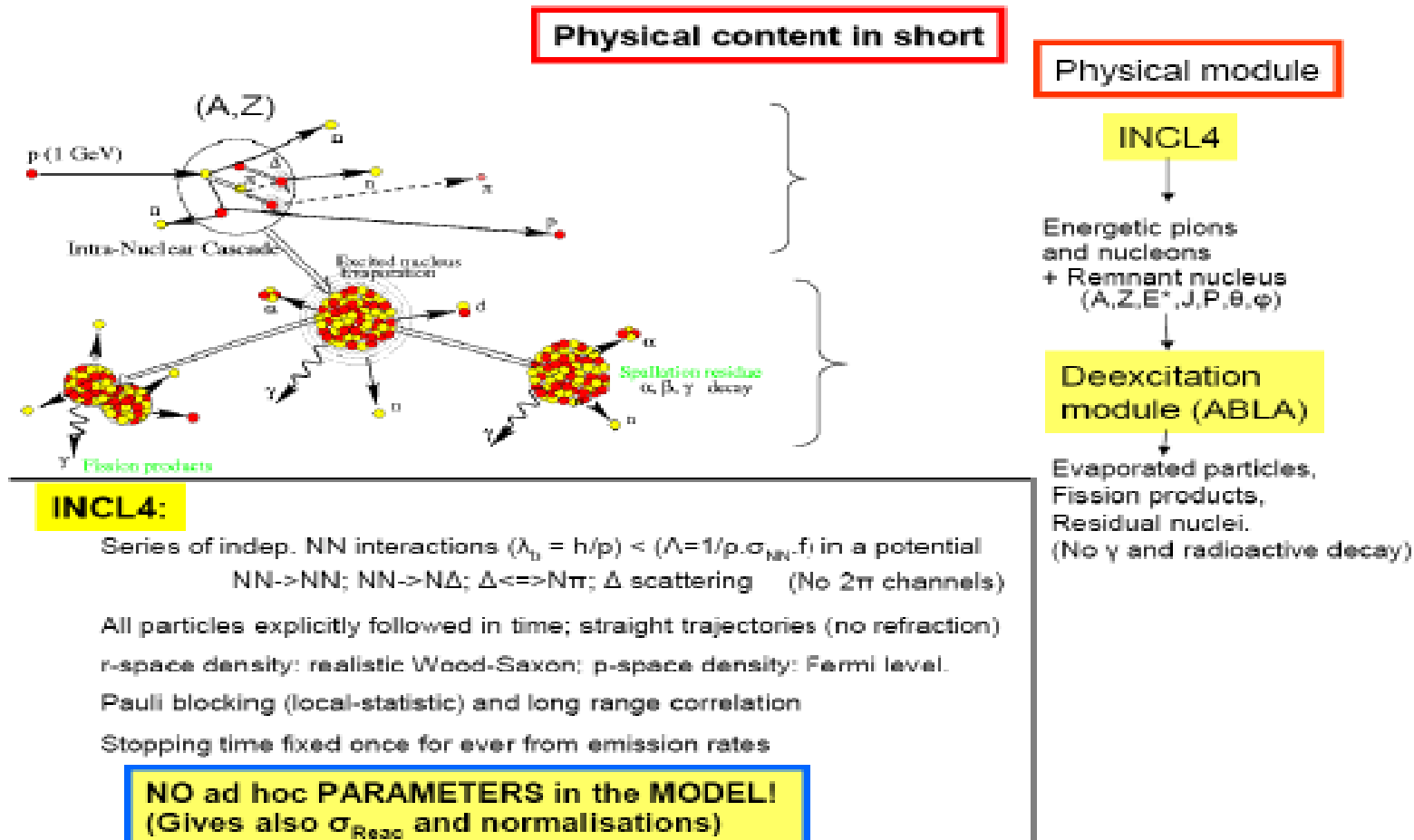# Hadronic Parallel Session 3:
New models

Overview

- A. Heikinnen, ABLA/INCL
- M. Kosov, CHIPS
- T. Koi, Ion-ion
- V. Grichine, Diffuse elastic
- D. Wright, RPG
- P. Trusscot, new reqirements

INCL/ABLA phyiscs

Physical content in short

(A,Z)

p (1 GeV)

Intra-Nuclear Cascade

Excited nucleus Evaporation

d

α

Spallation residue α, β, γ decay

n

γ

Fission products

Physical module

INCL4

↓

Energetic pions
and nucleons
+ Remnant nucleus
$(A,Z,E^*,J,P,\theta,\phi)$

↓

Deexcitation
module (ABLA)

↓

Evaporated particles,
Fission products,
Residual nuclei.
(No γ and radioactive decay)

INCL4:

Series of indep. NN interactions $(\lambda_b = h/p) < (\Lambda=1/\rho.\sigma_{NN}.f)$ in a potential
 NN->NN; NN->NΔ; Δ<=>Nπ; Δ scattering   (No 2π channels)

All particles explicitly followed in time; straight trajectories (no refraction)

r-space density: realistic Wood-Saxon; p-space density: Fermi level.

Pauli blocking (local-statistic) and long range correlation

Stopping time fixed once for ever from emission rates

NO ad hoc PARAMETERS in the MODEL!
(Gives also σ_{Reac} and normalisations)

In conclusion

- INCL candidate tag is now ready. It contains set of tests, an example application, and a short documentation for Physics Reference Manual.

- In ABLA testing we have have found problems in fission, yet candidate tag for December release should come in time.

- We will proceed with re-modeling of INCL code. A significant requirement/complication is that we want to synchronize design Geant4 and stand-alone C++ version of INCL.

- We seem to have now enough manpower to attack these issues:
  - Pekka Kaitaniemi is starting in November his INCL relates PhD work at CEA.
  - Also, a significant contribution might come from INFN-Catania. They are interested developing Geant4 capability for Carbon medical beams.

Conclusion for CHIPS quasi-elastic

- Total & elastic hN cross-sections are updated
- Calculation and approximation of $R=\sigma_{QF}/\sigma_{IN}$
- G4QuasiFreeRatios class provides a pair of $(\sigma_{QF}/\sigma_{IN}, \sigma_{QE}/\sigma_{QF})$ for inelastic processes
- Scattering on quasi-free clusters is possible
- G4QuasiFreeRatios is used in G4QCollision
- G4QuasiFreeRatios is used in QGS/FTF. It improves the longitudinal Shower Shape.

Outline of Ion/ion talk

- Current Capability of Geant4 for Heavy Ions interactions
  - G4BinaryLightIonReaction
  - G4WilsonAbrasionModel
- New Model based on QMD
- DPMJET-2.5 Interface
- Summary

Summary

- QMD based heavy ions interaction model is under development

- Mean field calculator, ground state nucleus generator and elemental collision channels are already developed and under testing.

- DPMJET-2.5 Interface is also developing which can treats nuclear-nuclear interactions from 5GeV/nuc to the order of 1000TeV/nuc.

Optical Elastic Differential Cross Section Model

Vladimir Grichine

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Abstract

Differential elastic hadron-nucleus cross-sections are discussed in the framework of optical approach. The model predictions are compared with experimental data. The contribution of Coulomb scattering is discussed for charged hadrons.

Differential elastic cross-section of 9.92 GeV/c protons on Pb
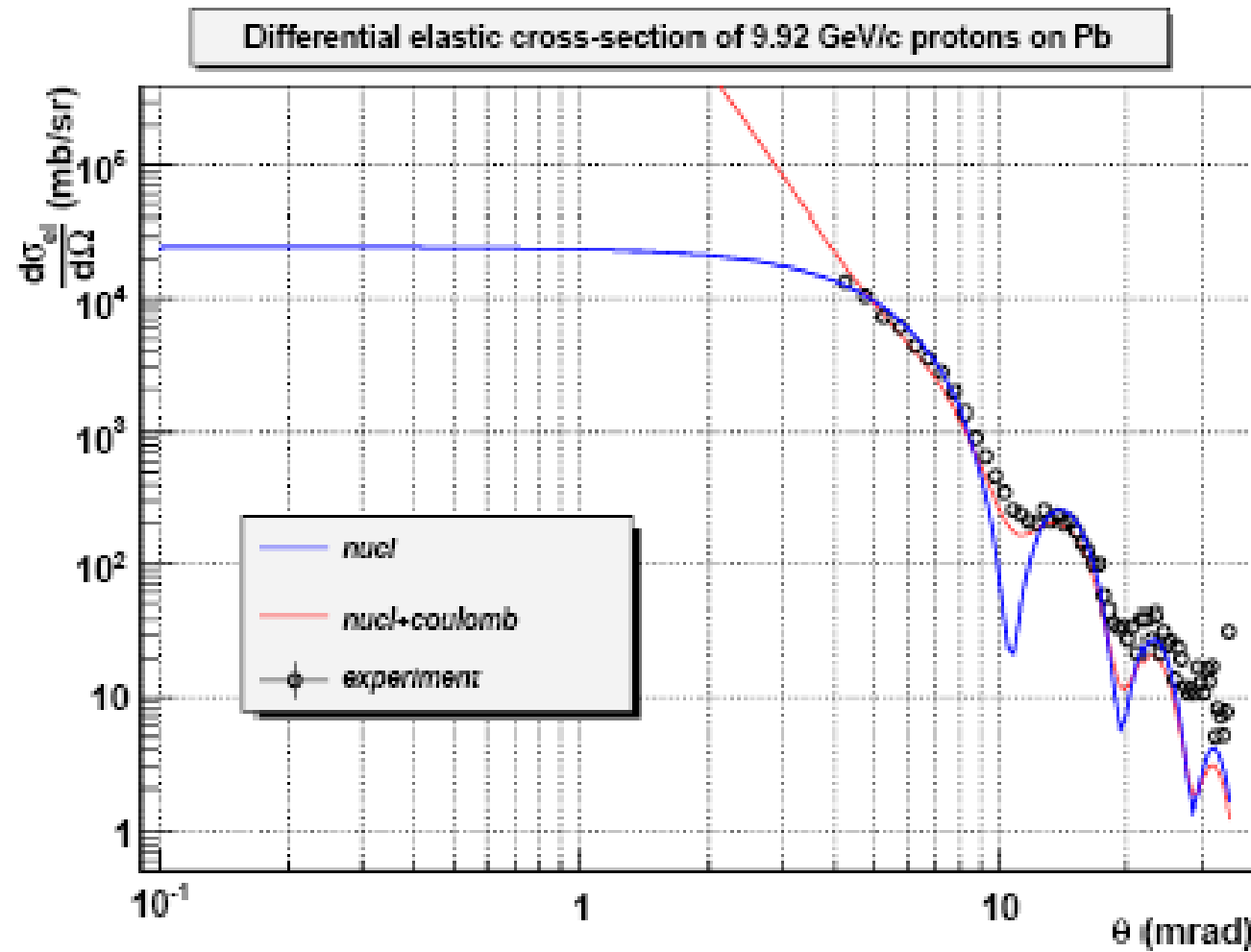
$\sigma_{el}^{cw}(0, 4\ mrad) \sim \sigma_{el}^{cw} = 2.11854 \cdot 10^{9}$ mb, with $\lambda = 0.143101$ micron.

$\sigma_{el}^{cw}(4\ mrad, 40\ mrad) = 919.547$ mb, with $\lambda = 329689$ micron (33 cm).

Re-Parameterized Gheisha Model

- Proposed as a replacement for LEP

- Maintain basic LEP/Gheisha concept, but
  - correct all known problems of LEP
  - use the best, most up-to-date cross sections
  - improve the parameterizations
    - use mostly medium energy data instead of high energy data used in original Gheisha
  - streamline and objectify the code

Development Schedule

- Depends on number of people involved
- Tentative schedule for 2008 (for nucleons and pions)
  - development: present – March 08
  - first comparison to data: March 08 – June 08
  - tuning: June 08 – October 08
  - first public release: December 08
- Kaons, hyperons, anti-particles will follow in 2009
  - draw on Bertini experience
  - attempt a correct description of oscillations
  - a better parameterized description of anti-nucleon interactions