Current Status of the UNO Software

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• Current Status
• What needs to be done
Software Goals

- Top Priority Physics Studies
  - UNO as a VLBL detector
    - Requires detailed reconstruction programs to study $\pi^0/e^-$ separation
  - Proton decay: $p \rightarrow \nu K^+$, $p \rightarrow e^+\pi^0$

- Secondary Studies
  - Response vs. PMT (10% vs 40%, 8" vs 20", multi-hit vs single hit)

- Need a package that anybody can use for physics studies
Current Situation

- Most existing physics studies done using SK code
  - Only available to SK collaborators
- Existing UNO software
  - Simulation of UNO
  - Relatively complete event infrastructure
    - include event display, event bookkeeping, ...
    - Good for energy response studies, &c
  - Sorely lacking event reconstruction code
Physics Simulation and Analysis Working Group Tasks

Contacts: Toki and McGrew

- Distribution and Support
- Processing and Resource Requirements
- Code Development and Library Design
- Physics Analysis
Organization of Existing Software

External

CMT

CLHEP

GEANT

ROOT

UnoCore

UnoPolicy

UnoUtility

External Simulation Infrastructure & Data Structure

Esim

csim

Csim

Analysis

FitCore

EventDisplay
Core Data Model

Global Data Structures

- Event: collected information for an event
- EventModel: “reconstructed” description of the entire event
  - Collection of Track and Vertex objects
  - Multiple models per event
- Trajectory
  - Tree of Track and Vertex, mostly useful for MC
- HitSelection:
  - Selection of hits used in an EventModel

Component Data Structures

- Sensor:
  - Where, what, neighbors, &c
- Hit: collected light
  - Single PE, or multiple PEs
- Vertex: A position position.
  - Has out-going tracks
- Track: A light producing particle or shower
  - Has vertex, momentum, direction, &c
Core Utilities

- **Geometry:**
  - Where am I? How far to wall?
- **Light Attenuation**
  - Includes dispersion, non-exponential, QE vs wavelength
- **System of Units**
- **Minimizers**
- **Trajectory access**

- **CSIM**
  - Detector Simulation
  - Input from NUANCE
  - Includes detailed UNO geometry

- **ESIM**
  - Electronics Simulation
  - Input from CSIM
  - Extensible for complex photo-detectors and electronics

- **Event Display**
An Event: it all works

~300 GeV Horizontal Muon
Example Analysis Chain

CSIM + ESIM → Point Fit → Ring Counting

Precise 1 Track Fit → Energy Calibration

Shower vs Non-shower ID

Specialized Fitters proton decay

π° Selection proton decay

e vs π° ID VLBL

“Energy Flow” tau search
What Needs to be Done

- Finish Implementing Basic Reconstruction
  - Vertex fitter (~1 person month)
    - Preliminary implementation by Jungdoo
  - Implement e/μ ID (~1 person month)
  - Visible energy, attenuation, &c (~1 person months)
  - Ring Finder (~2 person months)
  - Implement π⁰ reconstruction ala SK
    - 2 person months
  - Studies of Detector Response using tools
What **Really** Needs to be Done

- Pick specific goal (VLBL oscillations)
  - Many steps can be “faked”
    - Point fit, Ring counting, Energy calibration, $e$ vs $\mu$
  - Some steps are critical
    - $e$ vs $\pi^\circ$
- Concentrate on critical steps
What We Need

- Support for users of UNO code
- Sufficient CPU to do the work
- Reconstruction Design and Development
  - Base on SK/K/IMB experience
  - Might be done by one competent C++ programmer (physicist?) in one year
Conclusions

- Much of the core software exists
- Most physics/reconstruction tools missing
- Have chosen to concentrate on VLBL osc.
  - Input to a “proposal”
  - Possible “PRD”
- Hope from R&D support
  - We need hardware and personnel to progress
- ANYBODY who is interested in participating
  - Meeting on Saturday morning
Who's been working
and why we need more help

- Clark McGrew & Chiaki Yanagisawa
  - T2K is nearing construction phase and uses most of our time

- Brett Viren
  - BNL support responsibilities. Over subscribed for VLBL development and MINOS

- Walter Toki and Jungdoo Lee
  - Experience with large simulation farms