Simulation Development Introduction and Overview

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Workshop objectives

Workshop consists of two sessions loosely separated into "development activities" and "physics needs",

- lots of time for discussion and comments
- this is a working meeting so please do not hesitate to voice opinions!

- **Assess performance and/or shortcomings of the existing BABAR simulation (primarily SP8)**
- **Evaluate the potential improvements to the simulation resulting from future development and the physics impact of these improvements**
- **$64k question: Given limited resources, what development is desirable (or even possible) to do?**
  - what resources are available for this development?

Motivation for development?

Anticipate factor 2 - 3 more data before completion of BABAR physics program

- SP8 represents only ~half the final simulated data set for BABAR
- Some known issues with current simulation which could impact physics performance (impact has not been demonstrated!)

- **Why not move forward?**
  - Need for physics motivation
    - Is current simulation “good enough”?
  - Some potential risk associated with any move to a new SP version
    - (e.g. SP8 production delays and wasted resources due to G4 ionization bug)
  - Substantial effort needed for simulation validation and upgrading of analyses
    - Not desirable to have SP8 for Run 1-5 but SP9 for Run 6/7 ...
  - Limited resources available in Sim Dev group and at subsystem level for additional development and validation, CLHEP migration etc

Development plan?

19 series development would be targeted for 22-series simulation production ("SP9") for use with Run 6 data

- **No actual plan yet for what this would include :**
  - could just be 22-series version of SP8 (i.e. no changes)
  - could include Geant4 improvements
  - and/or could include additional detector geometry or response improvements

	Release	Geant Version	CLHEP version	
SP5	12.4-12.6	4.0		
SP6	14.3 -14.4	5.2	1.8.0.2	
SP7	16.x (not used)	6.1	1.8.1.0	
SP8	18.1 -18.6	6.1	1.8.1.0	(V01-06-16)
SP9	22.x	7.1 (proposed)	1.8.1.0	(V01-06-18)
>SP9	?	8.x ?	1.9 or 2.0	

"Any future simulation development must be motivated by physics needs"

CLHEP migration

BABAR does not use "standard" CLHEP version, hence for compatibility with Geant4 we would need to migrate our version

- Ongoing effort by **Dennis Wright** and (over past year) **Hojeong Kim**

- **Most recently, "HepString" package removed and replaced with std::string package**
- **CLHEP/String/Strings.cc, Strings.h, Strings.icc removed**
  - ~140 BABAR packages directly affected (mostly non-simulation)
  - Substantial problems with validation; to date a total of ~14 (IFR) packages have been successfully validated
  - NOT NEEDED IF WE NEVER MOVE BEYOND G4.7.1!
- **Any move beyond Geant4 V7.1 will require CLHEP 1.9 or 2.0**
  - CLHEP 2.0 has multi-library structure
  - CLHEP namespace migration required
  - MUCH MORE DIFFICULT MIGRATION!

Validation

- **Coordinated validation effort of proposed new Geant4 version (7.1) in 19 series currently in progress**
  - GHit level validation: see talk by Dennis Wright
  - Subsystem level validation: effort in various groups, see e.g. talk by Roberto Sacco
  - “Overall” validation: discussion with Validation Board HN, DQG will provided comparison of releases 19.4.0 (G4 6.1) and 19.4.1a (G4 7.1)
  - Physics-level validation: tools groups generally contributing, but need additional input from AWGs!
- **“Hanging” problem in 19.4.1 has delayed production of MC validation samples**
  - problem is now fixed and samples are expected to become available in the near future

Moose reproducibility issues

Several problems identified in SP8 production with the reproducibility of SP runs in Moose

1) Known issue associated with AMD/Intel comparisons (i.e. same run processed on two different machines)
2) ~few % of runs show O(1000) histogram differences either between sites, or between processings at same site
3) 18.6.0 validation showed differences in all runs for "/VtxOprMon/x Primary Vertex" histos, which subsequently went away in 18.6.1a...
4) In 18.6.1a validation, ~5% of runs show small random differences in various physics histograms

e.g. "/PhysMonModule/Mass J/Psi -> mu+ mu-"

- **Differences are present at ghit level, hence appear to originate in Geant or subsystem simulation**
  - Poses a significant problem for SP site validation
  - Substantial barrier for validation of new development activities
- **High priority issue, but few resources available within Sim Dev group to address it**

Manpower issues

- **Available resources within the simulation development group are getting dangerously low (and expected to decrease further in the immediate future)**
- **"Core" development effort is currently at level of ~1FTE**
- **Some subsystems have no identified simulation representative, others handle simulation issues at a "best effort" basis**
  - At the most recent regular Simulation Development meeting there were more members of BABAR computing/management team present than contributing members of the sim dev group...

Lack of resources and erosion of expertise within the simulation group could be a show-stopper for any future development and/or simulation validation