LCFIPlus Performance Tests with ILCSOFT-v01-19-05

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LCFIPlus is a multi-function tool for jet flavour identification.

- vertex finding
- jet clustering
- flavour tagging

They can be done separately.

Current concern :

Among these steps, "**vertex finding**" is supposed to be performed as a part of common reconstruction at sample mass production because

- it is used for almost all analyses,
- it is time-consuming.

(Jet clustering and flavour tagging steps are usually performed at user level depending on processes to look at.)

Urgent matter is to confirm
LCFIPlus works without problem before the coming mass production (by the Ichinoseki workshop?).

LCFIPlus performance tests

How ?

Comparing with ~~the previous results that is already published.~~
the latest samples and the DBD samples
with a same software setup (ilcsoft-v01-19-05).

About test samples :

comments in common :

- bbar process,
- $\sqrt{s}$=91.2GeV,
- W/O ISR,
- event-reconstructed (PFO, vertex)

New sample specific :

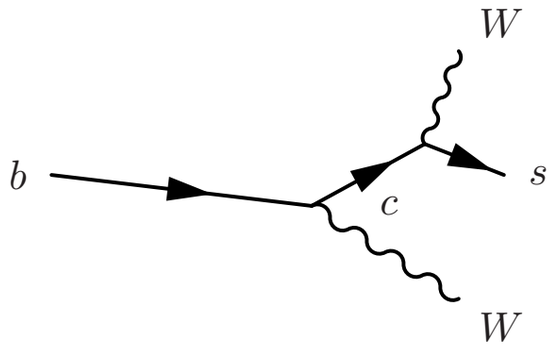
- produced recently with the latest ILD-models and reconstruction software.

DBD sample specific :

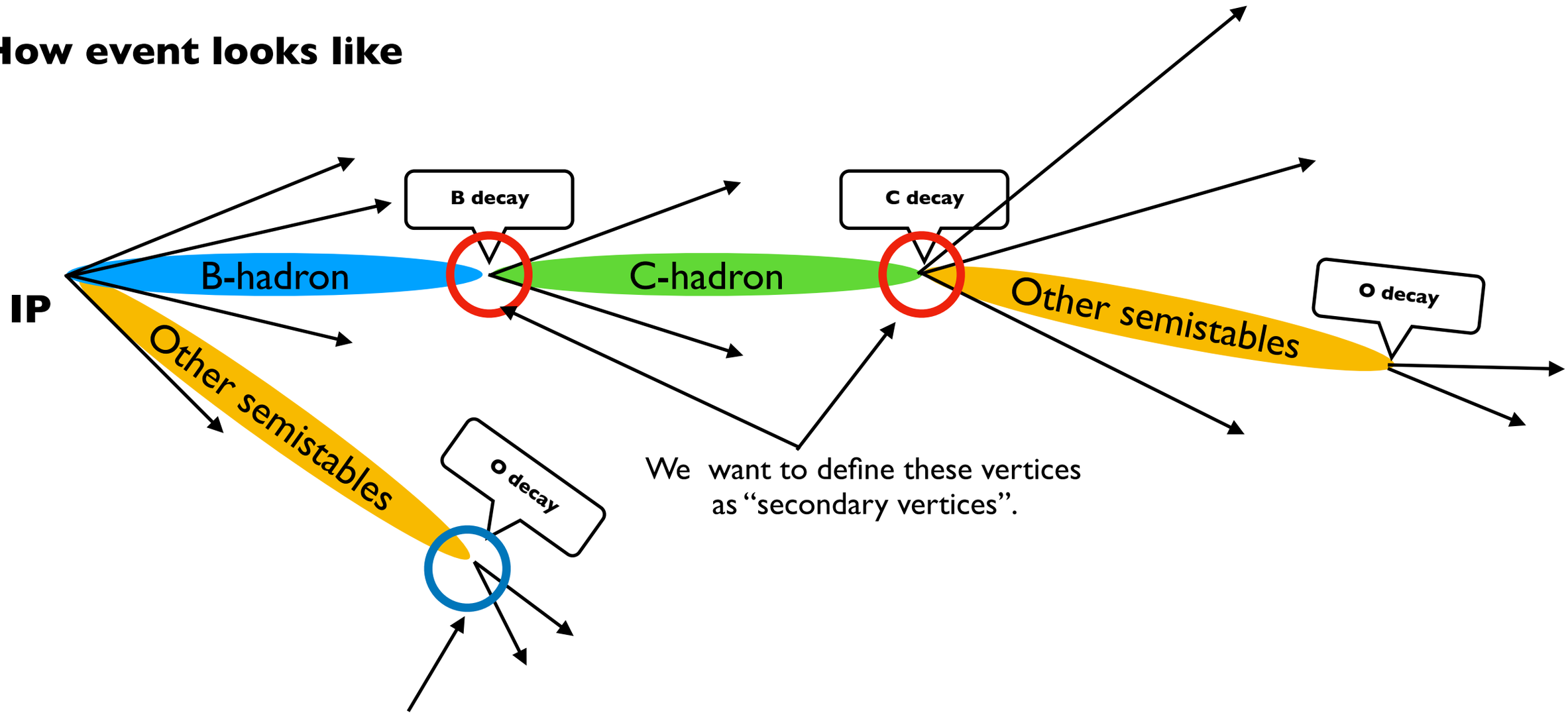
- produced in DBD study with the ILD-models and reconstruction software at that time.

Event signature and term definition

Feynman diagram



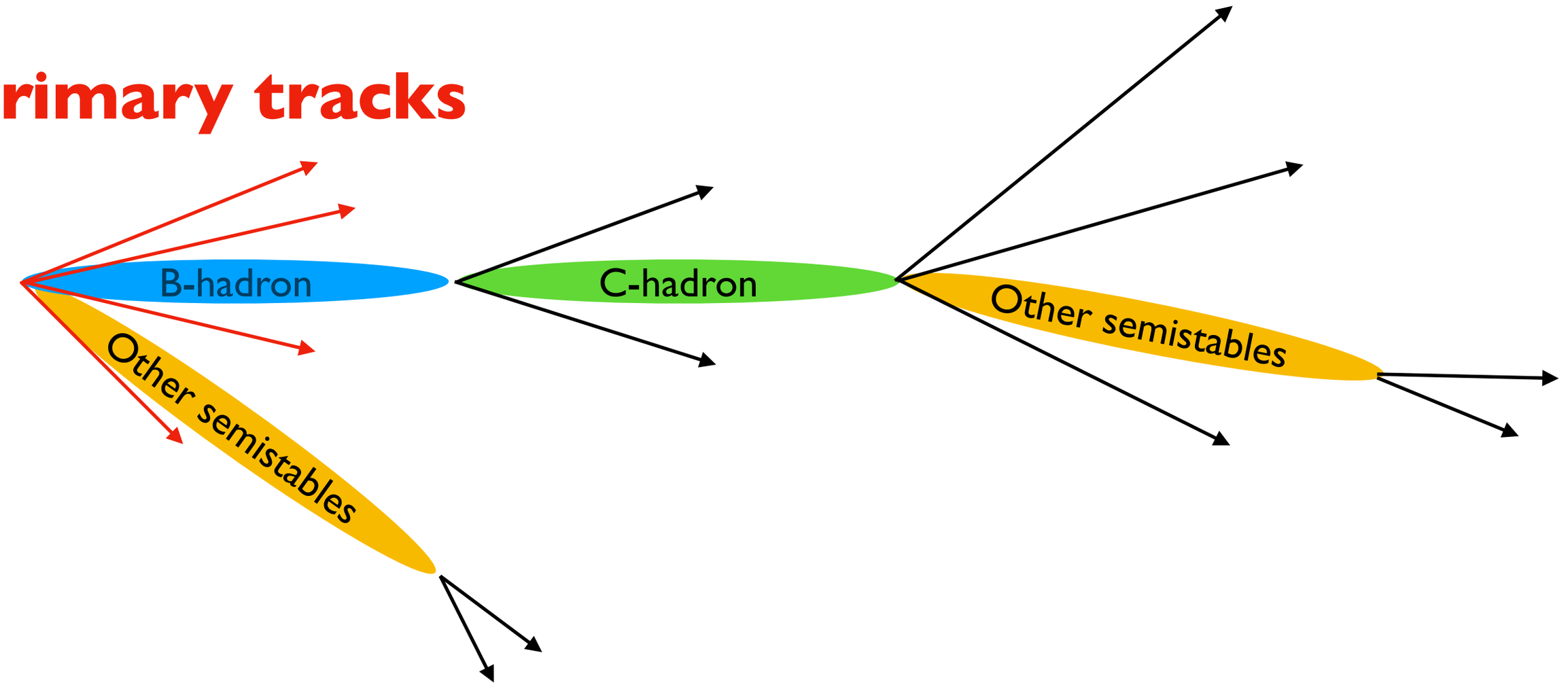
How event looks like



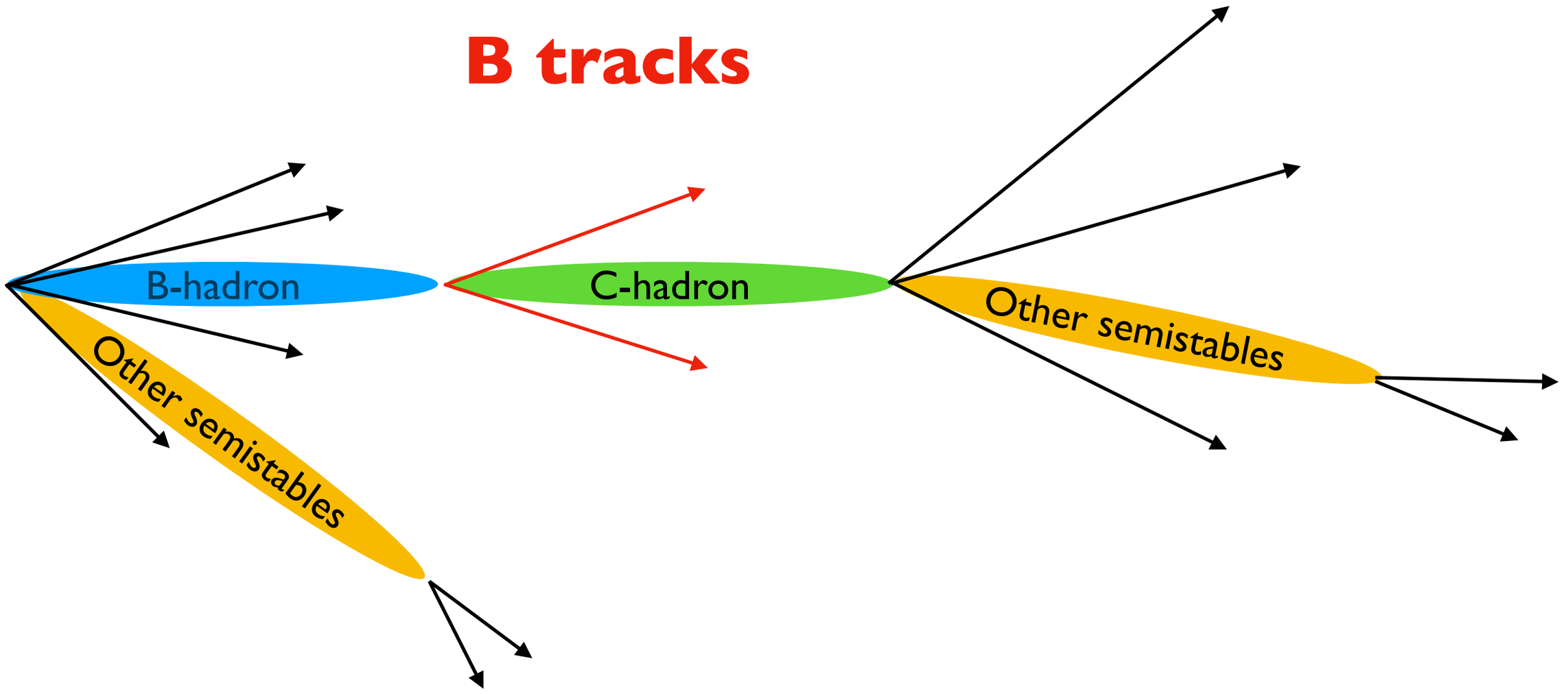
We want to define these vertices as "secondary vertices".

This vertex can actually be defined as secondary vertex,
but we are not interested in this vertex. (—> remove this vertex by V0 rejection algorithm)

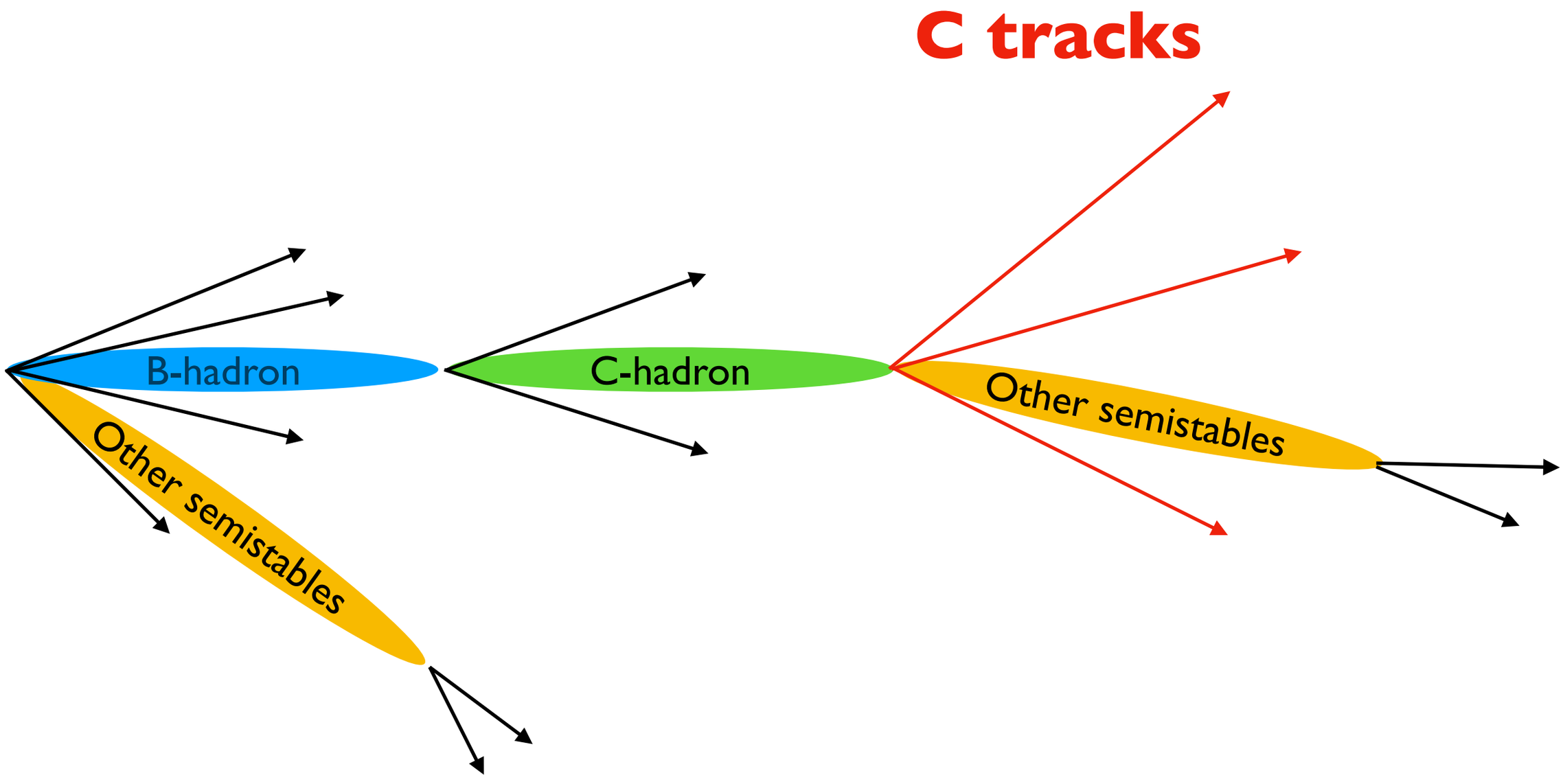
Event signature and term definition



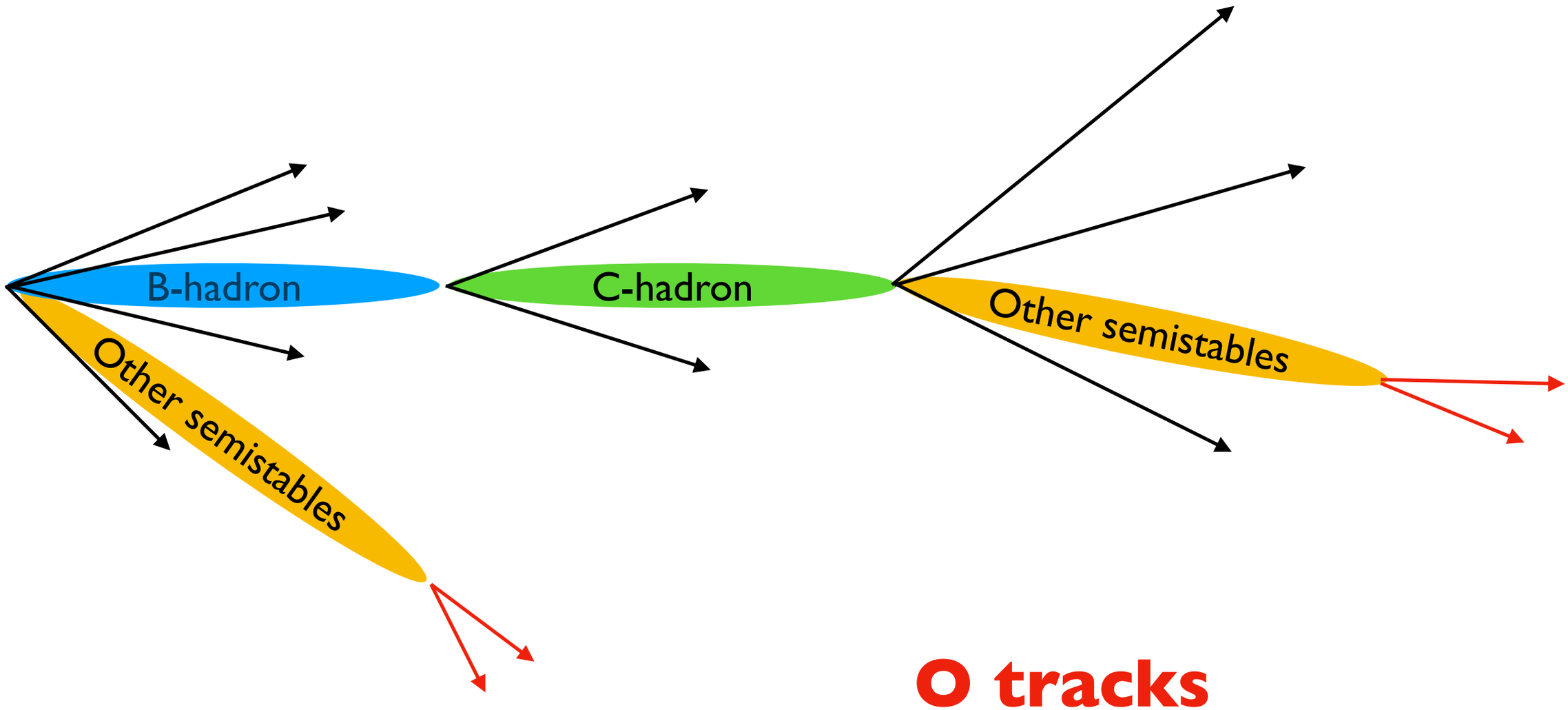
Event signature and term definition



Event signature and term definition



Event signature and term definition



0 tracks

Event signature and term definition

In summary,
we categorized tracks by their ancestors being semi-stables (e.g. B, D, K, π,...) (if exist).

of tracks in categories : New (ILD-l5 model) vs DBD

	New	DBD
nPrimaryTracks	= 913039	= 4845286
nPrimaryTracksInSecVtx	= 2023 (0.2 %)	= 11234 (0.2 %)
nBTracks	= 561479	= 2901676
nBTracksInSecVtx	= 334663 (59.6 %)	= 1683847 (58.0 %)
nBTracksInSecVtxCorrectDecayChain	= 331960 (59.1 %)	= 1667652 (57.5 %)
nBTracksInSecVtxCorrectParent	= 204521 (36.4 %)	= 999507 (34.4 %)
nCTracks	= 542794	= 2825299
nCTracksInSecVtx	= 340029 (62.6 %)	= 1697957 (60.1 %)
nCTracksInSecVtxCorrectDecayChain	= 318598 (58.7 %)	= 1588121 (56.2 %)
nCTracksInSecVtxCorrectParent	= 215529 (39.7 %)	= 1052934 (37.3 %)
nOTracks	= 113128	= 715640
nOTracksInSecVtx	= 1412 (1.2 %)	= 21363 (3.0 %)
nOTracksInSecVtxCorrectDecayChain	= 1403 (1.2 %)	= 21240 (3.0 %)
nOTracksInSecVtxCorrectParent	= 730 (0.6 %)	= 12536 (1.8 %)

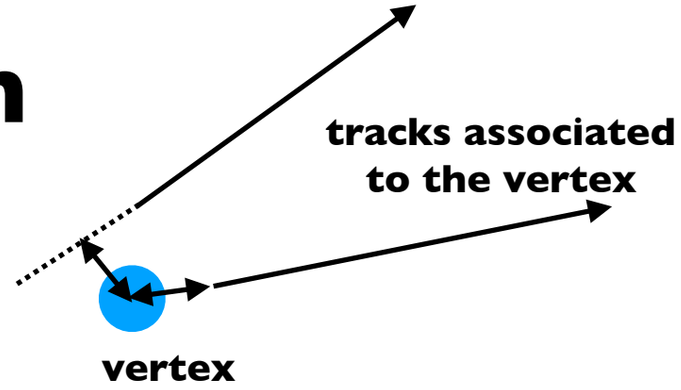
How to look at this table?
The table divided into four categories (PrimaryTracks, BTracks, CTracks, OTracks) highlighted in green boxes.
- 1st line in each category shows the total number of tracks that were assigned to its category,
- 2nd line in each category shows the number of tracks that were assigned to any secondary vertices (percentage is the value for each 1st line, the same hereafter.),
- 3rd line in each category shows the number of tracks that were assigned to secondary vertices that are in correct decay chains.
- 4th line in each category shows the number of tracks that were assigned to correct vertices

of tracks in categories : New (ILD-s5 model) vs DBD

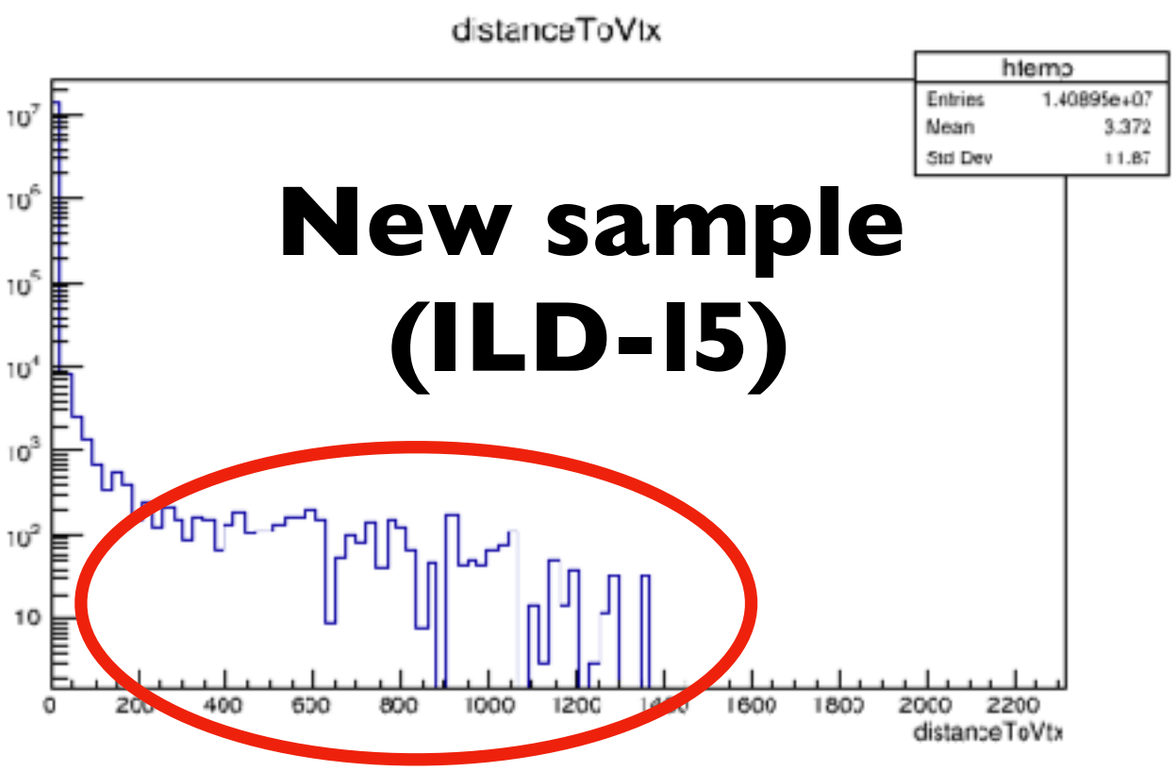
	New	DBD
nPrimaryTracks	= 889603	= 4845286
nPrimaryTracksInSecVtx	= 1967 (0.2 %)	= 11234 (0.2 %)
nBTracks	= 556241	= 2901676
nBTracksInSecVtx	= 332900 (59.8 %)	= 1683847 (58.0 %)
nBTracksInSecVtxCorrectDecayChain	= 330234 (59.4 %)	= 1667652 (57.5 %)
nBTracksInSecVtxCorrectParent	= 203824 (36.6 %)	= 999507 (34.4 %)
nCTracks	= 538712	= 2825299
nCTracksInSecVtx	= 338856 (62.9 %)	= 1697957 (60.1 %)
nCTracksInSecVtxCorrectDecayChain	= 317558 (58.9 %)	= 1588121 (56.2 %)
nCTracksInSecVtxCorrectParent	= 215088 (39.9 %)	= 1052934 (37.3 %)
nOTracks	= 108402	= 715640
nOTracksInSecVtx	= 1424 (1.3 %)	= 21363 (3.0 %)
nOTracksInSecVtxCorrectDecayChain	= 1413 (1.3 %)	= 21240 (3.0 %)
nOTracksInSecVtxCorrectParent	= 767 (0.7 %)	= 12536 (1.8 %)

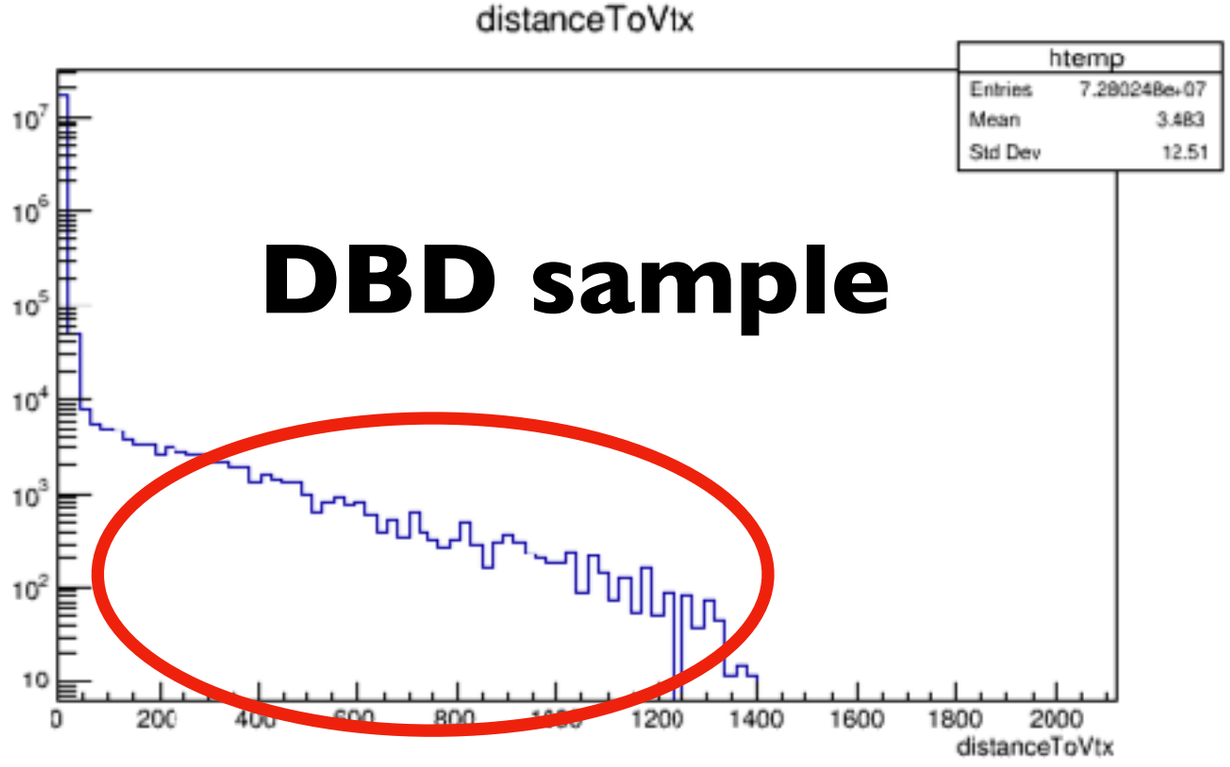
Almost same results as ILD-I5 model.
ILD-I5 model seems slightly better (in terms of absolute values, not fraction).

Track distance to vertex position



I expect small values, but …





There are a (non-negligible?) number of entries at far regions.
I'm investigating what is going on there (Note that there may be some bug in my code to produce the above plots).
If this is really what happens, we could improve the vertexing performance.

Next step :

- **Understand what the plots shown in the previous page means.**

- Compare with e.g. track parameter distribution for the coming mass production.

- **Check flavour tagging performance.**
  (We have found something to be understood, but I think the first priority now is to clear up the above items.)

Backup

Definitions of semi-stables which define B, C, O tracks

```
const int semistableBs[] = { 511, 521, 531, 541, 5122, 5132, 5232, 5332};
const int semistableCs[] = { 411, 421, 431, 4122, 4132, 4232, 4332};
const int semistableOs[] = { 11, 13, 15, 22, 130, 211, 310, 321, 2112, 2212, 3112, 3122,
3212, 3222, 3312, 3322, 3334 };
```