Calculation of elastic and inelastic ion-ion cross-sections

Mikhail Kosov, 12th Geant4 Workshop (GB, Sep.2007)

First CHIPS R&D for Ion-Ion interactions

- **Prepare for nuclear/hypernuclear transport**
  - ☐ G4QIonIonCrossSection can be used for nuclear fragments and hyperfragments:(Z,N,L)=(Z,N+L,0).
  - ☐ G4QLowEnergy for inelastic ion-ion interactions.

- **For heavy ions the elastic par is about 45%**
  - ☐ G4QIonIonCrossSection provides σ_{el}/σ_{tot} ratio.
  - ☐ G4QIonIonCrossSection provides **t** for elastic

- **High energy inelastic interactions are needed**
 - ☐ CHIPS G4QHighEnergy class (to be developed)

Preliminary solution for Ion-Ion XS

- **Glauber calculations have been done for AA elastic and total cross-sectioins**
  - A: D, He, Li, Be, C, Al, Cu, Sn, Pb, U (no H)
- **Calculated cross-sections have been fitted**
  - Parameterization of $\sigma_{tot}(A_1,A_2)$ cross-sections
  - Parameterization of $\sigma_{el}/\sigma_{tot}(A_1,A_2)$ ratios
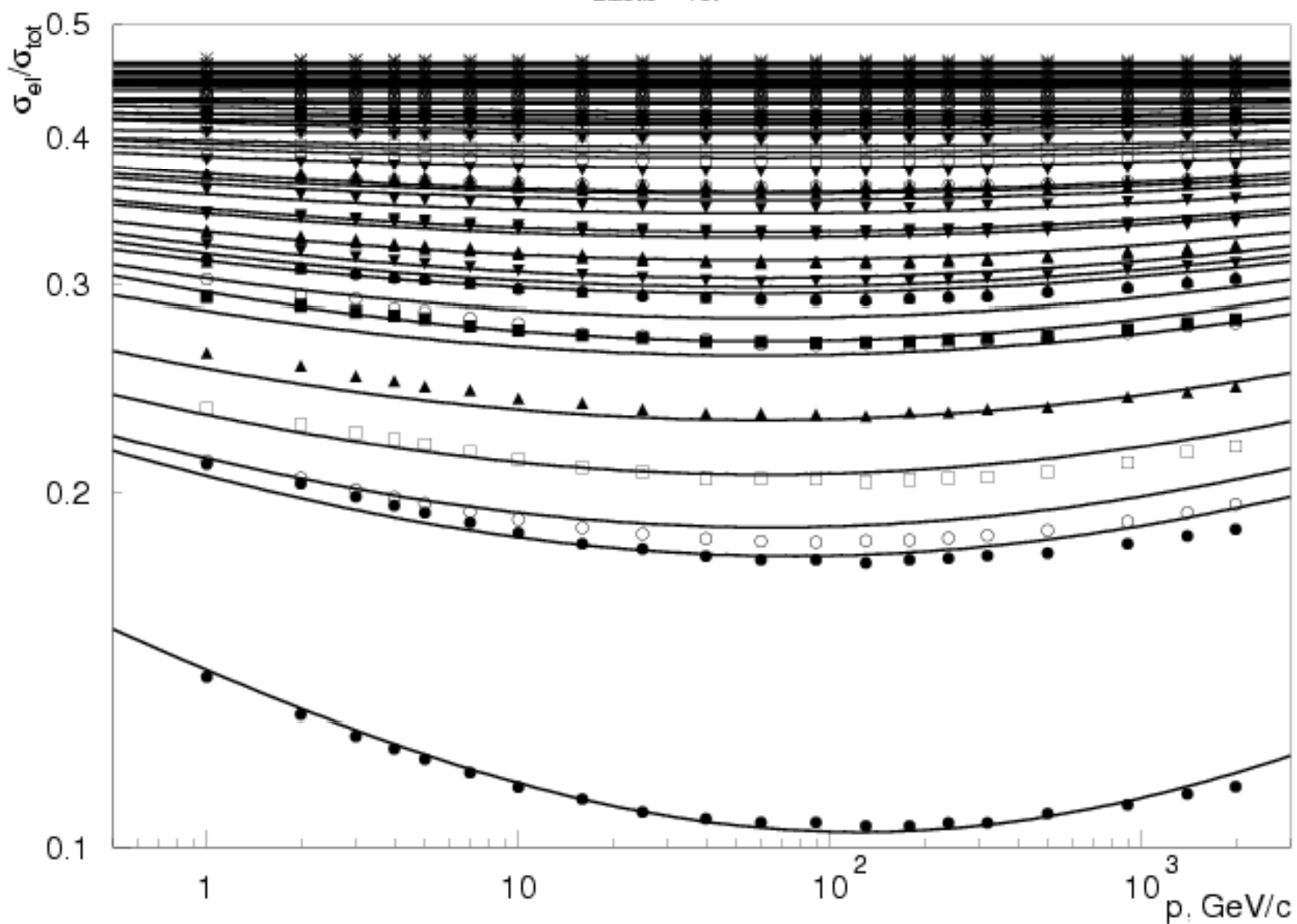- **In future measurements should be collected and the found parameterization formulas should be tuned to the data.**

Momentum Dependence of σ_{Tot} for different AA combinations
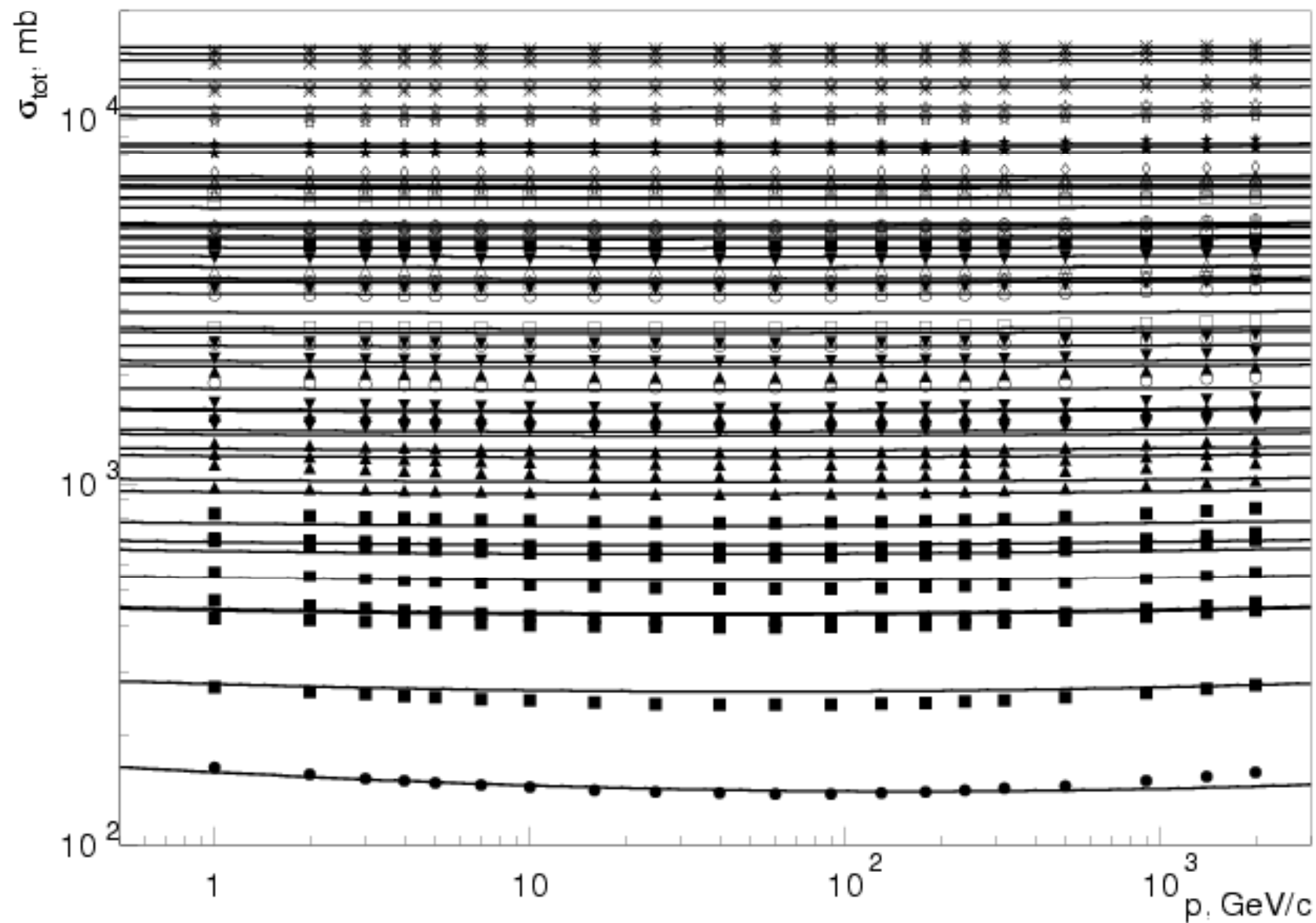
Momentum dependence of $\sigma_{Elastic}/\sigma_{Tot}$ Ratio for different AA combinations

Simulation of elastic cross-section

- **Ion-Ion elastic cross-section is very forward**

- **With good accuracy the t-distribution is energy independent**

  - For mean squared radius $<R^2>$ the nuclear form-factor can be calculated as $F_A(t)=e^{<R2>t/6}$

  - With the diffraction cone parameter is B (it is energy dependent, but $B << <R^2>/3+<r^2>/3$, where r and R are radii of target and projectile):

  $$d\sigma/dt=C\cdot e^{(B+<R2>/3+<r2>/3)t}$$

Conclusion

- CHIPS is prepared for the Ion-Ion transport
- As an SU(3) package CHIPS supports hypernuclei
- Interaction cross-sections are provided
- Ion-Ion elastic scattering is already supported for all energies, providing a narrow diffractive cone
- Low energies inelastic interactions of the most of the nuclear fragments are already supported
- High energy inelastic interactions must be implemented in SU(3) form.