Outline

• High priority for 2012
• Model development
• Validation and Testing
• Cross sections
• Code Review
High Priorities for 2012

• Reproduce observed shower shape parameters
  - resolution, length, width

• Develop more physical way of merging/integrating models
  - vs. energy/angular distribution/multiplicity
  - physics list improvements

• Code review to improve:
  - CPU/memory performance
  - multi-threaded performance
Model Development (1)

- Completion of low energy charged particle models
  - using CIEMAT-translated databases
    - Pedro Arce (February 2012)
- Fast (CPU) neutron capture model/data
  - Anything left to be done here, validation?
    - Vladimir Ivantchenko, Tatsumi Koi
- Improvement of LEND/GIDI
  - Tatsumi Koi, Bret Beck
Model Development (2)

- Radioactive decay
  - clean-up
  - speed-up
  - add spontaneous fission channel
    - Dennis Wright (March 2012)
- re-design
  - Dennis Wright, Laurent DeSorgher (December 2012)
Model Development (3)

• **Photo-nuclear, electro-nuclear, muon-nuclear**
  - use direct gamma interaction in Bertini for cascade energies
  - study possible improvements to low energy gamma interactions
  - re-examine handling of high energy gammas
    • **Dennis Wright (June 2012)**
  - examine using Binary cascade as alternative to CHIPS or Bertini
  - examine gamma-nuclear cross sections (there are two - which is best?)
    • **Witold Pokorski (June 2012)**
Model Development (4)

• Precompound/de-excitation
  - improve CPU performance, code clean-up
    • Vladimir Ivantchenko (December 2012)
  - add coalescence mode to precompound
    • Jose Manuel Quesada, Anton Ivantchenko, Miguel Cortes
  - add alternate Fermi breakup model, improve multi-fragmentation model
    • Jose Manuel Quesada, Miguel Cortes (June 2012)
  - add correlations in gamma decay chains to photon evaporation model
    • Jason Detwiler (June 2012)
  - add alternate photon evaporation model
    • Vladimir Ivantchenko (March 2012)
Model Development (5)

- **Bertini cascade**
  - improve re-scattering interface
    - **Mike Kelsey (June 2012)**
  - 5% CPU increase
    - **Mike Kelsey (June 2012)**
  - investigate use for capture models
    - **Mike Kelsey, Julia Yarba (December 2012)**
  - complete direct interaction of gammas
    - **Dennis Wright (January 2012)**
Model Development (6)

• **INCL/ABLA**
  - Integrate remaining INCL++ features, extend to light ion reactions bug fixes
    • Davide Mancusi, Pekka Kaitaniemi, Alain Boudard (September 2012)
  - Eventually remove old INCL from QGSP_INCLXX
    • Davide Mancusi (December 2012)
  - improve ABLA and other de-excitation code
    • Alain Boudard (September 2012)
Model Development (7)

• **Binary cascade**
  - software review, improvement
  - study and add coalescence model
  • **Gunter Folger (June 2012)**
Model Development (8)

• Transition region and shower shapes
  - study transition from cascade to high energy models (more physical coupling of models)
  - find ways to better reproduce resolution, shower length and width (empirical or theoretical)

• Vladimir Uzhinsky, Mike Kelsey, Andrea Dotti, Alberto Ribon, Dennis Wright (December 2012)
Model Development (9)

• **Fritiof (FTF)**
  - improve anti-nucleus nucleus interactions (parameter tuning, validation, smooth transition to Reggeon cascade, documentation)
    - **Vladimir Uzhinsky, Aida Galoyan (April 2012)**
  - improve nucleus-nucleus interactions: add projectile residual in final particle list, reggeon cascading in target and projectile (A > 11), de-excitation of projectile residual, validation, documentation
    - **Vladimir Uzhinsky, Aida Galoyan (July 2012)**
  - Improve elastic nucleus-nucleus and antinucleus-nucleus scattering, including real part of scattering amplitude and correct treatment of Coulomb interactions
    - **Aida Galoyan (June 2012)**
Model Development (10)

• Fritiof (FTF)
  – Review and software improvement
    • Gunter Folger, Alberto Ribon (June 2012)
Model Development (11)

- **QGS**
  - model improvements, including addition of Reggeon cascade, review of cross section calculation, update of model parameters, check of fragmentation functions

- **Vladimir Uzhinsky (December 2012)**
Model Development (12)

• CHIPS
  – development and maintenance
    • Mikhail Kossov
Model Development (13)

- Elastic scattering
  - replace G4HadronElastic with G4WHadronElastic, then rename to G4HadronElastic
    - Vladimir Ivantchenko, Gunter Folger, Tatsumi Koi, Dennis Wright (December 2012)
  - continued development of coherent elastic
    - Nikolai Starkov
New Model Development Projects

- Review, improve EM dissociation
  - Vladimir Uzhinsky (2013)
- Investigate high pt production models
  - Vladimir Uzhinsky (2013)
- Study flow effects in nucleus-nucleus scattering
  - Vladimir Uzhinsky (2013)
- New muon stopping and capture model
  - Krzysztof Genser, Julia Yarba, Daniel Elvira (June 2012)
- Use Vanderbilt biasing scheme to replace hadronic cross section biasing
  - Dennis Wright (December 2012)
Cross Sections

• Continue cross section re-design
  • Gunter Folger, Tastumi Koi, Vladimir Ivantchenko, Dennis Wright (December 2012)

• Cross section validation
  • Anton Ivantchenko (June 2012)

• Cross section development
  - complete the parameterization of elastic cross sections for p, pbar, pi, K on p, calculate Glauber cross sections for p, pbar, pi, K on A, and nucleus-nucleus
    • Vladimir Grichine, Aida Galoyan (May-June 2012)
Validation and Testing (1)

- Continuing validation effort
  - test30, test35, IAEA validation
    - Anton Ivantchenko, Vladimir Ivantchenko, Alex Howard
  - medium energy validation (test47: validation vs. ITEP data up to 7.5 GeV)
    - Julia Yarba
  - Stopping and at-rest validation (test48)
    - Julia Yarba, Krzysztof Genser
  - calorimeter validations and shower studies with various physics lists (especially in transition region)
    - Alberto Ribon, Andrea Dotti
  - Grid validation
    - Alberto Ribon, Andrea Dotti
Validation and Testing (2)

- Continuing validation effort
  - improvements in hadronic validation suite (increased automation)
    - Hans Wenzel, Julia Yarba (June 2012)
  - rerun shielding tests for SATIF-11
    - Tastumi Koi (March 2012)
  - INCL/ABLA
    - Pekka Kaitaniemi, Alain Boudard, Davide Mancusi (December 2012)
  - comparison to MIPS and BNL data between 10 and 100 GeV
    - Sunanda Banerjee
Validation and Testing (3)

- New validation projects
  - radioactive decay validation suite
    - Dennis Wright, Laurent DeSorgher (2013)
  - expansion of high energy validation suite
    - Gunter Folger (2013)
  - QGS validation (and check fragmentation functions)
    - Vladimir Uzhinsky (August 2012)
  - FTF validation for pi/K-nucleus and nucleus-nucleus
    - Vladimir Uzhinsky (June 2012)
  - ion-ion
    - Anton Ivantchenko, Tatsumi Koi (December 2012)
Validation and Testing (4)

• New validation projects
  - ENDL/GIDI validation and documentation
    • Tatsumi Koi, Bret Beck (June 2012)
  - CIEMAT translated database testing
    • Daniel Cano Ott, Tatsumi Koi (June 2012)
  - Validate Bertini-Precompound interface
    • Mike Kelsey (March 2012)
  - Testing diffuse elastic and nucleus-nucleus elastic models within a physics list
    • Vladimir Grichine (June 2012)
Validation and Testing (5)

• New testing projects
  - more testing and checking of energy/momentum conservation
    • Gunter Folger (June 2012)
  - study/evaluate the movement of E/p checking out of G4HadronicProcess and into separate class
    • Dennis Wright, Gunter Folger (June 2012)
Code Review (1)

• Examine ways to improve multi-threaded performance
  - enforce const-ness, etc.
    • All (December 2012)

• Review GEM code to look for improvements
  • Anton Ivantchenko, Vladimir Ivantchenko (June 2012)

• Code speed-up
  - evaluate possible savings by reduction of number of virtual classes (flatten hadronic framework)
    • Gunter Folger, Dennis Wright, Vladimir Ivantchenko (December 2012)

• Code clean-up
  - remove isotope production infrastructure from processes, move to LEP models
    • Dennis Wright (January 2012)
Code Review (2)

• Reproducibility
  – improve “strong” reproducibility: recover same results when run is stopped and re-started as when run goes continuously to completion
  – examine random seed handling
    • Alberto Ribon (June 2012)

• Re-visit error handling/diagnostics (restore whiteboard functionality?)
  • Dennis Wright (2013)
Code Review (3)

- move some hadronic code to global: G4Clebsch, new 6-j and 9-j code, new code for Legendre polynomials
  - Jason Detwiler (June 2012)

- review Bertini code to recover 5% CPU loss
  - Mike Kelsey (June 2012)

- quasi-elastic code has been extracted from CHIPS, but needs re-engineering to enable easier/more consistent use
  - Witold Pokorski (June 2012)

- standardize model implementation to avoid code duplication and enforce toolkit nature of models
  - Witold Pokorski (2013)