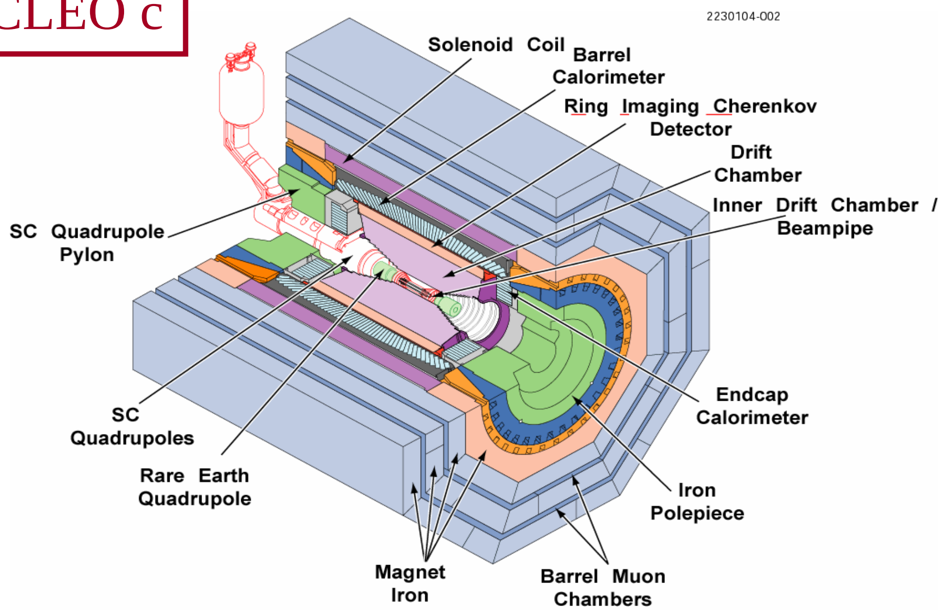
Charged Particle Reconstruction at Cornell

Dan Peterson, Cornell University

CLEO c



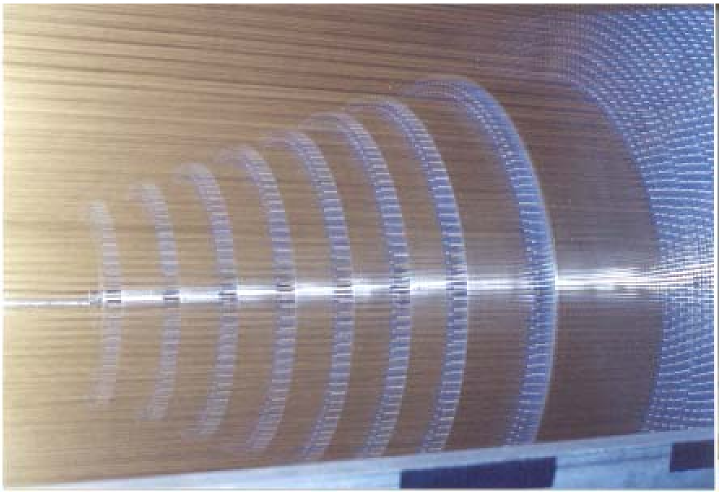
The Cornell group has been responsible for CLEO charged particle tracking since the inception in 1978.

built the chambers
operated and maintained the detectors
calibrated the detectors

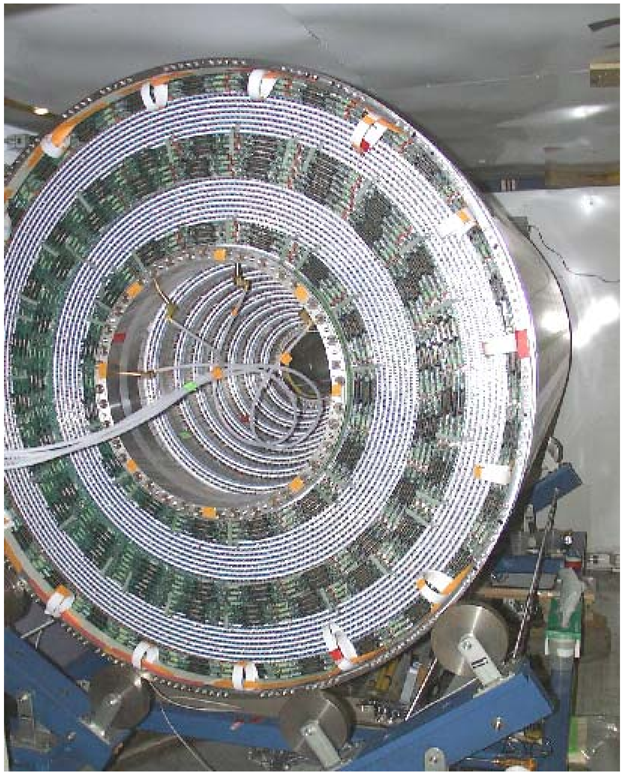
and

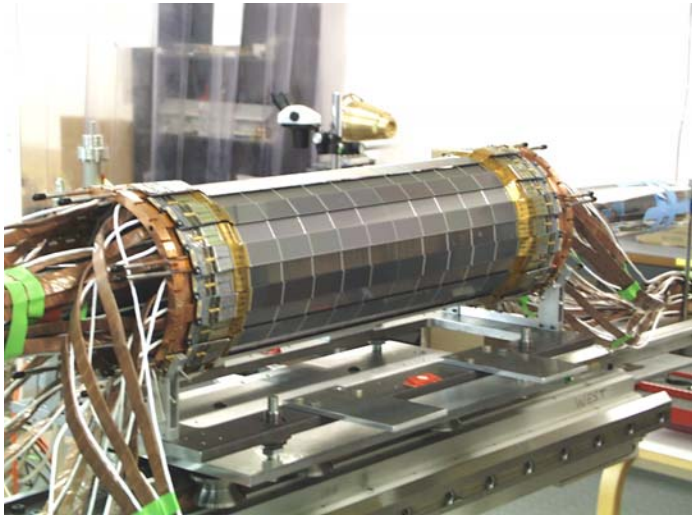
provided, maintained, upgraded the particle track reconstruction.

CLEO tracking devices

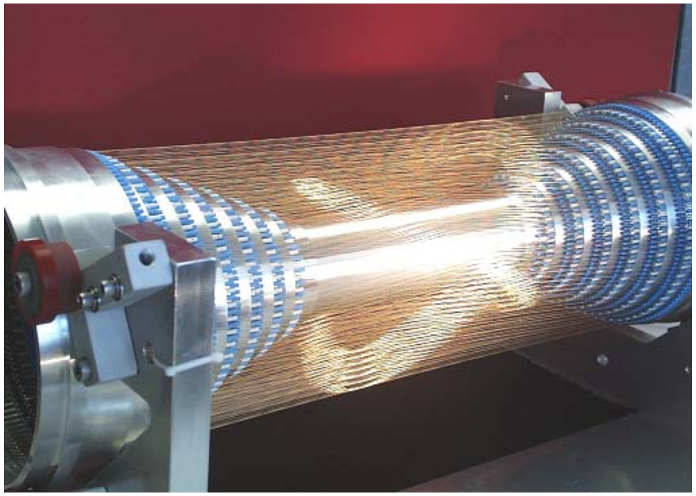


DR3





SI3



ZD

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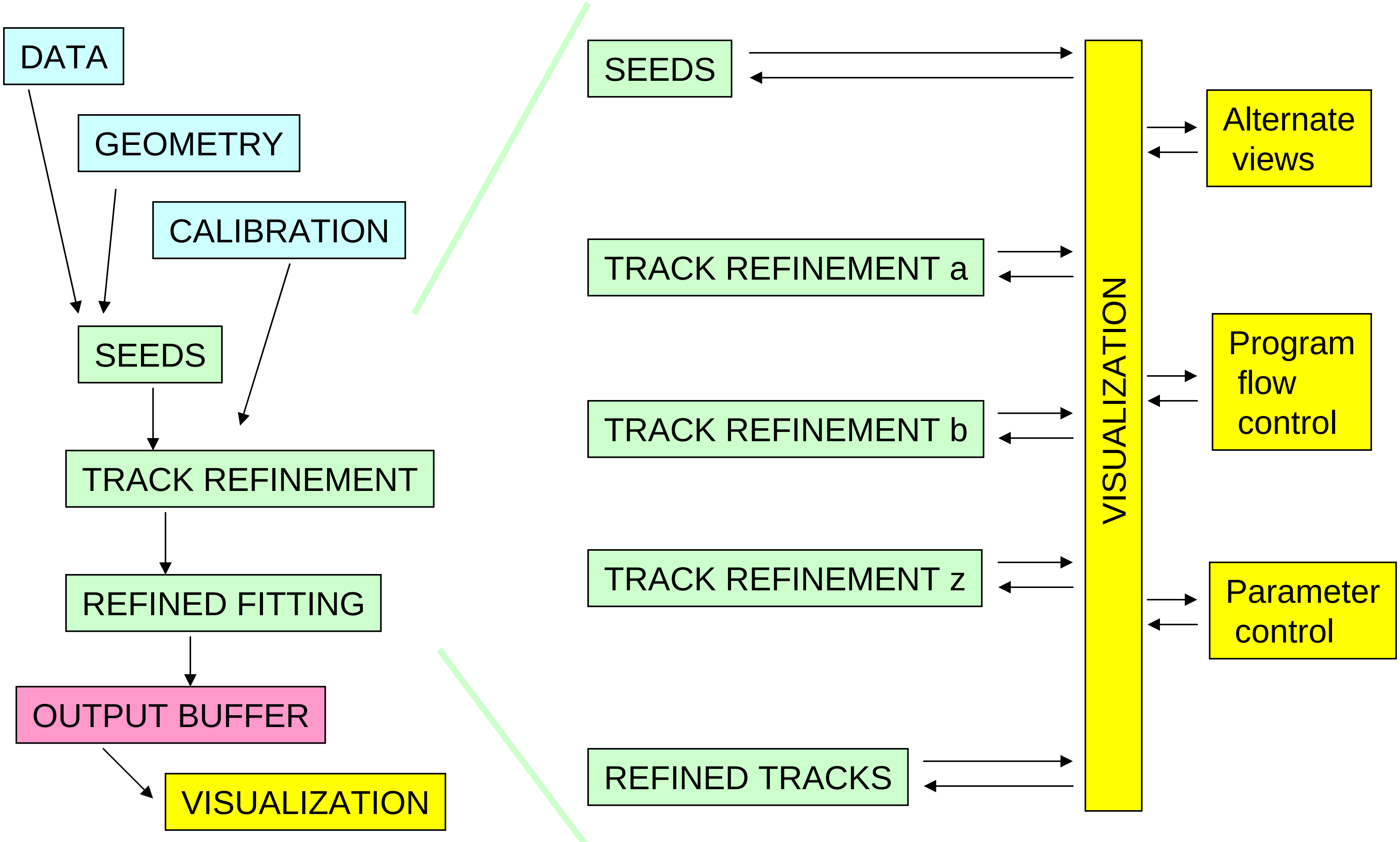
Visualization is everything



CLEO Pattern recognition

Various methods:

Some depend on intrinsic resolution, at some level requiring 3 points define circle (globally or locally).

This will probably be the case for the all silicon detector; layer-layer spacing >> track separation.

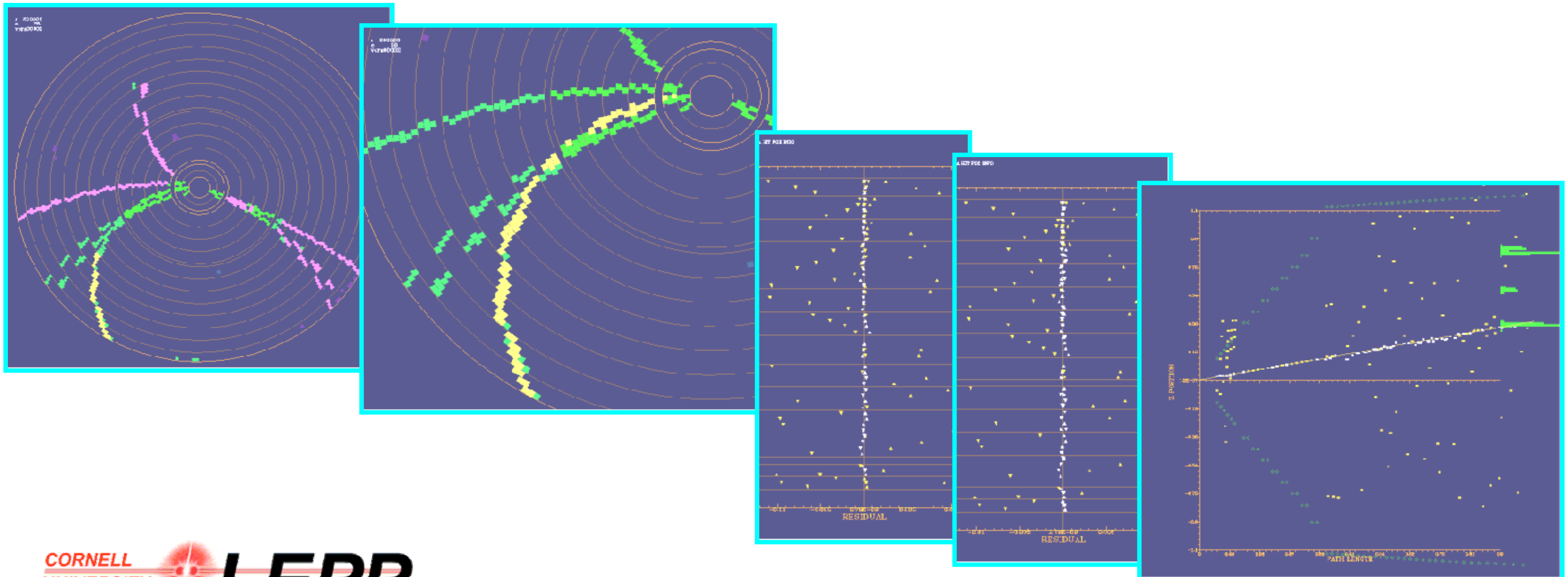
The current CLEO method does not depend on intrinsic resolution to seed the track.

The method uses local "chains" of isolated hits at cell level,

extends into noisier regions,

then applies local-ambiguity-resolution using the precision information,

extends and adds still unidentified hits, now using precision information.



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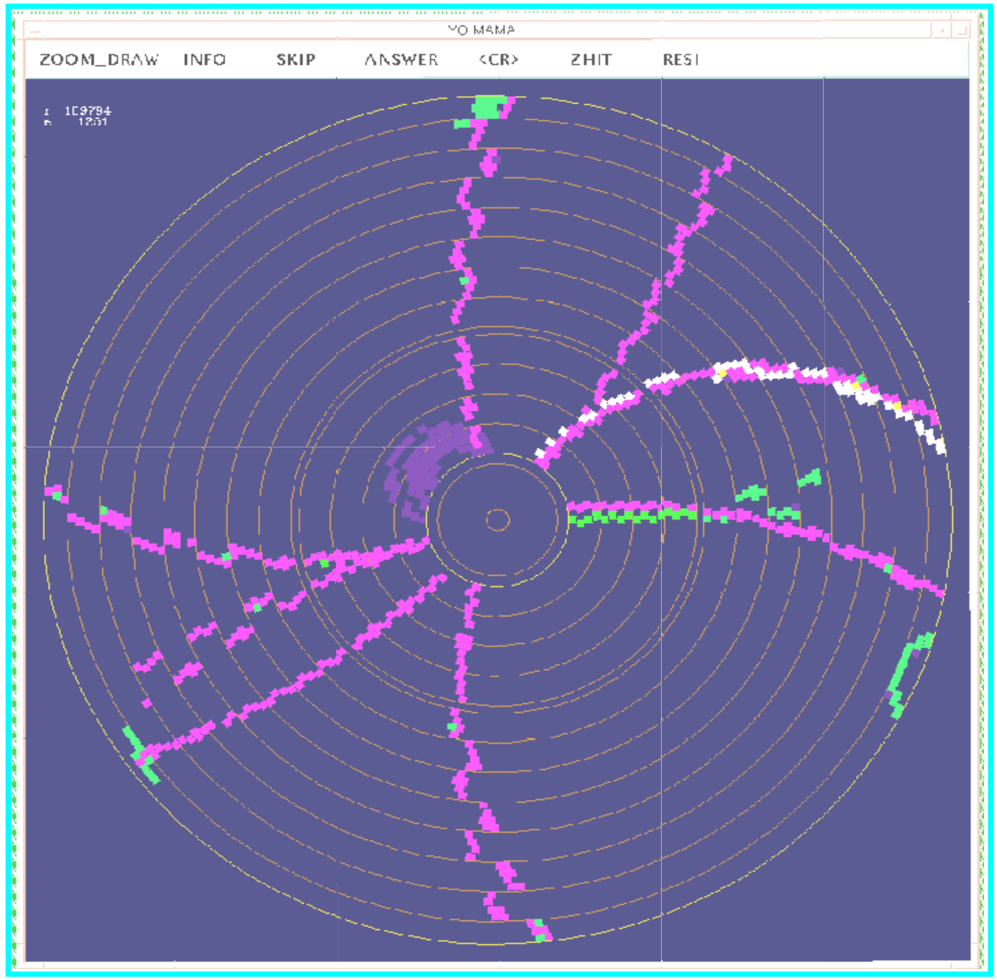
Versatile Seed-finding

CLEO pattern recognition algorithm is
NOT applicable to
an all-silicon tracking system.

There are attributes that
would be retained.

versatile seed finding –
Seed finding must sensitive in regions that are cleanest for each track.

multi-stages for track refinement –
Track refinement must be capable of recognizing a bad development of a candidate and then releasing the hits to other seeds.



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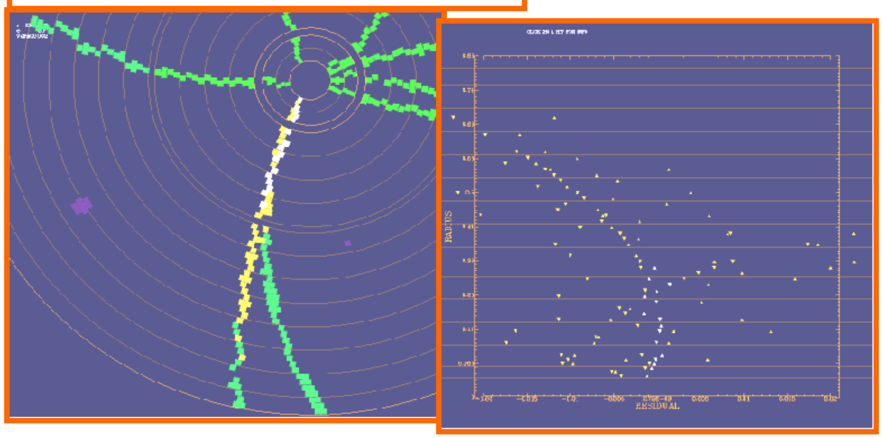
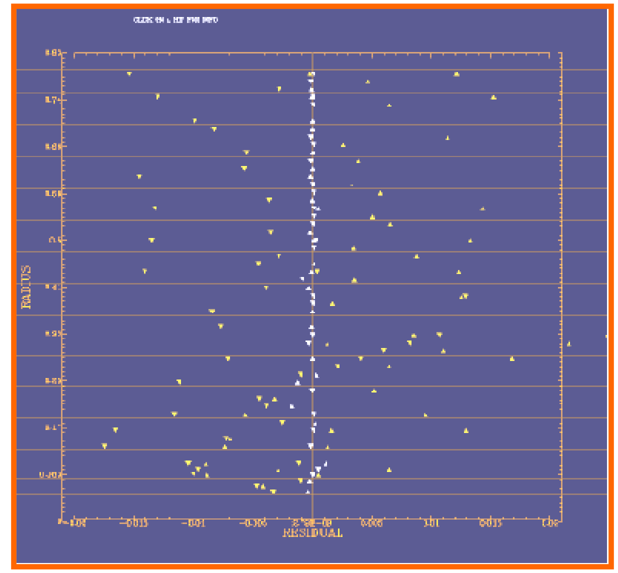
pathologies: examples of visualization aided development

a) significant track overlap



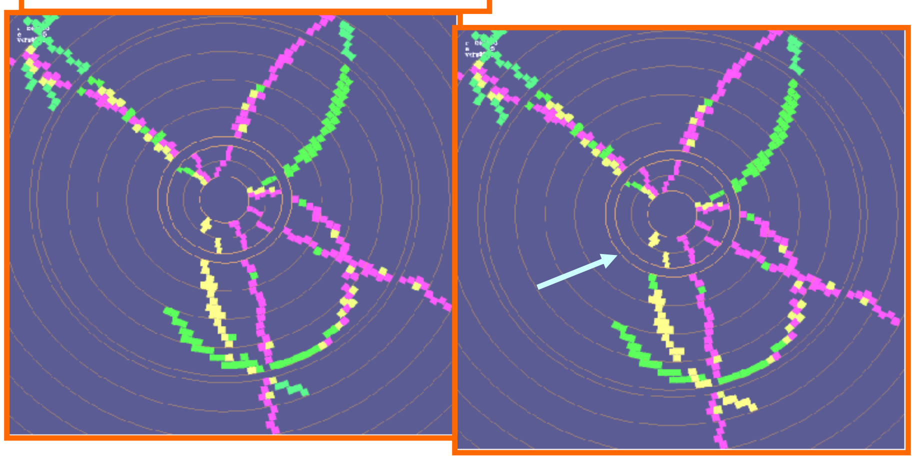


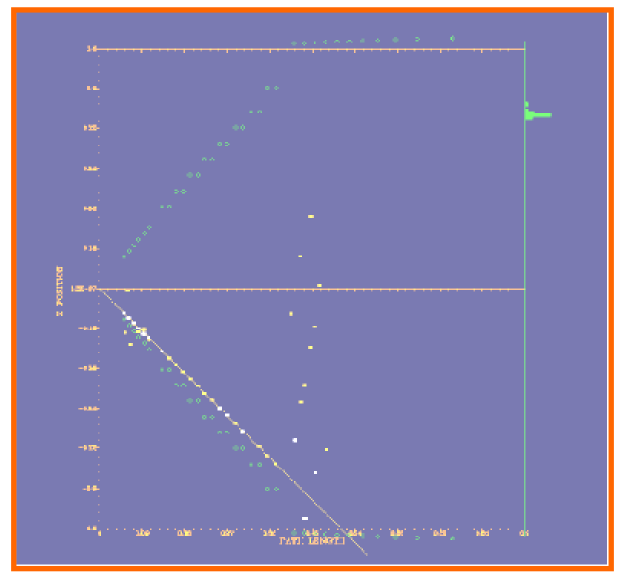
Loop:

initiate the **local-ambiguity-resolution**

with various dZ hypotheses.

b) complexity in the ZD





Loop:

initiate the **chain-finding**

with various dZ hypotheses.

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Kalman Fitting

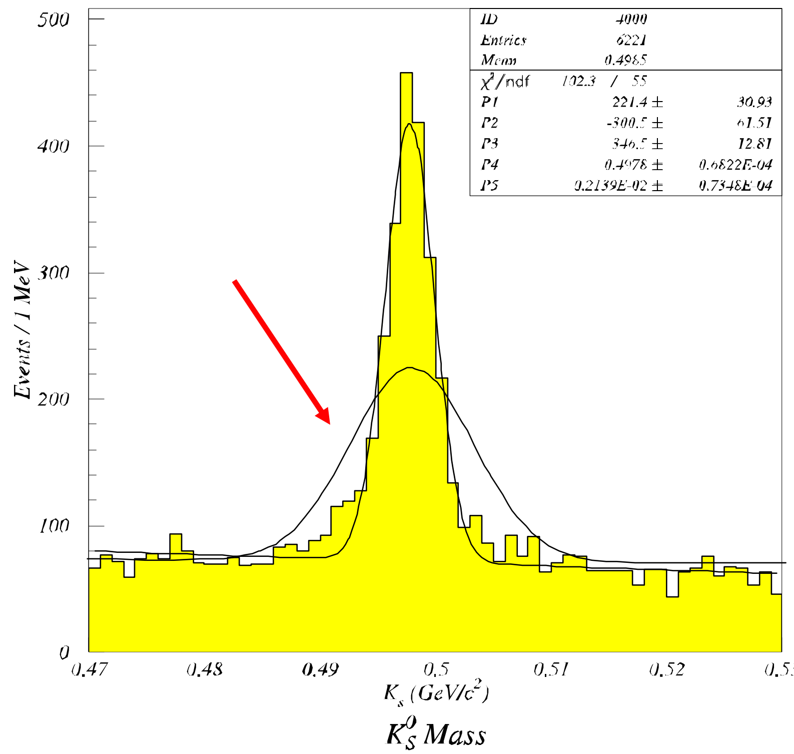
a transport method that compensates for
energy loss and
degradation of information due to scattering

This is the CLEO final fit and, therefore, includes
calibration,
alignment,
fitting weights, and hit deletion.

Our implementation also provides utilities to
delete non-physical hits in a neutral decay hypothesis
and refit.

One of the authors (Ryd) of the original CLEO II program and the sole author (Sun) of the CLEO III/c program are current members of the Cornell group.

Kalman methods could be applied in the pattern recognition; Sun is available to contribute to the effort.



CLEO III
without Kalman: (projection fits in finder)
K^0 resolution is $\sigma \simeq 5$ Mev.
with Kalman fitter: K^0 resolution is $\sigma \simeq 2$ Mev.

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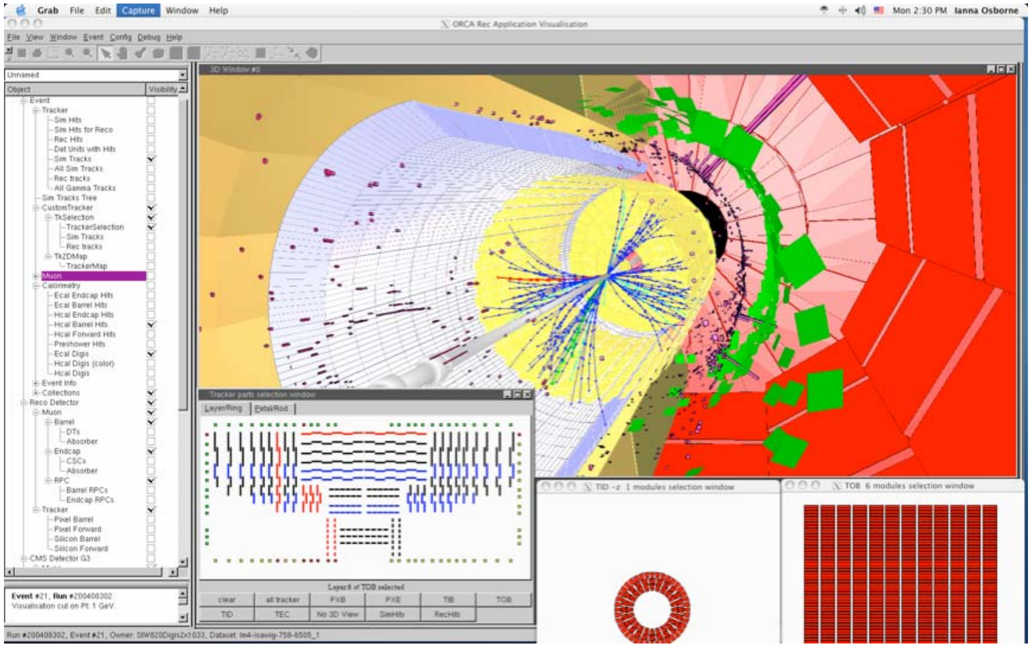
visualization: where to start

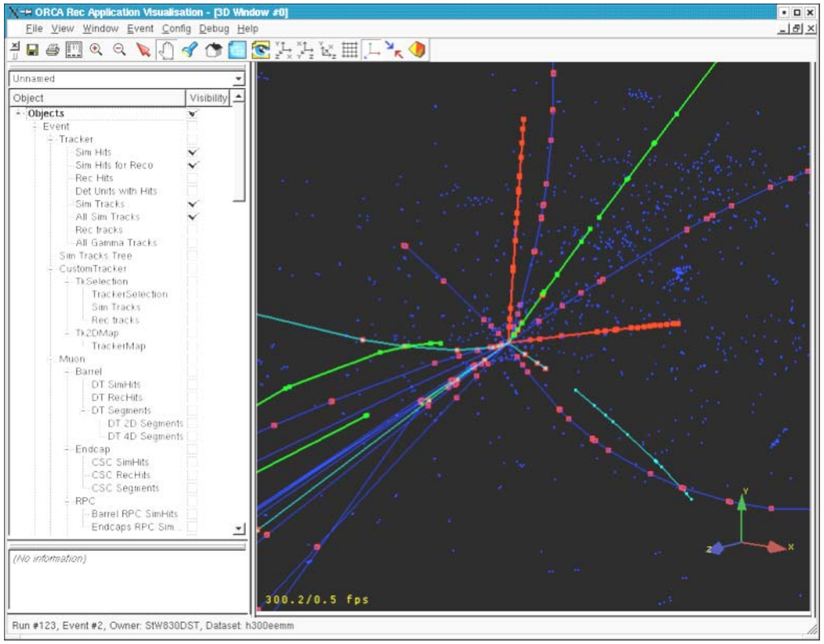
IguanaCMS:

This may be more than we need. We should be careful to avoid something that is slow or difficult to adapt.



The “Tracker SimTracks”, (ordered SimHits connected by straight line segments):

This would be a useful tool for separating decays from pattern recognition faults.



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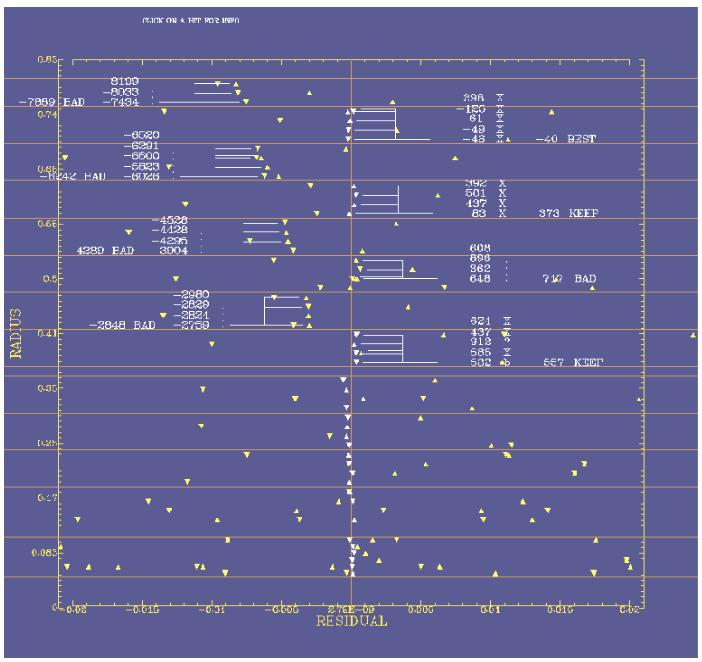
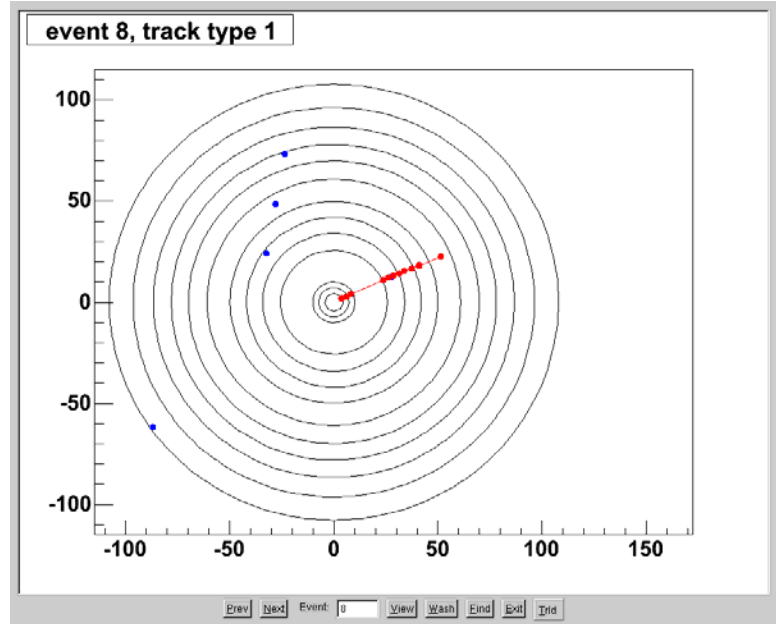
visualization: where to start

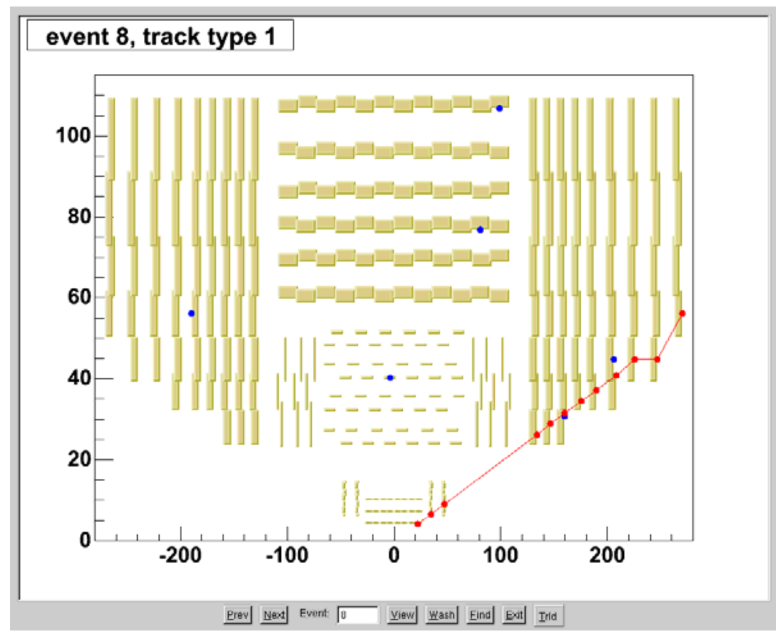
The “simple” tool:

The r-ϕ and r-z views are usable.

We would need to add
the residual view,
possibly with diagnostic information.







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What we need …

We would need to start with a framework providing
"data", calibration, geometry, and result classes.

A working event visualization would be very helpful. (IguanaCMS, other ?)
A framework for creating a menu to control program flow would be helpful.
A framework to create alternate views would be helpful.

What we do …

Personnel: Peterson, Sun, an undergrad, maybe Thom, Wittich, students,
advice from computing group: Chris Jones …

Create other views in the visualization: residual, sz, traceback information

Start with a simple pattern recognition.

Add sophistication through studying pathologies.

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