D meson decay into a K and p, geometrical efficiencies

Preliminary analysis of geometry effects in the reconstruction of D mesons using detector patches in place of full cylindrical coverage. This work is very preliminary and needs to be checked.

Simulation conditions for D generation:
- Interaction D source distributed with Gaussian of s = 10 cm along z axis
- dN/dh distribution of Ds uniform over h +- 3
- Count only Ds where both the K and p could be measured by TPC in h = +-1
- Count only Ds where the K and p have p > 800 MeV/c

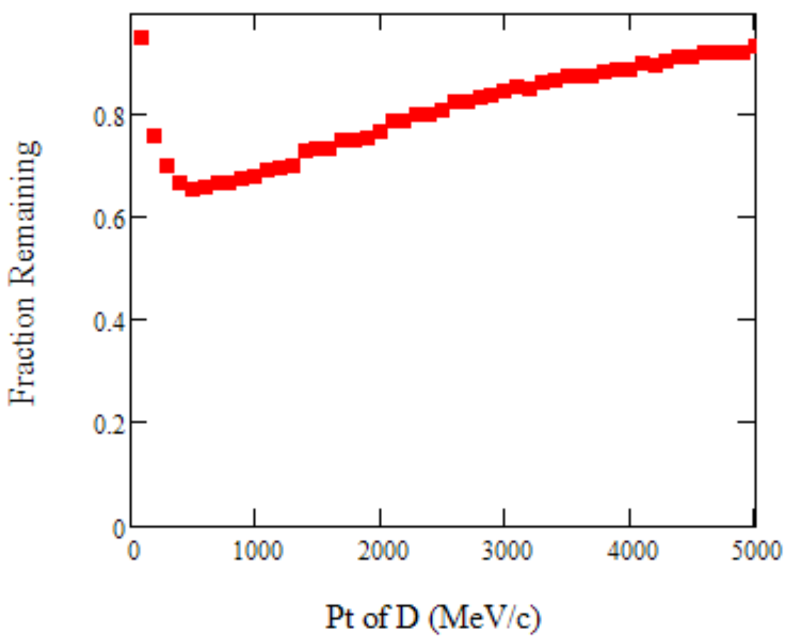

Fig. 1 Fraction of pairs remaining after requiring that both the pion and kaon have a momentum greater than 800 MeV/c shown as a function of D pt. This shows that not too many pairs are rejected using this momentum constraint.

All further comparisons show affects of geometry only. Only pairs that satisfy the TPC constraint and the minimum Pt constraint are used in the measure of fraction accepted. A fraction accepted = 1, means that all of the pairs that satisfied the TPC and p minimum constraint are recorded in the specified pixel detector configuration.

Efficiency for full cylinder geometry:

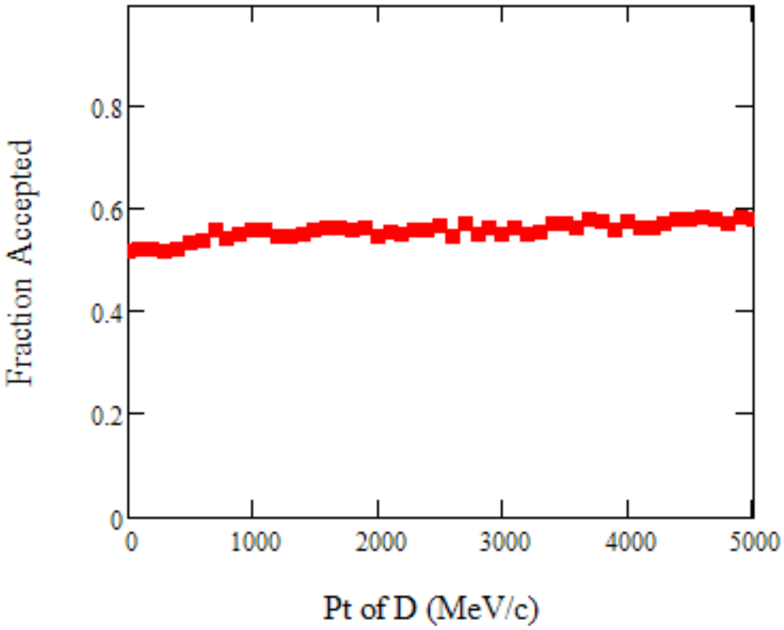

Fig. 2 Geometrical efficiency for detecting both the K and the p in a 20 cm long cylinder with an
8 cm radius.

As shown in Fig. 2 when using the standard cylindrical geometry the detection efficiency for Ds is quite uniform for varying Pt of the D. This is not the case when limiting the geometry to selected patch coverage. One can choose geometries to enhance detection in defined Pt regions. This is illustrated in a **video** showing how the K and p separate as a function of the Pt of the D. In the video one element of the pair is selected to lie in a limited region on the cylinder while the other element of the pair appears as dictated by generated kinematics.

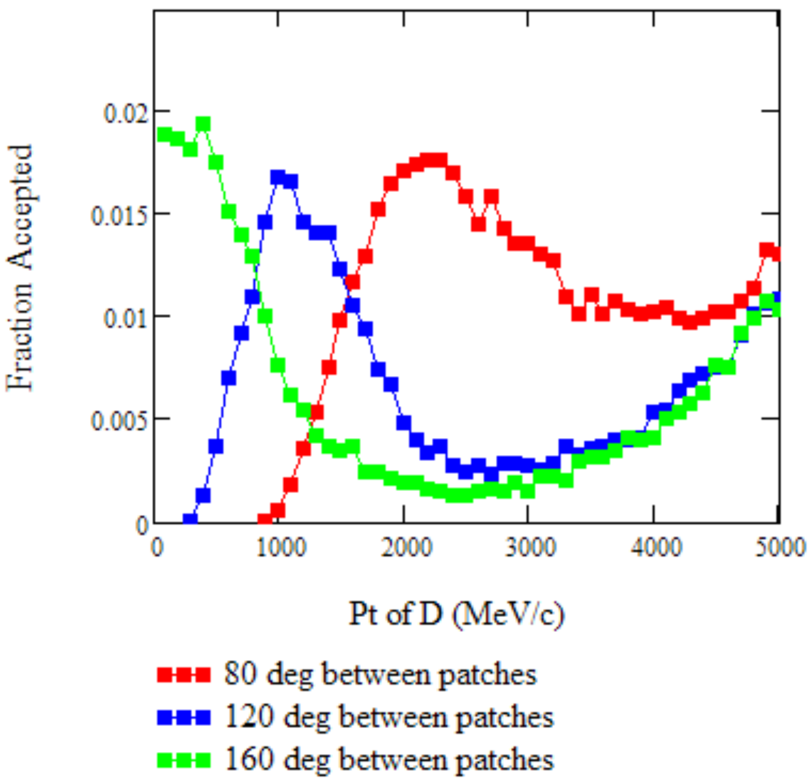

Fig. 3 Geometrical efficiency for two patches of detector shown as a function of D Pt. Three cases are shown with different separation angles between the patches. A **video of the 120 deg configuration** illustrates the geometry. The patches correspond to single modules with one ladder at 2.5 cm radius and 3 ladders at 8 cm radius, subtending 40 deg in f. The case shown is with the ladder active over 10 cm in z. This configuration of patches would require a total of 40 ~2 cm sq chips. The 120 deg separation most closely matches the peak in the D pt distribution.

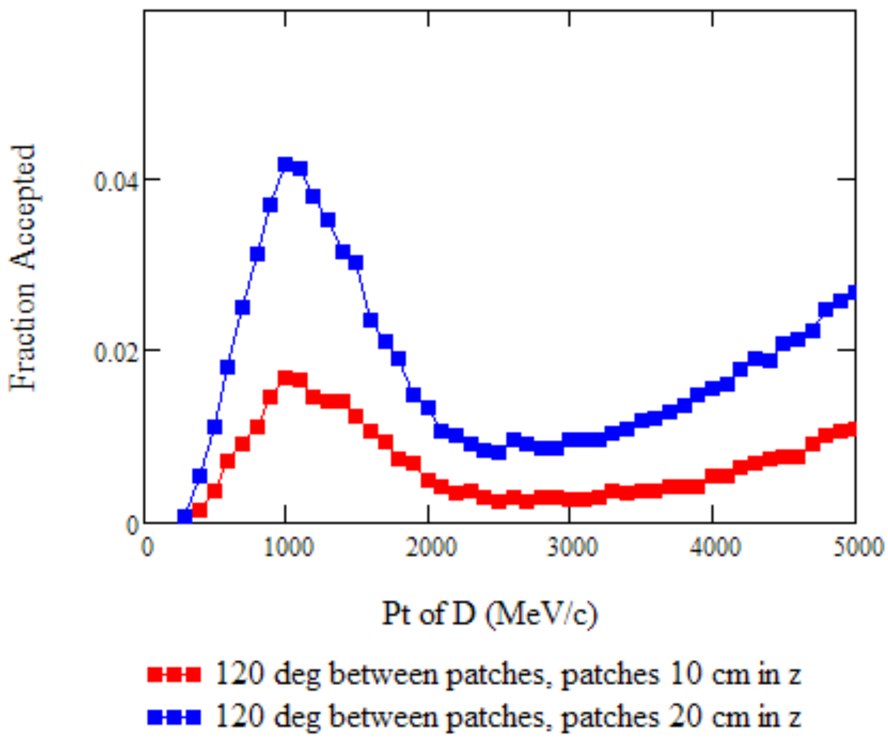

Fig. 4 Geometrical efficiency for two patches of detector shown as a function of D Pt. Two cases are shown with different patch lengths, 10 and 20 cm long in z. The two patches are separated by 120 degrees. The 10 cm configuration requires 40 detector chips and the 20 cm configuration would require 80 chips.

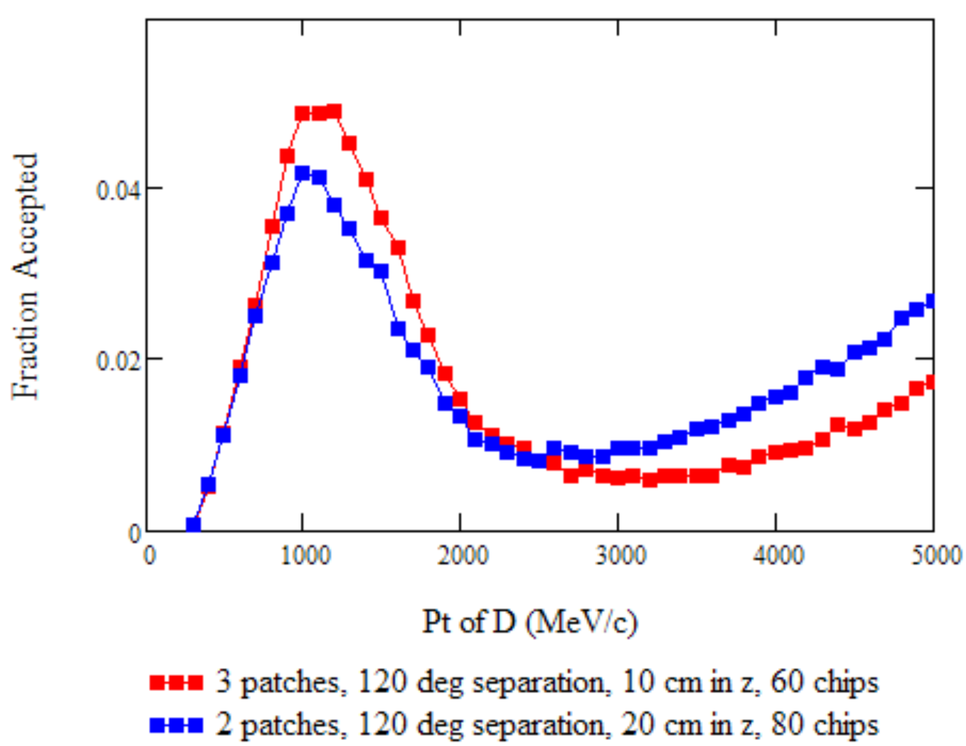

Fig. 5 Geometrical efficiency comparing a 3 patch configuration with a 2 patch configuration. The two patch example in this case has longer active ladders and requires more chips (80 chips) than the 3 patch configuration (60 chips). Even with fewer chips the 3 patch pattern one gets better performance in the 1 GeV Pt region.

Conclusion

One looses considerable performance by going to partial coverage. The geometry choice for placing the patches significantly changes the performance for different regions of pt. If economy of chips were the driving factor (which is probably not the case) then 3 modules separated by 120 degrees is the preferred configuration.

Using patches even with these reduced efficiencies may still be quite interesting for physics in a prototype run and should be evaluated.