

# Directory structure

An overview of hadronic part  
Of physics lists

# Overview

- Hadronic Physics and builder classes

# File names / classes

- Physics lists, in lists
  - XYZ\_ABC.{hh ,icc}
- Hadronic Physics builders, in lists, one per physics list
  - HadronPhysicsXYZ\_ABC.hh, and .cc
- Physics builders, in builders
  - Named G4.....Physics.{hh,cc}
  - EM
  - Ion
  - ...
- Hadronic builders,
  - per particle and `model', or set of particles
    - Model is FTFP, or QGSBinary
  - But also some per model: G4FTFBuilder, G4QGSBuilder, but no G4BertiniBuilder
- Utility classes

# Builder classes/Inheritance

- G4VNeutronBuilder
  - G4BertiniNeutronBuilder
  - G4BinaryNeutronBuilder
  - G4FTFBinaryNeutronBuilder
  - G4FTFCNeutronBuilder
  - G4FTFPNeutronBuilder
  - G4INCLXXNeutronBuilder
  - G4LEPNeutronBuilder
  - G4LHEPNeutronBuilder
  - G4NeutronHPBuilder
  - G4NeutronLENDBuilder
  - G4PrecoNeutronBuilder
  - G4QGSBinaryNeutronBuilder
  - G4QGSC\_CHIPSNeutronBuilder
  - G4QGSC\_QGSCNeutronBuilder
  - G4QGSCEflowNeutronBuilder
  - G4QGSCNeutronBuilder
  - G4QGSPNeutronBuilder
- G4VProtonBuilder
  - G4BertiniProtonBuilder
  - G4BinaryProtonBuilder
  - G4FTFBinaryProtonBuilder
  - G4FTFCProtonBuilder
  - G4FTFPProtonBuilder
  - G4INCLXXProtonBuilder
  - G4LEPProtonBuilder
  - G4LHEPProtonBuilder
  - G4PrecoProtonBuilder
  - G4QGSBinaryProtonBuilder
  - G4QGSC\_CHIPSProtonBuilder
  - G4QGSC\_QGSCProtonBuilder
  - G4QGSCEflowProtonBuilder
  - G4QGSCProtonBuilder
  - G4QGSPProtonBuilder

# Builder classes/Inheritance

- G4VPiKBuilder
- G4BertiniPiKBuilder
- G4BinaryPiKBuilder
- G4FTFBinaryPiKBuilder
- G4FTFCPiKBuilder
- G4FTFPiKBuilder
- G4INCLXXPiKBuilder
- G4LEPPiKBuilder
- G4LHEPPiKBuilder
- G4QGSBinaryPiKBuilder
- G4QGSC\_CHIPSPiKBuilder
- G4QGSC\_QGSCPiKBuilder
- G4QGSCEflowPiKBuilder
- G4QGSCPiKBuilder
- G4QGSPPiKBuilder
- G4VPionBuilder
- G4BertiniPionBuilder
- G4BinaryPionBuilder
- G4FTFBinaryPionBuilder
- G4LEPPionBuilder
- G4QGSPPionBuilder

# Builder classes/Inheritance

- G4VHadronModelBuilder
- G4FTFBuilder
- G4QGSBuilder
- G4VKaonBuilder
- G4BertiniKaonBuilder
- G4FTFBinaryKaonBuilder

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# Builder Classes / Inheritance

- G4VHadronModelBuilder
  - G4FTFBuilder
  - G4QGSBuilder
  
  - Used by HadronInelasticQBBC
  - And G4IonBuilder

# G4"modelcombination" "particle(s)" Builder

- Inherit from one class per set of particles
  - Proton(1), neutron(1), pion(2), Kaon(4), PiK(6)
- Holds models, energy range limits
- Set cross section
- Provide Build()



# More Builder classes

- Standalone Classes, no inherit(ing/ance),
  - Used by HadronPhysicsxyz
    - G4NeutronBuilder
    - G4ProtonBuilder
    - G4PionBuilder
    - G4KaonBuilder
    - G4PiKBuilder

# What do these do?

- G4{Neutron,Proton,Pion,Kaon,PiK}Builder
  - Keep particle specific Processes
  - Implement RegisterMe()
  - Implement Build to call Build for all registered models for all processes
- Differ in
  - Number of particles, e.g. pion has pi+ & pi-
  - Processes: all have Inelastic, but neutron also capture, fission

# Dependencies

- G4VModularPhysicsList: lists
- Current directory structure
- How to improve
- ~~Summary~~, expected outcome.

# Current directories - lists

- **Lists**/include: 66 .hh, 34 .icc
  - 34 physics lists
  - 25 HadronPhysics... + **G4**HadronInelasticQBBC
  - 3 cuts classes, MaxTime...,MinEkin..., SpecialCuts
  - 4 G4 classes:
    - G4GenericPhysicsList
    - G4PhysListFactory
    - G4PhysListUtil, utility class to get process manager, obsolete, ..
    - **G4VHadronPhysics**
      - Used by G4HadronInelasticQBBC
      - And by example Hadr02 in Ion{DPM,UrQMD}Physics

# Current directories – builders -1

- Builders: 142 .hh, no .icc
- 31 G4...**Physics**.hh
  - 9 Em, 1 Chips
  - 6 Ion, 1 Chips
  - 5 Elastic, 1-2 Chips
  - 3 Stopping, 1 Chips
  - 8 misc
    - ChargeExchange, Decay, Optical, RadioactiveDecay
    - Chips: Atomic, CaptureAtRest, Neutrino, PhotoNuclear
- 88 G4...**Builder**.hh
- 23 Misc

# Current directories – builders -2

- Builders: 142 .hh, no .icc
- 23 Misc:
- 4: messengers, 2 Chips
- 5: Em \_option{1...4}, + EmDNAPhysicsChemistry → ...Physics.hh
- 4: G4HadronElasticPhysics{HP,LEND,LHEP,XS} → ...Physics.hh
  - wrongly named ?
- 10 Misc misc
  - CompileTimeConstraints.hh
  - G4BuilderType.hh
  - G4DataQuestionnaire.hh -- util to check fro data file environment variables
  - G4NeutronCrossSectionXS.hh
  - G4NeutronTrackingCut.hh --
  - G4OpticalProcessIndex.hh
  - G4PhysicsConstructorFactory.hh
  - G4PhysicsConstructorRegistry.hh
  - G4WarnPLStatus.hh , util class to mark a list as experimental or obsolete
  - TheoModelFactory.hh

# Directory structure

- Move HadronPhysics”physicsList” out of lists.
  - ~ one class per physics list, excluding em variations
  - Uses classes from builders, is not a builder
  - New directory
- Split hadronic, em, and other builder classes
- Util
- Management?

# New directory structure

- [edupad.ch/rikx0lFbL7](https://edupad.ch/rikx0lFbL7)



# Summary