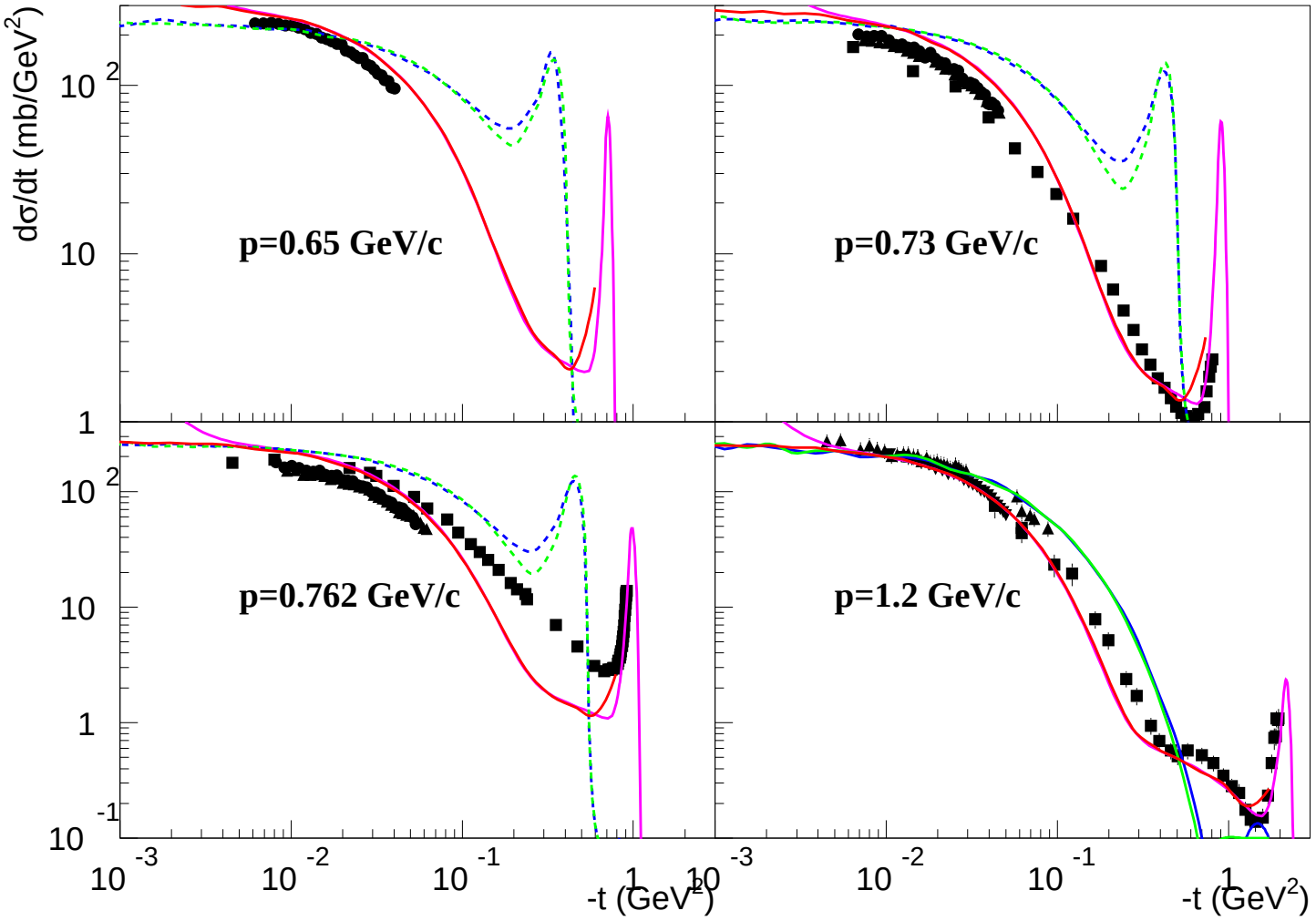

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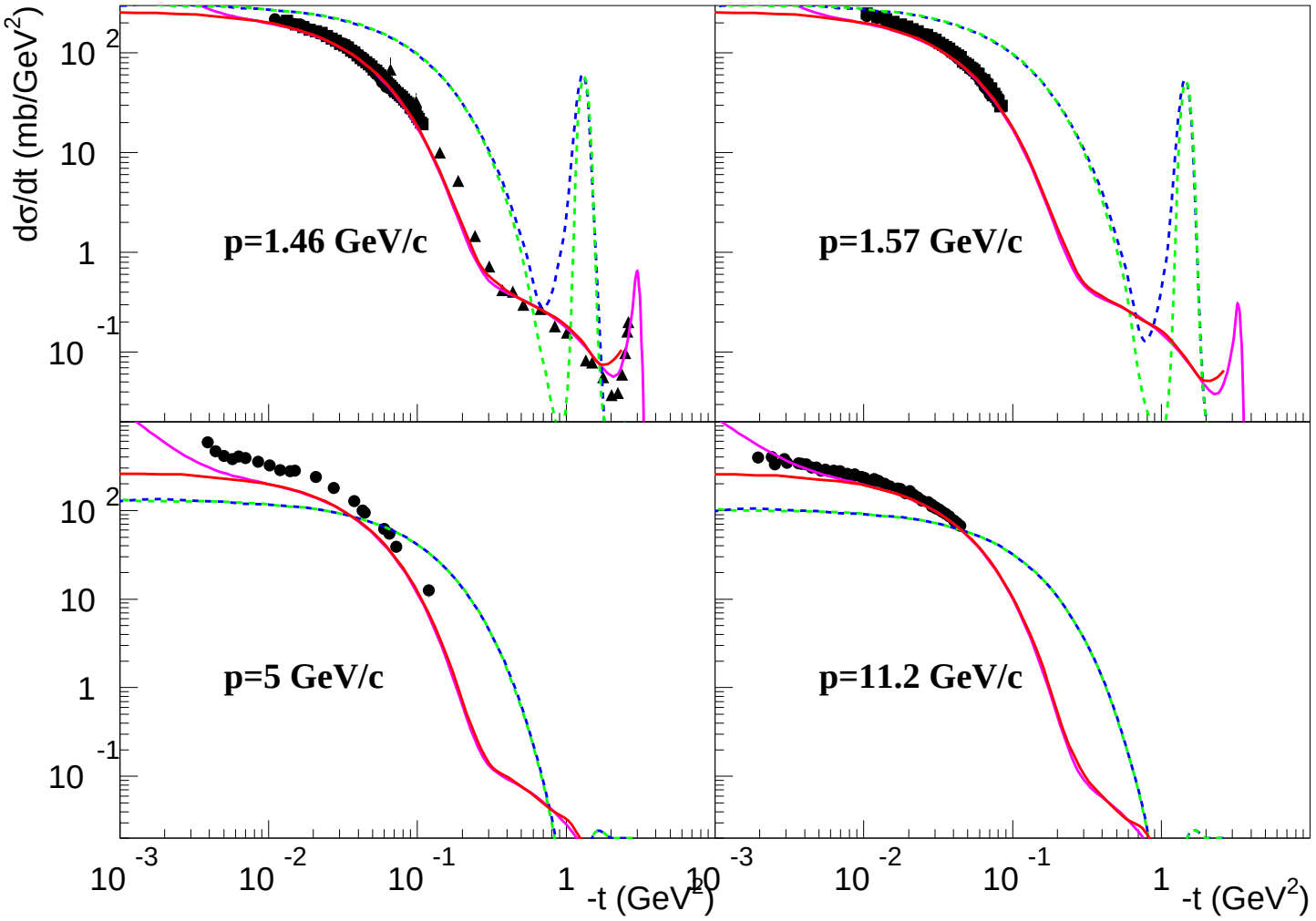

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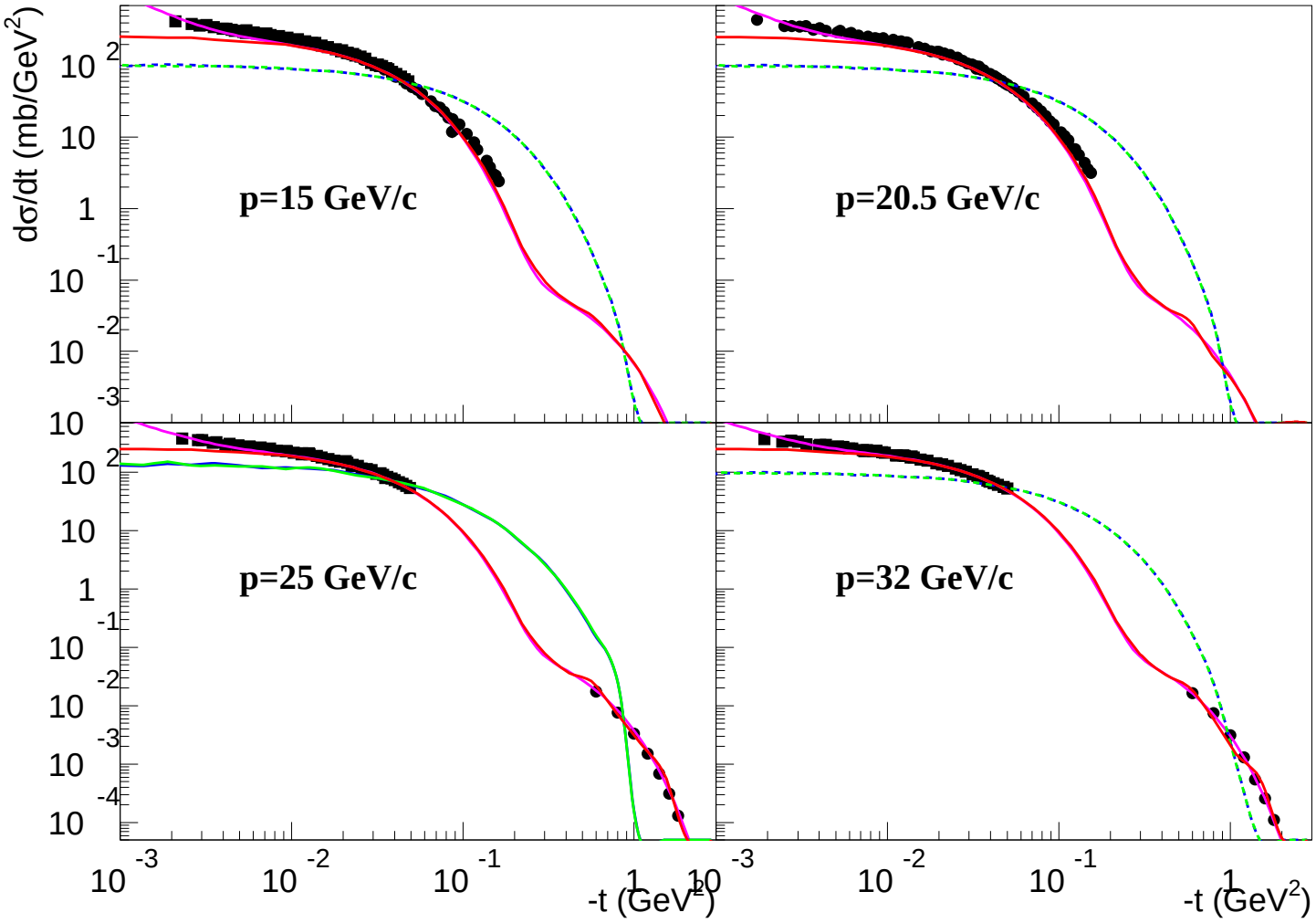

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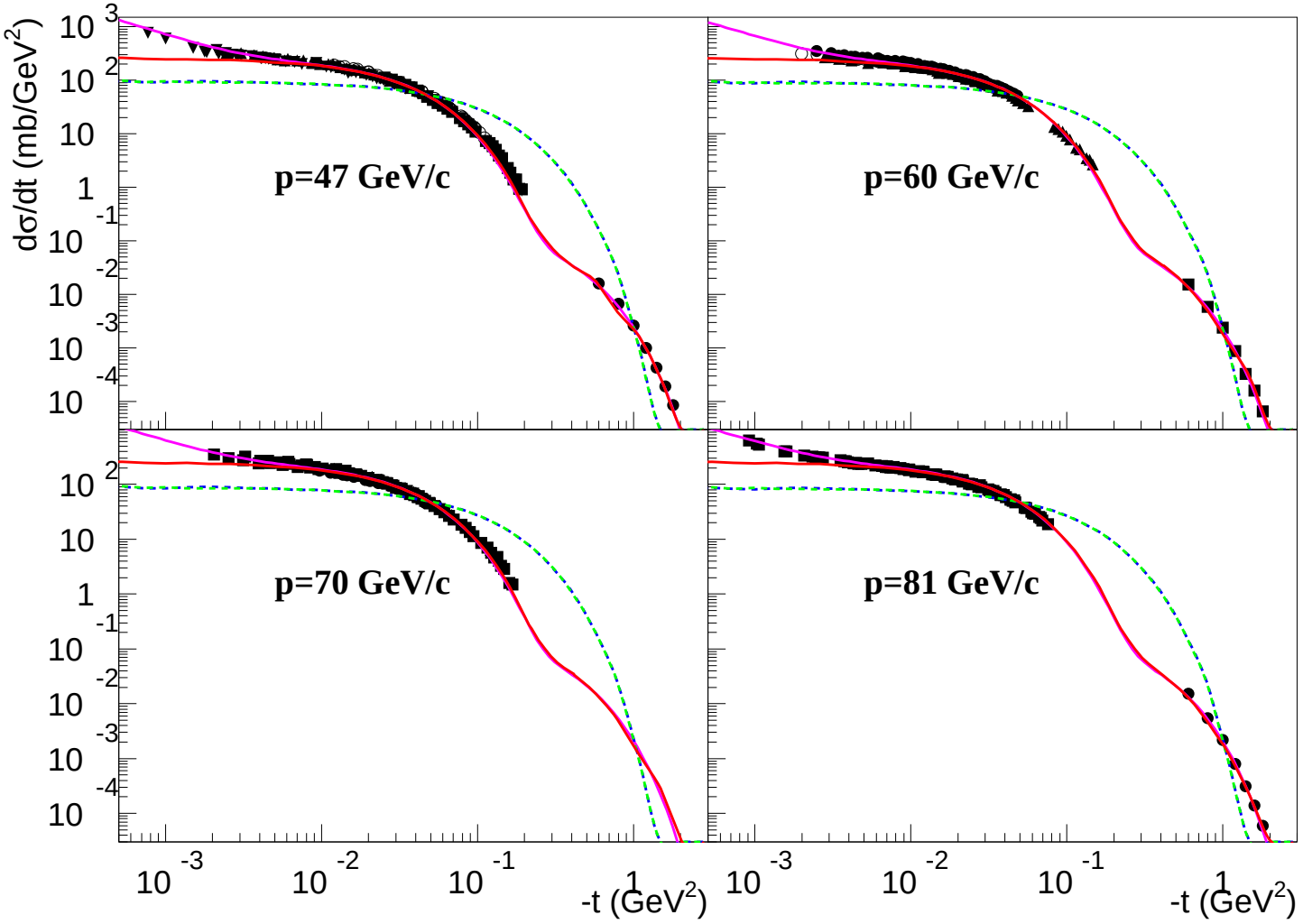

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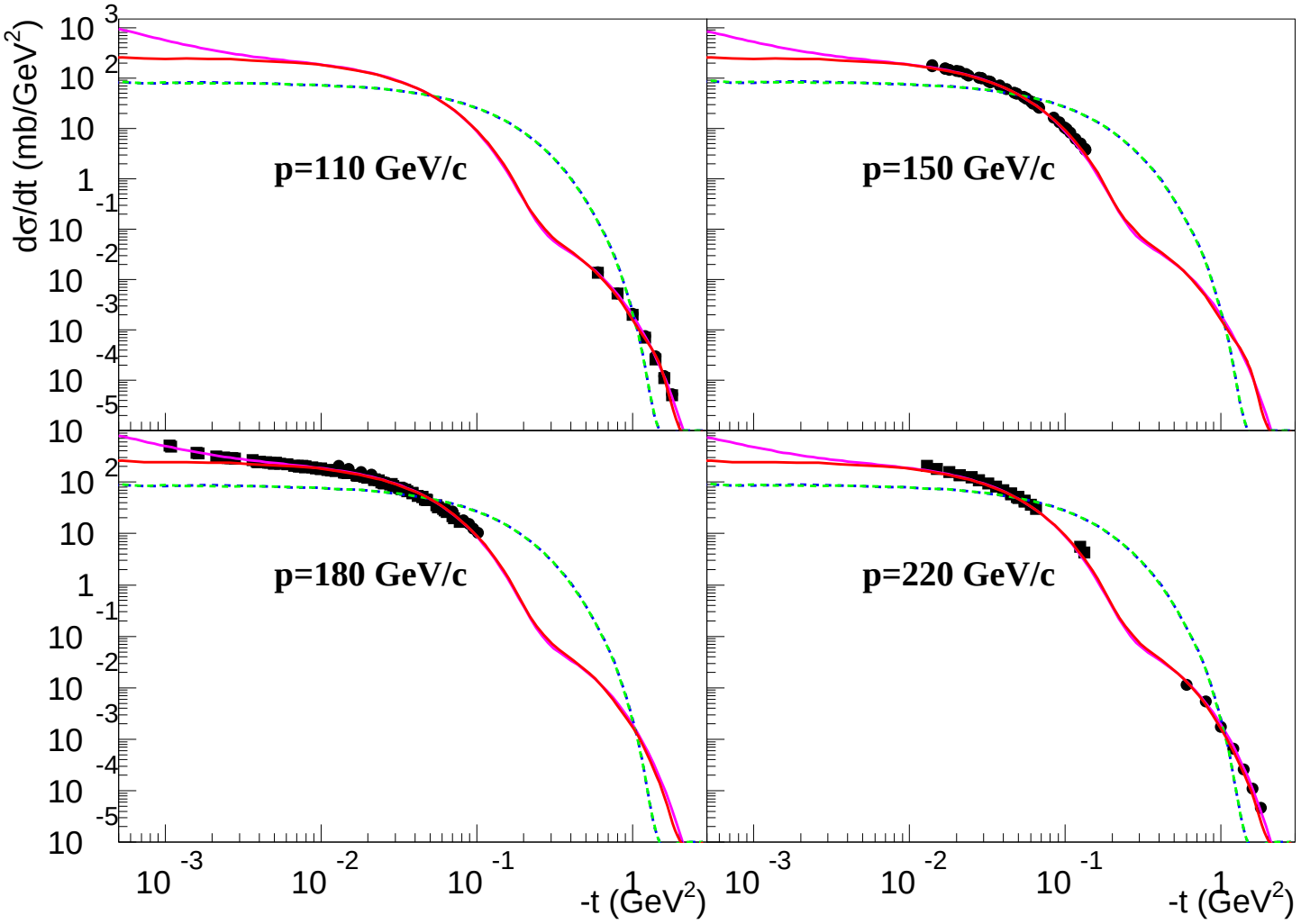

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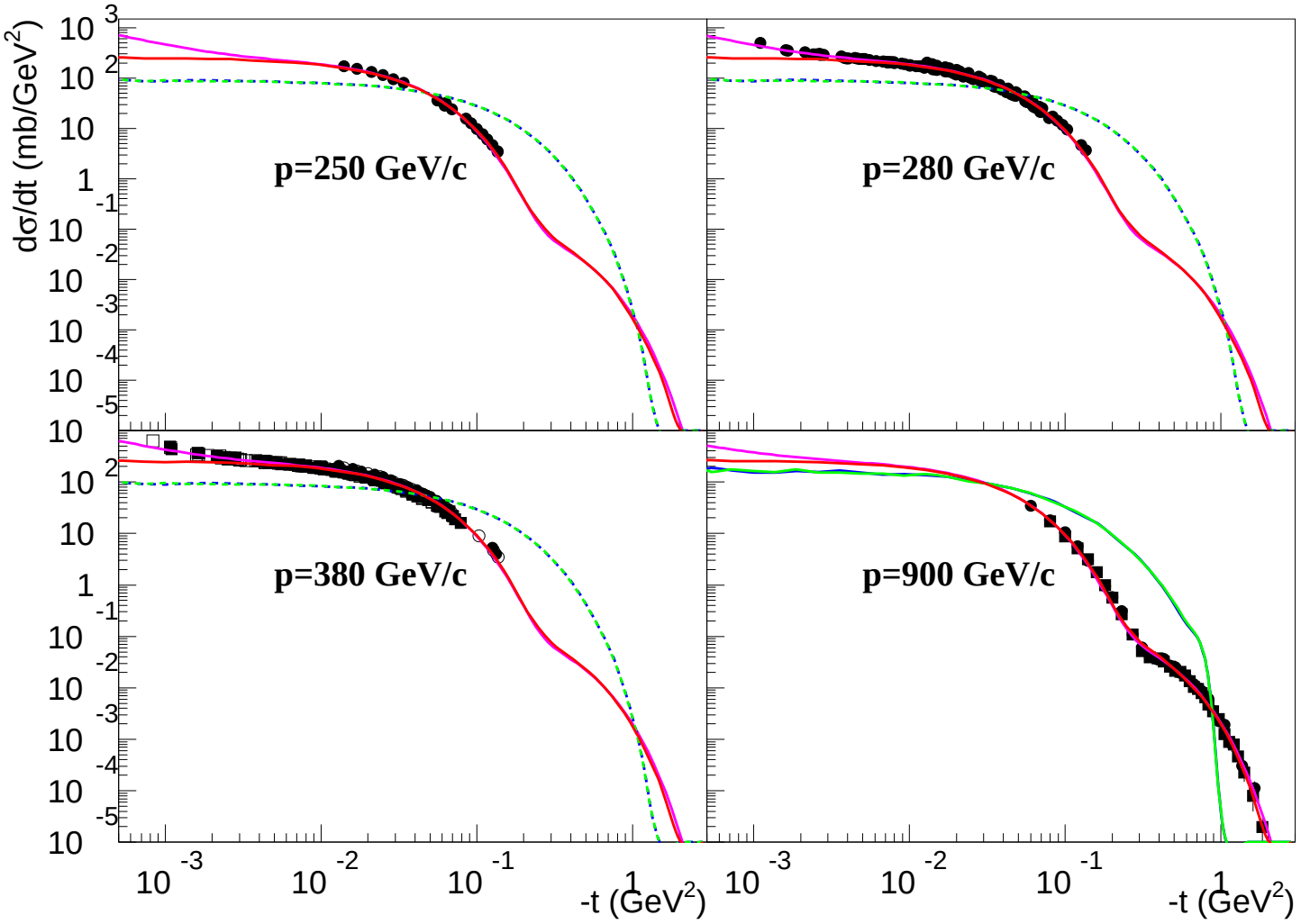

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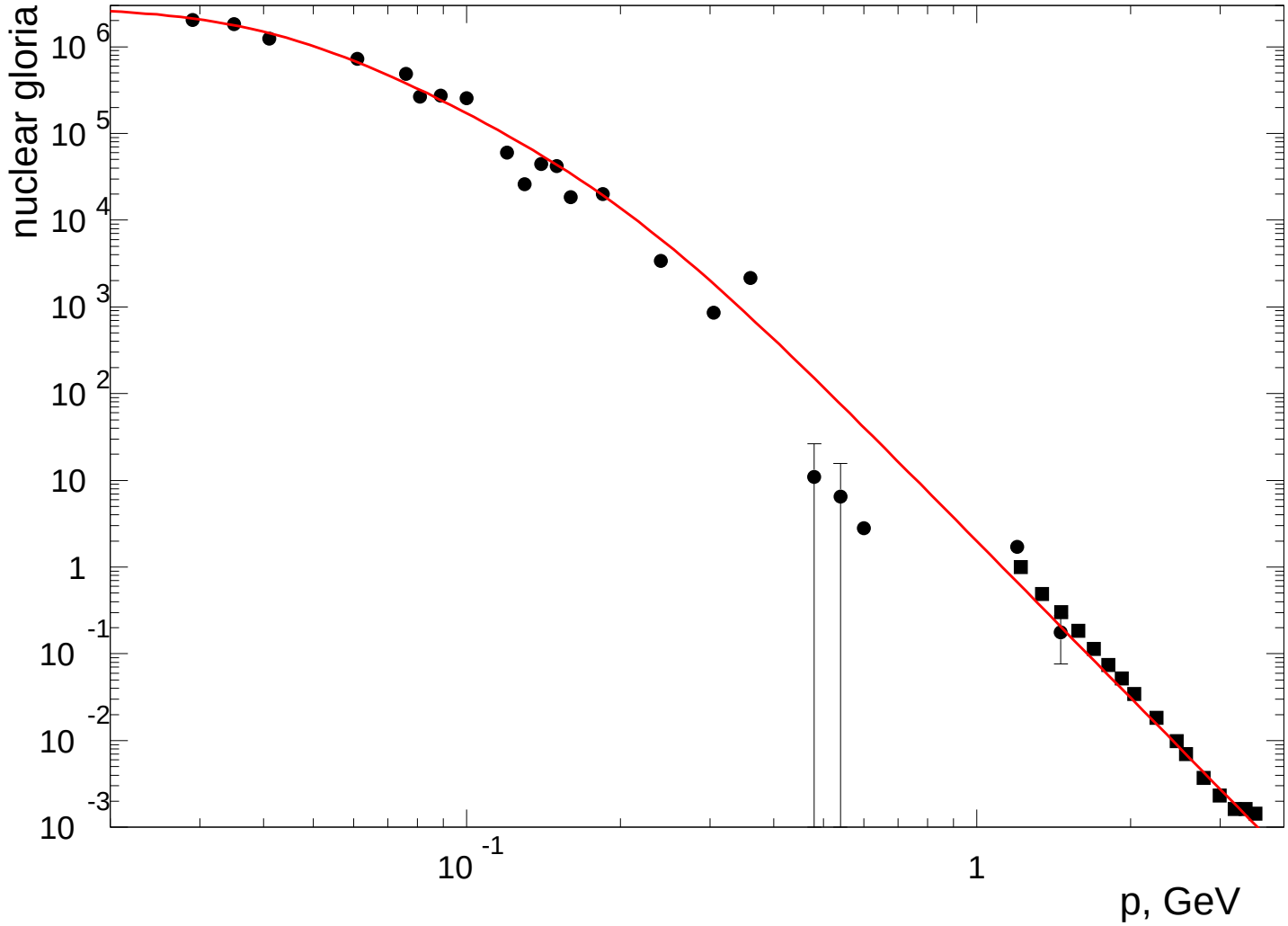

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Approximation of pHe elastic scattering

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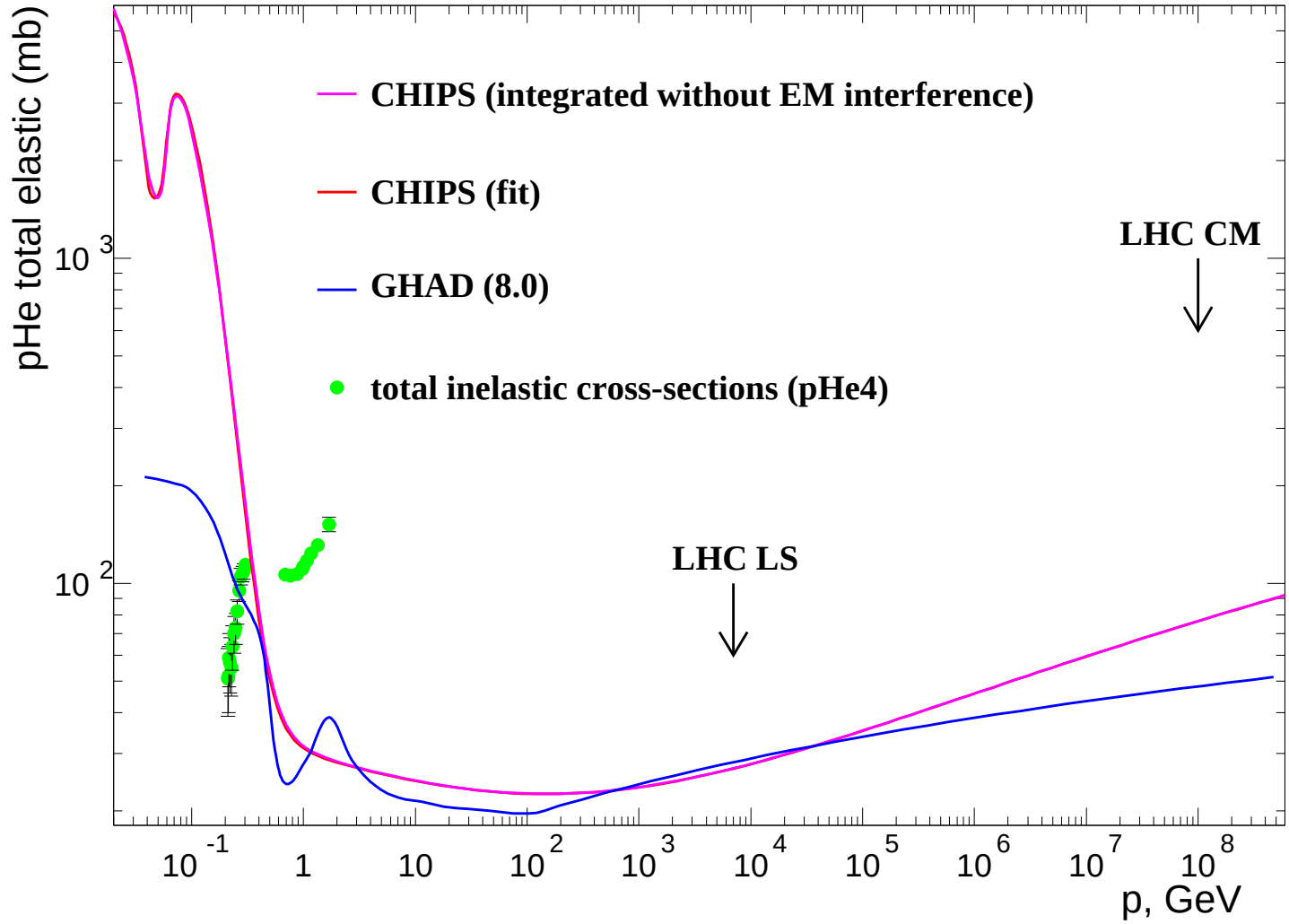

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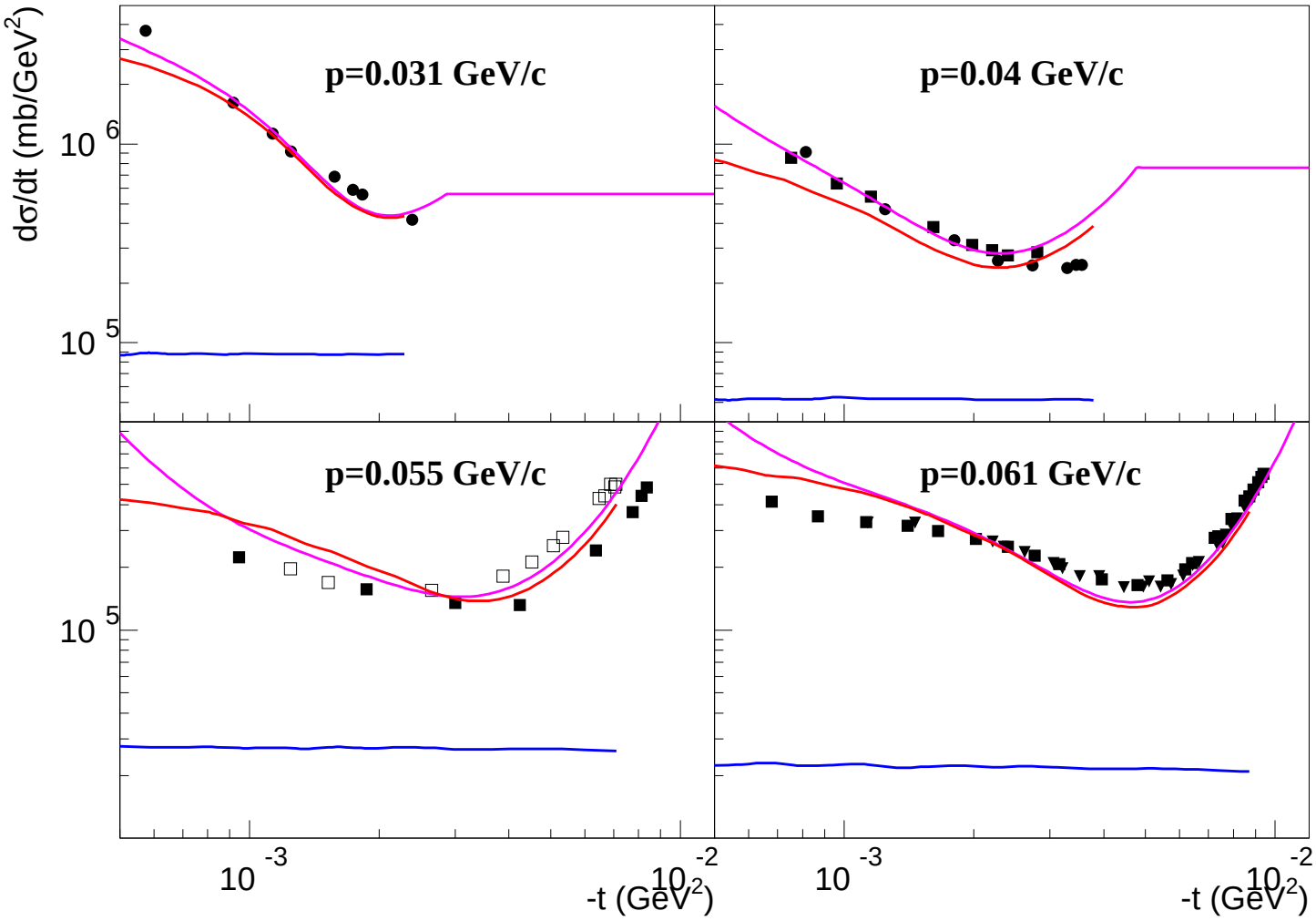

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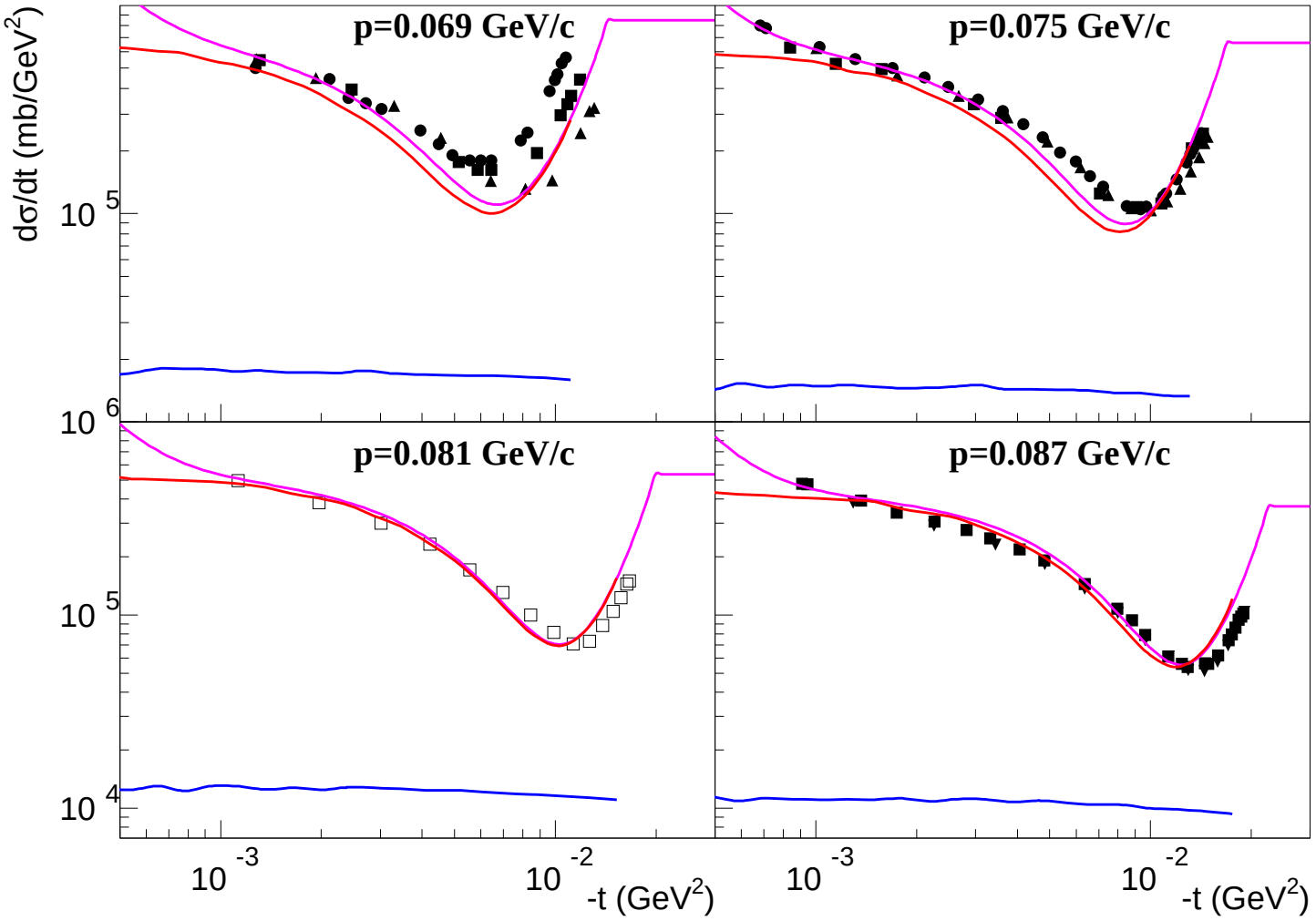

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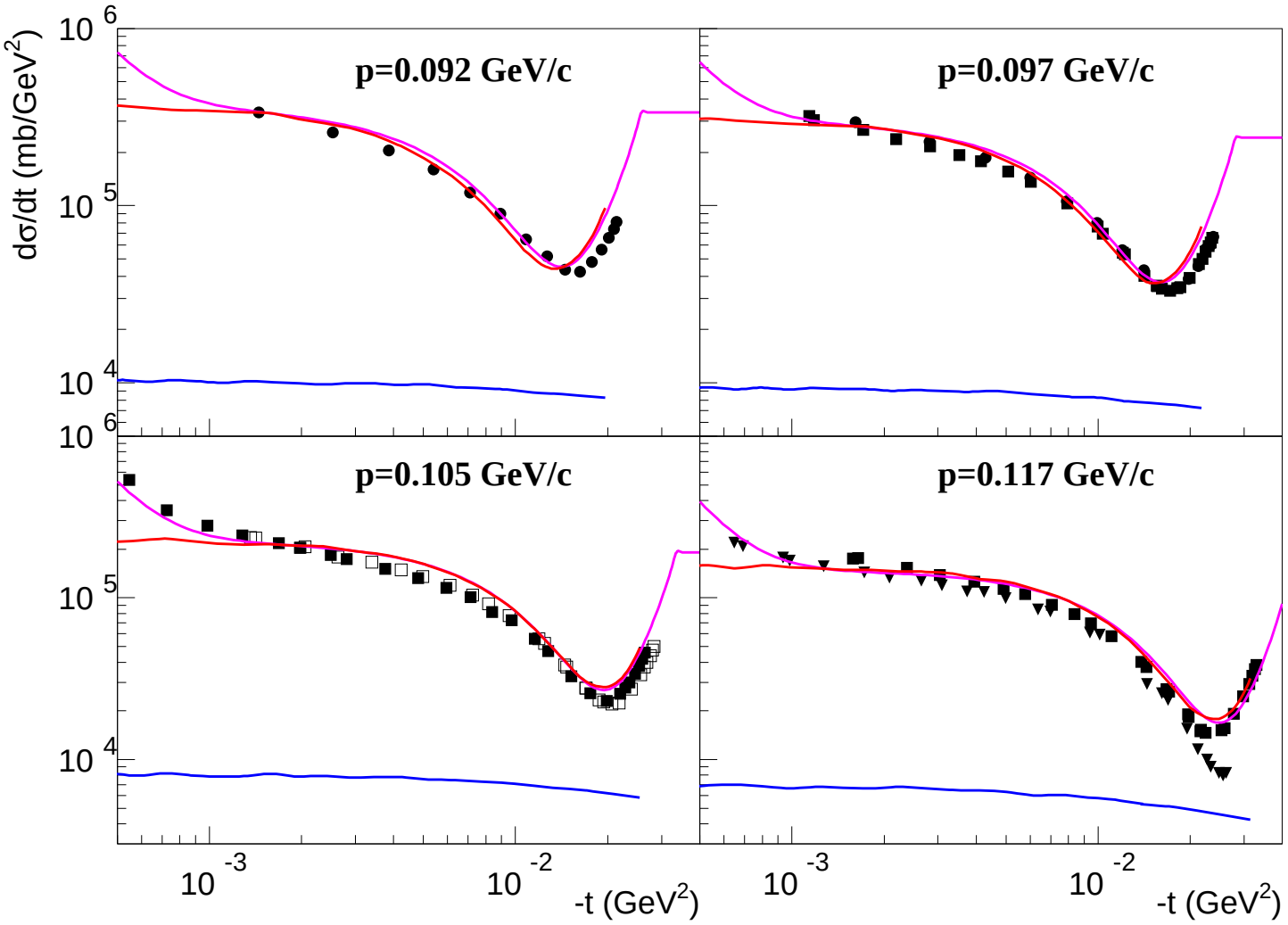

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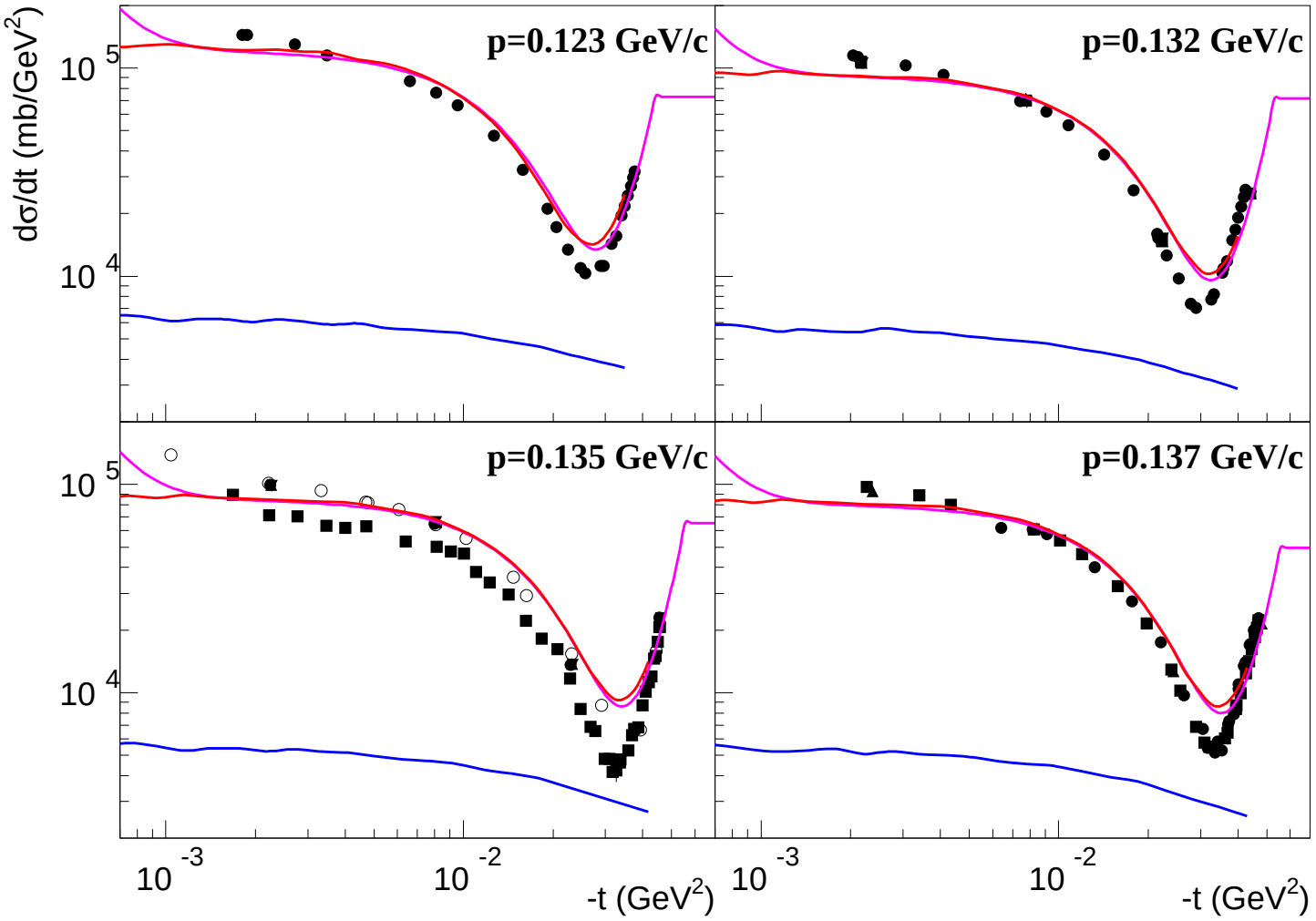

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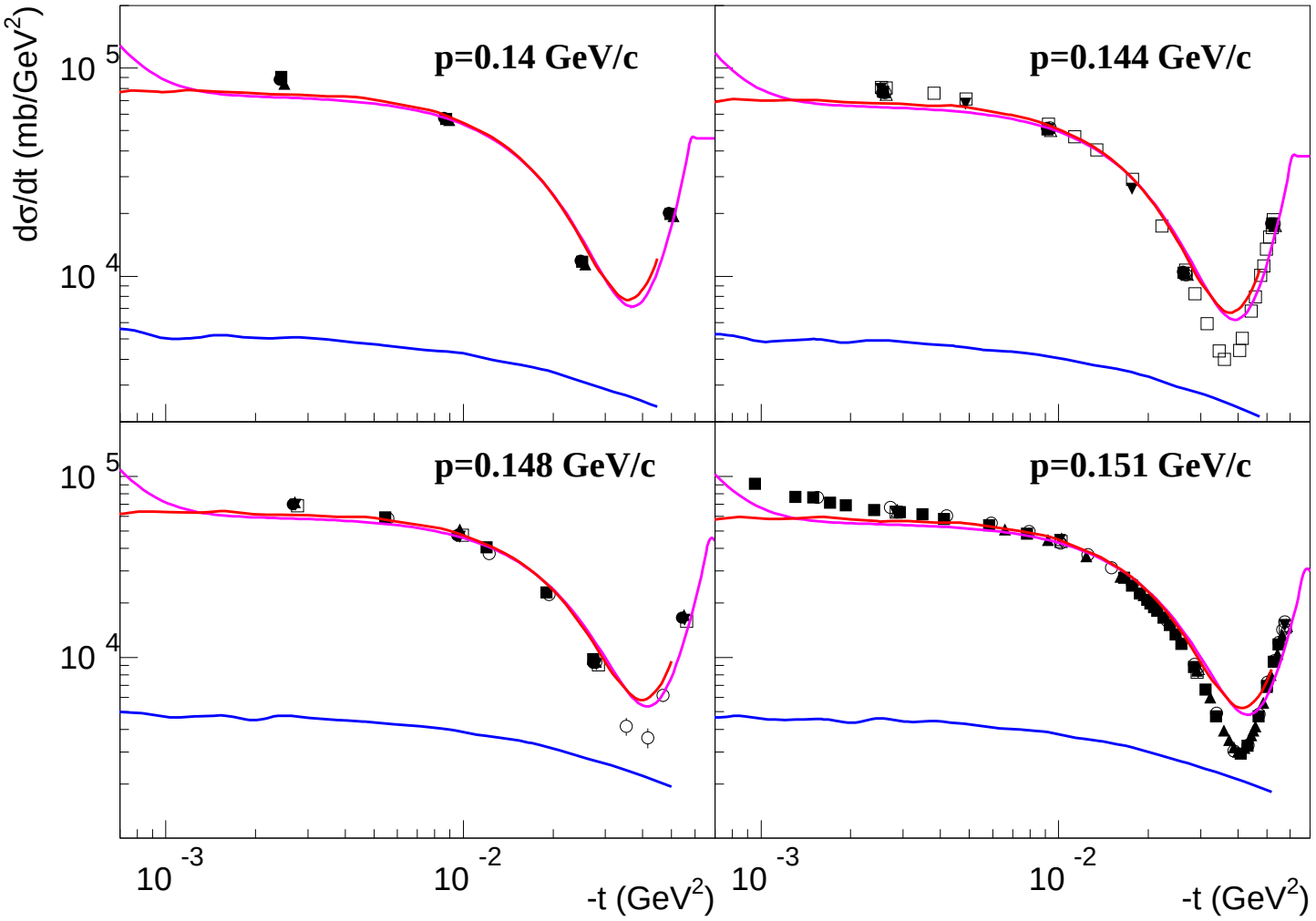

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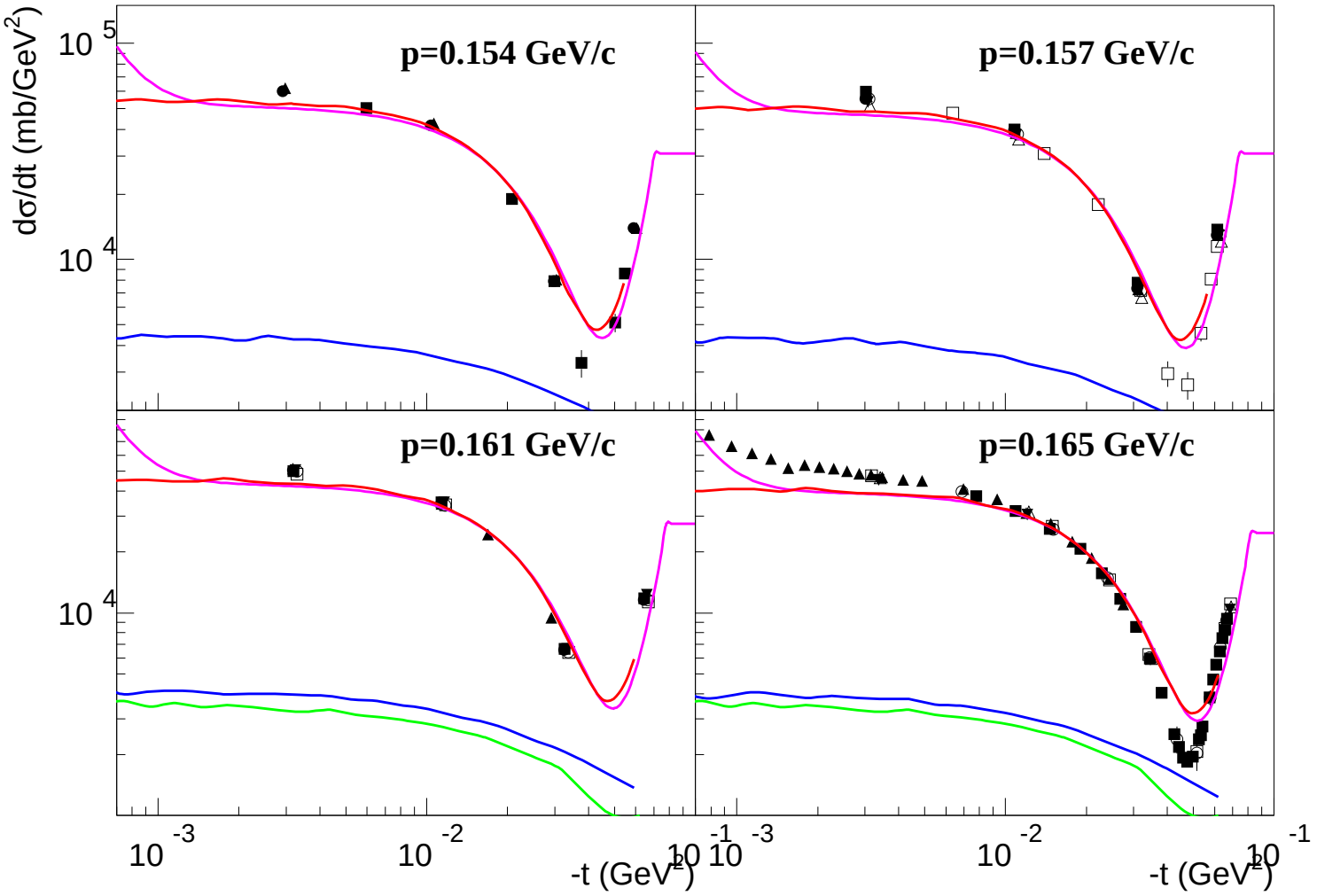

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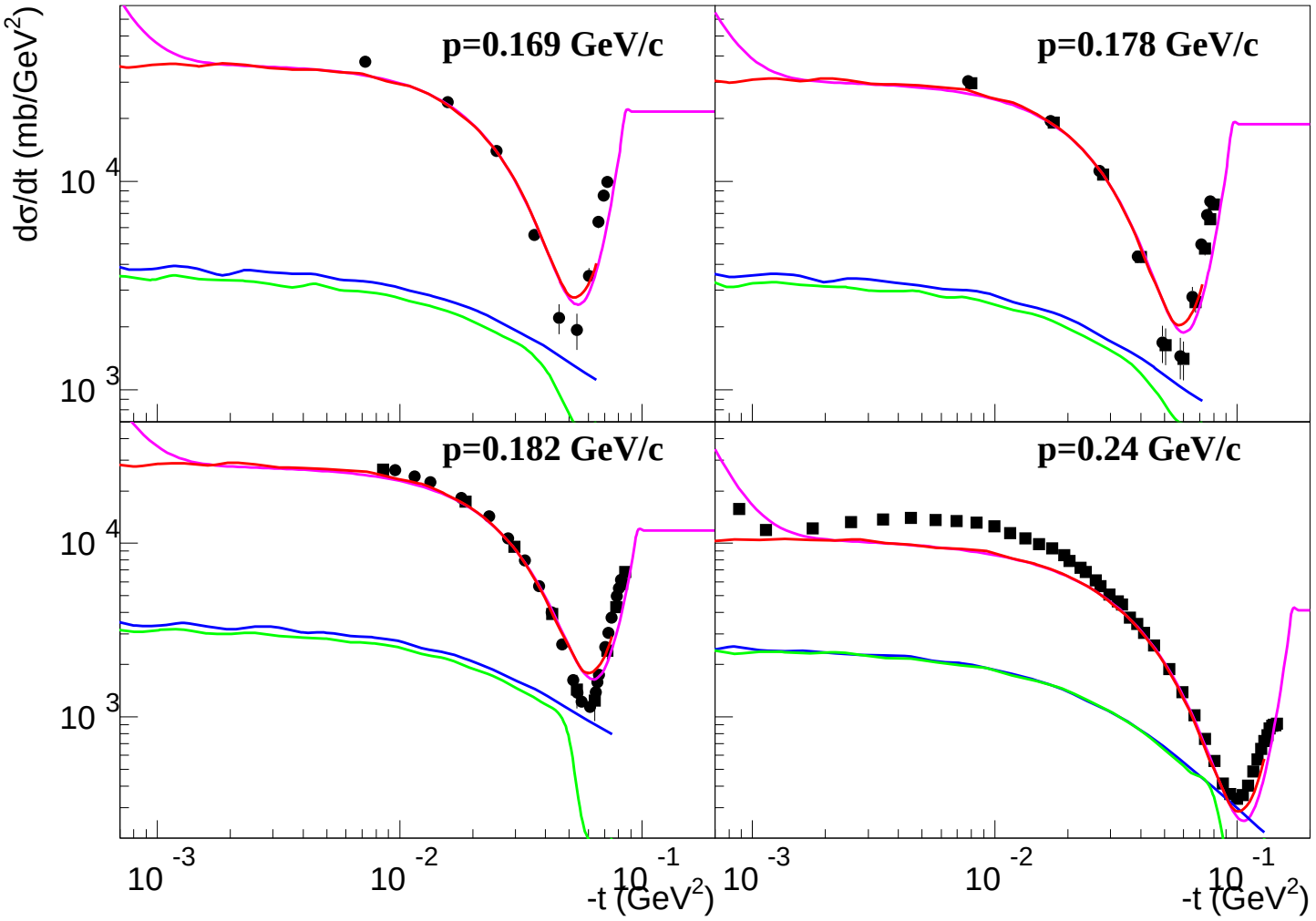

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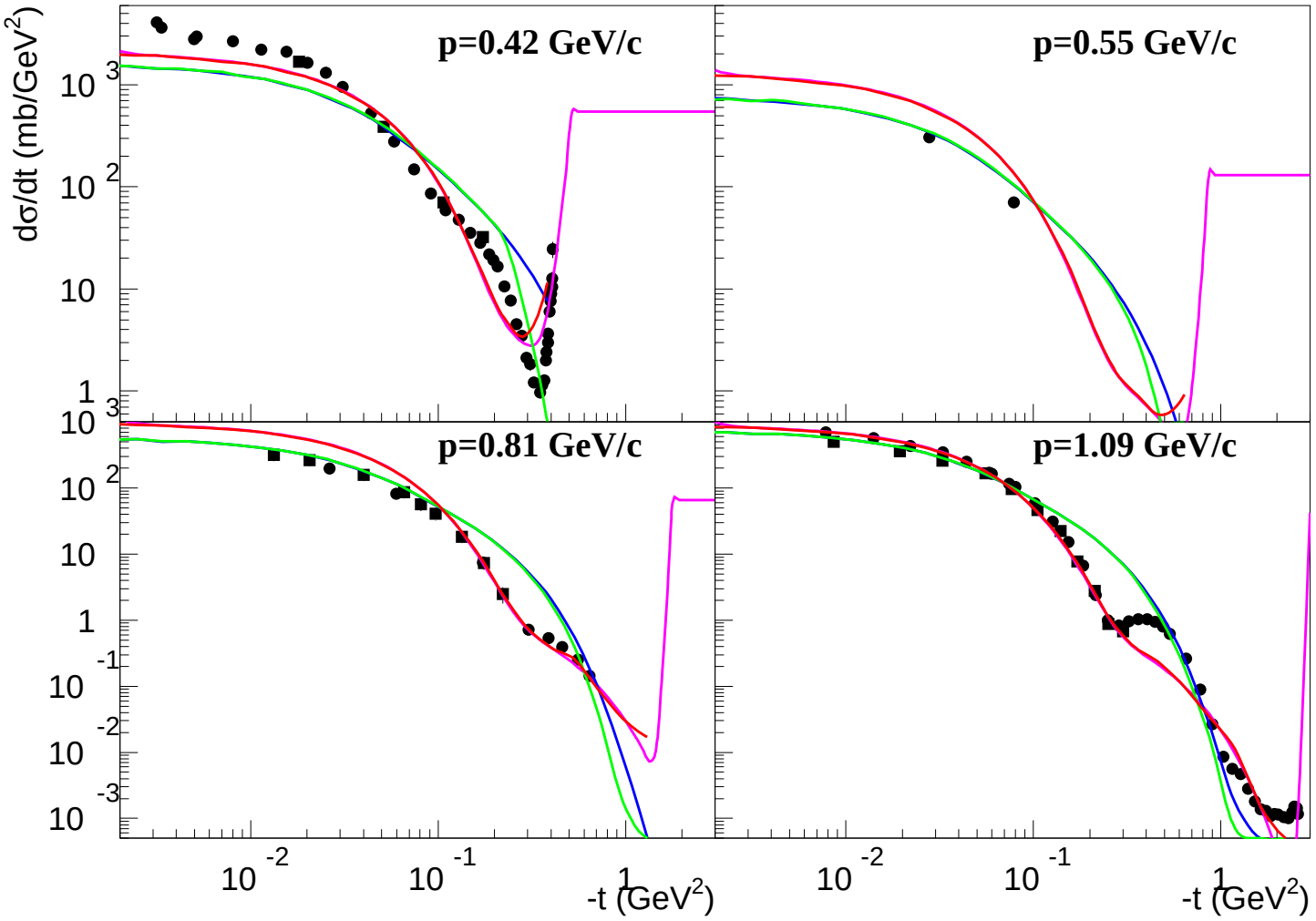

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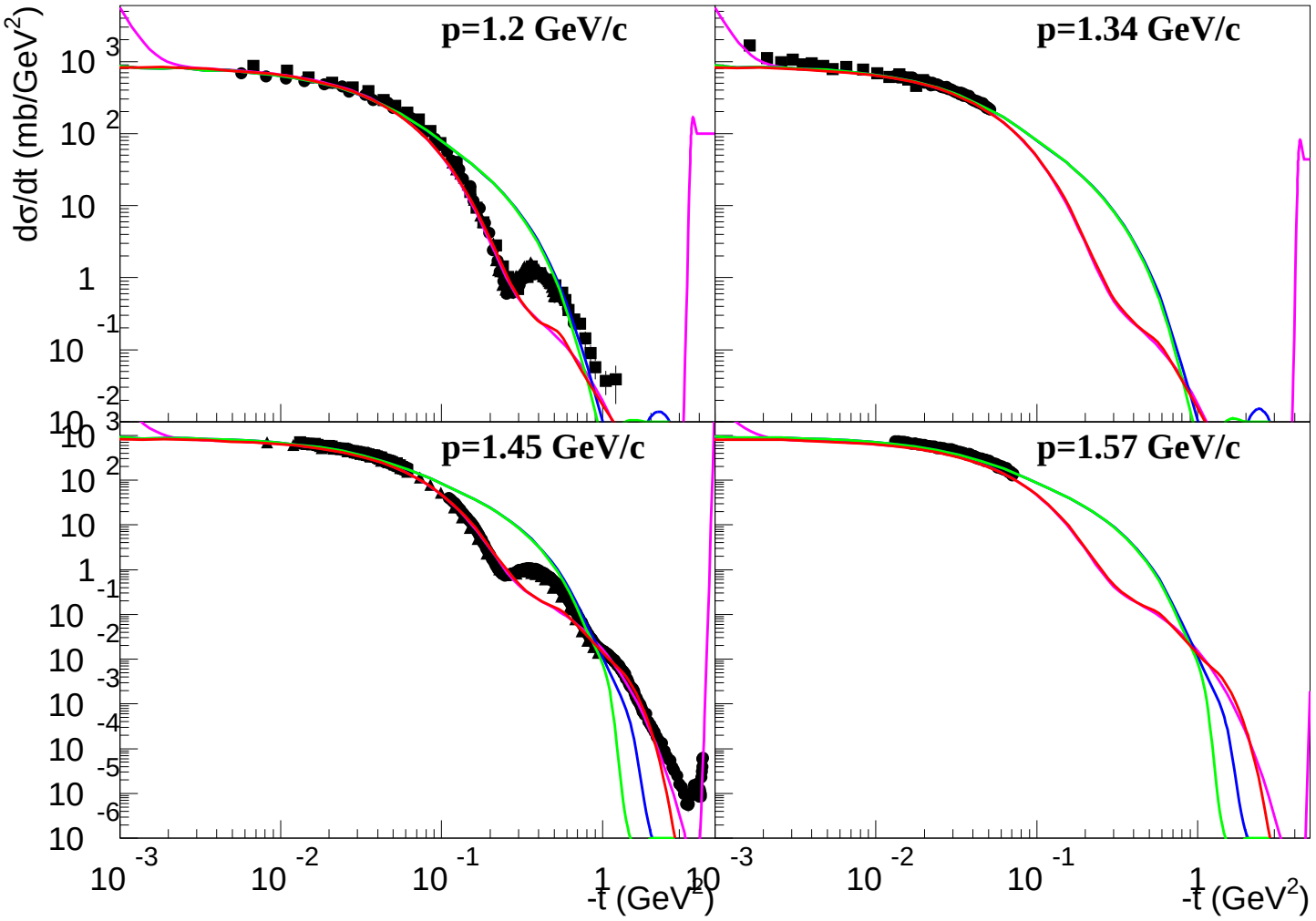

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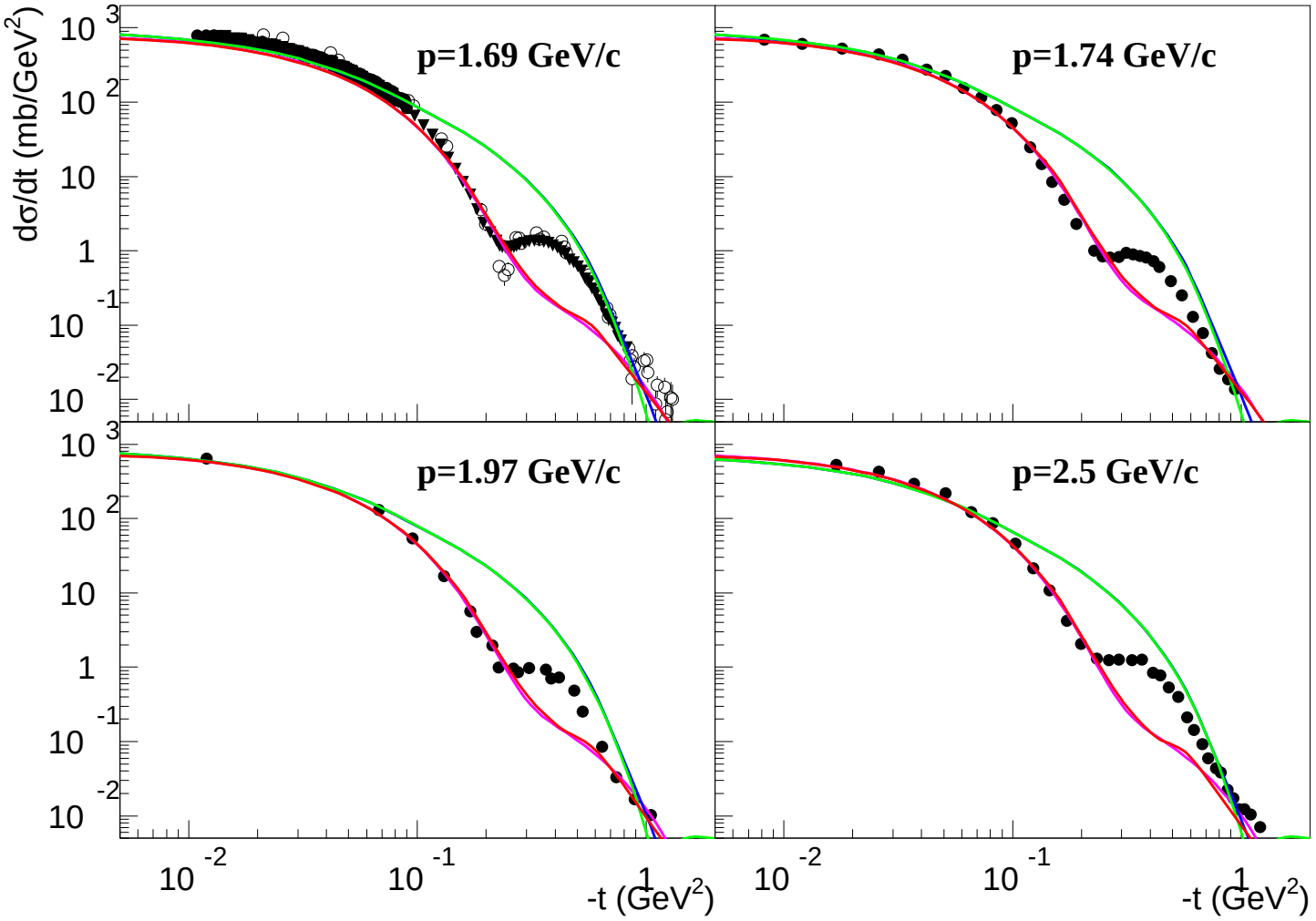

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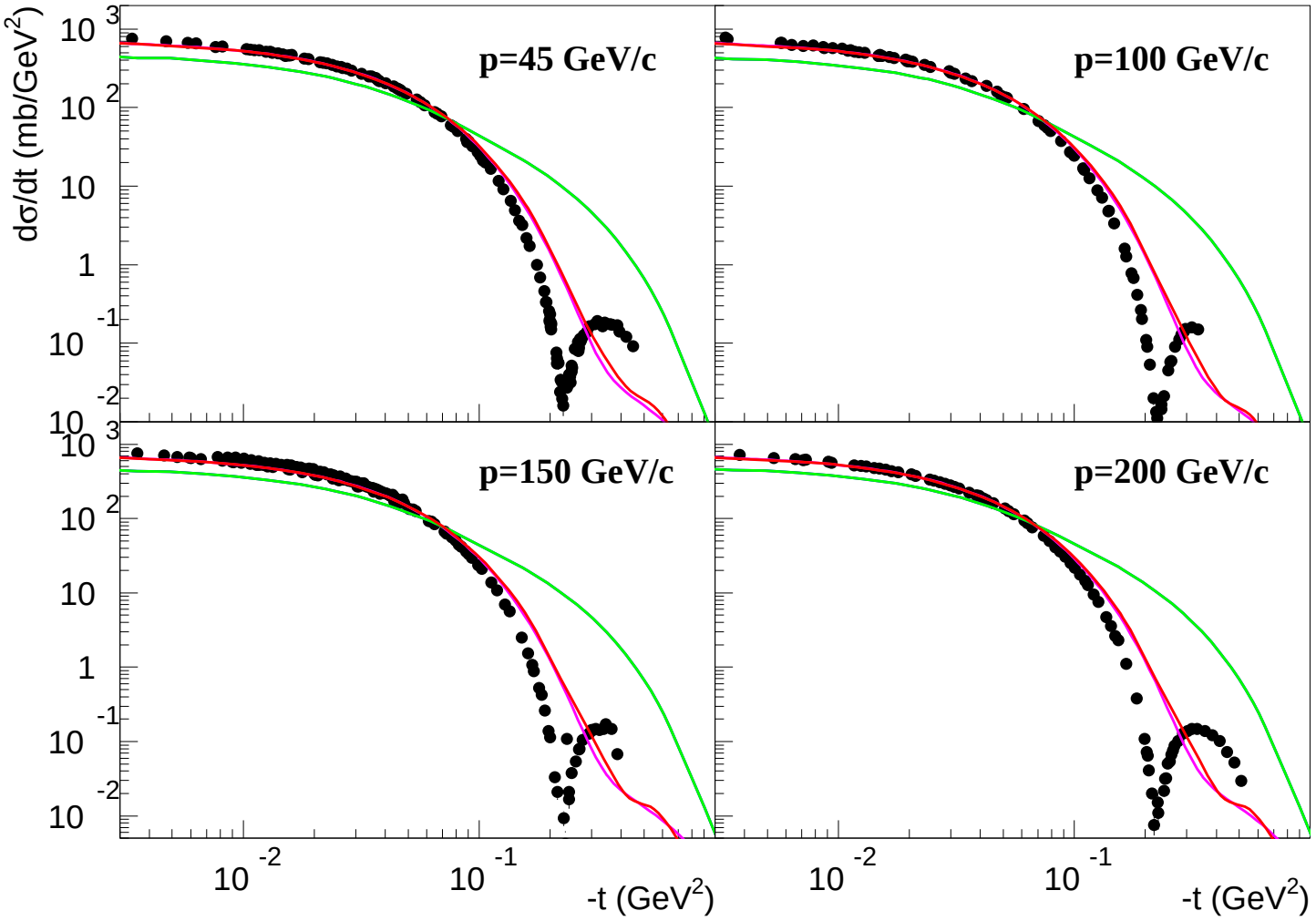

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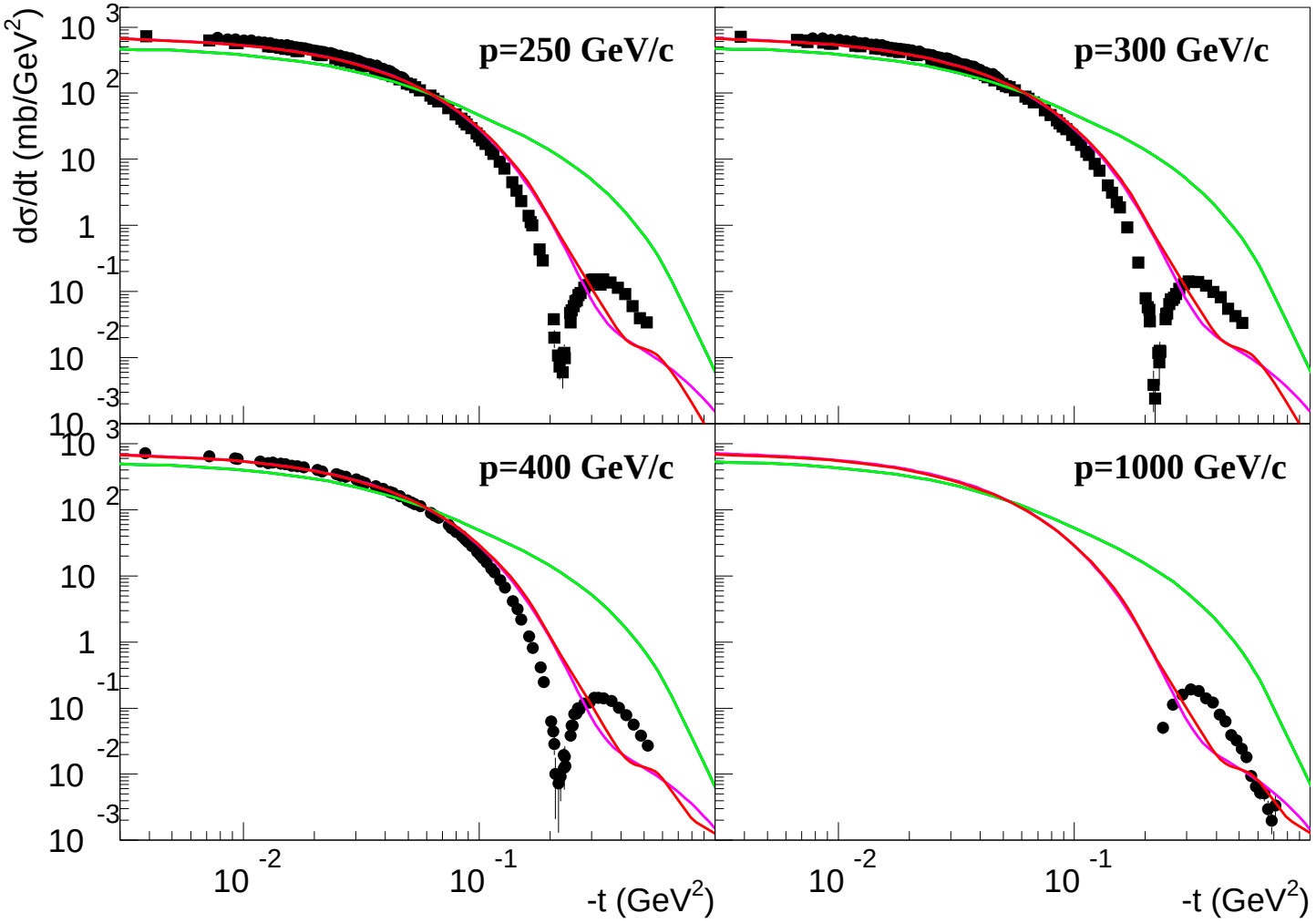

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Approximation of pBe elastic scattering

$$\frac{d\sigma}{dt} = A_1 \frac{e^{-B_1|t|^{1/2}}}{|t|^{1/2}} + A_2 B_2 e^{B_2 \cdot t} + \frac{A_3 B_3}{n} (B_3|t|)^{n-1} e^{-(B_3|t|)^n}$$

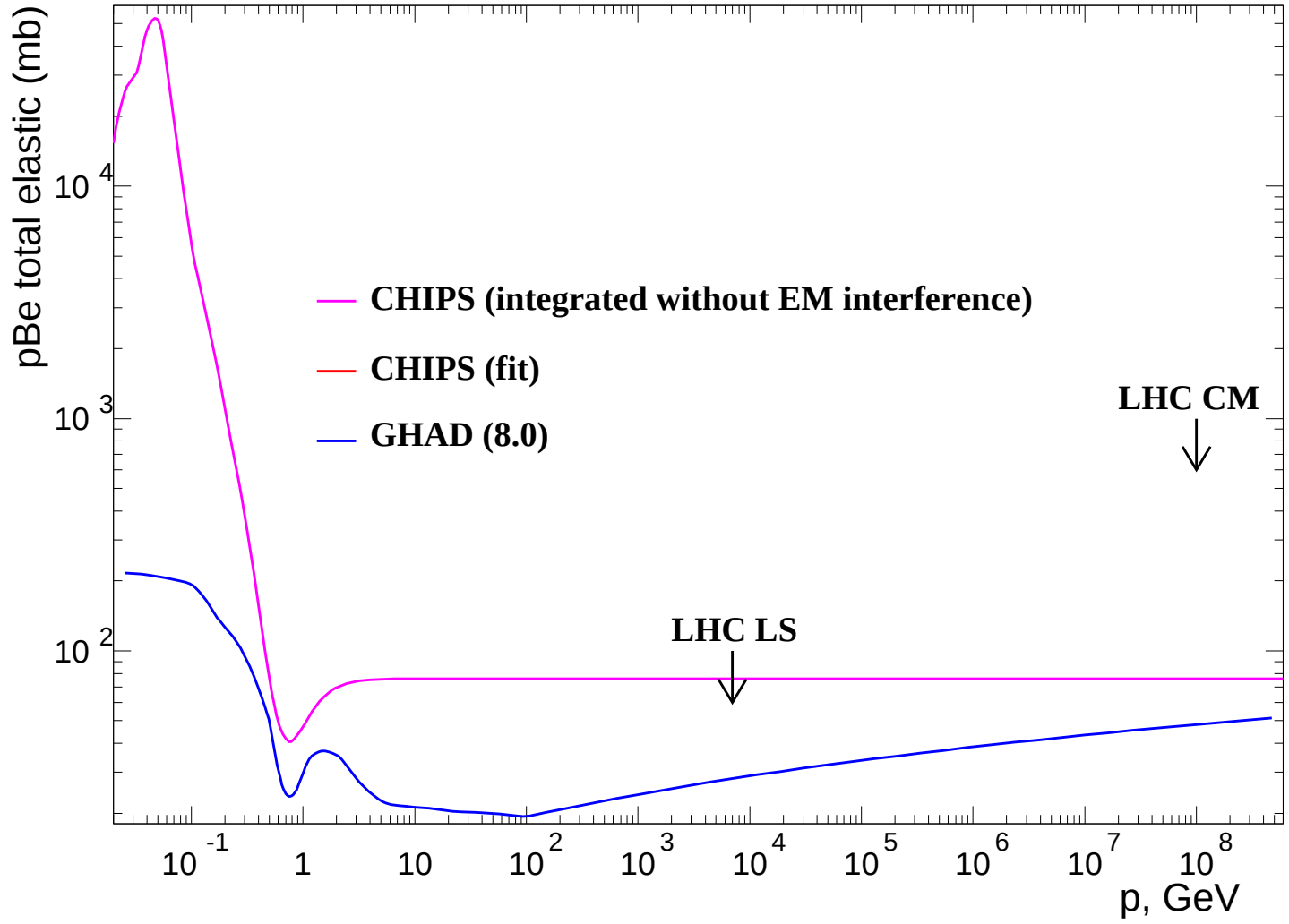
1. Interference with electromagnetic (Coulomb) scattering.
2. The main maximum of diffraction (a diffraction cone)
3. The second maximum of diffraction
4. *** There is no nuclear gloria. ***

The Coulomb parameters are the same as for pHe (practically no data).

A new approximation method for the second diffraction maximum is used.

The measurements above T = 1 GeV do not exist, so the Glauber model must be used for the primary t-distributions.

Verification and development of pA elastic scattering.



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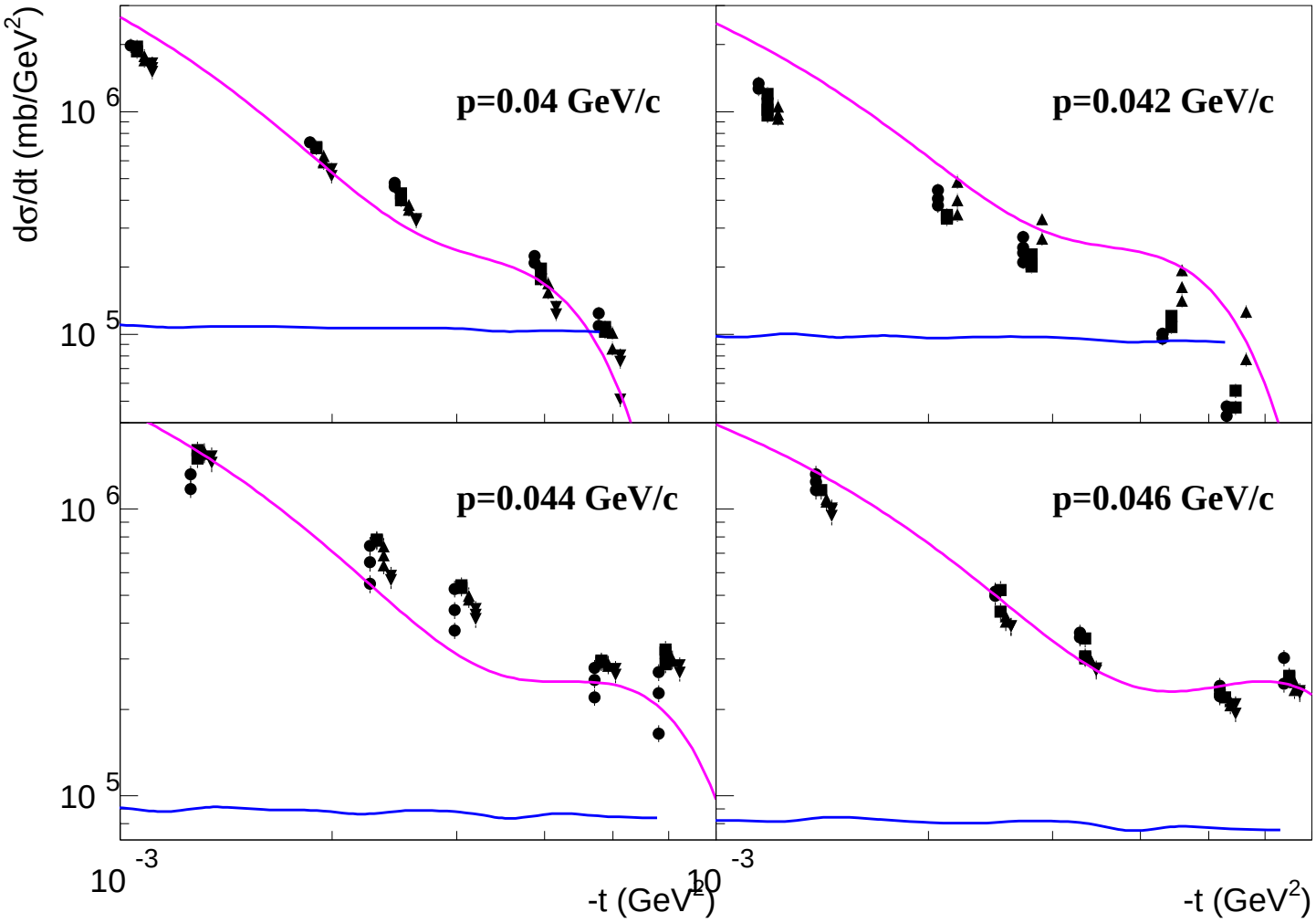

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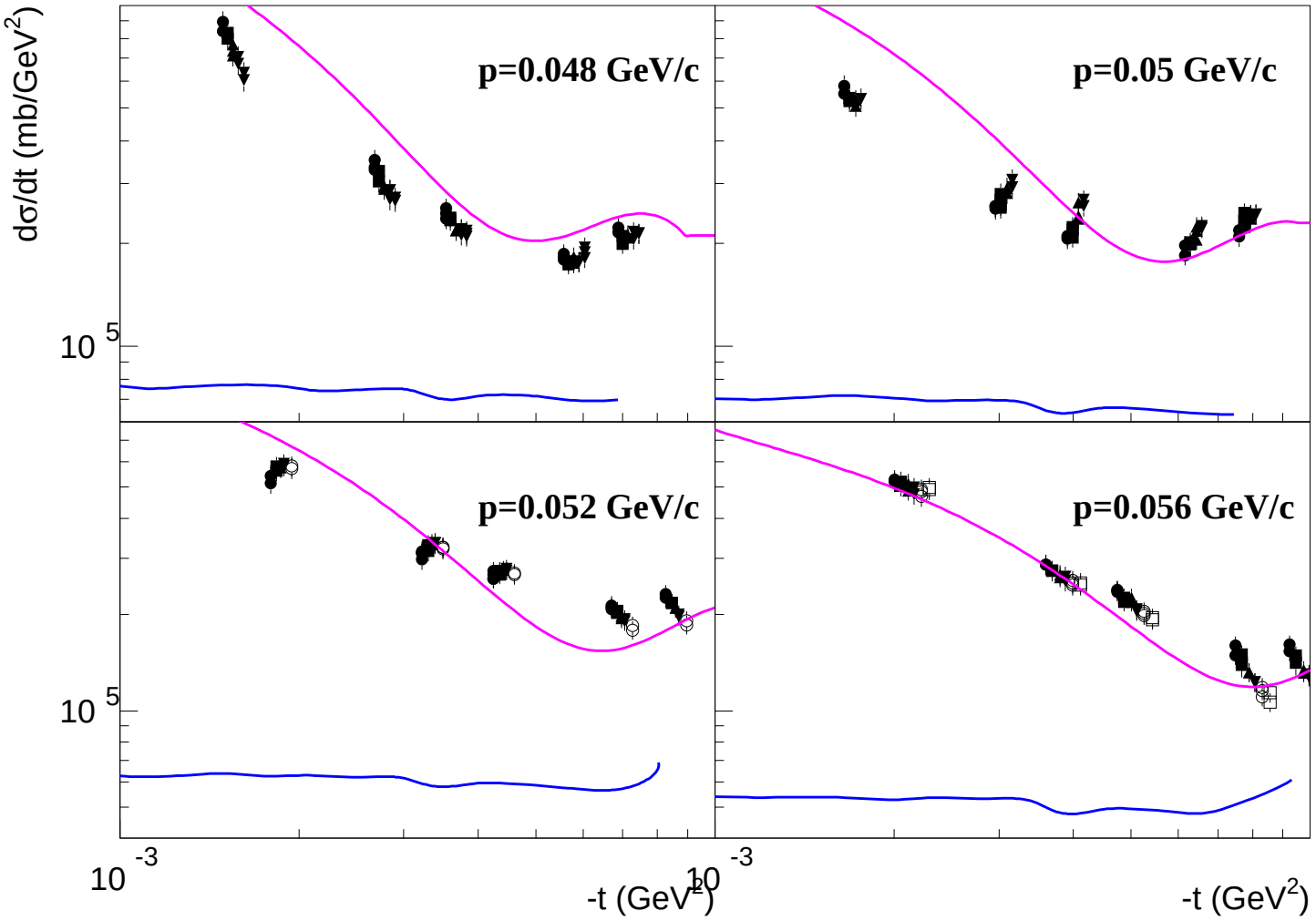

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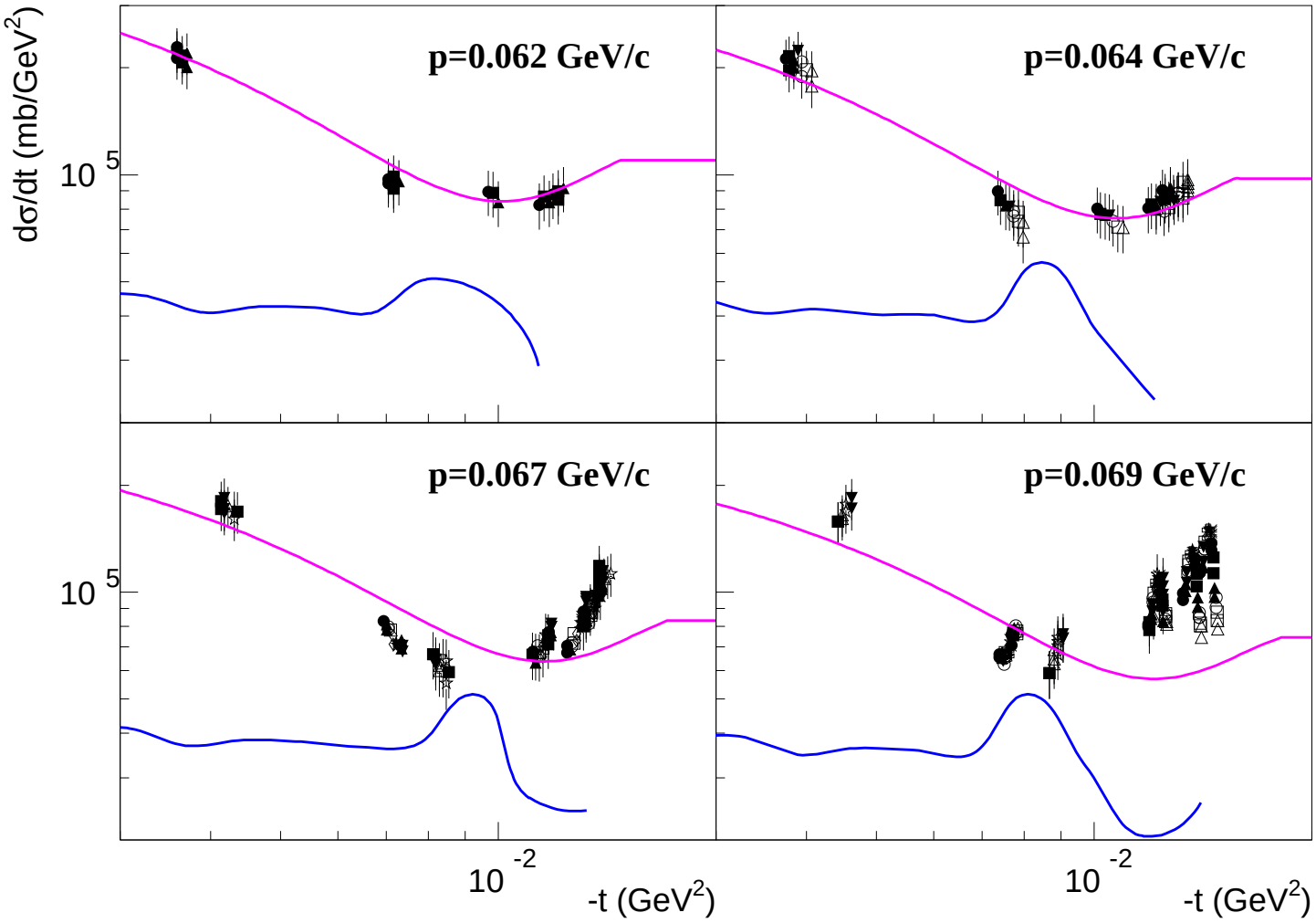

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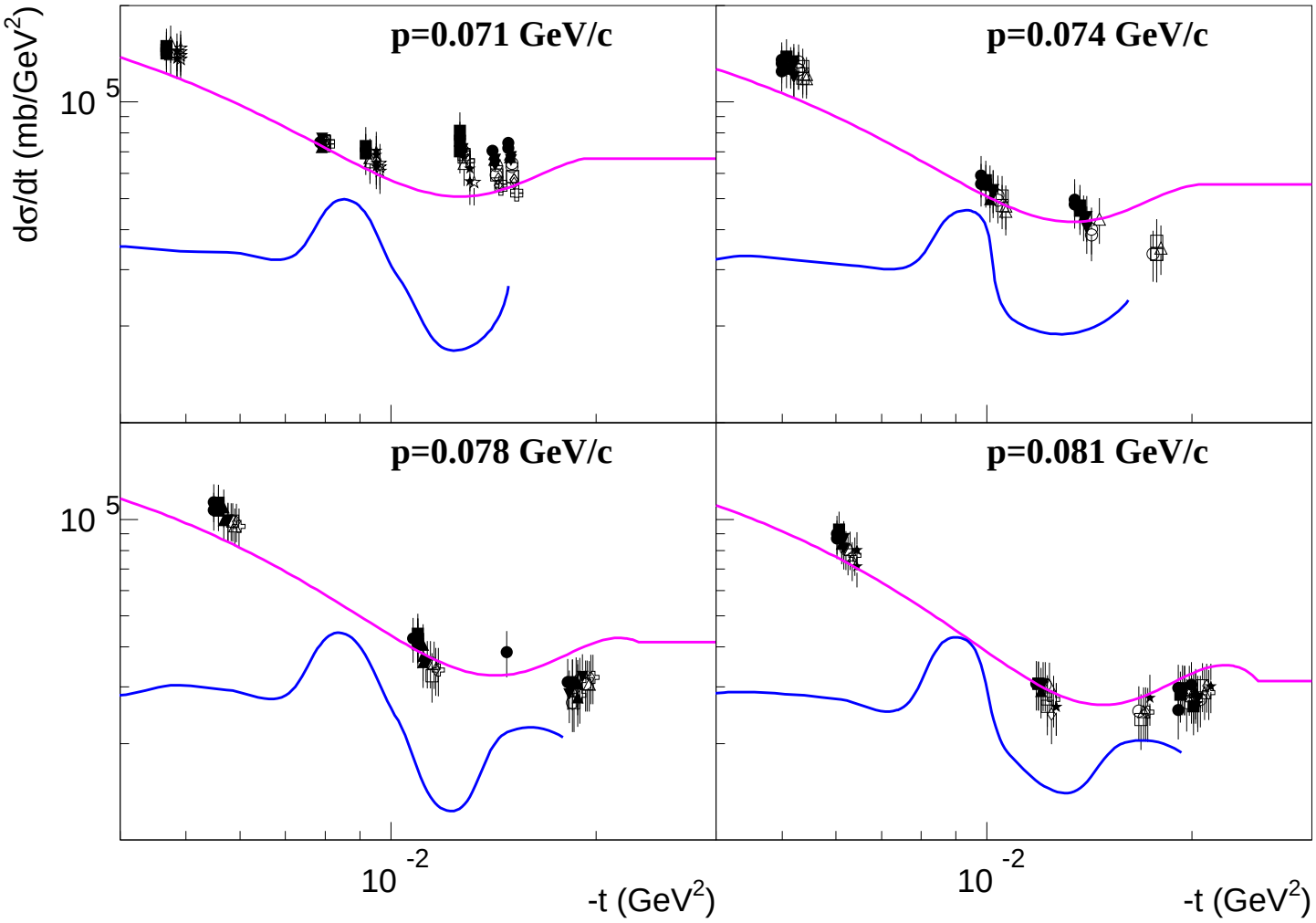

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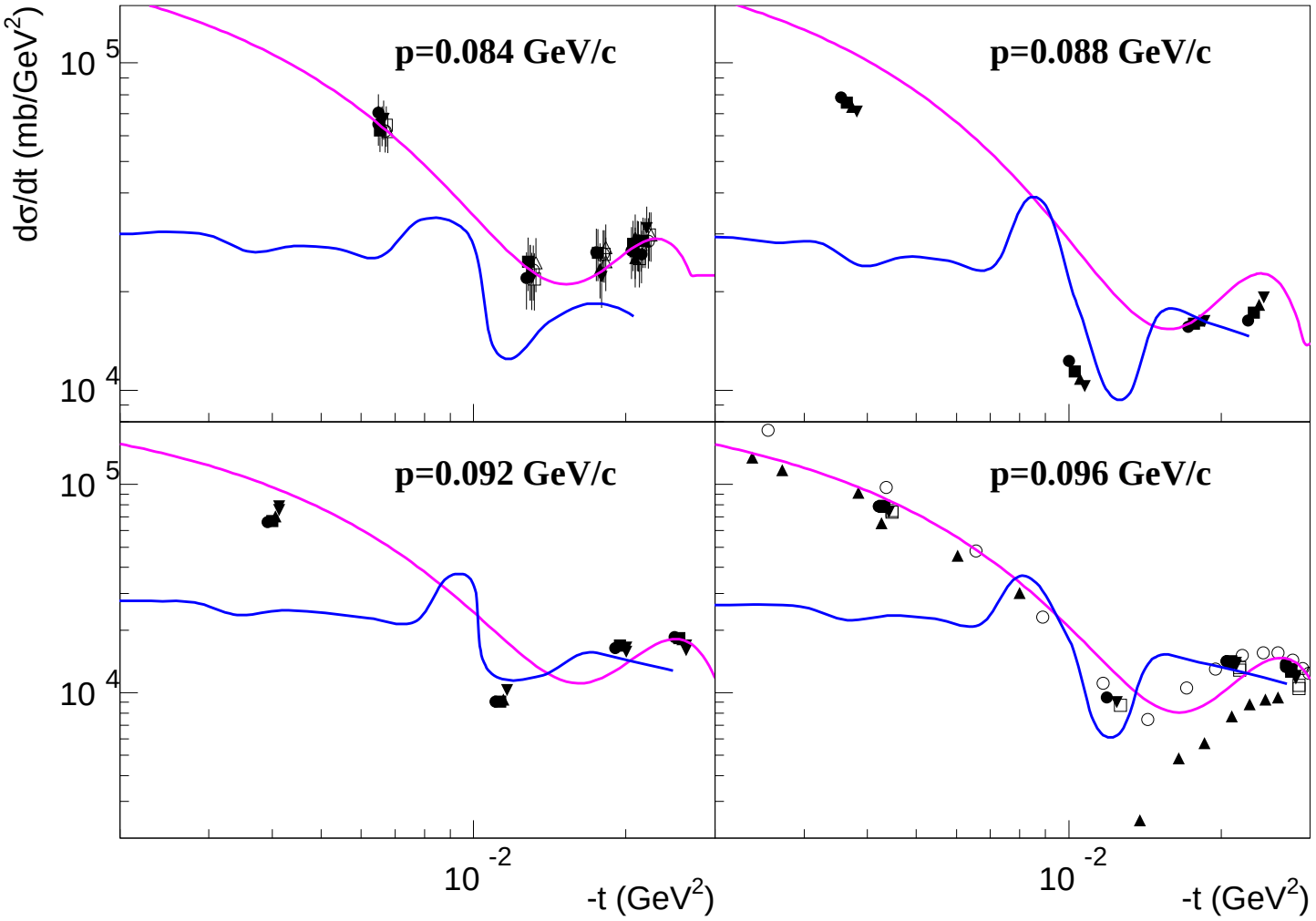

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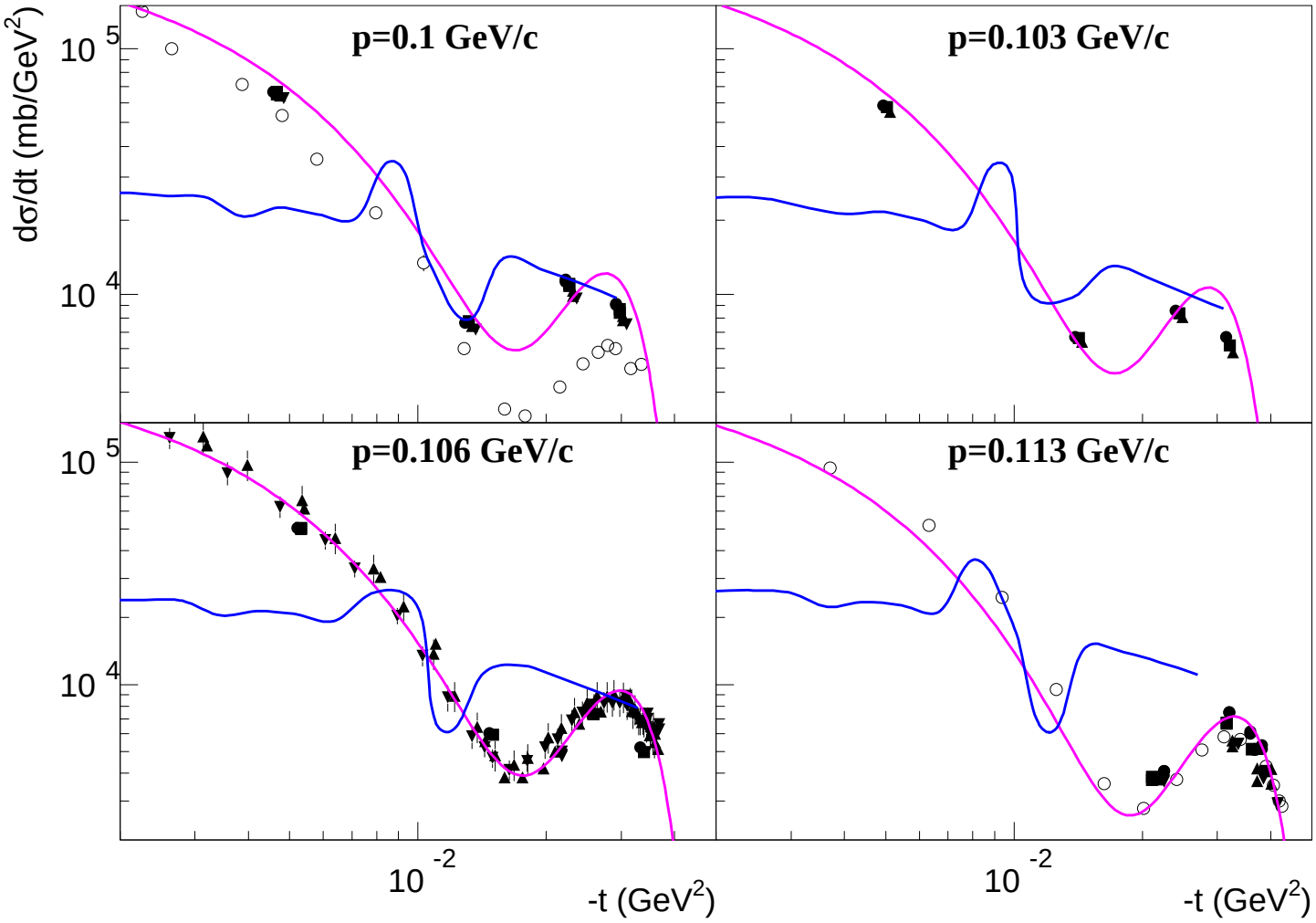

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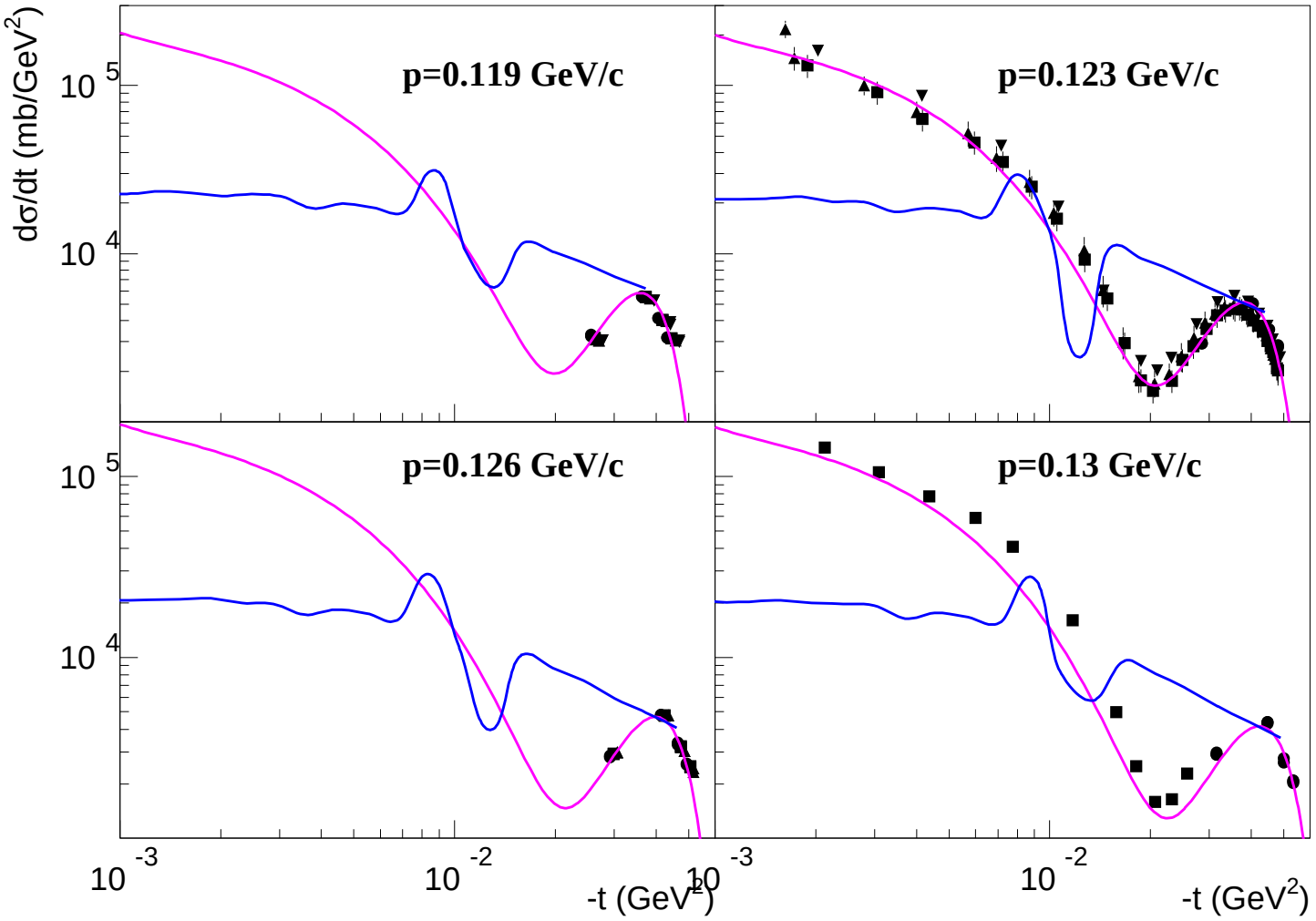

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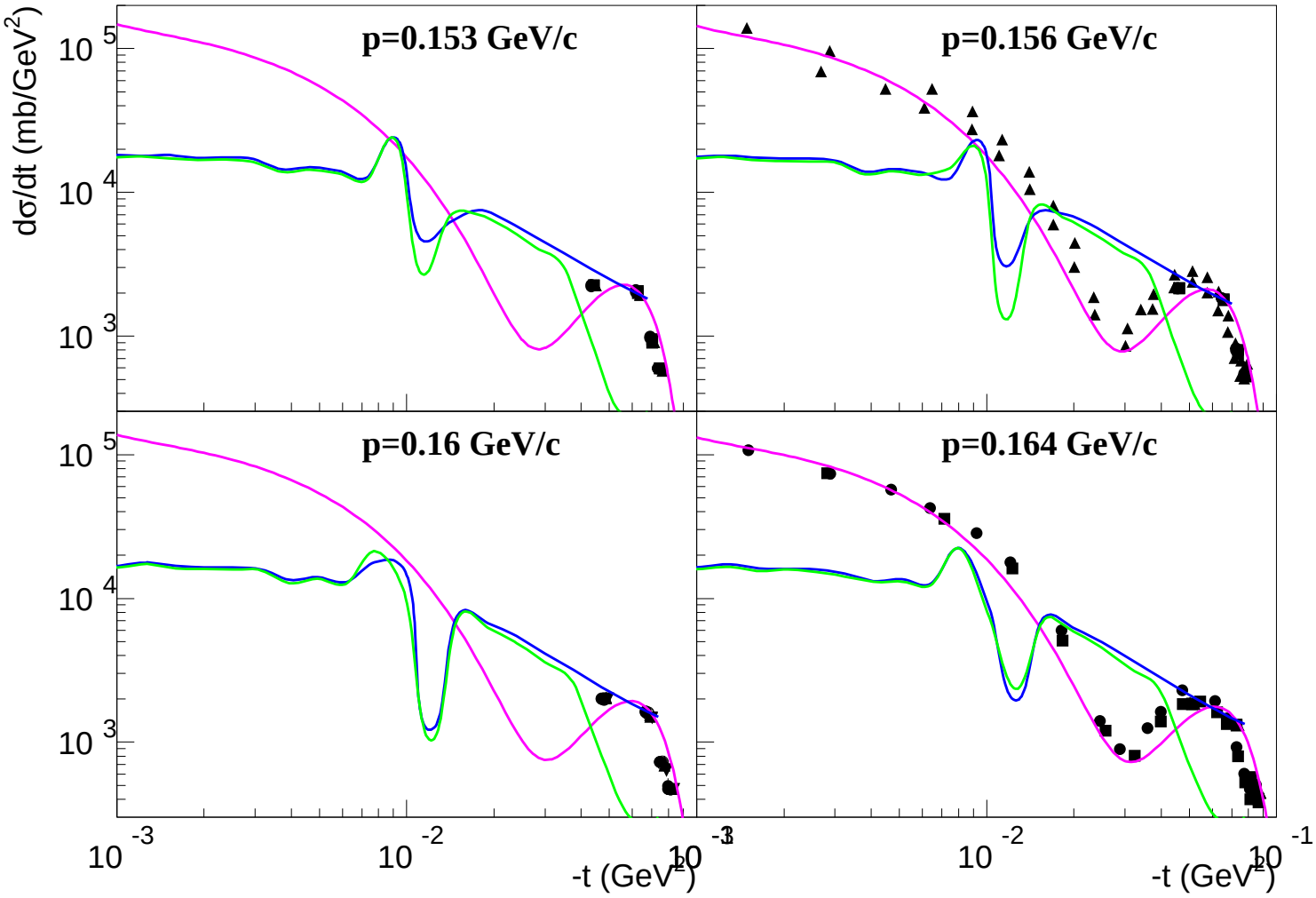

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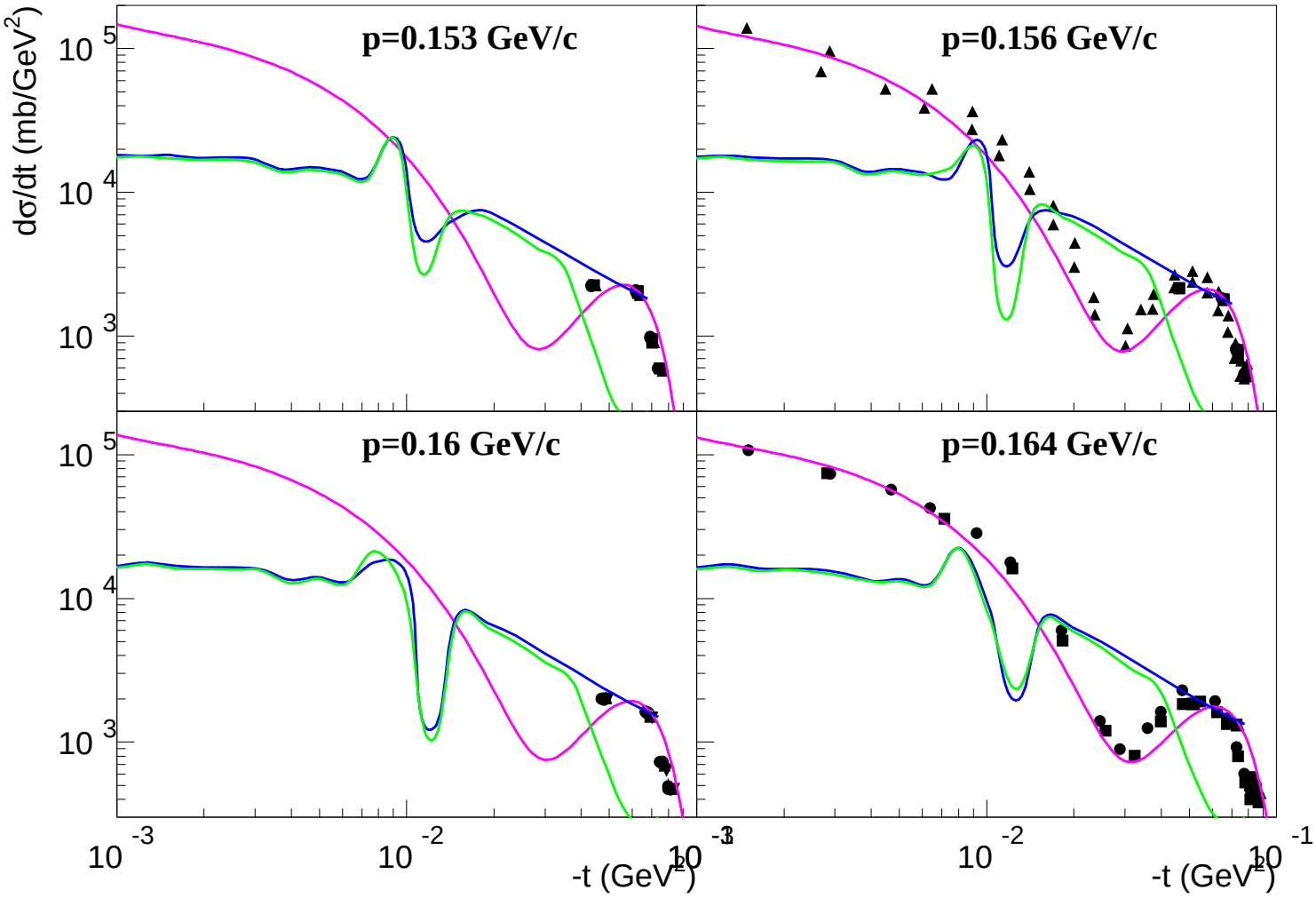

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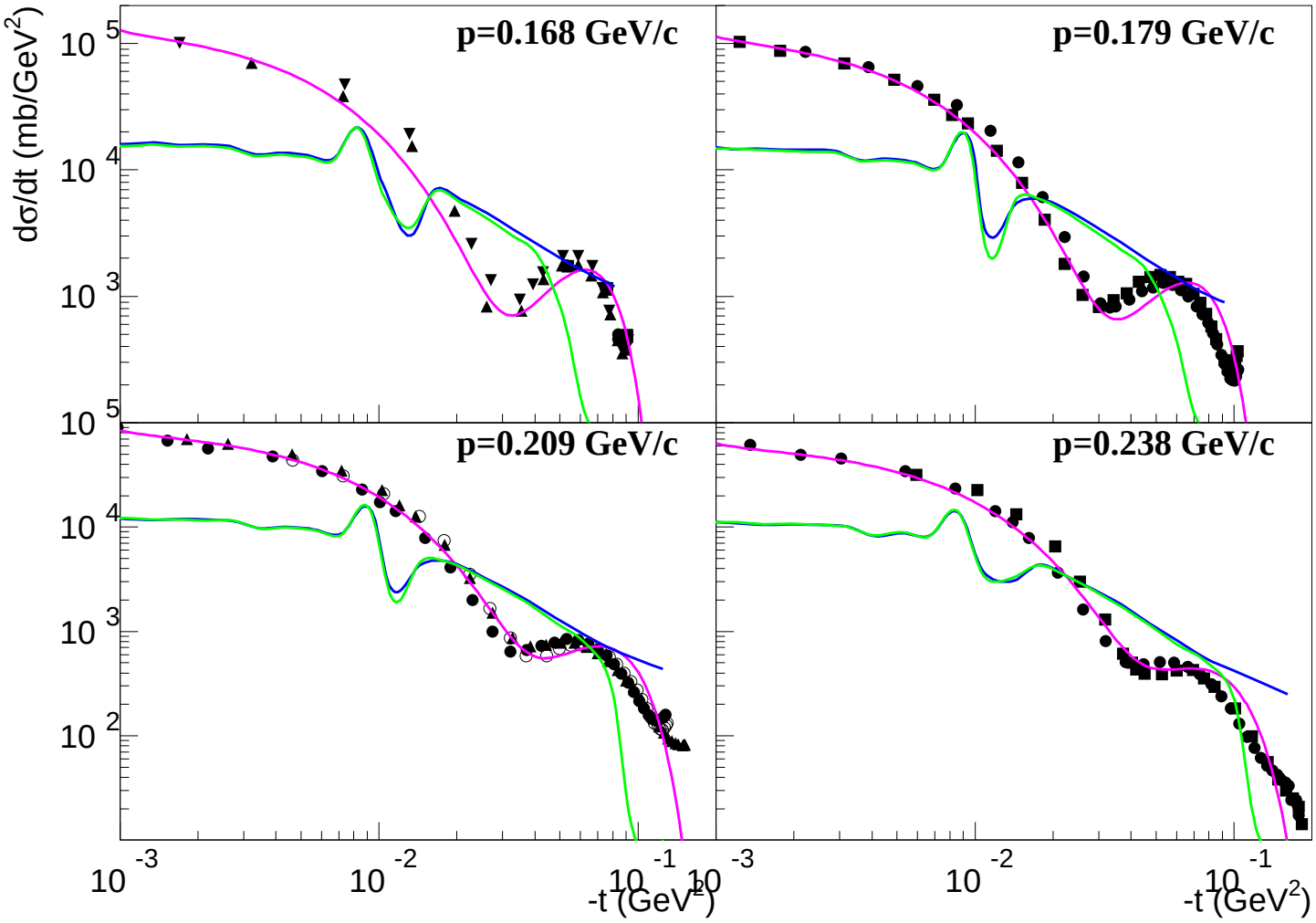

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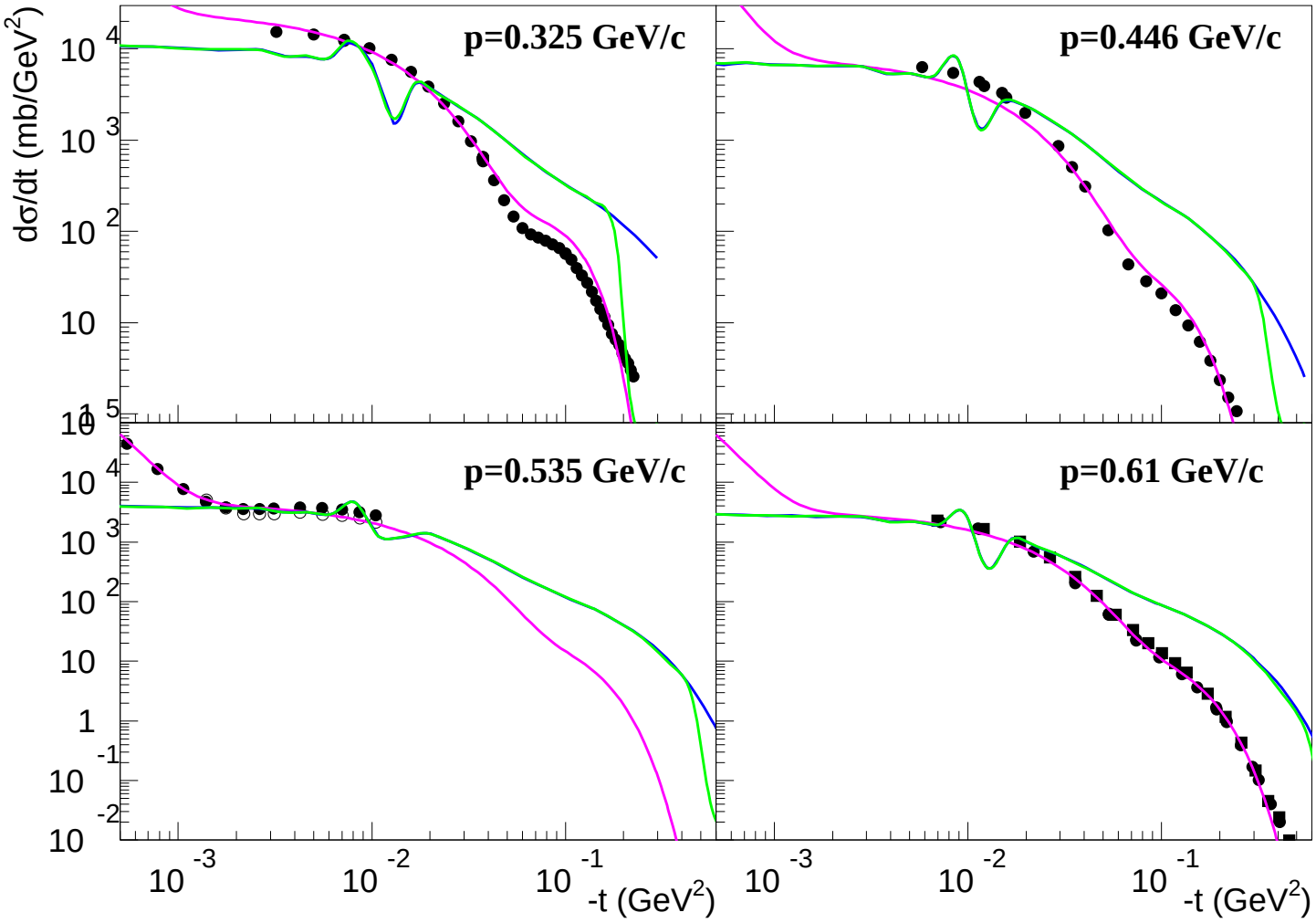

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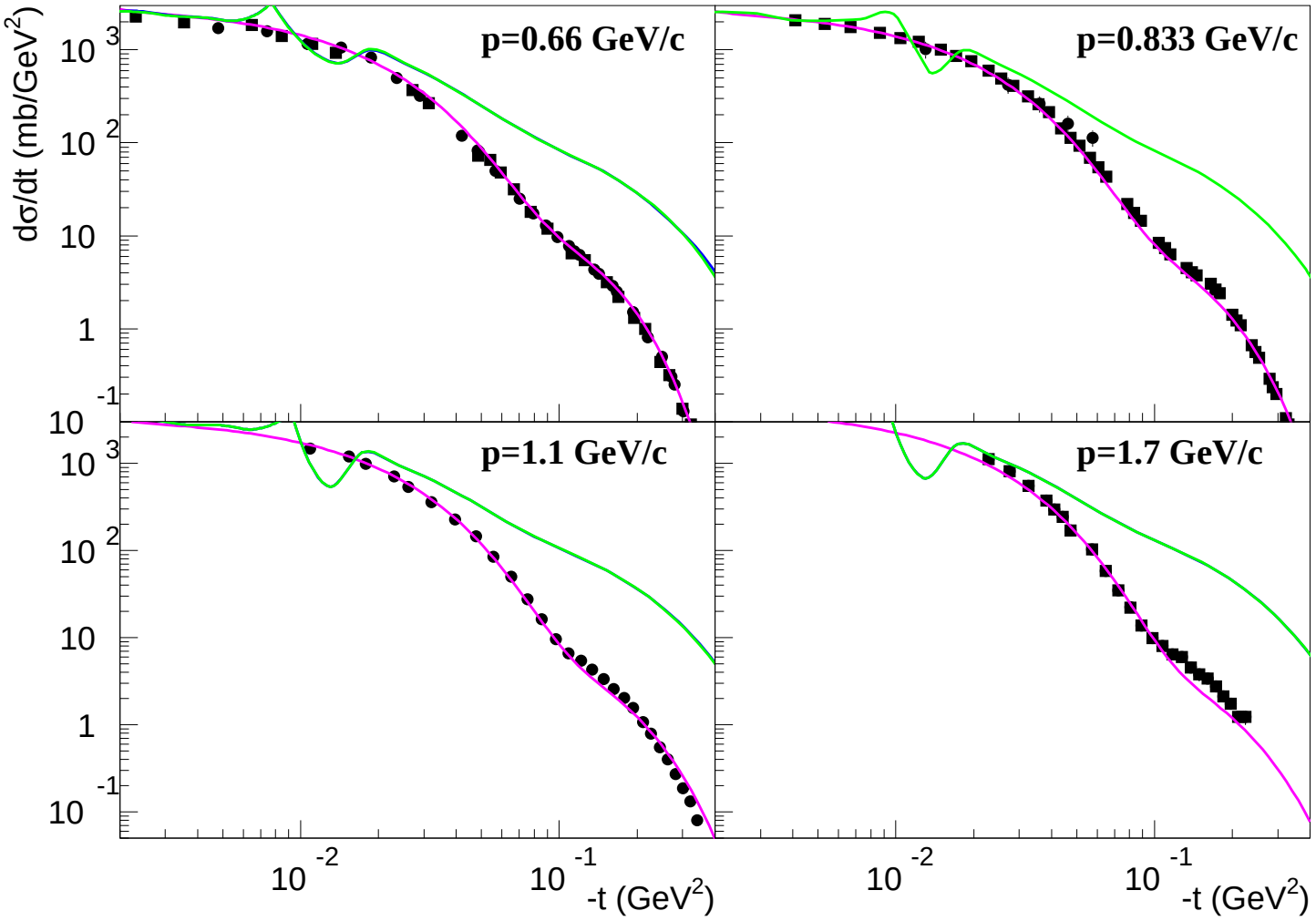

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Conclusion

- CHIPS gives a detailed approximation of the existing data;
- ***BUG*** In GHAD neither G4HadronCrossSection, nor G4HadronElasticProcess are sensitive for the isotope content of the G4Element, so at present a deuterium target can not be simulated;
- For internal use the G4QElastic process is made up to pHe-elastic;
- The existing GHAD (G4LElastic) approximation is bad everywhere and below 100 MeV/c does not produce a recoil nucleus;
- G4LElasticB produces the recoil nucleus everywhere, but looks to be too isotropic;
- G4ElasticHadrNucleusHE and G4ElasticCascadeInterface do not work.