Tracking meeting 11/1/00

Histogram based pattern recognition

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General Philosophy

⋆ Pattern recognition starts from:

- a "telescope", i.e. hint about the track direction (in practice it could be a SL segment or a COT track...)
- set of layers that may contain hits deposited by the track

⋆ Every hit contributes in a indipendent way to the final decision. Only the sum of the information counts, not the order.

- No combinatorial
- Not very sensitive to single spurious hits

⋆ Being based on one-dimensional histograms, this approach is best suited to those situations where the telescope provides an adequate measurement of all the relevant parameters except one

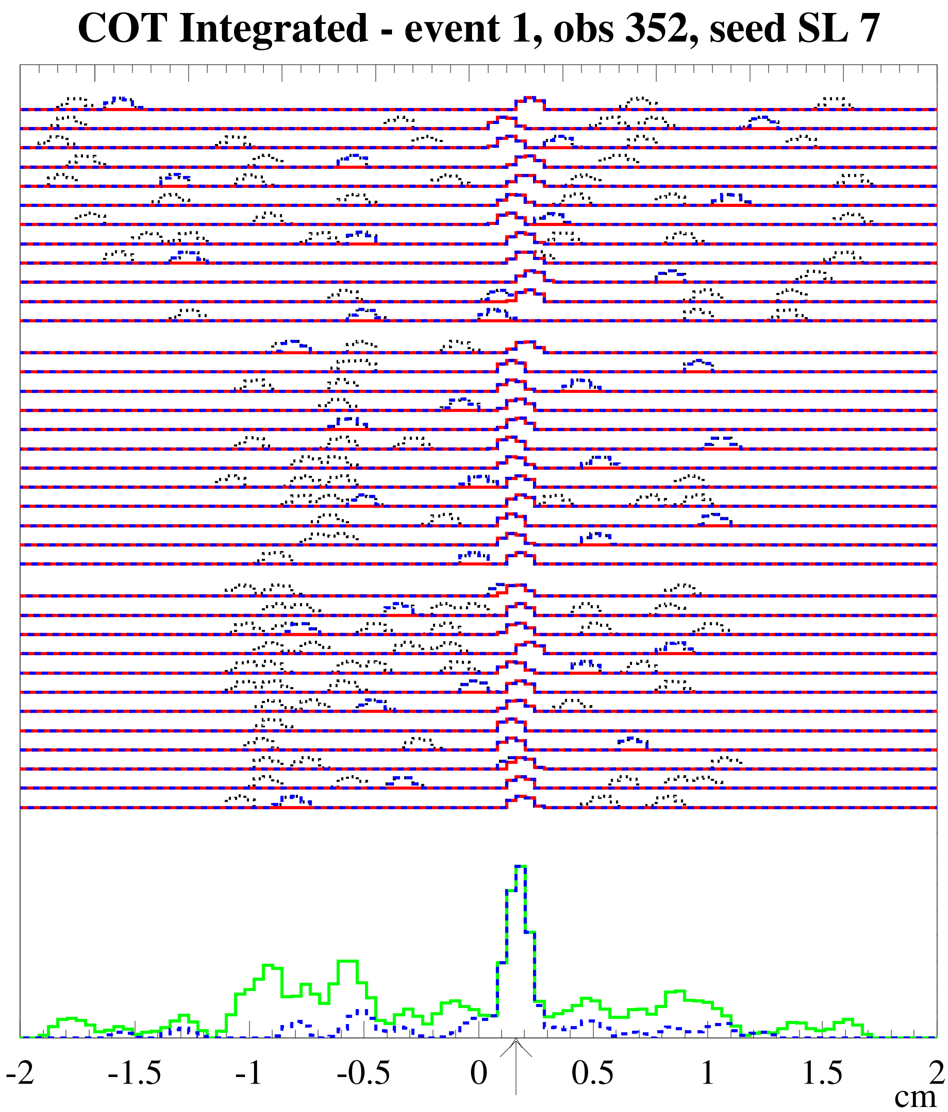
⋆ No full 3D fits are necessary during the pattern recognition, only a fast histogram search is used.

Strategy

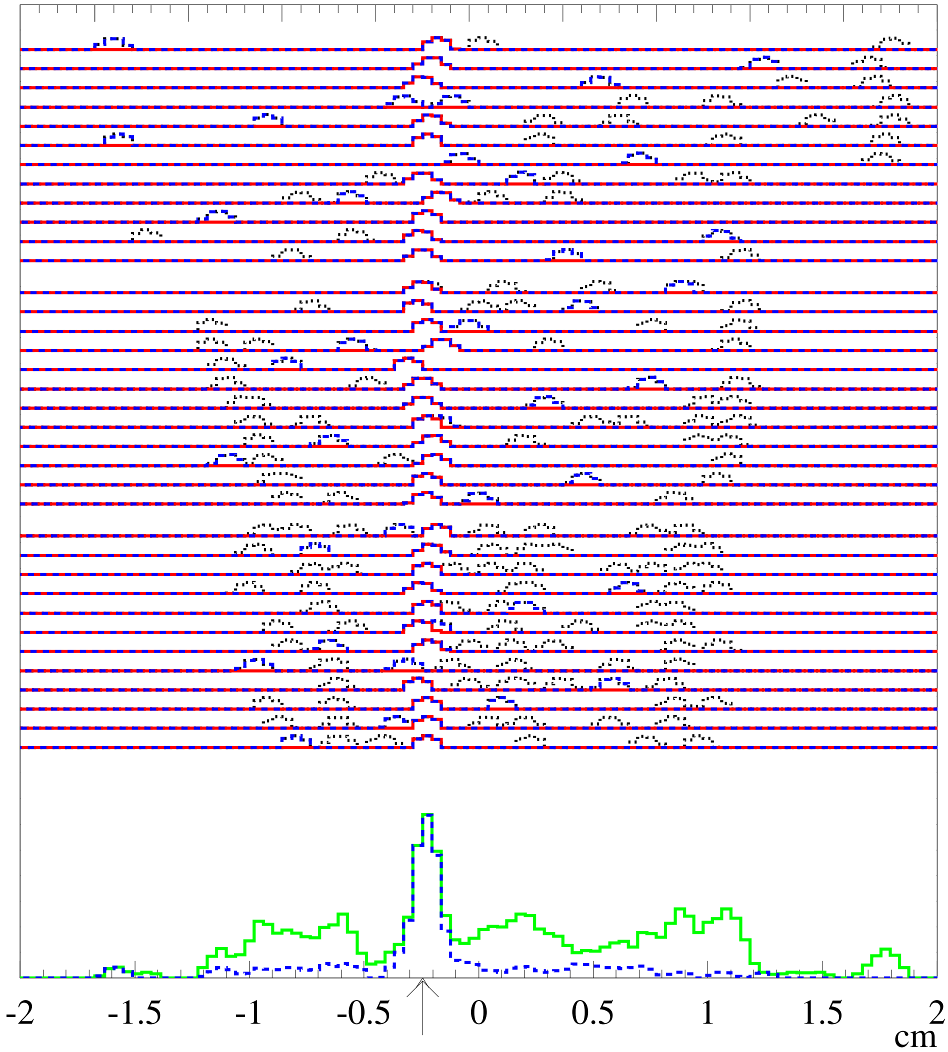
- ⋆ The "telescope" defines a (wide) search road
- ⋆ For each layer a one dimensional histogram is created. The abscissa (x) represents the mismatch between the telescope parameters and the true track parameters.
- ⋆ For each hit on a layer:
  - – Evaluate F[telescope,hit](x):
    - ∗ F embeds how much the telescope needs to be shifted to match the hit.
    - ∗ F's relative to hits belonging to the same track are expected to be peaked at similar values of x.
  - – Plot F into the layer's histogram (taking into account the hit resolution)
- ⋆ Sum the histograms in the different layers
- ⋆ Find the position of the maximum
- ⋆ Pick up the hits closest to the maximum
- ⋆ See Figure →

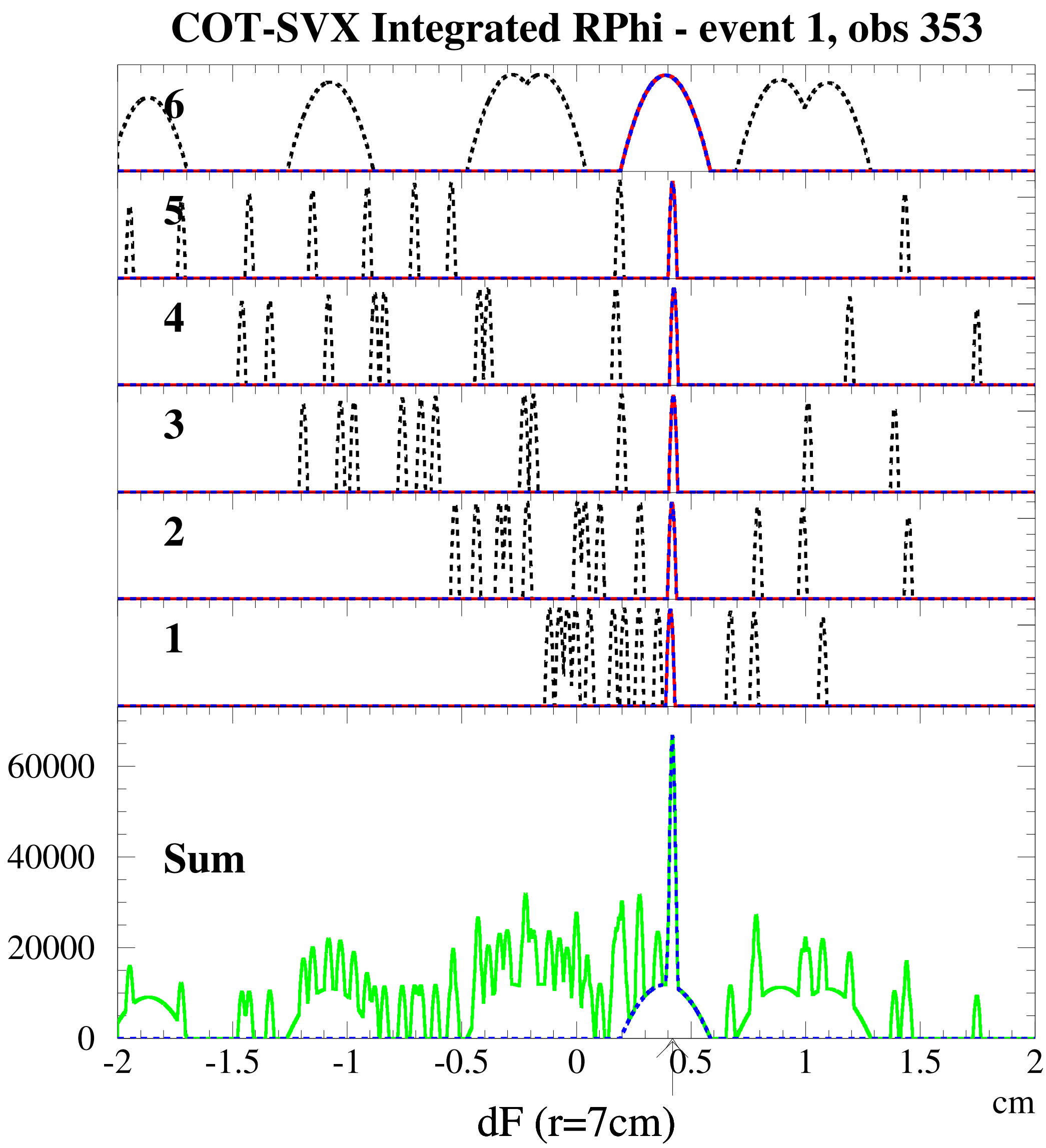
Status of the implementation

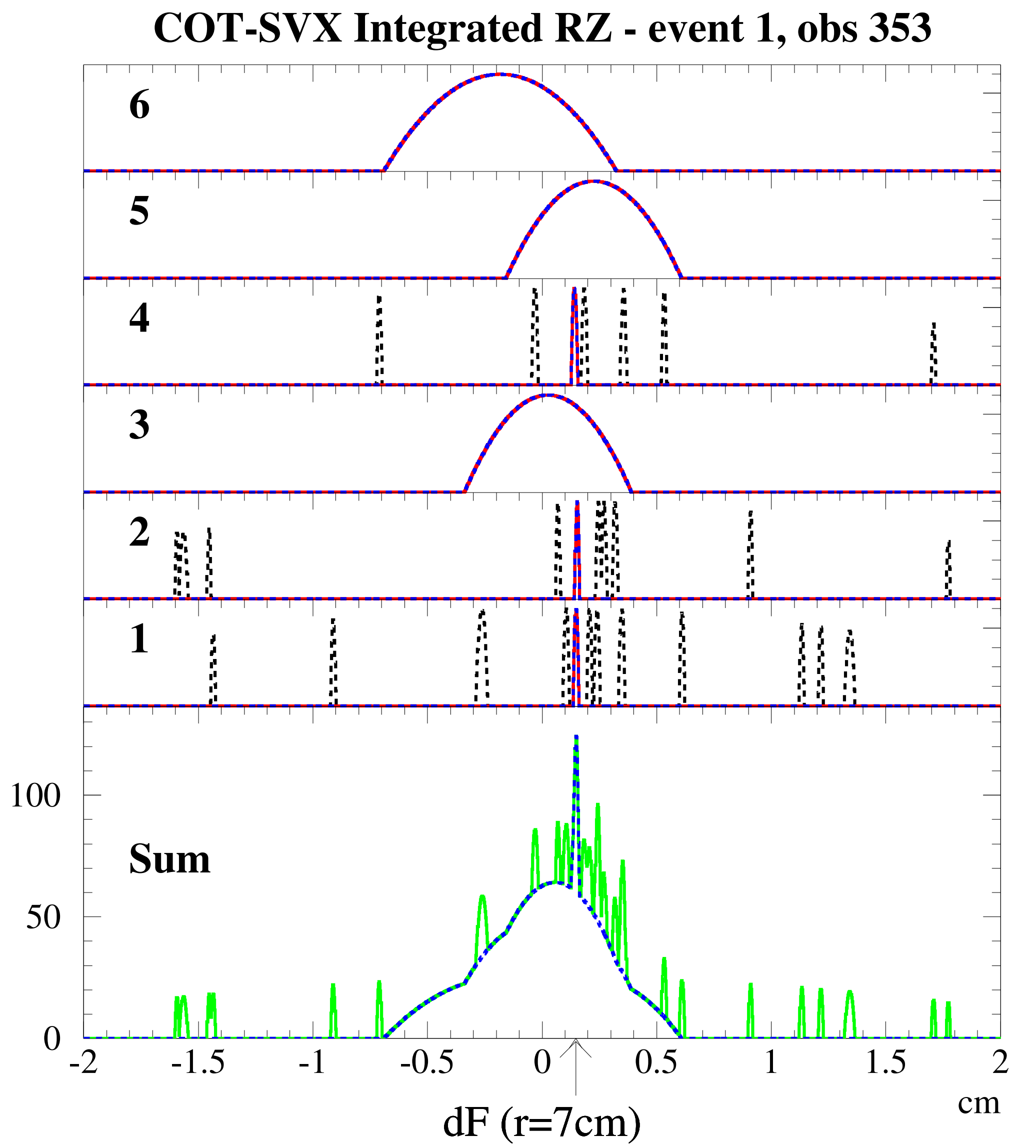
- ⋆ The approach is general, so it can be applied to different situation at CDF. The actual implementation has been written for:
  - a) COT $r\phi$ pattern rec (seed segment + hits)
  - b) COT-Silicon linking $r\phi$ and rz (rec COT track+Si hits)
- ⋆ More info at: //www-cdf.fnal.gov/internal/people/links/PaoloGatti/my.html

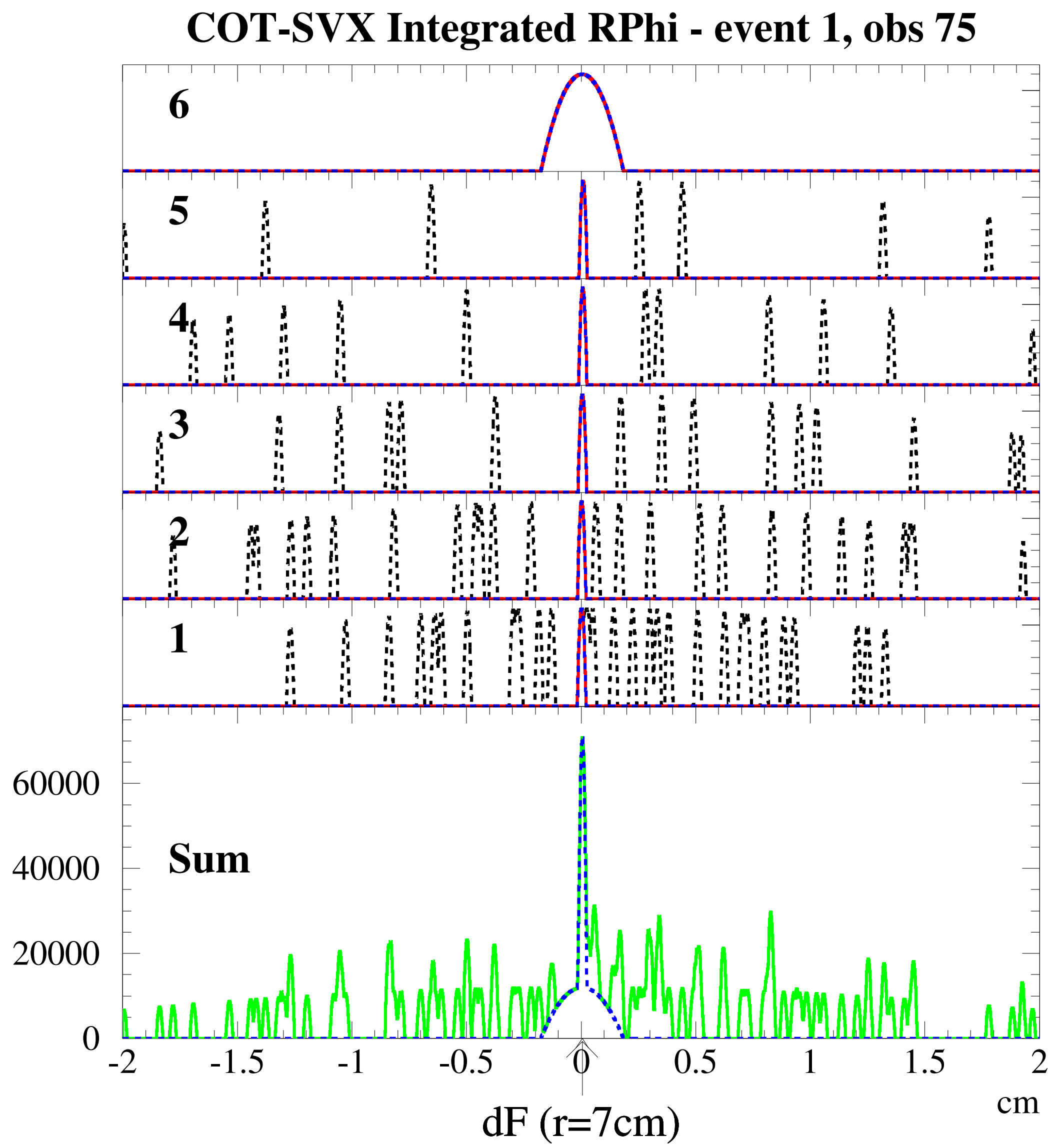

COT Integrated - event 1, obs 352, seed SL 7
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
cm

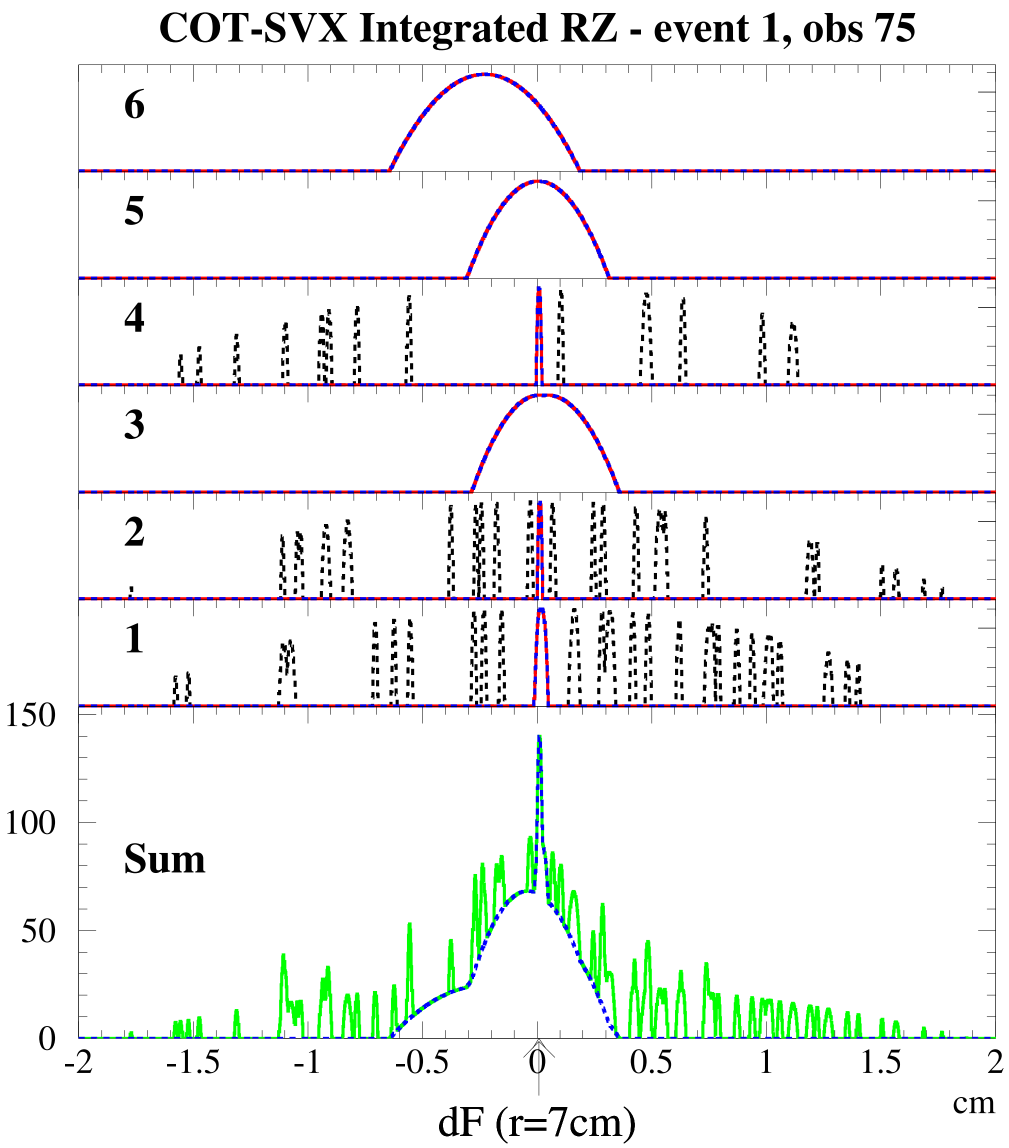
COT Integrated - event 1, obs 355, seed SL 7




COT-SVX Integrated RPhi - event 1, obs 353
6
5
4
3
2
1
Sum
60000
40000
20000
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
cm
dF (r=7cm)


COT-SVX Integrated RZ - event 1, obs 353
6
5
4
3
2
1
Sum
100
50
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
cm
dF (r=7cm)


COT-SVX Integrated RPhi - event 1, obs 75
6
5
4
3
2
1
Sum
60000
40000
20000
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
cm
dF (r=7cm)



COT-SVX Integrated RZ - event 1, obs 75
6
5
4
3
2
1
Sum
150
100
50
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
cm
dF (r=7cm)

Future plans

⋆ Short term (before Xmas):

- Evaluation of the performances of the present strategy for the $r\phi$ COT. Including a short write up as a CDF Note as a documentation.
- Evaluation of the performances of the present strategy for the $r\phi$ COT Silicon linking. Pending fixing problems in Silicon simulation.
- We do not see as urgent timing studies to speed up the COT code right now in view of what is explained below.
- First study of interplay of prompt vs large d tracks rec. strategies. We'd like to asses the characteristics of both strategies, in terms of strenght and weaknesses.

⋆ Longer term (next year):

- Goal for the COT: to have a deep merging/integration/optimization of the COT tracking algorithms (SL and HT).
- Goal for the Silicon: the code has not been touched in a long time. Needs optimization. In this case I'd see efforts for the optimization useful only in the view of a better definition of the integration/interplay with OI and other SI strategies. This needs to be discussed.
- However, the Padova group will be very reduced:
  - Alberto R. left CDF early this year
  - Paolo G. will get is PhD next January. No guarantee of a position to offer him from Padova. It'd be great to have him for a few more months.
  - Patrizia A. is available to spend time at FNAL next year to guarantee continuity on the subject and work with possible newcomers.
- The HT needs help.

COT strategy in more detail

⋆ Pattern recognition failures for the HT are mainly due to the following reasons:

1) segment quality: uncertainty in the direction angle $\Delta\alpha$ gives a systematic shift (slope) to the position in the histogram of the hits belonging to the same track. They do not align well in vertical and a maximum cannot be found.
2) multiple scattering effects: pointing resolution varies as a function of the material traversed

⋆ The propagation of the uncertainty on the segment direction to the hit position resolution in the histogram scales as a function of the distance of the hit from the segment.

⋆ This uncertainties can be taken into account "blowing up" appropriately the width of the blob on the histogram: the correct hits will overlap better.

⋆ Moreover, The COT pattern rec. can be optimized for the two categories: *i*) prompt tracks and *ii*) large-d tracks

⋆ For prompt tracks the function used for the mapping can be a circle that passes trough the center position of the segment, the hit position and the beam spot.

⋆ For displaced tracks the circle is tangent to the segment and passes trough the hit.

⋆ This "unconstrained" method is completely general and could be used for all situation, however is extremely sensistive to the segment quality.

⋆ A optimization of the passes is foreseen: marking out the best tracks while moving from the easiest situation to the more difficult: a preliminary implementation is under study.