Pattern Recognition

Introduction:

We are treating the upstream half of the spectrometer and the downstream half of the spectrometer as two distinct detectors. Except where explicitly stated otherwise, this document addresses analysis of a single detector (i.e. the upstream half of the spectrometer). Each process is duplicated for the other detector (i.e. the downstream half of the spectrometer).

We have taken this approach because…

1) We wish to begin analysis prior to completion of the second detector.

2) The particles that interest us most produce tracks in only one detector.

We have assumed that a particle passing through the detector will produce an MWPC signal and a time associated with that signal. We define t_o to be the time associated with that signal.

Summary:

•Important exceptions to 2) above do exist. In order to address them appropriately later we will use t_o's from both detectors in the analysis of a single detector.

•Time windows of width $\delta t + \Delta t$ about each t_o are created. (Asymmetric about t_o, $\Delta t > \delta t$)

•Hits are assigned to the their respective time windows. Overlapping windows may result in some ambiguous assignments.

•If windows are not sufficiently distinct to allow resolution of tracks the event is not fully analyzed, though some characterizations of the event will be noted.

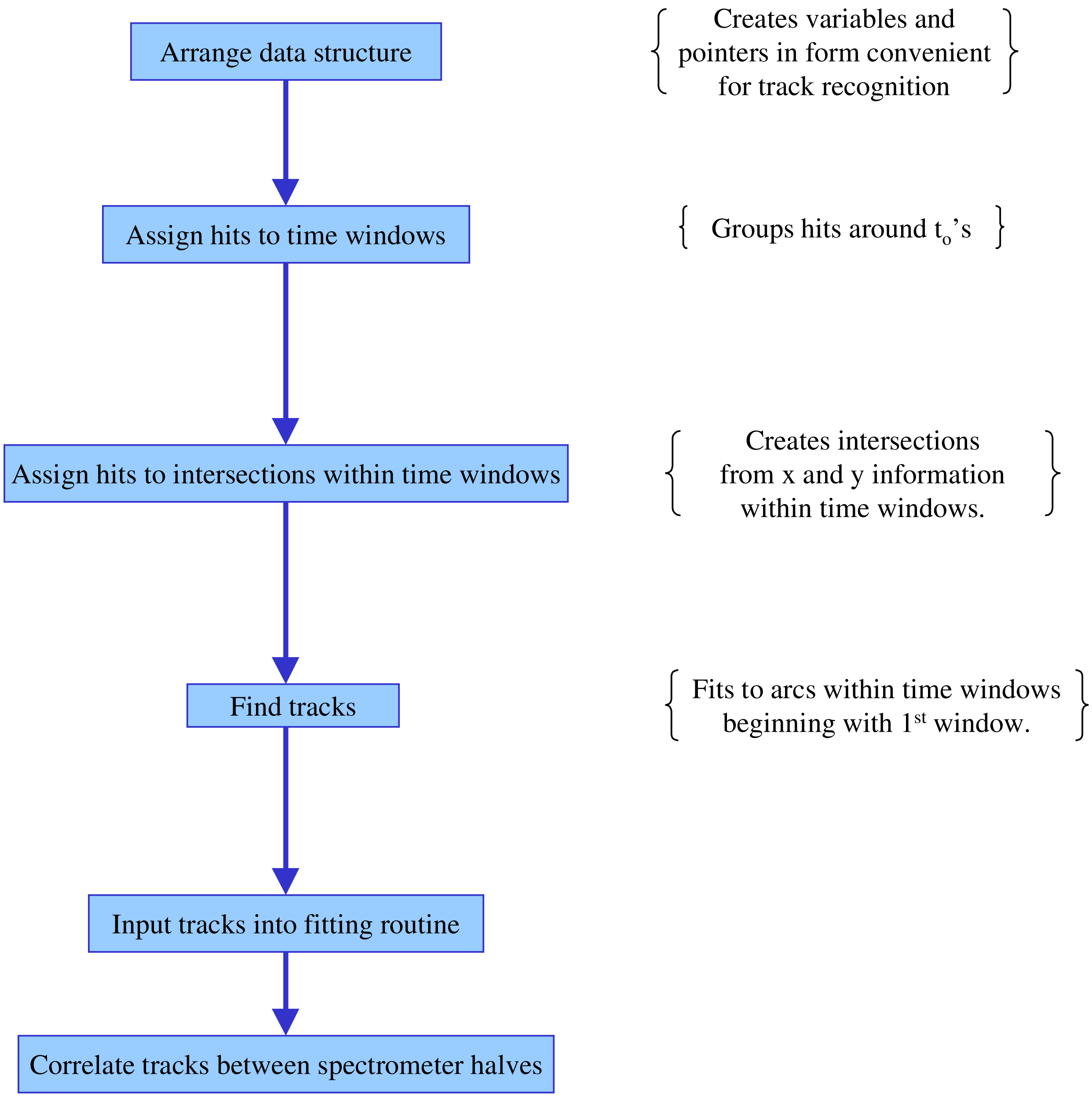
•Within time windows x and y hits are combined to form "intersections" where intersections are small 3 dimensional regions.

•Tracks are reconstructed through the intersections beginning in the dense stack with unambiguously assigned intersections.

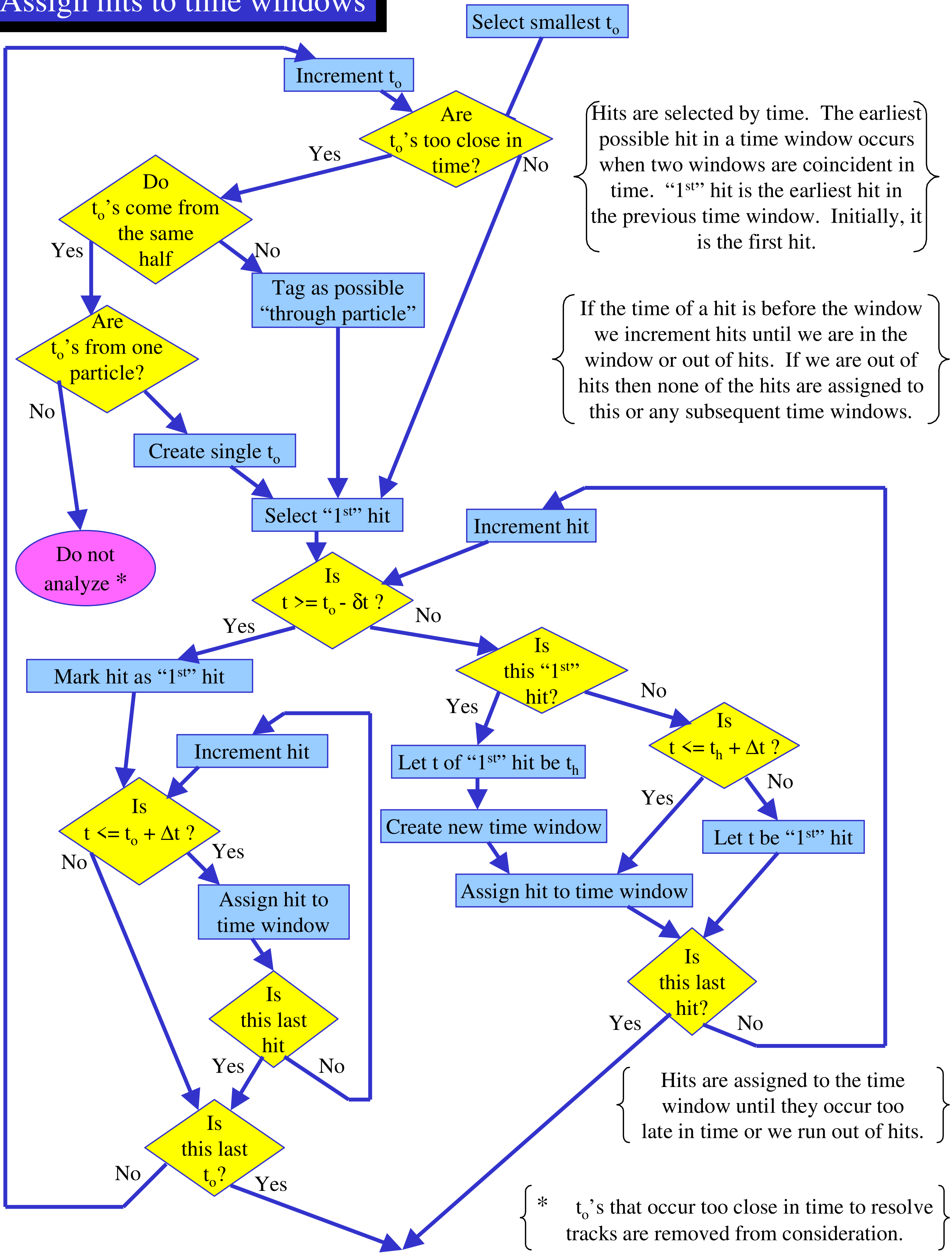
•Tracks are sent to a fitting routine.

Definitions:

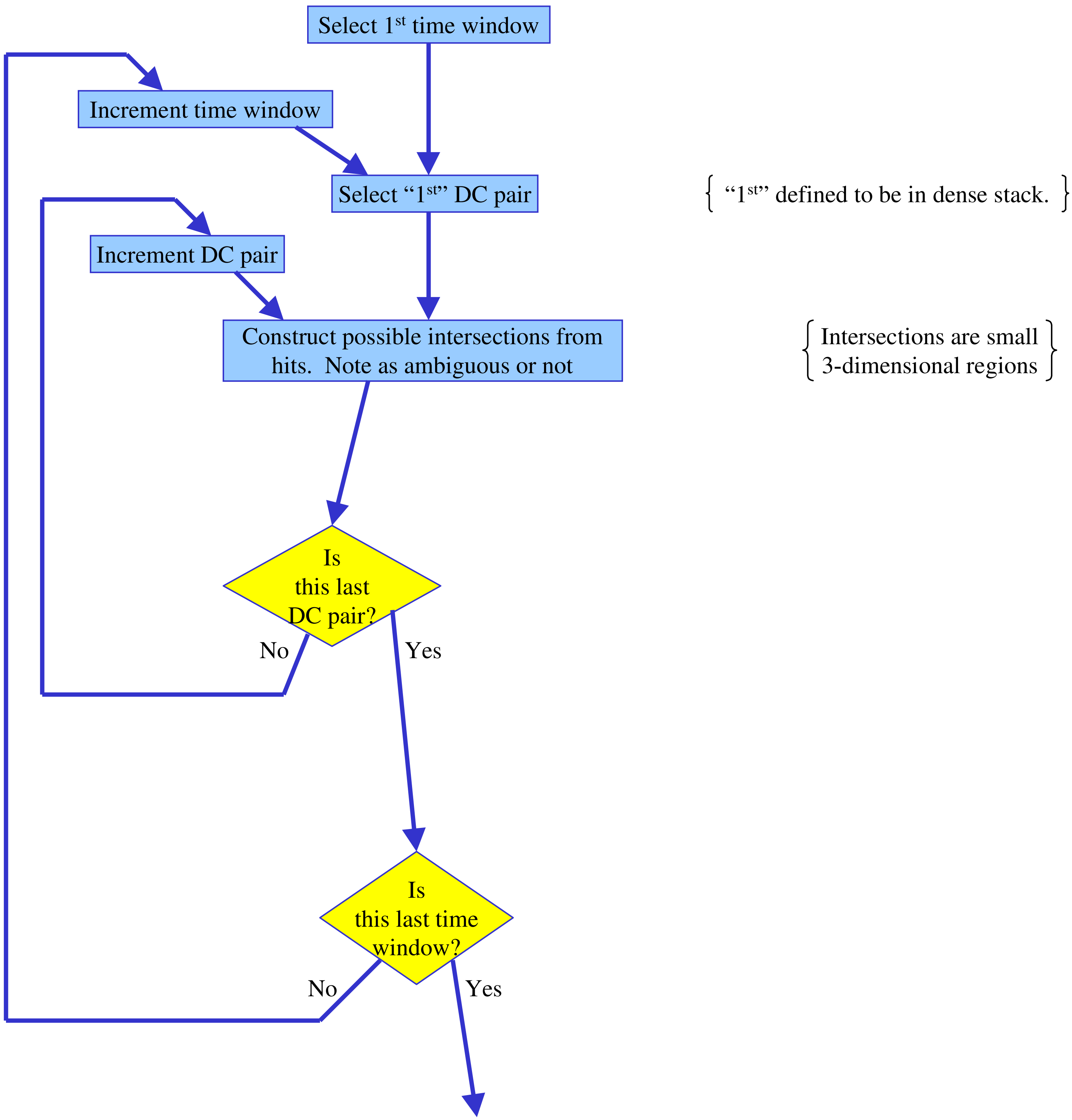
•Arc	Portion of track ignoring z information
•Contiguous	Sufficiently close in x and y, varies directly with difference in z
•DC pair	Combination of two drift chambers consisting of both an x and y plane
• δt	Portion of time window prior to t_o
• Δt	Portion of time window after t_o
•1^{st} hit	Marker to note earliest candidate for given time window
•Helix	Portion of track including z information
•Intersection	Small 3 dimensional region about a pair of hit wires (x and y)
•Start	Marker to note earliest candidate for a track from half 2 to match to a track from half 1
•t_o	Time particle was detected in spectrometer
•t_h	An estimated t_o for hits without a t_o signal
•Time Window	Range of time, $\delta t + \Delta t$, about a t_o
•Track Estimate	Location of a track in a given DC pair
•Weight	Measure of predicted ability to resolve track in given DC pair

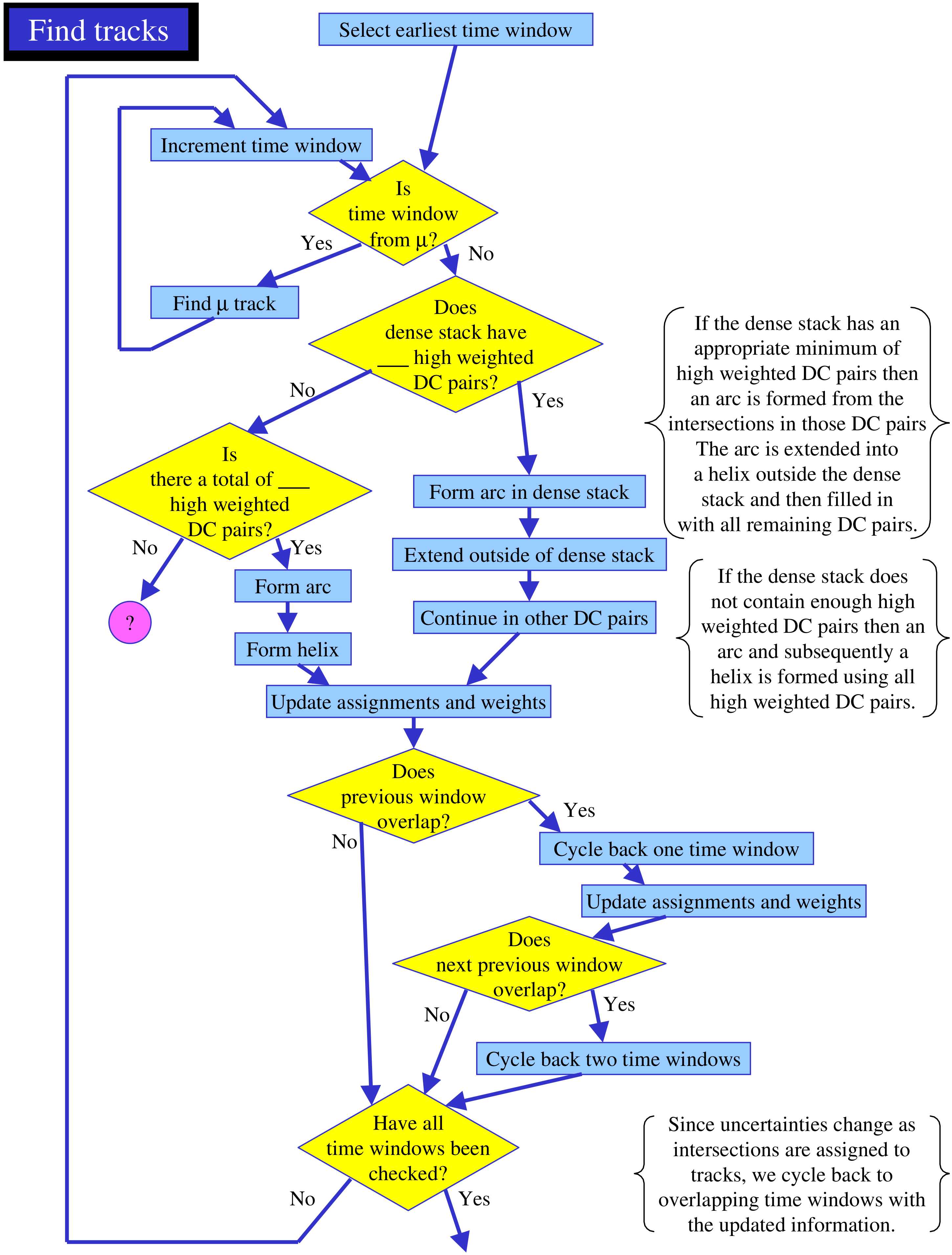

Arrange data structure
Creates variables and pointers in form convenient for track recognition
Assign hits to time windows
Groups hits around t_o's
Assign hits to intersections within time windows
Creates intersections from x and y information within time windows.
Find tracks
Fits to arcs within time windows beginning with 1st window.
Input tracks into fitting routine
Correlate tracks between spectrometer halves

Assign hits to time windows



Assign hits to intersections within time windows

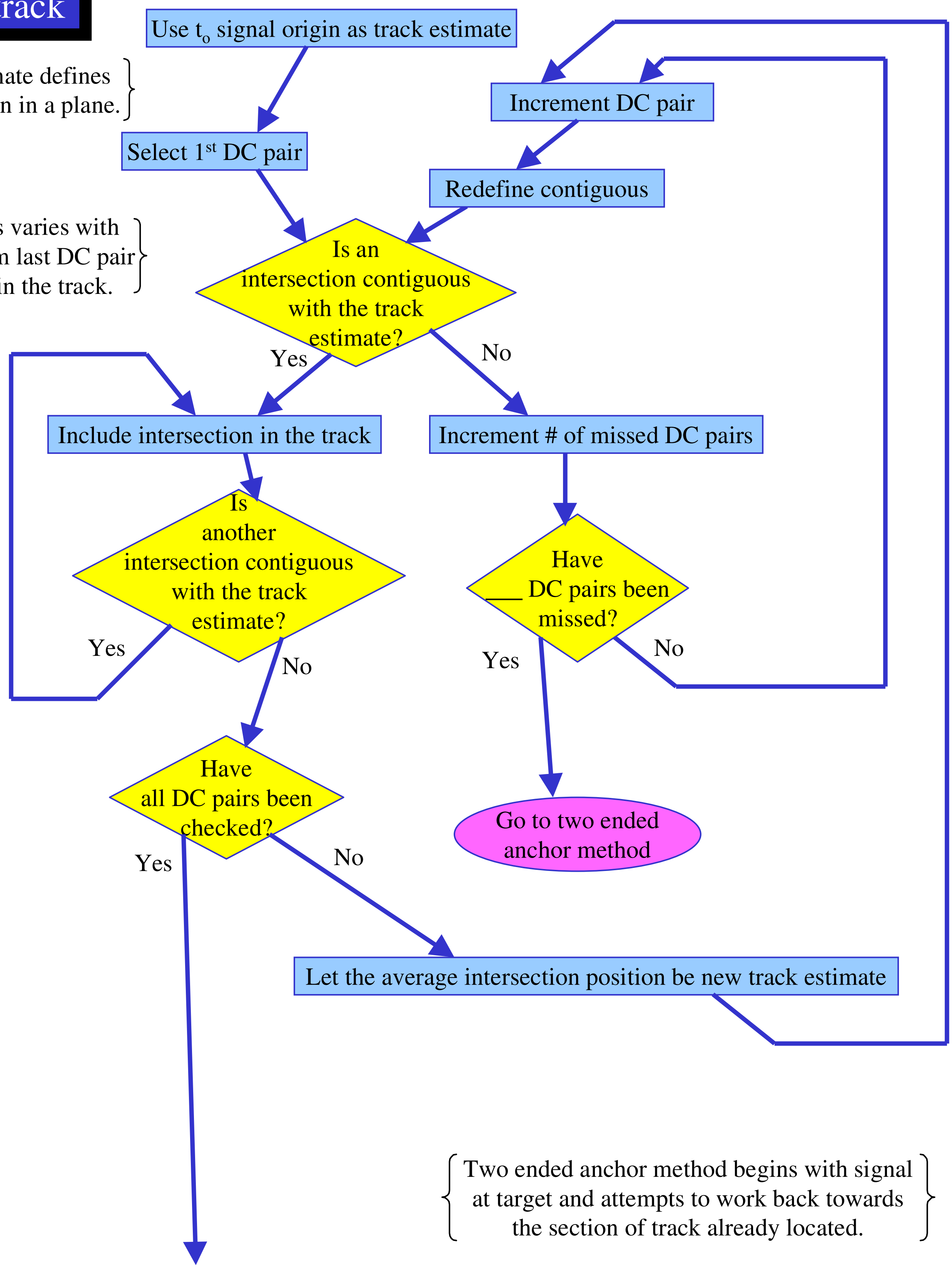



Find tracks
Select earliest time window
Increment time window
Is time window from μ?
Yes
No
Find μ track
Does dense stack have ___ high weighted DC pairs?
No
Yes
If the dense stack has an appropriate minimum of high weighted DC pairs then an arc is formed from the intersections in those DC pairs The arc is extended into a helix outside the dense stack and then filled in with all remaining DC pairs.
Is there a total of ___ high weighted DC pairs?
No
Yes
?
Form arc
Form helix
Form arc in dense stack
Extend outside of dense stack
Continue in other DC pairs
If the dense stack does not contain enough high weighted DC pairs then an arc and subsequently a helix is formed using all high weighted DC pairs.
Update assignments and weights
Does previous window overlap?
No
Yes
Cycle back one time window
Update assignments and weights
Does next previous window overlap?
No
Yes
Cycle back two time windows
Have all time windows been checked?
No
Yes
Since uncertainties change as intersections are assigned to tracks, we cycle back to overlapping time windows with the updated information.

Find μ track

Track estimate defines track position in a plane.

Contiguous varies with distance from last DC pair with a hit in the track.



Two ended anchor method begins with signal at target and attempts to work back towards the section of track already located.

Correlating Tracks between Spectrometer Halves

We wish to correlate tracks between the detectors to produce complete tracks for any particles that pass through the entire spectrometer. (i.e. cosmics, beam positrons,...)

In addition, on occasion, a decay positron may scatter in such a way as to pass through both detectors.

We also note that the absence of the muon track in the downstream detector gives us a control case as we evaluate our ability to separate the muon track from other tracks.

Furthermore, we will wish to use the entire spectrometer as we do calibrations.

Correlate tracks between spectrometer halves