



RECENT UPDATES IN HADRONICS

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Outline

- General infrastructure update
 - Hadron elastic scattering
 - De-excitation module
 - Summary and plans
 - Item for discussion
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- The main motivation of these efforts:
 - *provide robust hadronic code for Geant4 10.6 which is expected to be the next CMS production release*
 - Check cross sections
 - Check elastic and inelastic models
 - Optimize Physics List

General infrastructure update for 10.6beta

- Removed final state rotation both from elastic and inelastic processes
- Removed G4HadronicException and try/catch pattern from cross section sub-library and GetMeanFreePath() method, use only G4Exception
- Removed default GHEISHA cross sections
- Share cross section data between threads for XS and BGG classes
- Created new utility G4NuclearRadii with several parameterizations of nuclear radius
- Updated Starkov parameterizations for pions and kaons
- Added G4PARTICLEXS2.0 dataset

General infrastructure update after 10.6beta

■ For 10.5ref07

- *Fixed problems for proton and pion x-sections introduced to 10.6beta*
- *Fixed thread safety in BGG classes*
- *Improved initialization in FermiBreakupVI model*
- *In the case of one model for a hadronic process, drop checks on applicability of this model*

■ Plan for 10.5ref08

- *Fix kaon x-sections at low energies*
- *Fix G4NeutronCaptureXS for isotope cross sections without data*
- *Make initialization in XS and BGG cross section classes only for elements used in geometry and add lazy initialization as a backup*
- *Provide G4PARTICLEXS2.1, which should fix non-regularity at 20 MeV*
- *M.Novak has updated G4PhysicsVector and for log vectors offer maximally efficient code*

Hadron elastic models

- There is summer student contribution
 - *Alikhan Yeltokov was working for 8 weeks*
 - *The main goal is to study performance of elastic scattering for pions and protons with energy up to 1 GeV*
 - *See next talk*
- G4HadronElastic – based class for hadron elastic models
 - *By default implements GHEISHA scattering function*
 - *Now tuned for pion data*
- G4ElasticHadrNucleusHE – based on Glauber approach, original author N. Starkov
 - *There were technical problem and ineffective memory usage and initialization*
 - *Now data are shared between threads and no lazy initialization for pions (initialized before event loop)*
 - *Added parameterization for large angle scattering (was sharp cut)*
- Diffuse elastic model (V.Grachine) and CHIPS models are also validated

De-excitation module in 10.6beta

- G4FermiBreakUpVI

- *Fixed Coulomb Barrier correction – may affect medical tests*

- G4PhotonEvaporation

- *Fixed #2124 – limit value for IC probability*
- *Fixed #2123 – if no data for a given level make transition to the closest one*

- G4Evaporation

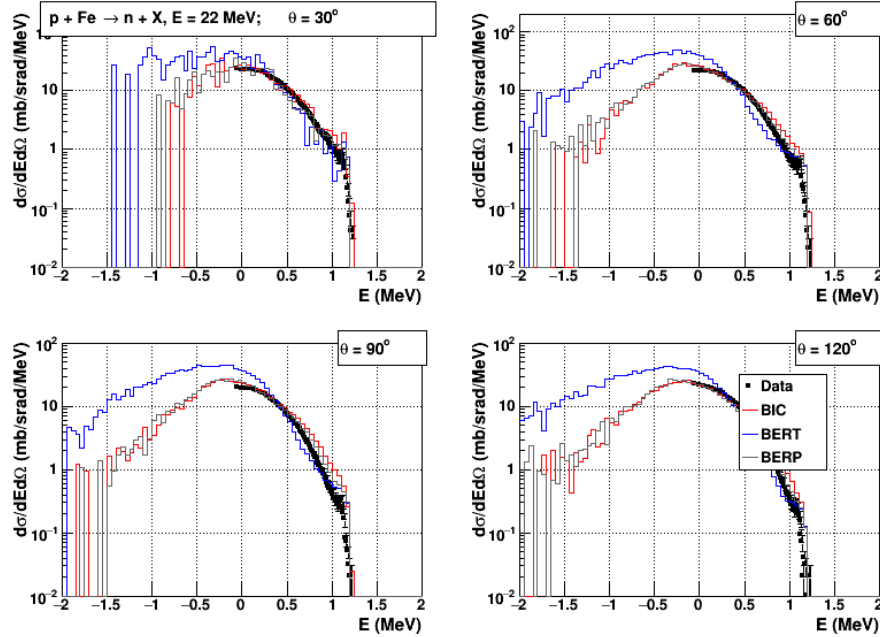
- *Simplified method of integration of differential inverse cross section and sampling of final state*

De-excitation module in 10.5ref08

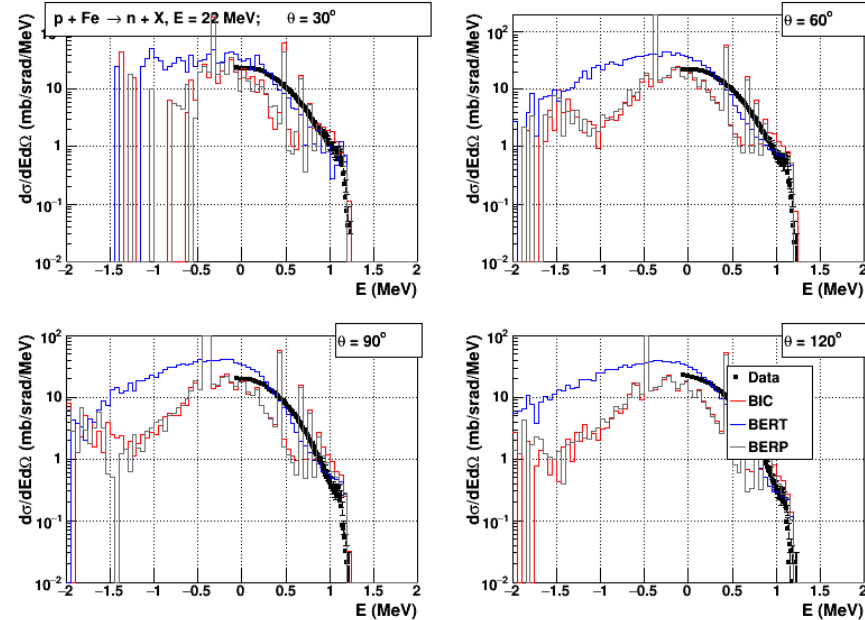
- General clean-up of classes and addition of C++11 patterns is being performed
 - *It was triggered by needs of the new GEM model and concerns from medical community*
 - *Any modification is validated using test30*
- Introduced a possibility (optional), forcing final state after each evaporation to correspond to one of level for given isotope
 - *There is a problem, which not allows making this option the default*
 - *This issue needs further study, may be activated together with Radioactive decay*

Proton 22 MeV scattering of Fe

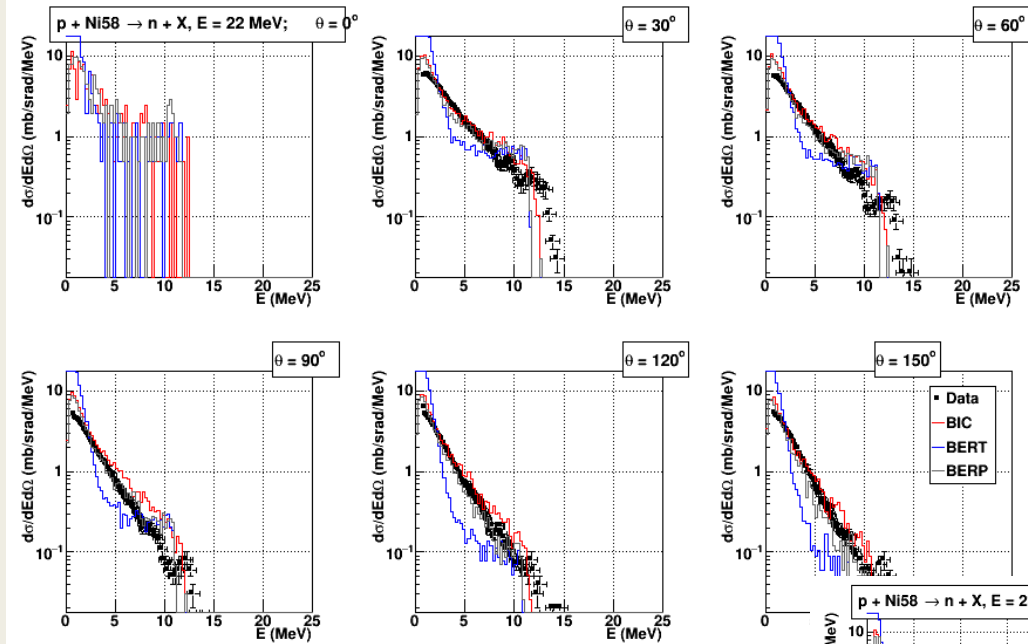
10.5



New results have peaks, not supported by data

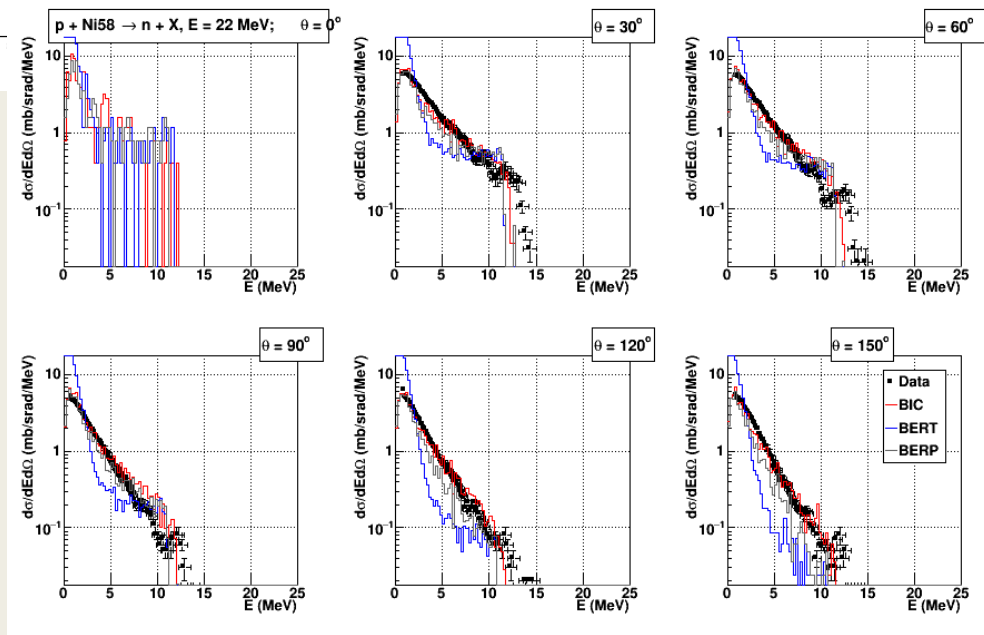


Proton 22 MeV scattering of Ni58



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New looks fine
Probably good data
for isotopes involved
in this test



Summary and plans for 10.6

- Migration to git allows make several infrastructure modification
 - *We need to be careful and fix problems created in these improvements*
- Infrastructure modifications for 10.6 are nearly completed, only few things remains:
 - *G4PARTICLEXS2.1*
 - *Kaon cross sections*
 - *Optimal initialization of data in BGG and XS*
- Elastic model evaluation:
 - *We may expect improvements for pions, extra validation required*
- De-excitation module
 - *We plan to add alternative GEM model*
 - *Tune parameters and options*
 - *Add gamma de-excitation to FermiBreakUpVI*

Item for discussion

- In the new user forum we have a thread:
 - *Illegal ion/mass number in binary cascade model "G4IonPhysicsPHP"*
 - *There is joshua7317 receipt (likely correct):*
 - What is your environmental variables for compiling and running?
 - I would suggests using `DO_NOT_SET_PHP_AS_HP=1` when compiling, and `DO_NOT_SET_PHP_AS_HP=1`, `G4PHP_DO_NOT_ADJUST_FINAL_STATE=1`, `G4PHP_DO_NOT_CHECK_DIFF_COEFF_REPR=1` when running.
- How a developer and/or expert can know and correctly define these environment?
 - *There are many requests concerning AllHP Physics List crashes in the user forum*