# Unified Tracking

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# Users will use what meets their needs.

## User-centered design

- Users don't care about the elegance of what's under the hood (but we as developers and human/computing resource managers clearly do)
- We can't force users to use a technologically superior solution that they don't want to use (or we'd all be using HDF files instead of ROOT files)
- Users will evaluate on other criteria than developers.

Disclaimer: if you work with undergrad and grad students, you know the main users.

# Users will use what is easy to evaluate.

## User-centered design: fast to evaluate

- Can users find it quickly?[1]
- Can users download evaluate the features quickly?
- Can users run on a provided test data sets quickly?
- Can users run on their own data sets quickly?

## User-centered design: easy to adapt & extend

- Languages and structure: physicists don't know what a *lambda* is (other than wavelength)
- Containers: easier provided software, could be harder to modify
- Environment: does it require specific dependencies or is it generic?

[1] proio: *GmbH in Germany or street in Brazil?*

# What is tracking?

## Fitting problem subject to constraints

- Pixel, strip, wire, paddle: $\pm x \pm \Delta x$ at 95% C.L.
- L/R ambiguity, $f(r, \theta) = c$ in strawtubes

## Additional complications

- Magnetic field approximations
- Kalman filters

## Followed by selection criteria and feedback

- Unphysical solutions, multiplicity

# Unified Tracking?

## Experiment-independent track reconstruction

- Input: geometry and constraints
- Output: reconstructed tracks

## What is a hit?

- Hits as $x, y, z, t$ in 3D space as stored by Geant4, with analogous concept in reality
- Digitized hits: including effects of read-out electronics, noise, inefficiency, smearing,...
- Resulting constraints as input for tracking
  - Point, line, plane, virtual plane

# Unified Tracking?

## Common arguments against

- "Our experiment combines two types of detectors that are not usually found in the same experiments."
- "We have a detector that requires special treatment."
- "What we have works well, thank you very much."

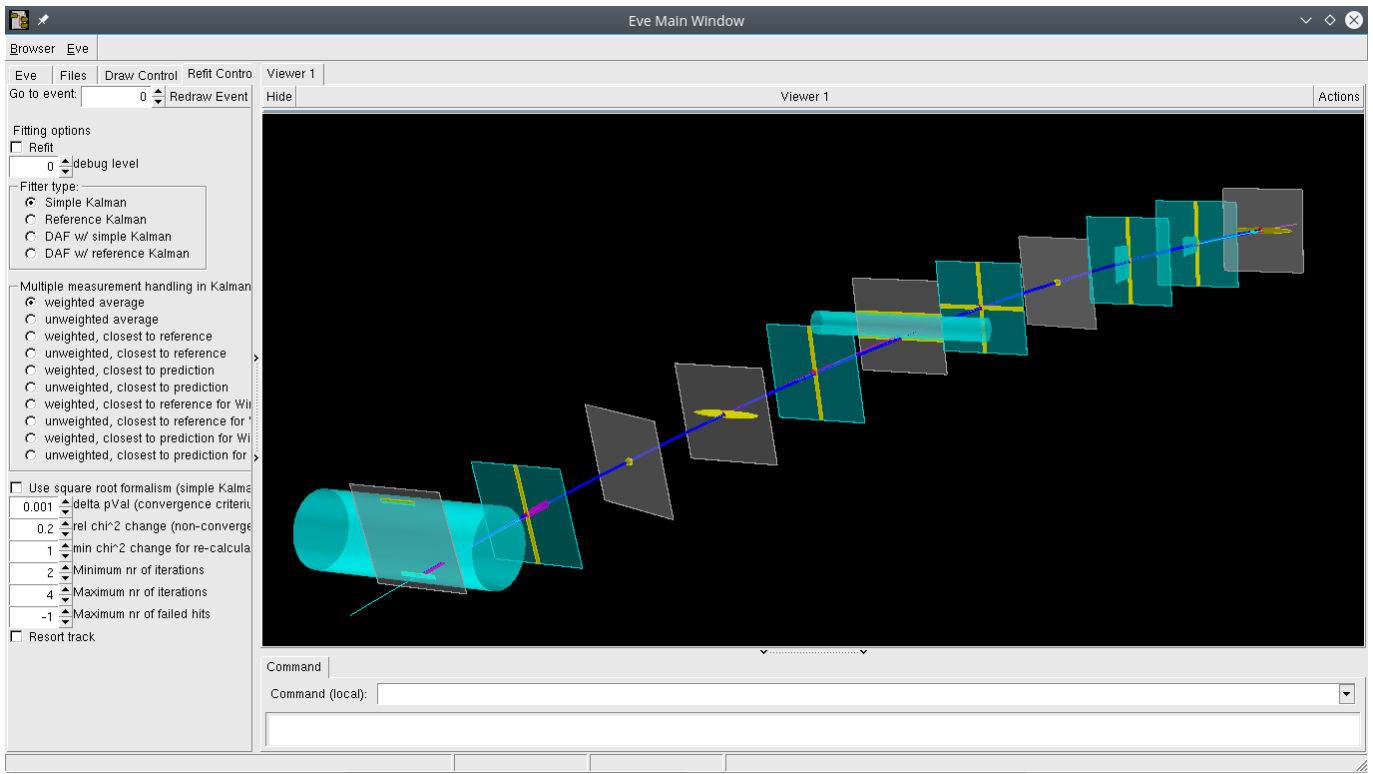
## But think about starting from constraints

- Concerns can be implemented before (digitization) or after (selection)

# Existing Frameworks

## GenFit

- `http://github.com/GenFit/GenFit`



# Man speculative approaches may revolutionize tracking

Only accessible if barrier to experimentation is low

- Image recognition algorithms
- Machine learning algorithms

Requires that barrier to entry is low

- Input should be standalone
- Hits should include/link to geometry, or include only important constraint info

Parallelism

# Todo for discussion

## Interfaces needed

- Hits from MC
- Constraints for track finding, from MC hits or from
- Track candidates for reconstruction
- Tracks from reconstruction

## Layers needed

- Generic digitization to constraints from hits based on detector characteristics
- Generic track finding (e.g. GenFind)
- Generic track fitting (e.g. GenFit)