ILC Detector R&D Paper – LCIO

Major R&D Efforts:

The LCIO software toolkit [1] was developed to provide a common event data model (EDM) and persistency format for Linear Collider physics and detector simulations. It was developed as a joint effort between SLAC and DESY and has been adopted by all of the detector concepts for both ILC and CLIC[2]. Many of the subdetector R&D groups (e.g. CALICE and LCTPC) have also adopted LCIO for both their simulation needs and for testbeam data.

The software toolkit consists of an Application Programming Interface (API) as well as reference implementations in Java and C++ and a binding to python. This, plus its deliberately simple design and well-documented EDM, has allowed the LC community to mix-and-match its software applications. Events simulated in C++ can be reconstructed in Java and analysed in python, providing enormous flexibility to the end user, who can concentrate on analyses and not be hampered by programming language limitations.

(Software) Engineering Challenges:

The implementation of a complete EDM for all HEP applications is very difficult, if not impossible. LCIO has succeeded by reducing the problem to its simplest solution, but providing end users flexibility to adapt to their specific needs. Custom classes can be implemented using extensions to existing classes or using generic objects and relations between collections of data. The LCIO development team has also added functionality as new classes have been requested by users. Maintaining strict control over the structure of the LCIO EDM and persistency has ensured that any LCIO file can be opened and interpreted without having access to the code which created it.

Detector R&D Plans:

Continued development of LCIO will be driven by user demand and developer's resources.

Collaborating Institutes:

SLAC and DESY.

Applications beyond the ILC:

The Heavy Photon Search experiment [3] at Thomas Jefferson National Laboratory has adopted LCIO as its event data model and data persistency format. Physics and detector studies for CLIC [2] and the Muon Collider [4] have also used LCIO. The authors of the Whizard [5] event generator have expressed interest in using LCIO as their binary persistency format for Monte Carlo events. This could lead to its integration into other experiments. Because of its simple and well-documented persistency format LCIO is a perfect candidate for HEP data archiving applications.

[1] http://lcio.desy.de/
[2] http://clicdp.web.cern.ch/
[3]https://confluence.slac.stanford.edu/display/hpsg/Heavy+Photon+Search+Experiment
[4] http://map.fnal.gov/
[5] https://whizard.hepforge.org/