Short report on short tracks code

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I have analyzed previous data from FINU02000 to FINU02089 by fidarc v6.00 with SHORT flag selected and studied the momentum distribution of positive particles from K^+ vertices, for each type of track. The recognized track are separated in the following categories.

1. STRAW-DCH2-DCH1-OSIM-ISIM(-ISIM)
2. STRAW-DCH2-DCH1-OSIM
3. STRAW-DCH2-DCH1 (discarded in the present version)
4. STRAW-DCH2-OSIM-ISIM(-ISIM)
5. STRAW-DCH2-OSIM
6. STRAW-DCH1-OSIM-ISIM(-ISIM)
7. STRAW-DCH1-OSIM
8. DCH2-DCH1-OSIM-ISIM(-ISIM)
9. DCH2-DCH1-OSIM
10. DCH2-OSIM-ISIM(-ISIM)
11. DCH1-OSIM-ISIM(-ISIM)
12. OSIM-ISIM-ISIM

A variable of "TYPE" is defined in the reconstruction program as:

$$\text{TYPE} = 10000 \times N(\text{STRAW}) + 1000 \times N(\text{DCH2}) + 100 \times N(\text{DCH1}) + 10 \times N(\text{OSIM}) + N(\text{ISIM}).$$

For example, a track recgnized as STRAW-DCH2-OSIM-ISIM-ISIM has TYPE=11012. I follow this definition in this report for simplicity.

First of all, the momentum distributions for so-called long tracks (TYPE=11110) and short tracks (01110) are shown in Fig. 1 and 2. No other cuts are applied. If we have one or two ISIM hits to be connected with the track, the resolution become worse, especially for long tracks (Fig. 3 and 4) and short tracks (Fig. 5 and 6). It is worse than when reconstructed with the original pattern recognition. This is possibly because the ISIM hits participate in spline fitting with large weights and the backtracking up to the vertex is done.

One of the merits of short track codes is to recover a track passing through an inefficient chamber, such as STRAW-(DCH2)-DCH1-OSIM. Fig. 7 shows the momentum distribution for TYPE=10110 where a hit in DCH2 is missing. A big tail of the μ^+ peak are seen. In Fig. 8, the momentum distribution for TYPE=11010, where a hit in DCH1 is missing, is shown. An unphysical structure, centered at $\sim 210\,\mathrm{MeV}/c$ appears. By looking at event display with a track whose momentum is in this region, I found the main reason of the deformation is due to the aluminum frame for the chamber (see Fig. 18 for example). The energy loss correction for this material is not done. It looks like most of the reconstructed particles pass through the chamber frame instead of an inefficient chamber. This problem will be more serious when a proton or deuteron is reconstructed since it has larger energy deposit in the material. When one or two hits in ISIM are added to the track, the momentum distributions are changed as shown in Fig. 9–12.

When the short track, which does not reach straw tubes, has no corresponding hits in DCH1 and ISIM hits are used for fitting, the results are shown in Fig. 13 and 14. When only one ISIM hit is used, there are more larger unphysical background. The 4-point track with two ISIM hits clearly has the μ^+ and π^+ peaks with acceptable resolution and may be used for further analysis.

For a track with DCH1-OSIM-ISIM(-ISIM), the μ^+ and π^+ peak are observed well. A track with two ISIM hits has smaller background than with one ISIM hit. Since the observed μ^+ or π^+ has enough transverse momentum so as to reach DCH2, the validity for smaller transverse momentum ($\lesssim$ 130 MeV/c) cannot be discussed here. This is true for a track with OSIM-ISIM-ISIM (Fig. 17).

In summary,

1) As a starting point, a long track (11110) and short track (01110) have a good momentum resolution.

2) Adding ISIM hits in fitting does not necessarily bring better resolution.

3) 3-point tracks causes a strange momentum distribution, especially for 10110 and 11010. This is mainly due to the energy loss inside the chamber frame. This effect is more significant in case of proton or deuteron.

4) Further study is needed for a particle with smaller transverse momentum (00111, 00112 and 00012). Possibly, very slow π^- from Λ is useful by looking into the invariant mass of the proton and π^-.

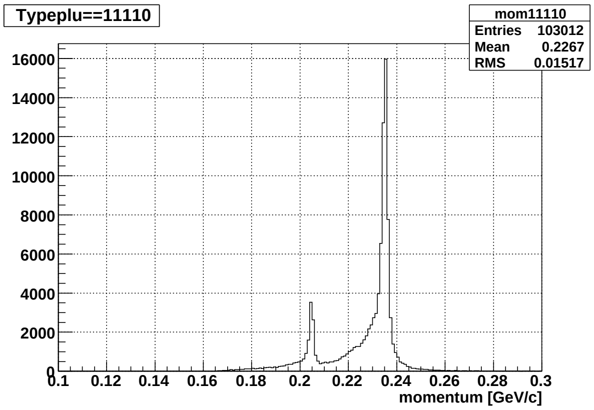

Fig. 1: momentum distribution for TYPE=11110

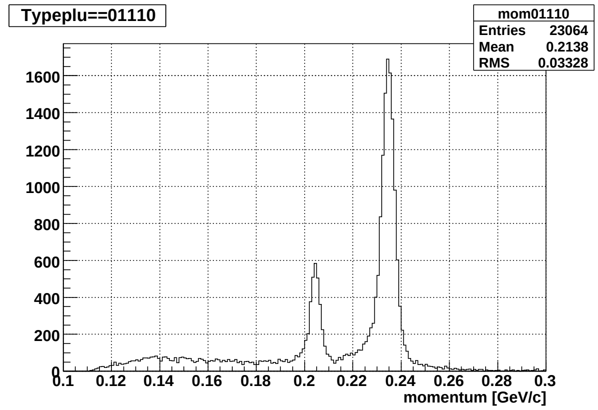

Fig. 2: momentum distribution for TYPE=01110

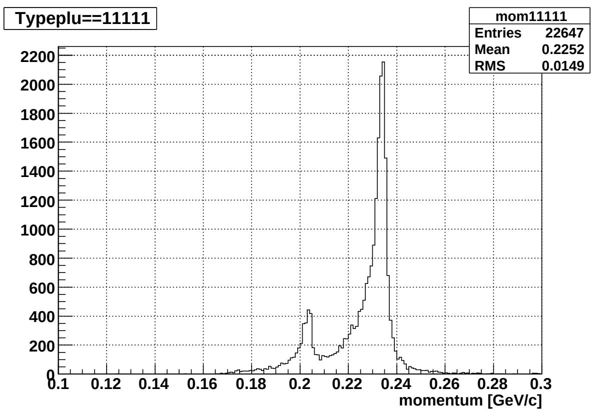

Fig. 3: momentum distribution for TYPE=11111

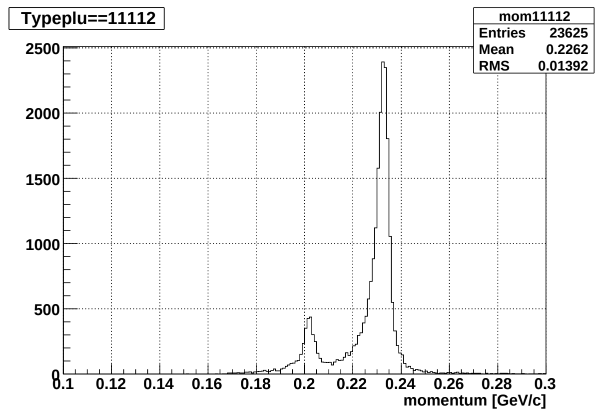

Fig. 4: momentum distribution for TYPE=11112

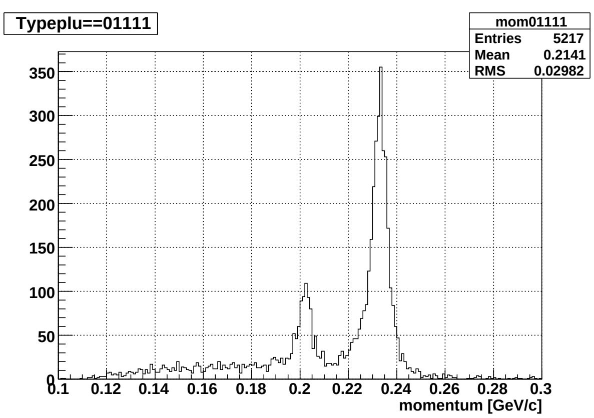

Fig. 5: momentum distribution for TYPE=01111

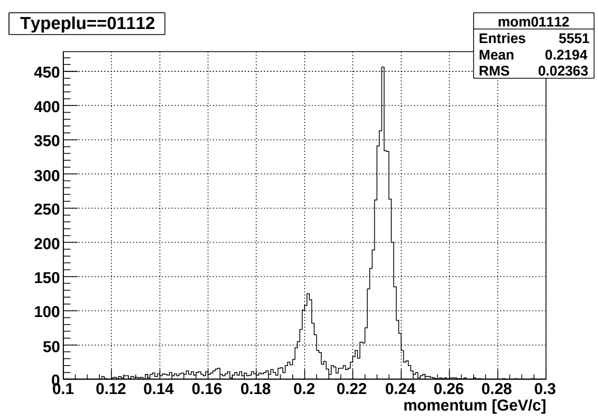

Fig. 6: momentum distribution for TYPE=01112

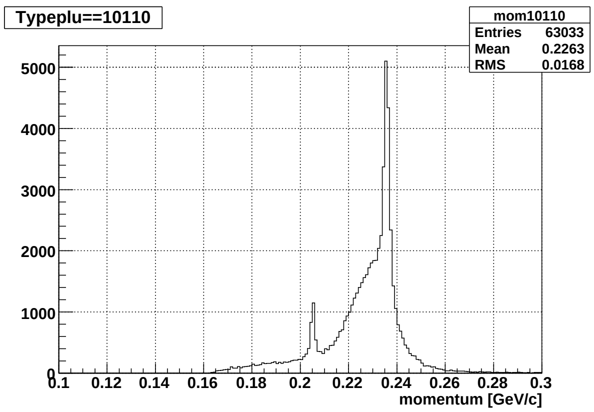

Fig. 7: momentum distribution for TYPE=10110

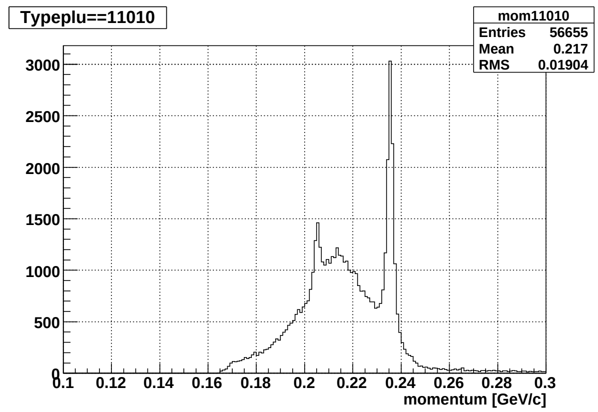

Fig. 8: momentum distribution for TYPE=11010

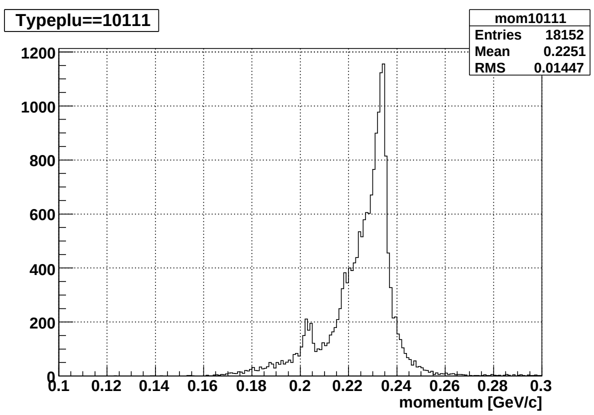

Fig. 9: momentum distribution for TYPE=10111

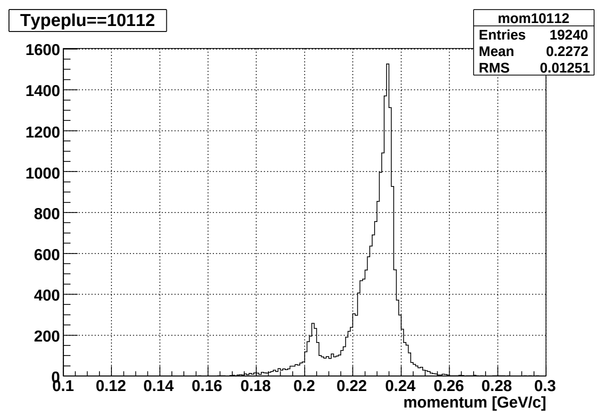

Fig. 10: momentum distribution for TYPE=10112

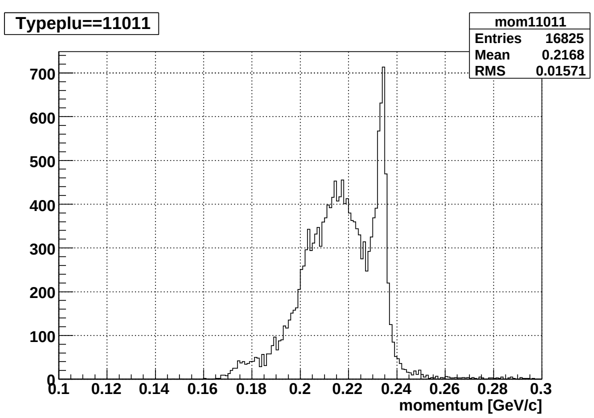

Fig. 11: momentum distribution for TYPE=11011

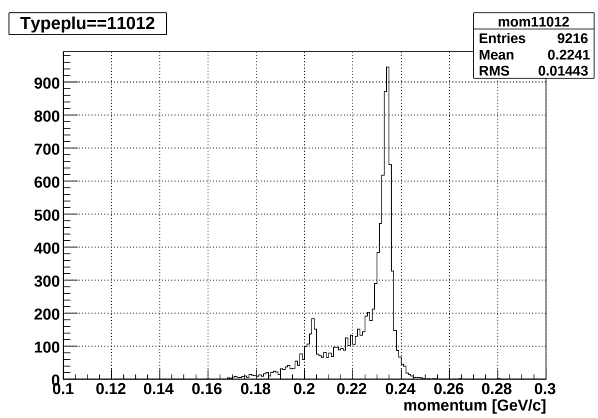

Fig. 12: momentum distribution for TYPE=11012

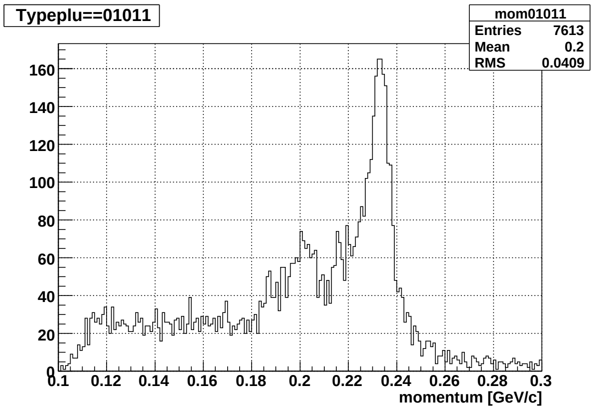

Fig. 13: momentum distribution for TYPE=01011

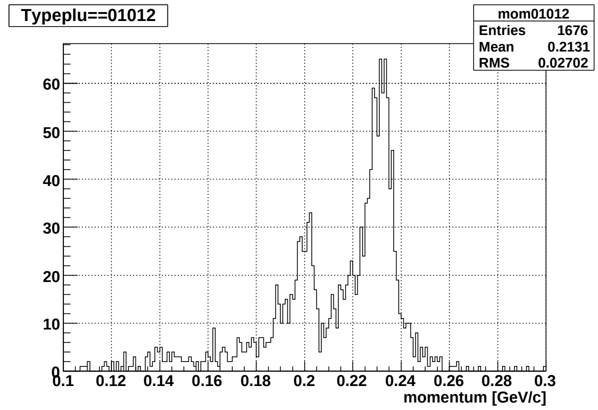

Fig. 14: momentum distribution for TYPE=01012

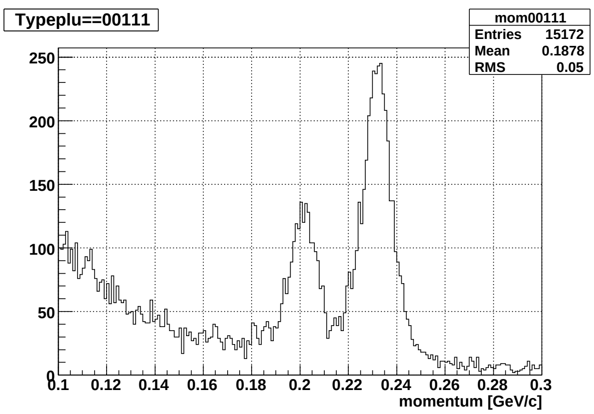

Fig. 15: momentum distribution for TYPE=00111

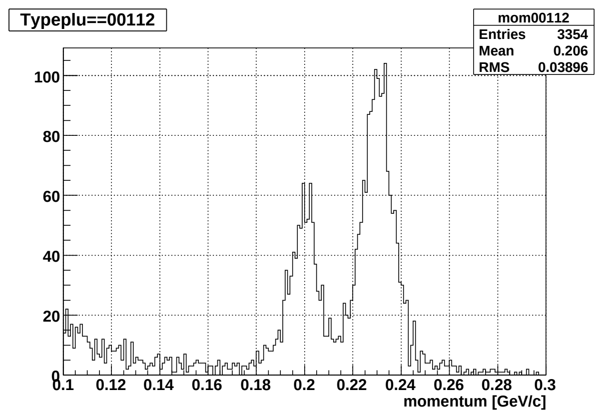

Fig. 16: momentum distribution for TYPE=00112

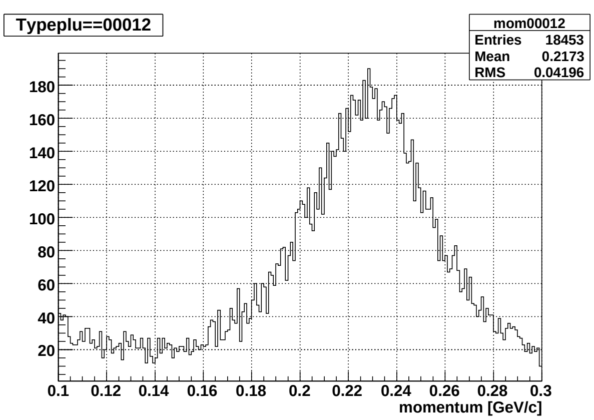

Fig. 17: momentum distribution for TYPE=00012

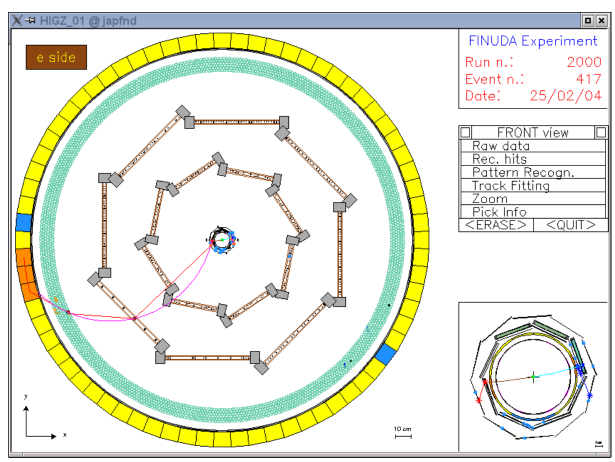

Fig. 18: Event display with a μ^+ (TYPE=11010)