Tracking Analysis report
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This status report summarizes some lessons learned from analysis work done in two area by Eun-Joo, Fouad and myself in the last 10 days or so. Contributions have also been made by Yury and J.H . Please note this but a progress report and as such may contain mistakes and or misunderstandings. Unless otherwise quoted the analysis has been done on run 2235 a 90-degree MRS at 0 field. Two separate issues are studied, Vertex finding, and geometries for the MRS TPCs.

Vertex finding.

For many reasons this is a very important issue. It goes to the heart of the present global analysis as well as being a starting point for tracking and PID. There are several other activities in this area within the collaboration. In this note we stress the need for agreeing in dealing with this in a uniform way, while still allowing developments.

Optimizing the estimates from the global detectors i.e. BB and ZDC.

Beam-Beam Counters

Yury has spent quite a bit of time on this. The method developed early and used in most applications is that of the fastest in each tube. This is I believe what has been used in Bjoerns comparison to the different vertex finding methods. He has also worked on a method doing averaged following better corrections. This though only used the large tube. See his note #1 for more details.

ZDC

The ZDC is pretty straightforward using at present the timing from the summed signals. M.Murray will study possible improvements (slewing corrections, using more than one tube etc.).

The present status is pretty much summarized in the first two plots showing differences between position (in cm) calculated by ZDC, BB vs. position from tracking in TPM1 (single track deviation where the track projected y is near 0). The track positions are calculated simply projecting all tracks having a y-projection around 0 ($-1<y<3$) and calculating the difference. This allows to get values also for events with low multiplicity. The range $-1<y<3$ was picked due to the offset in tracking.

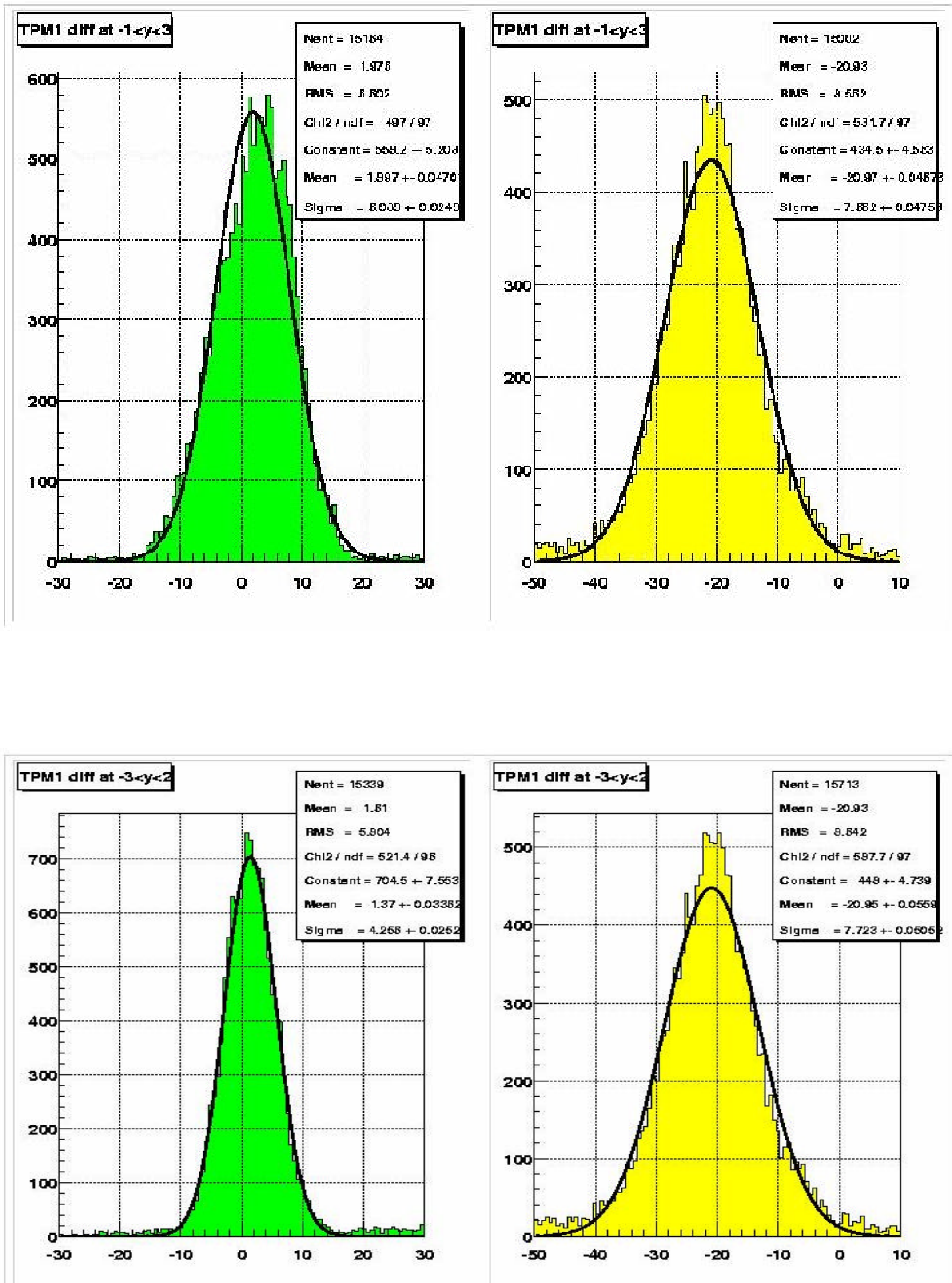

Fig 1. Beam Beam and ZDC timing differences.

1. The ZDC deviation is the largest with an RMS deviation of 7.2cm. (two left panels)

2. The BB fastest is only slightly better, 6.0 cm (top left)
3. The weighted BB quite a bit better down to 4.2 cm. (bottom left)

The RMS is large 7 cm saying that the 'real' vertex as derived from ZDC has a 30% chance of being more than 7 cm away. This should be remembered when considering the Multiplicity results. Since for most collisions baring the very peripheral we have two measurements of the same quantity, this estimate can be improved by adding the data with the appropriate weights. This point to the need to develop one analysis module class that pulls all the global vertex information together, rather than people using individual pieces of code in Macros. As a final comment a ‘best’ vertex can be calculated using the weighted sum of the BB and ZDC result. Since the RMS (ZDC) >=RMS(BB) this give only a slight improvement probably down to RMS(BB) = 4.0. It should be noted there is still work to be done for the BB due to the omission of the small tubes.

MRS TRACKING.

Geometry for TPM1 and TPM2

The intrinsic geometry comes from drawings, and our measurements.

From the survey numbers given to us after the July open period we trust that the best numbers for the TPCs are

TPC	pos (from IP)	y-pos (from beam height)	Pos from midline	
TPM1	94.4 cm	-0.4 cm	0.0	
TPM2	286.6 cm	1.50 cm	0.0	

The 286.0 cm is different from what has been used in the simulations so far (292 cm), but do agree with the distance between center of support post. This value should be checked. The position deviations from the centerline are probably good to about one mm. This is confirmed by the excellent matching in the bend plane (see figs below). At the time of the survey the AGS surveyors indicated that could not position the two TPCs completely perpendicular to the mid-line due to constraints from the holes in the support stand. Again, the deviation is likely small, seems to showup the the Alz plots and should be checked further.

Procedure to determine geometry.

The procedure is hampered that the present files used have relative few tracks in TPM2. A summary (raw file) containing only events with TPM2 tracks will greatly speed up the process. Also we are still studying the actual geometry of the TPCs so offsets etc are not really final.

Vertical Conversions parameters.
These parameters are among the adjustable parameters that one is allowed to vary. The setup imposes limits though.

The parameters used to describe the conversion of drift time to distance within the +-10cm high TPC active volume are:

fTimeBaseOffset: Distance from active volume midplane (i.e. mid of window opening) and 10 cm above the 5KV cathode plane. This distance is 12.0 cm and the other 12.45 cm for TPM1 and TPM2, respectively.
fTimingOffset: The time from the interaction until the first time bucket SCA readout. Estimated to be 500-700 nsec. (LVL0 time at 320 + trigger clock + sending signals
fDriftVelocity: This is known from TPM1 with the 90-10 mixture to be 1.56 cm/ microsec ('96 measurements). A change of Vdrift with 0.05 cm/microsec corresponds to a vertical position change of 0.4 cm for tracks with constant time (i.e. around timebin 80) in TPM1.
fTimeBucket: The SCA time clock was 10MhZ for all runs after June20, 2000.

TPM1

The first step in the procedure is to check to alignment with the beam-pipe.Since other experiments, notably STAR and PHOBOS has shown the estimates for the vertex using projections of many tracks and obtained interaction points off 0,0 (in X,Y) the constraint for Dy is not zero identical but within an interval around 0 . (-.5-0.5 perhaps).

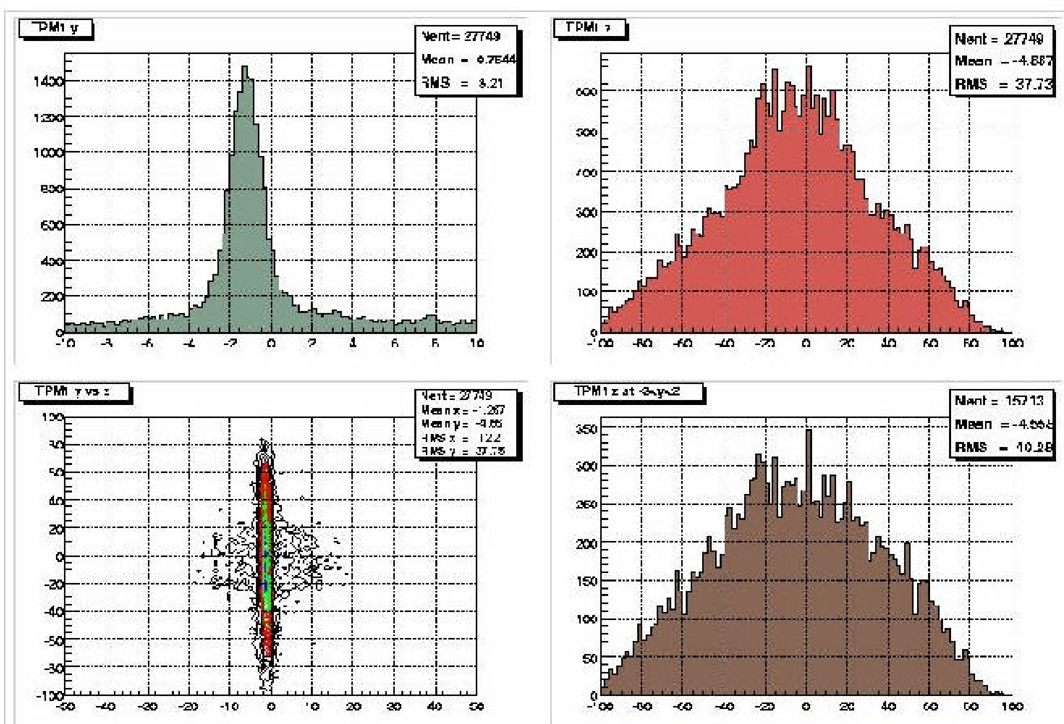

Fig 2. Track projections from TPM1 towards IP. Frame one is calculated Y-offset (1.2 cm centroid for peak). The right hand shows the Z-projections for top) all tracks and b) tracks with near y~0. The left lower is the 2D correlation.

TPM1-TPM2 matching

All tracks from TPM1 and TPM2 are projected to the nominal mid-plane of D5 and we construct difference plots between all track combinations in the position Y (vertical) Z (horizontal) and in the slopes Ay and Az. The nomenclature is that of the global coordinates, suitable at 90 degree. This matching will tell us about the TPM1 vs TPM2 alignment.

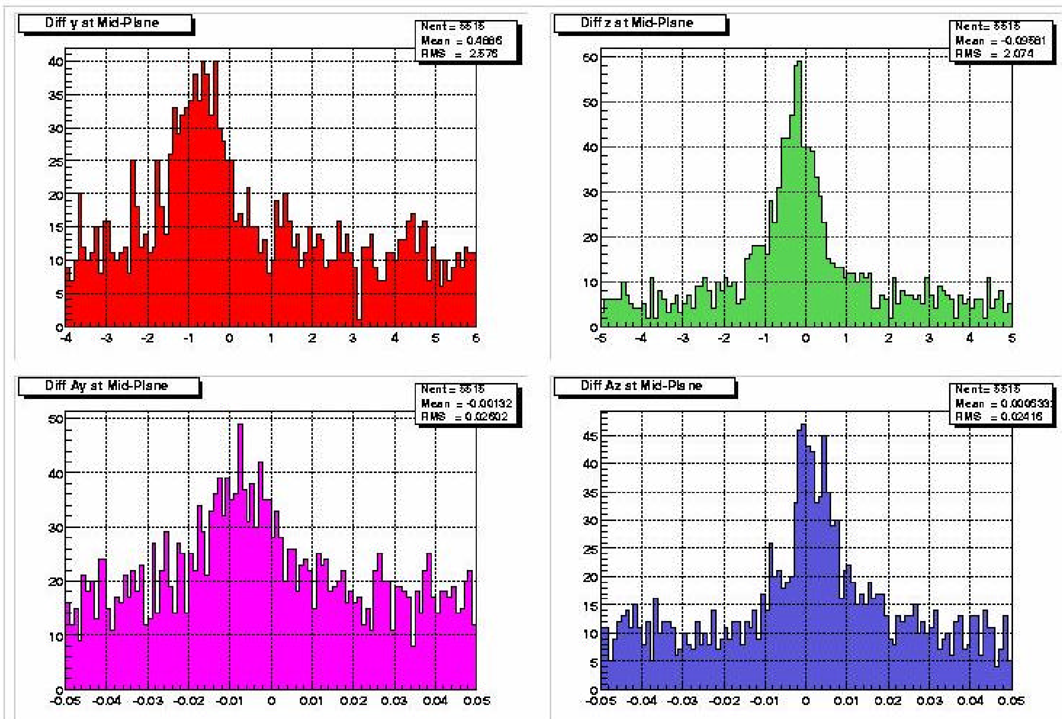

Fig 3 Matching Plot.

The differences are for all quantities Diff y == Y(TPM1 track) – Y(TPM2) track etc. The four panels are 1) Diff Y 2)Diff Z i.e. horizontal. 3) Aly and 4) Alz. The peaks indicate good matching candidates. The width for perfect geometries is expected to be dominated by multiple scattering, and as a secondary factor detector resolution. That these peaks in fact correspond to real straight through tracks can be seen in the following plots showing several correlation’s between the parameters.

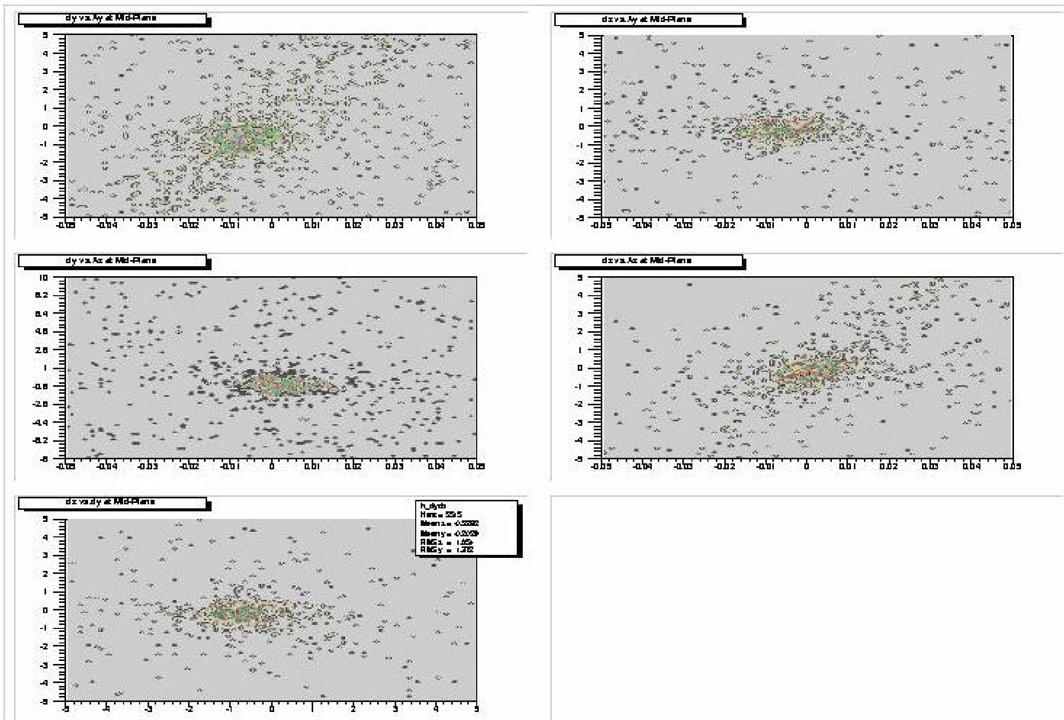

Figure 4. 2D matching correlation's.

The one plot that deviates from expectation is the upper left showing D(y) vs D(aly). A correlated band away from (0,0) indicates residual y,aly correlation. This is not understood. It could e.g. come from poor determination of local tracks in the TPC with some clusters assigned to wrong timing . The center values of D(x) and D(ax) are close to zero while offsets are seen for both D(y) and D(ay).

There are still other additional consistency checks to be performed.

- Projection of matched track to various places in spectrometer to ensure within proper geometric envelope and matching geometric size.
- Ensure these are properly centered
- Matching for sub samples of events e.g. those above and below mid-plane to look for systematic deviations and possible identify sources of non-zero centered distributions.

Application of parameters to non zero field tracking.

We though it interesting to see how well the chosen parameters work. For this we analyzed run 2238, a 90 degree 4KG run, and looked at the standard matching plots from BrModuleMatchTrack. The Plot below shows the distributions for track matching deviations for all and accepted track combinations. The cuts were made quite wide and seem to work reasonable well (likely due to the low track multiplicity). The resulting momentum spectrum is given next.

For this last plot one should remember that the TPM2 track acceptance is asymmetric favoring identification of tracks bending towards larger angles.

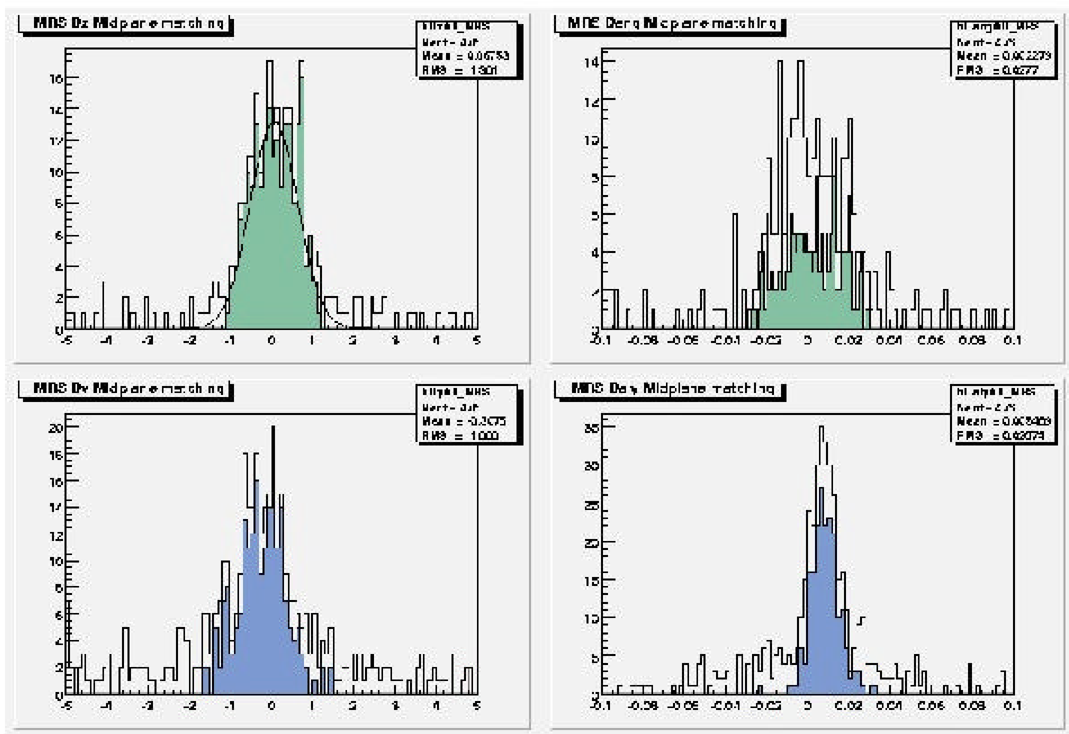

Fig 5. Matching plots in X (horizontal plane) top and vertical (Bottom). The track matching of course only applies to Dang, Dy and Daly. The Dx is for illustration only. The color filled histograms are for tracks accepted by all 3 cuts.

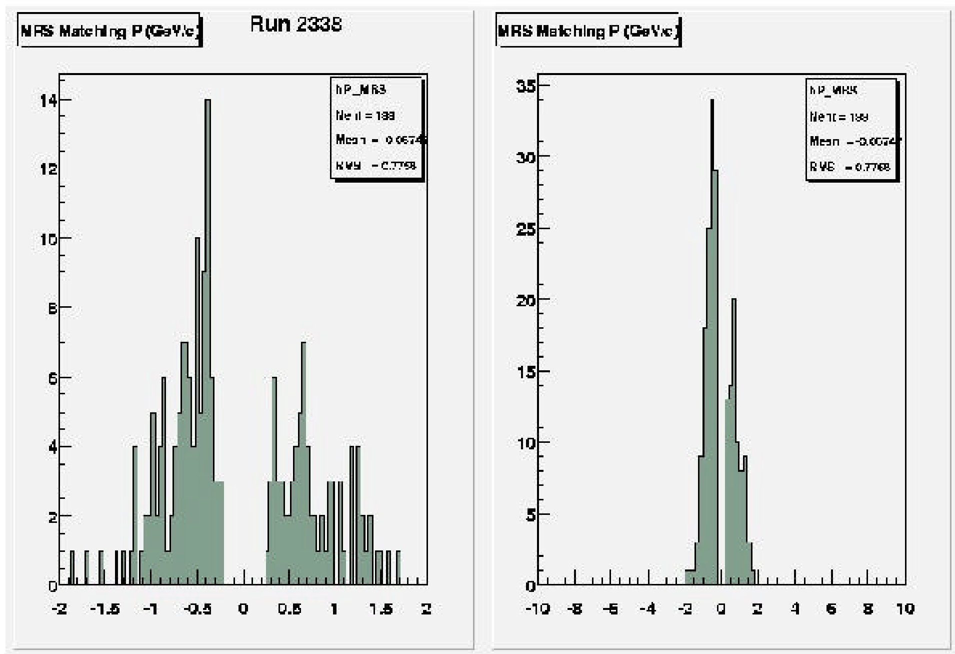

Fig 6. Calculated momentum spectra in GeV/c from matched tracks. The two plots are identical except for histogram range.

Appendix:

Parameter used in analysis (the .geo and DetectorParams.txt file)

TPC	TPM1	TPM2
Det center x (cm)	94.4	286.6
Det Center y (cm)	-0.4	2.5
Det center z (cm)	0.0	0.0
Driftvelocity (cm/micsec)	0.0016	0.0016
FPadBasePosition (sec)	12.0	12.5
FtimingOffset (nsec)	500	500

Action items

1. Push the writing of a common global rdo-module with vertex information from BB, ZDC and weighted values, and with members (fields) so TPM1 results can be added on.
2. Re-survey of TPM1, TPM2, T1 and T2 after Sep 19 re-opening of the IR.
3. One more iteration on parameters (for now).
4. Investigate possible deviation (Delta (aly) between TPM1 and TPM2).
5. Write (simple) selection program to create data files with events likely to have good TPM2 tracks.
6. Investigate zero field runs and matching at 60 and 45 deg.