Summary of Parallel Session 7A New models and requirements Hadron4

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- 3 status reports of Model
  - SAID F.J.
  - INCL P.K.
  - QMD and Low Energy Neutron T.K.
- 2 introductions of coming experiment
  - Proton and Pions beam at PSI A.H.
  - Ions beam at GSI L.D.
- 1 discussion item from user
  - Radio Active Decay
- 3 discussion items from S.C.
  - Medium Term plans
  - Long term plans
  - Integration of Precompound/De-excitation with Other Models (time out)

SAID: Scattering Analysis Interactive Dialin

- A repository of experimental data and an interactive analysis facility, allowing to compare and extract data and partial-wave solutions (PWA) for elastic scattering.
- **R. A. Arndt** (1933–2010) & **L.D. Roper**, Virginia Polytechnic
- Originated c.1980, accessed by 300bd and 1200bd dial-in.
- In the VAX era, program and database were distributed on 9-track tape to ~250 institutions.

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Last login: Sat Sep 11 20:36:48 2010 from assa80.phys.va.gwu.edu
The following reactions are available under SAID
 nn- Nucleon-Nucleon elastic
 pn- Pion-Nucleon elastic. (includes Pi-N -> Pi-Pi-N)
 pr- Pion photo production
 epr- Pion electro- production
 kn- K+N elastic
 pd- Pion-deuteron -> proton-proton
 pde- Pion-deuteron elastic
 sim- Run Physics Simulations
 demo- Run SAID demo
 show- Look at .PCT file
 cprsol - setup/run comparisons for PR/EPR reactions
Enter the code (eg. NN) of the reaction you want to study->
```

Data Extraction and Processing for Geant4 models

- Hadronic Models for elastic scattering **G4LEnp** and **G4LEpp** were constructed from SAID differential cross sections at energies from 10 MeV to 1.2 GeV (Wellisch-Greeniaus-Jones TRIUMF/UofA).
- Recently we extended the energy range to 5 GeV, the upper limit of the supporting data (Kwan-Jones TRIUMF).
- **G4LEnp** cross section includes charge exchange.
- By default **G4LEpp** omits Coulomb scattering effects and hence can also be used for *n*-*n* scattering.
- Total cross sections from SAID are not used in Geant4.
- Some MATLAB scripts were developed to provide a semi-automatic procedure for data extraction, integration, normalisation, and generation of C++ code.
- **G4LEnp** and **G4LEpp** are only occasionally found in user applications. The main use is internally in Binary Cascade!

Summary and outlook

INCL4.2:

- Feature release in December 2010 (Geant4 9.4)
- Maintain with bugfixes until INCL++ is ready to replace it (at least until end of 2011)

INLC++:

- January/February 2011: Include in Geant4 repository
- June 2011: First public beta release
- December 2011: First public stable release

Fe 1GeV/n on Al

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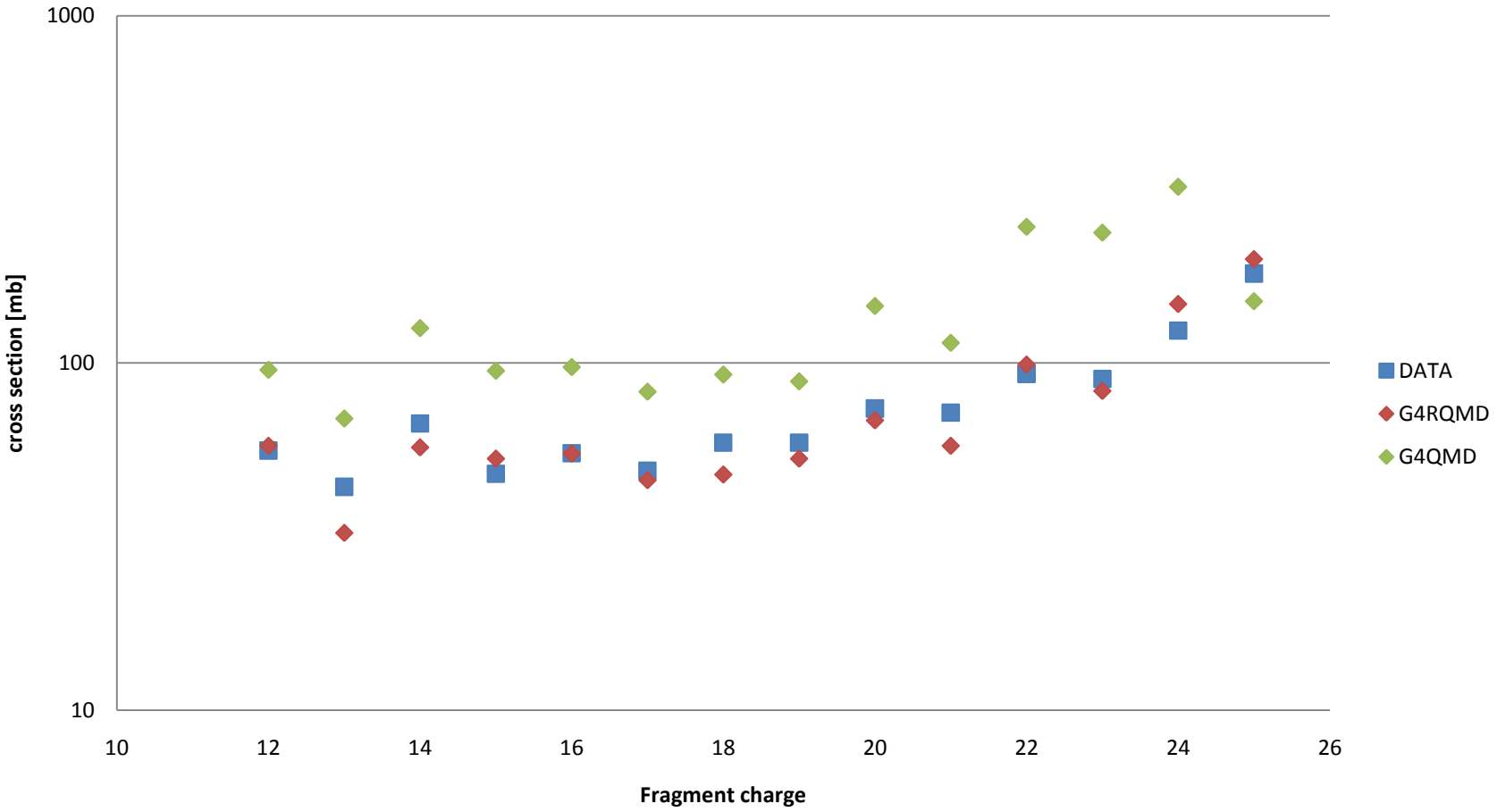
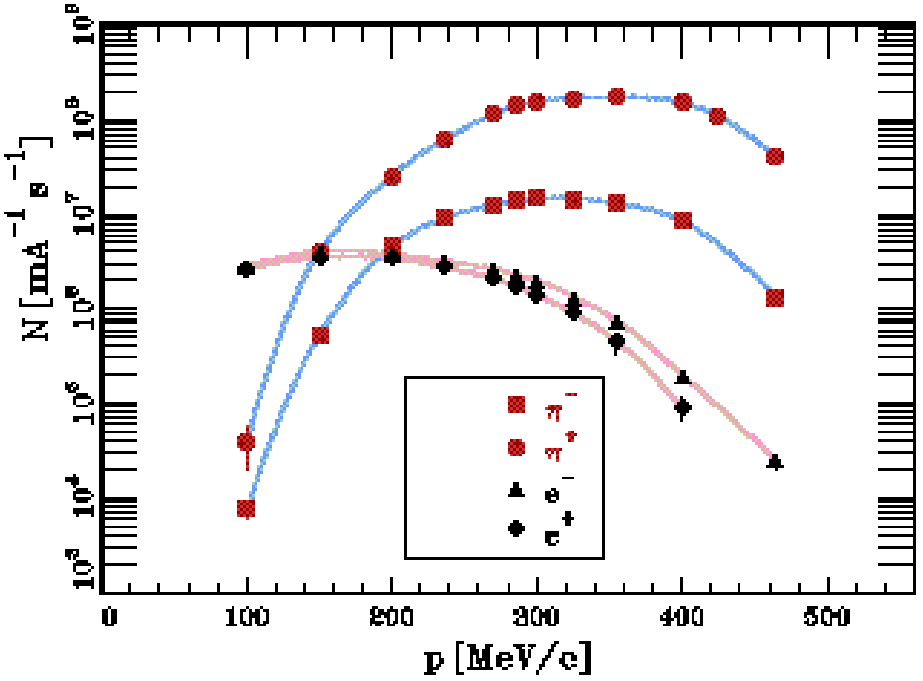


PiM1 beam @ PSI:

- π^+, π^-, p, e^+, e^-, decay μ^+, μ^-
- Momentum selection from 80 MeV/c to 590MeV/c
  - 3.5MeV to 170MeV for proton
  - 21MeV to 433MeV for pions
- π–purity up to 99% (1% μ^+, μ^-)
- Momentum: 0.1% resolution, 2.9% FWHM
- Intensity up to 4.4×10^8 particles/s (!)



- http://aea.web.psi.ch/beam2lines/beam_pim1.html

Radioactive decay and atomic deex

- Branching ratio of **x-rays** typically **under-estimated**
  - Maybe because the code does not handle **more than one atomic vacancy** at the same time
- Interface cannot handle **local energy deposit**: affects especially EC decays, which leave an atomic vacancy (and hence x-rays)
- Bug report **#1001** (open since Feb 2008)
  - **5-fold bug report** with a complete analysis and a proposed patch
  - Complex solution, affecting a number of classes (→ to be analyzed carefully)
- Potentially, same problem of non-correct local energy deposition also for the photon evaporation

Questions and requirments

- Ensure a total decoupling of decay (alpha, beta, EC) from nuclear de-excitation (IT)
  - Set halhlifethreshold = 0 sec by default (1 μs)
  - Not enough ; why ?
  - SetHLThreshold() working ? Correct Messenger
- Provide a function GetDecayMode()
- How to control atomic rearangement mechanisms (ICM and ARM) ?
  - Internal conversion and Auger electrons
- Update interface to G4AtomicDeexcitation
- Momentum conservation in IT mode ?

MAIRE, Michel

- Not only Hadronic but also EM process are involved this problem.
- Category coordinator of Hadron and EM will organize a meeting with stakeholders about this issue.

Medium Term Model Development

- Low Energy Neutron
  - Detailed model than ENDF based
  - Thermal Scattering
    - Adding new materials ??
    - Guide line for cross section for “Material”? “G4_???”
- Elastic Process for Ion
  - ESA Projects
  - Cross Section will be in 9.4.? Final State will follow V. G.
- Low Energy Ion (Much below 100MeV/n)
  - ~~Precompound~~ DeExcitation is used in Binary Light Ion Cascade
  - VUU BUU
  - AMD
- CHIPS

Hadronic Physics Not Covered by Current Models

- ULTLA High Energy Model
  - Much beyond LHC 14TeV cms
  - Air shower from highest energy cosmic ray 10^{20} eV (proton, Fe?)
  - DPMJET (Interface) can be used (now)
  - HIJING will be available soon (V. U.)
- Low Energy Ion-Ion
  - Important in many fields
- Isotope production estimator
  - Many other competitor provide this kind functionality
- Anti Particles especially nucleus
  - Ionization loss will be implement soon
  - Should be implement at least some kind of (very simple) annihilation model.
- Neutrino
  - CHIPS can be used (now), validation should be done and in public
  - Some kind of biasing technique required
- Biasing
  - Some implementation exists, but none used
  - Need re-design

Integration of Precompound/De-excitation with Other Models

IVANTCHENKO, Vladimir

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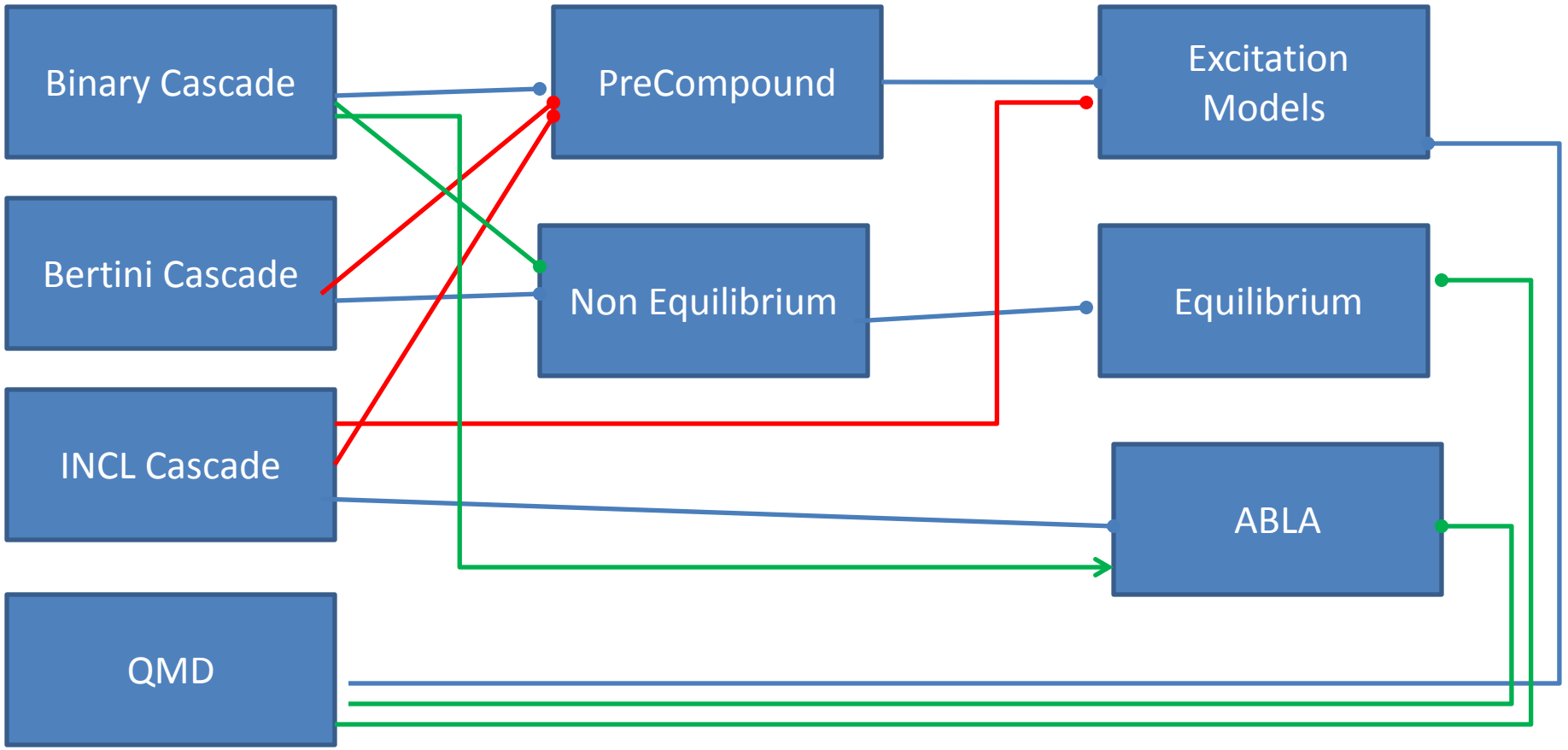
QUESADA MOLINA, Jose Manuel

Exchange (sub) models



Current

Near future

future

I hope to have a same discussion for High Energy <-> Cascade integration in next year

Post-Cascade Modules

Bertini cascade model four post-cascade processors

`G4BigBanger`
: Non-physical "blobs" of nucleons (e.g., A=6, Z=0) dispersed

`G4Fissioner`
: Just what it says

`G4NonEquilibriumEvaporator`
: Neutron, proton, light-ion emission from highly unstable nuclei

`G4EquilibriumEvaporator`
: Gamma, nucleon emission from unstable, metastatble nuclei

$\Longrightarrow$ Encapsulated in `G4CascadeDeexcitation::collide(...)`

Julia Yarba (FNAL) replaced these with `G4PreCompoundModel`

`G4ExcitationHandler::BreakItUp` replaces `BigBanger`

`G4PreCompoundModel::DeExcite` replaces `Fissioner`, `EvaporatorS`

$\Longrightarrow$ Encapsulated in `G4PreCompoundDeexcitation::collide(...)`