Reconstruction Software and Simulation Studies to be Done for CD-2

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Abstract

The June 2006 Lehman review of the 12GeV project at JLab gave a very specific recommendation that the simulation and reconstruction software for GlueX be developed in time to validate the detector design prior to the CD-2 review. This document lists some specific studies that should be completed prior to the CD-2 review. In addition to the studies themselves, it describes the prerequisite tasks that must be completed before these studies can be done.

1   Introduction

Several aspects of the overall GlueX detector design have been developed and checked in the past using the MCFast parametric simulation package [1][2]. Validation of the design at the next level requires an ab initio simulation package such as GEANT and full[1] reconstruction software. This will help ensure that there are no significant "holes" in the GlueX detector design and that the baseline range defined in CD-2 is as accurate as possible.

The driving force of this document is the CD-2 review in the summer of 2007. Working backwards from that, we do the following:

A.) outline specific studies that should be performed prior to the review in order to validate the GlueX detector design.

B.) list specific software tasks that must be completed as prerequisites to studies in A

Item A above refers primarily to the GlueX detector as a whole and details are given in section 4. Item B refers primarily to reconstruction packages for individual detector systems with details given in section 3.

A software workshop is scheduled which will serve as the transition point between B (which must happen first) and item A. Details on the workshop are given in section 2 below.

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[1]Here "full" does not necessarily mean final nor complete. It refers to the ability to extract tracks/showers/hits from realistic backgrounds and reconstruct them at a level where believable resolutions can be obtained.

2 Software Workshop

A GlueX software workshop will be held at JLab Nov. 10-11, 2006. The primary goals of the workshop are:

1. Give reports that document the completion of the software tasks listed in section 3.

2. Produce the final list of Monte Carlo studies to perfomed prior to CD-2 and identify the specific manpower that will do them. Section 4 is a suggestion for things that might go on this list and will serve as a starting point of the discussion.

These goals are given more specifically in the official charge of the workshop which is given in the following subsection.

2.1 Charge of the Software Workshop

At the recent (June 2006) Lehman review, reconstruction software was strongly emphasized as a place to focus GlueX manpower over the next year. The intent was to use the simulation and reconstruction to validate the detector design as much as possible prior to the CD-2 review in 2007. In response to this, a software workshop will be held where presentations will be given summarizing specific milestones that have been met to address this goal. Specifically, the workshop shall serve as a turning point in which individual pieces of reconstruction code have been completed allowing studies of the GlueX detector as a whole to proceed. To meet this goal, the participants are charged with the following:

1. Verify the simulation (HDGeant) has the most up to date geometry and materials definitions for every subsystem. This should include support structures and cabling where appropriate.

2. Verify the simulation output contains enough information to properly mimic the actual detector responses for each subsystem (see GlueX-doc-654). This should include detector resolutions and possibly electronic noise, but need not include "invertable" values such as pedestals and ADC conversion factors.

3. Verify simulation properly models backgrounds, in particular, accidentals.

4. Reconstruction code needs to be in place for each subsystem at a level that it can produce output in physical units from the simulation input. All outputs should be well documented so collaborators unfamiliar with the subsystem can still use it in studies of the GlueX detector as a whole.

5. Form a prioritized list of studies that should be completed prior to the CD-2 review and assign manpower to each. These should include studies of physical channels with high multiplicity final states.

3 Software Tasks

Below is a list of software tasks that must be completed prior to the software workshop.

1. Implement Kalman filter for charged particle tracking

2. Write CDC stereo/axial matching to get z-info for track finding

3. Write photon tagger parametric generator

4. Revive TOF code and verify resolutions from HDGeant are consistent with TRI-UMPF data

5. Fix BCAL reconstruction issues so that π^o mass reconstructs properly. Check optimization

6. Implement Rad-ϕ code for FCAL. Verify HDGeant π^o mass reconstructs properly

7. Write UPV reconstruction

8. Cherenkov detector!

4   Monte Carlo Studies

Below is a list of items that could be studied with the GEANT based Monte Carlo and a full reconstruction package. This list will be used as a starting point for discussion of what studies *must* be done prior to CD-2.

1. Check overall hermiticity of detector
   - Acceptance vs. momentum vs. angle for charged and neutral particles
   - Resolution vs. momentum vs. angle
   - Resolution and acceptance for low multiplicity vs. high multiplicity events

2. Affect of material type and density on detector resolutions
   - FDC walls
   - FDC dead area
   - CDC/FDC cabling

3. FDC package placement

4. Track finding in realistic background conditions
   - Tracks/photons from unrelated photons from tagger

5. Reconstruction of showers that are shared between BCAL and FCAL

6. Resolution vs. misalignment
   - Pitch, yaw, roll, translation

7. Affect of dead channels
   - Dead wire/strip (group of wires/strips) in CDC/FDC
   - Dead tube in BCAL, FCAL, TOF, UPV, ...

5   Schedule

References

[1] Fermilab Computer Division *MCFast fast tracking simulation* http://cepa.fnal.gov/psm/simulation/mcfast

[2] P. Eugenio *A Study of Acceptance for the Stage 1 Hall-D Detector* GlueX-doc-16 (1999)

[3] J. Kuhn *Acceptance Study for the GlueX Detector System* GlueX-doc-277 (2004)

[4] C. Meyer and E. Smith *GlueX Reconstruction Software* GlueX-doc-662 (2006)

[5] R. Jones *Detector Models for GlueX Monte Carlo Simulation: A Status Report* GlueX-doc-654 (2006)