

Physics Validation Task Force Status Update

A. Dotti for the Physics Validation Task Force
18th Collaboration Meeting – Seville , Spain



Task Force

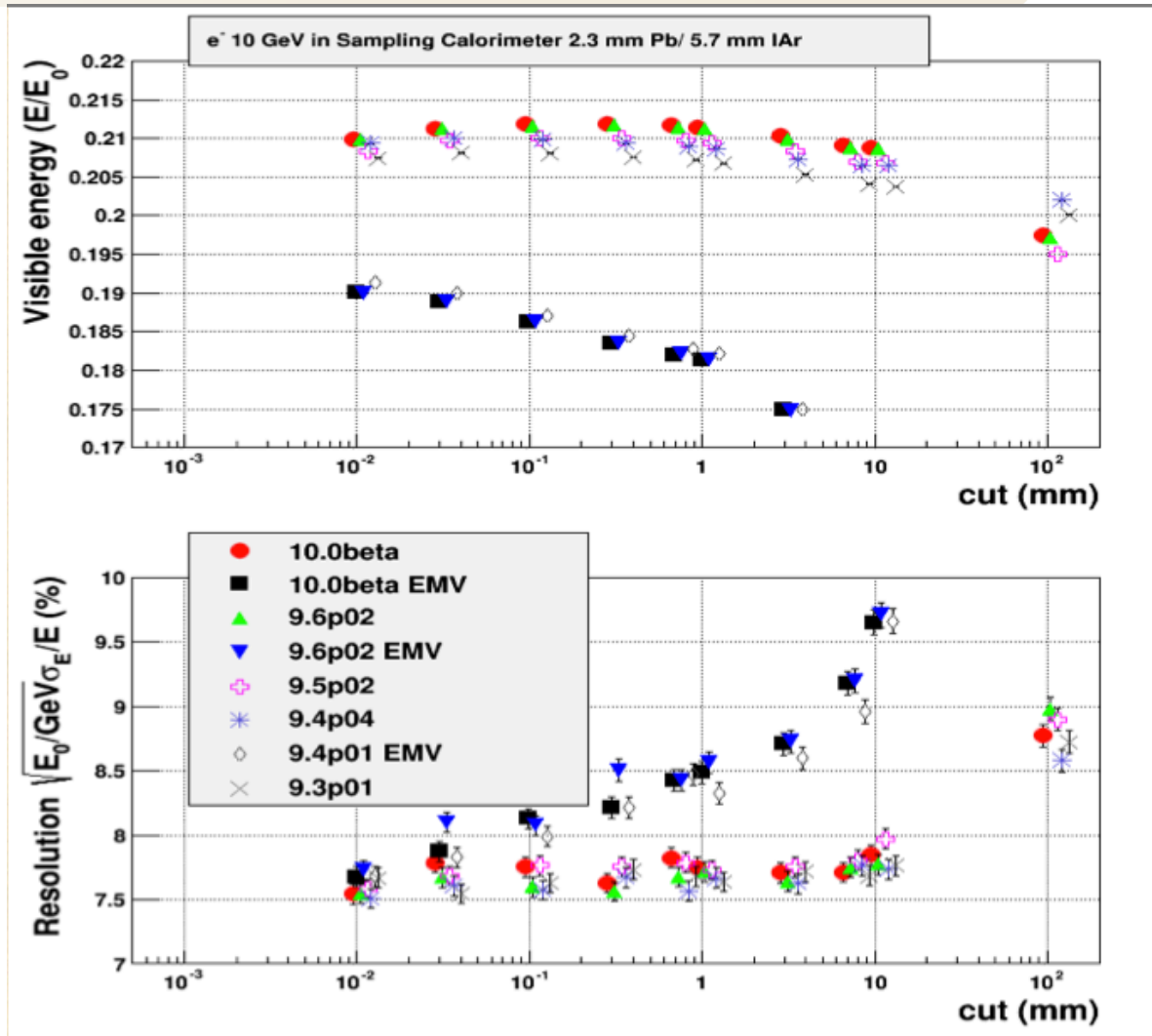
- Created in 2011
- Reports to SB
- No fixed “team”, all physics developers are involved: Andrea (coord), Hans (co-coord), Julia (tools, tests), George/Witek/Alberto (GRID), Vladimir (EM), ...
- Objectives:
 - **01** Organize the current validation activities of Geant4 physics processes for the leading application areas (building on the set of existing tests).
 - **02** Communicate with users to establish validation needs, i.e. capture new ones and document existing one
 - **03** Maintain web pages to organize major validation results
 - **04** Track validation/verification issues
 - Develop and maintain a web-based tool to track the issues
 - Report to SB on major issues
 - Communicate minor issues with Physics Working Group
 - **05** Ensure that the comparison with critical thin-target benchmarks is run for every release and patch
 - **06** Communicate with experiments and facilitate for potential data sets for comparison

Status of activities (2011-2013)

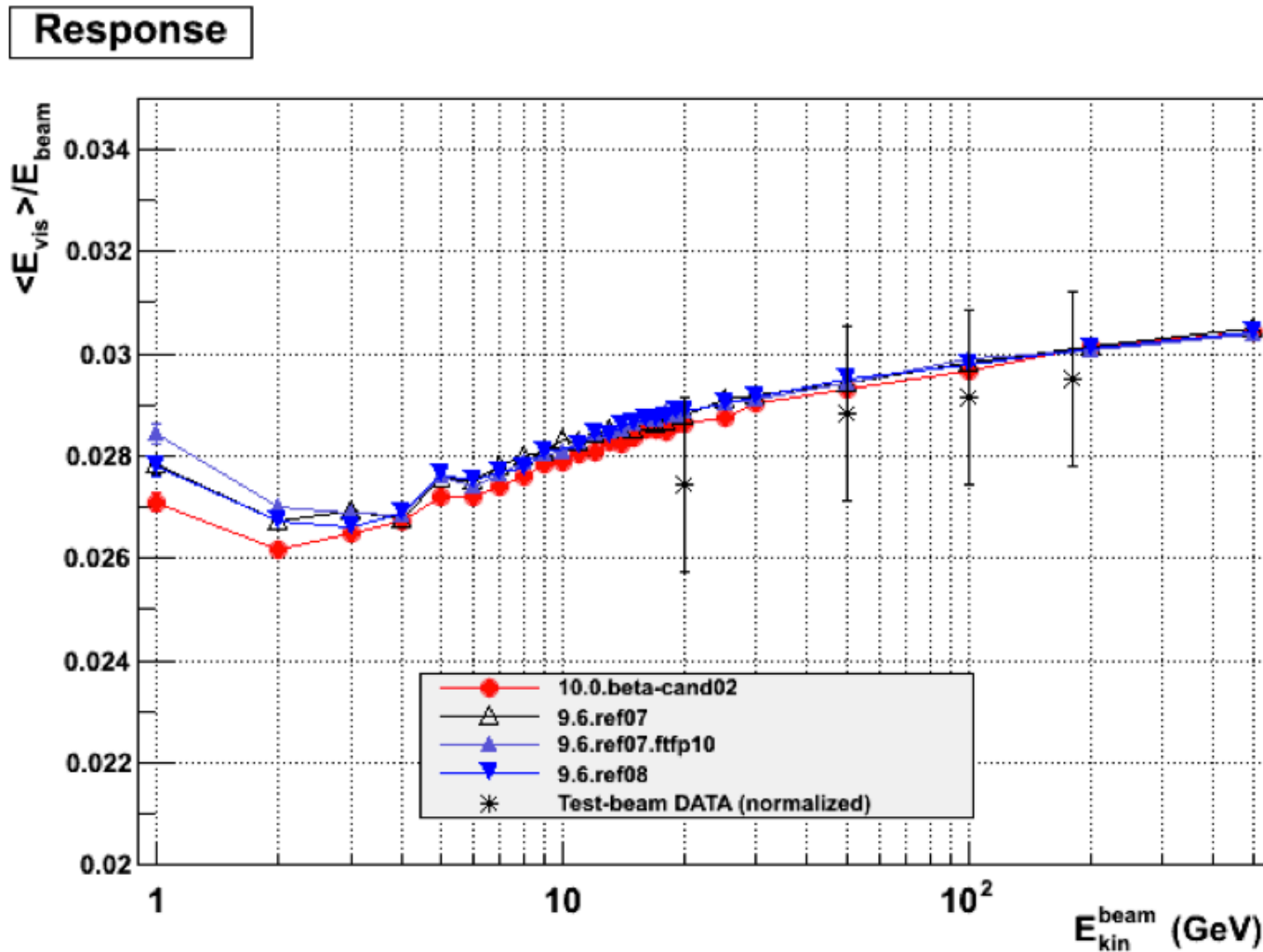
- **Communication with users** (O2,O3,O6):
 - Re-organized validation and results main pages in G4 website
<http://www.geant4.org/geant4/results/index.shtml>
 - See comments from Mike (Doc WG): need more work
 - FNAL-hosted Validation DB:
<http://g4validation.fnal.gov:8080/G4ValidationWebApp/>
 - Connection with LHC: <http://sftweb.cern.ch/validation/>
- **Added first sets of physics validation tests in CTest and developed GRID-based LHC validation** (O1, O4, O5)
- Migration of SimplifiedCalo and FullCMS to MT

- CTest PhysicsChecks is run every night:
 - Not yet widely used for physics testing
 - Current: hadronic showers regression testing; gammas in crystals; MSC
- **Both EM and HAD extensive validation test suites are run for every reference tag by experts and authors:**
 - Thin target validations based on published data
 - Based on full showers (calorimeters) – regression testing -
 - EM: monitor stability of response, resolution, shower shape vs production-cut
 - HAD: response, resolution, shower shapes vs beam energy
 - Developers provide periodic detailed reports done during WG meetings

EM Shower Stability



FTFP_BERT pions on Fe/Sci



Stable results: very important for LHC productions

FNAL-DB Status

Geant 4

Home > Results & Publications > Physics Validation and Verification

- Home
- Validation Overview
- Release Highlights
- Electromagnetic
- Hadronic
- LHC-feedback
- Expert



Welcome to the Geant4 Validation Repository
Please make your selection from the menu on the top

Database statistics	
Number of test setups	21
Number of test results (public and internal)	18128

List of Tests		
Name	Description	Working Group
ATLAS	shower characteristics of ATLAS Calorimeters	LHC-feedback
CMS	shower characteristics of CMS Calorimeters	LHC-feedback
HadrIon	Test of Physics Lists (thick targets, ion beams)	hadronic
HadrXS	Test of Physics Lists (cross sections)	hadronic
Hadrcap	is an analogous to Hadr00, with advanced features.	hadronic
IAEA	IAEA Benchmark of Nuclear Spallation Models	hadronic
Ndata	Test concerning developments of new nXS, it is calling HP XS as well as HPW XS.	hadronic
Testfragm	Test of hadronic generators (thin targets, ion beams)	hadronic
atlasbar	Test of ALTAS barrel type em calorimeter, determines response, resolution, and CPU performance	electromagnetic
placeholder	Dummy testdes	hadronic
simplifiedCalo	Test of Shower shapes using selected simplified calorimeter setups.	hadronic
test19	high energy test, provides comparison with NA61 (31GeV/c proton beam) and NA49 (158GeV/c proton beam) data sets.	hadronic
test22	Testing of the FTF model and comparison with experimental data for a wide energy region	hadronic
test30	Test of hadronic generators of inelastic processes	hadronic
test35	Test of hadronic generators of inelastic processes, based on results of HARP collaboration, Experiment PS214 at CERN.	hadronic
test37	Test against Sandia data, electron beam in semi-infinite media.	electromagnetic
test41	Comparison with MUSEAT experiment for multiple scattering validation	electromagnetic

To improve / issues

- Improve organization of web-pages for users
 - Top-level page with summary results for main application areas (should be “1-click-away” from G4 portal)
 - Targeted to novice users, first time users
 - Provide links to extensive documents
- Improve CTest system
 - **Cannot** substitute experts manual tests
 - **Can** provide fast feedback and early “warning”
 - Will provide additional tools and tests in next months (list identified during this workshop)
- Further promote FNAL-DB repository
 - SimplifiedCalorimeter web repository (CERN) being extended:
 - Includes new multiplicity test as requested by LHCb
 - Welcome convergence of the two tools code/resources (t.b.d.)

Geant4 Version 10: work-plan

- Before Version 10 release:
 - Continue current activities
 - Prepare new tests in CTest/CDash
- My opinion: given this is a major version we could **provide users/collaborators:**
 - Few (max 10) plots showing general trends with few past version (e.g. compare with 9.6.p02, 9.5.p02, 9.4.p04)
 - **Or direct link to a static copy of FNAL “Physics List” highlight**
 - To be linked from geant4.org website validation page (static page)
 - As soon as possible when release is available

Release Highlights

[Release Highlights](#)

• [Electromagnetic Physics Highlights](#)

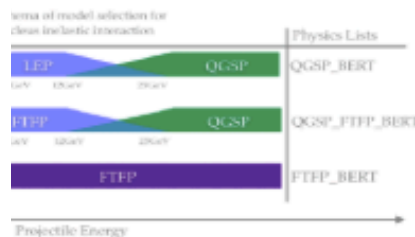
• [Hadronic Physics Highlights](#)

• [Release Notes](#)

• [Materials patch-02.](#)

Geant4.9.6.p02 - Development Highlights in the Physics Lists

In summary we would like to refer only to a group of Physics Lists that based on QGS(P), FTF(P), and Bertini. This diagram illustrates how the involved physics models are combined within each Physics List, to cover specific energy ranges (see image)



According to validation from HEP experiments (including but not limited to LHC and CALICE), **FTFP_BERT** is considered to be the most accurate physics lists for HEP simulation simulations in particular for calorimetric studies.

QGSP_BERT is very stable and is considered as a legacy physics list. The physics performance of this list is however inferior to FTFP_BERT.

The **QGSP_FTFP_BERT** has a conservative approach in which the high- and low-energy physics are the same as in the legacy **QGSP_BERT**, but the intermediate parametrized model is replaced by FTFP.

The Physics Lists listed below are common for the Physics Lists in question.

For a full list of changes and updates in other Physics Lists offered with the Geant4 package, please see [Release Notes](#), together with [h-01](#).

For more information on the **FTFP_BERT** and **QGSP_BERT** performance in calorimetric applications, see the [simplifiedCalo](#) collection of validation studies in the [Validation](#) section, via the link in the top menu bar.

The following Physics Lists include some, or most, or all of the updates below. The exceptions are LHEP and CHIPS based Physics lists that

Physics Lists and Updates:

• Complete removal of the WentzelVI model for e^+ and e^- above 100 MeV in all Physics Lists.

• Complete removal of CHIPS model.

• For kaons and hyperons, use of cross section data-s

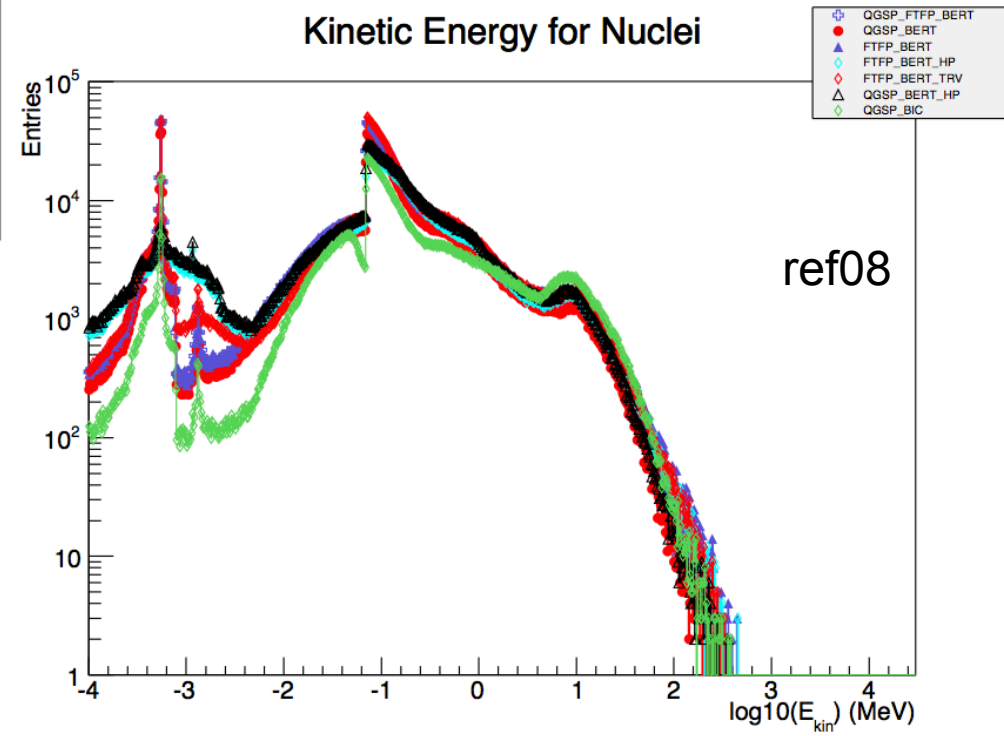
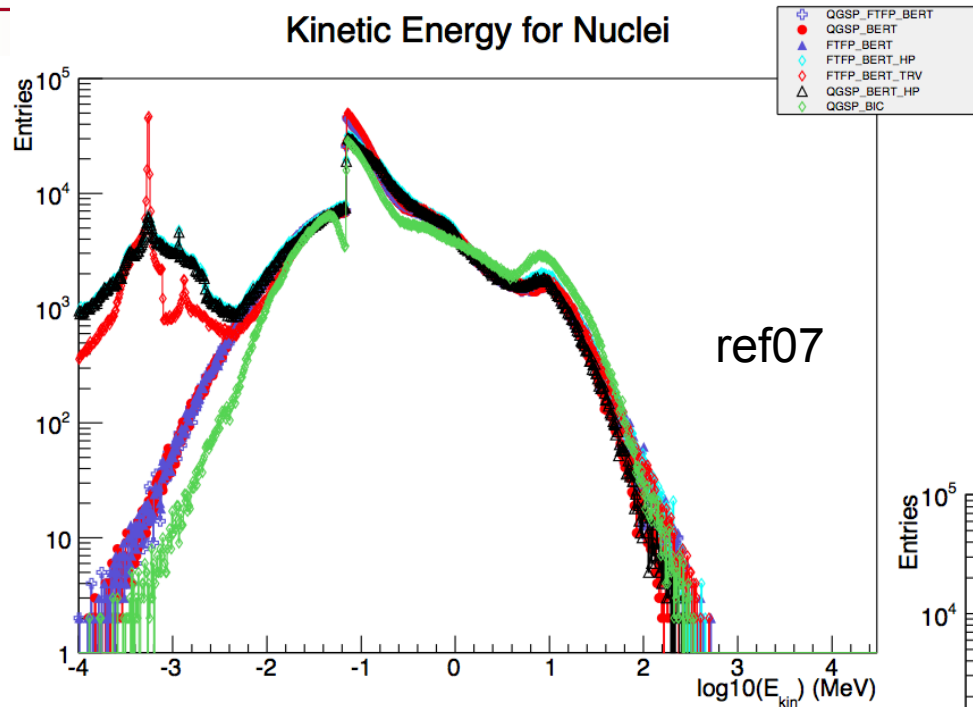
Geant4 Version 10 – workplan for 2014 -

- Extend validation testing:
 - Provide matrix with physics use cases / test showing coverage of automatic regression testing
 - Develop missing tools
- MT:
 - Verify coverage of MT testing and regression testing w.r.t. sequential (e.g. check other models/processes)
 - Strategy developed based on “strong reproducibility test” (see Plenary 3)
 - Focus on full application, not unit testing

Status of Physics Performances

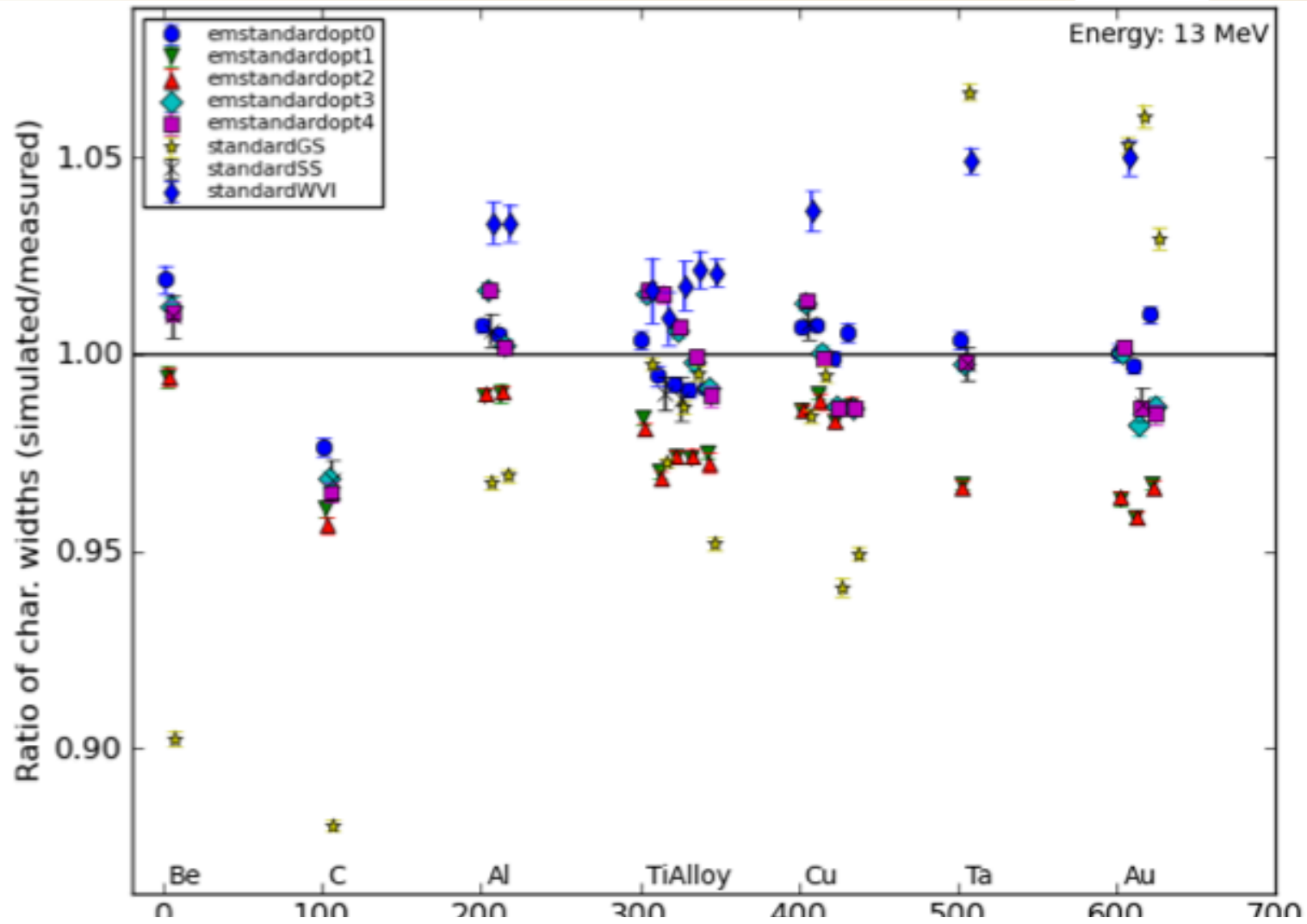
- Major improvements in 2013:
 - Removal of parameterized models
 - Re-organization of CHIPS codes
- Results are in general very stable, continuous improvements in all areas
- We are providing users a much more clear and simplified way to select a physics list
 - Example: all HEP experiment agree on the use for production of a single physics list
- Sorry, cannot cover everything, few slides biased by my background (only global variables)
- HAD, EM and LowEM working groups have extensive testing suites being presented at WG meetings
 - We should improve intra-collaboration communication of results (FNAL-DB)

Latest improvements: example



ref08: nuclear residual similar to HP models
No CPU penalty

Electron Scattering Test



Comparison with SANDIA data

