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physics_list module

Overview

- Physics lists – supported, experimental, and obsolete
- Current status
- Plans for 9.4
- Will not cover
 - Improvements in modeling

Physics Lists in physics_lists module

In 9.4 beta, or 9.3-ref-08, there are 42 lists

- Large number, but less than 70
- PhysicsListFactory returns list based on “input string”

- 15 Supported

- CHIPS
- FTFP_BERT_EMV, FTFP_BERT,
- LBE,
- LHEP, LHEP_EMV,
- QGSC_BERT
- QGSP_BERT, QGSP_BERT_EMV, QGSP_BERT_HP,
- QGSP_BIC, QGSP_BIC_EMV, QGSP_BIC_HP,
- QGSP_FTFP_BERT,
- QBBC

- 10 experimental lists

- FTF_BIC, FTFP_BERT_EMX, FTFP_BERT_TRV,
- QGS_BIC,
- QGSP_BERT_CHIPS, QGSP_BERT_EMX,
- QGSP_BERT_NOLEP, QGSP_BERT_TRV,
- QGSP_INCL_ABLA,
- Shielding

- 17 obsolete lists

- FTFC, FTFP,
- LHEP_BERT_HP, LHEP_BERT, LHEP_PRECO_HP,
- QGSC_CHIPS, QGSC_EMV, QGSC, QGSC_QGSC,
- QGSP_BERT_DIF, QGSP_BERT_NOE, QGSP_DIF,
- QGSP_EMV, QGSP_EMV_NOE, QGSP,
- QGSP_NOE, QGSP_QEL

Physics Builders

- All these lists are built using 'standard' building blocks 'G4AbcPhysics' for
 - EM physics
 - Hadron elastic scattering
 - **Hadron inelastic**
 - Ion inelastic
 - Stopping particles
 - Decay
 - Neutron tracking cut
- Extra builders exist to easy adding physics normally not included
 - Radioactive decay
 - Optical photon physics
- There is one or a choice of few per topic, except hadron inelastic
 - Reducing possibility for error, increasing testing coverage
 - And builder tested/validated in one setup will have same quality in all uses
- Hadron inelastic more rich
 - Often requires significant code (duplication) for small change

Current status

Lists deleted in 9.4 beta

- Physics lists obsolete&disabled since 93beta
 - FTF_EMV, replacment FTFP_BERT_EMV
 - QGSC_EFLOW, replacment QGSC_CHIPS
 - QGSP_EMX, replacement QGSP_BERT_EMX
- Had planned/wanted to delete most obsolete lists

Recently added PL

- CHIPS (9.3)
- QGSP_FTFP_BERT (9.3)
 - Using FTFP to replace LHEP
- Shielding (9.4 beta)
 - Based on FTFP_BERT, but
 - Including neutron_hp
 - G4IonQMDPhysics
 - Barashenkov + Glauber Gribov cross section for protons and neutrons via G4BGGNucleonInelasticXS
- QGSP_BERT_CHIPS (9.4 beta)
 - using CHIPS cross sections for kaons, and CHIPS for misc particles including anti-nucleons

Change of content, included in 9.4.beta

- Attempt to use better
 - **Kaon cross sections**, using CHIPS Kaon cross sections
 - Using G4QHadronInelasticDataSet for Kaons
 - Was using LHEP cross sections
 - **cross sections** and **final state** modeling for “misc” particles, including **anti-nucleons** and **hyperons**
 - Using G4QInelastic for these particles
 - Was using LHEP cross sections and final state modeling
- Within **QGSP_FTFP_BERT** and **FTFP_BERT**
- Added **QGSP_BERT_CHIPS**

Updates to ~all lists

- In 9.4 beta
 - Ctor with consistent signature for all builders
 - `G4XYZPhysics(G4int ver=0);`
 - Following a request by LHCb
- Post 9.4 beta
 - Replace builder for Elastic scattering by new builder following model design

CHIPS physics list

- Updates since 9.3, included in 9.4 beta
 - Elastic using G4QElasticPhysics
 - substituting G4HadronQElasticPhysics
 - Inelastic Ion interactions using G4QIonPhysics
 - substituting G4IonPhysics

Plans for 9.4

Change status, add/delete

- Remove obsolete lists
- Review status of supported lists
 - LBE
- Review set of experimental lists
 - Added to test a feature without success
- Any change must be reflected in testing
 - All supported lists are exercised in system testing using simplified calorimeter benchmark

Possible improvements

- Cross sections
 - In all QGS... And FTF... lists, we use
 - Axen Wellisch for proton and neutron
 - Barashenko for pions
 - High energy behaviour of these is wrong, no relativistic rise
 - Need new cross section joining with GG cross section to correct this
 - Is stuck in cross section re-design
 - There is a class mixing these, but this also modifies low energy behaviour, attempting to correct for Coulomb barrier
 - Effects on calorimetry need to be understood
 - Or, introduce new short term class to address this in 9.4
- Mechanism to avoid duplication for different EM option
 - Not for 9.4
- Documentation
- Open for suggestions

Any new physics lists for 9.4

- LBE, underground physics is outdated
 - Update, or create new?
 - DMX could form basis
- Rename any list?
 - Hadrontherapy ← QGSP_BIC
 - Other medical,....?

Recently asked questions

- Do we need to version physics list
 - There was change in results in testbeam simulation without change in physics list version
 - Underlying model FTF had changed
- Behaviour of PhysicsListsFactory
 - When asked for non existing physics list

Summary

- Most physics lists are stable
- Updates aim to
 - reduce unphysical behaviour near transition points with LEP by reducing use of LEP
 - Improve identifies weaknesses in cross sections or final state modeling (antiproton, Kaon cross sections)
- New Shielding physics list

Backup

- No backup