EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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The simulation of the background flux for year 2008 for DIRAC setup.

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GENEVA
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1 Preface

The aim of this work was to prepare the tool for the simulation of background tracks in DIRAC setup. The previous similar work was done for the old version of the collimator and shield. In this work we used the year 2008 GEANT-DIRAC setup description.

The FRITIOF program was used to simulate the proton-Ni interactions.There were prepared two samples of MC data. The first one includes such proton-nuclear interactions which produce 2 pions(coming from the star in target, having the momentum values in the range $1 \div 8$ GeV/c, passing through all the forward detectors and producing hits in these detectors) and any other particles(they also can come from the same star or they are the result of this star particle interactions in some setup parts) producing hits in the forward detectors. This last set of hits is recognized as correlated background.

The second sample is the proton-Ni interactions without such restriction(presence of two triggerlike particles). The parameters of these events were used to prepare the Monte-Carlo generator of accidental hits which uses the values of beam intensity and setup time gap.

The FRITIOF events were submitted into GEANT-DIRAC program. Only the events where there were some hits(with ionization loses in each layer(plane) equal or higher than it does have the minimum ionizing particle in the same layer) the forward detectors were accepted and this hit information was written into the file and analyzed after. The each sample of event hits was separated into two sets: 1)the hits belong to a tracks which passed through all three detectors(long tracks) and 2)the short track hits.

2 The correlated background.

The accepted events must contain at least two triggerlike tracks of charged particles which must go through all three forward detectors - all 25 planes must be hitted by these 2 pions. The hits which are different from those 50 hits were recognized as correlated background hits.

All the hits were recognized as belonging to the long tracks or short ones. The probability of long track(in case when there are 2 triggerlike pions) is in 2.3% and of any kind of short track is 11% (independly for MDC this parameter is 6.8%, 6.1% - for SFD and 4.1% - for IH). The correlation of hits of these three detectors are shown on Fig.1 and 2: we see that for short tracks the correlation between tracks in forward detectors is small.

Among of all the background hits there are 57% hits which belong to the tracks going from the target and hence 43% of hits belong to the tracks created outside the target(any kinds of interactions on the setup parts). The long tracks mainly come from the target(85%) but the short tracks come generally from outside of target(87% in case of MDC tracks, 97.5% - fiber detector and 99.0% - IH detector).

The two-dimensional distribution of X and Y coordinates where the long tracks cross the first plane of MDC is shown on Fig.3. The distribution of space angles(azimuthal θ and polar ϕ) of these tracks is shown on Fig.4. The two-dimensional distribution of momentum and time(the zero of time is in the target) when the long tracks cross first plane of MDC is shown on Fig.5. Some information about the original point of these tracks can get on Fig.6 where the x.vs.y plot is shown and these coordinates are the result of straight line extrapolation of tracks till the target position. About 80% of long tracks are going from the target.

The short tracks have the following properties. The two-dimensional distribution of X and Y coordinates where the tracks cross the first plane of MDC is shown on Fig.7. The distribution of space angles(θ and ϕ) of these tracks is shown on Fig.8 (the events with negative value of θ correspond to the back tracks). The two-dimensional distribution of momentum and time when the short tracks cross first plane of MDC is shown on Fig.9. The number of planes hitted are shown on Fig.10.

The two-dimensional distribution of X and Y coordinates where the tracks cross the first plane of fiber detector is shown on Fig.11. The distribution of space angles(θ and ϕ) of these tracks is shown on Fig.12. The two-dimensional distribution of momentum and time when the short tracks cross first plane of fiber detector is shown on Fig.13. The number of planes hitted are shown on Fig.14. The information about the original point of these tracks can get on Fig15 where the x.vs.y plot is shown and these coordinates are the result of straight line extrapolation of tracks till the target position. Only small part(3%) of these tracks are going from the target.

The two-dimensional distribution of X and Y coordinates where the tracks cross the first plane of IH is shown on Fig.16. The distribution of space angles(θ and ϕ) of these tracks is shown on Fig.17. The two-dimensional distribution of momentum and time when the short tracks cross first plane of IH is shown on Fig.18. The number of planes hitted are shown on Fig.19.

3 The uncorrelated background.

Here all the events were accepted.

All the hits were recognized as belonging to the long tracks or short ones. The long track probability is 2.7% per one interaction in the target and for short tracks this one is 4.3% for MDC, .06% - for SFD and 0.05% - for IH; the correlation of hits of these three detectors are shown on Fig.20 and 21.

Among of all the background hits there are 54% hits which belong to the tracks going from the target and hence 46% of hits belong to the tracks created outside the target. The long tracks mainly come from the target(87%) but the short tracks come generally from outside of target(84% in case of MDC tracks, 97.9% - fiber detector and 99.6% - IH detector).

The two-dimensional distribution of X and Y coordinates where the long tracks cross the first plane of MDC is shown on Fig.22. The distribution of space angles(θ and ϕ) of these tracks is shown on Fig.23. The two-dimensional distribution of momentum and time when the long tracks cross first plane of MDC is shown on Fig.24. The information about the original point of long tracks can get on Fig25 where the x.vs.y plot is shown and these coordinates are the result of straight line extrapolation of tracks till the target position. The most part(85%) of long tracks comes from the target.

The short tracks have the following properties. The two-dimensional distribution of X and Y coordinates where the tracks cross the first plane of MDC is shown on Fig.26. The distribution of space angles(θ and ϕ) of these tracks is shown on Fig.27. The two-dimensional distribution of momentum and time when the long tracks cross first plane of MDC is shown on Fig.28. The number of planes hitted are shown on Fig.29.

The two-dimensional distribution of X and Y coordinates where the tracks cross the first plane of fiber detector is shown on Fig.30. The distribution of space angles(θ and ϕ) of these tracks is shown on Fig.31. The two-dimensional distribution of momentum and time when the long tracks cross first plane of fiber detector is shown on Fig.32. The number of planes hitted are shown on Fig.33. The information about the original point of short tracks in SFD tracks can get on Fig34 where the x.vs.y plot is shown and these coordinates are the result of straight line extrapolation of tracks till the target position. Only small part(12%) of these tracks comes from the target.

The two-dimensional distribution of X and Y coordinates where the tracks cross the first plane of IH is shown on Fig.35. The distribution of space angles(θ and ϕ) of these tracks is shown on Fig.36. The two-dimensional distribution of momentum and time when the long tracks cross first plane of IH is shown on Fig.37. The number of planes hitted are shown on Fig.38.

Calculated in such a way the background flux in SFD is two times less than the real number of hits in this detector. The matter maybe is the noise in SFD.

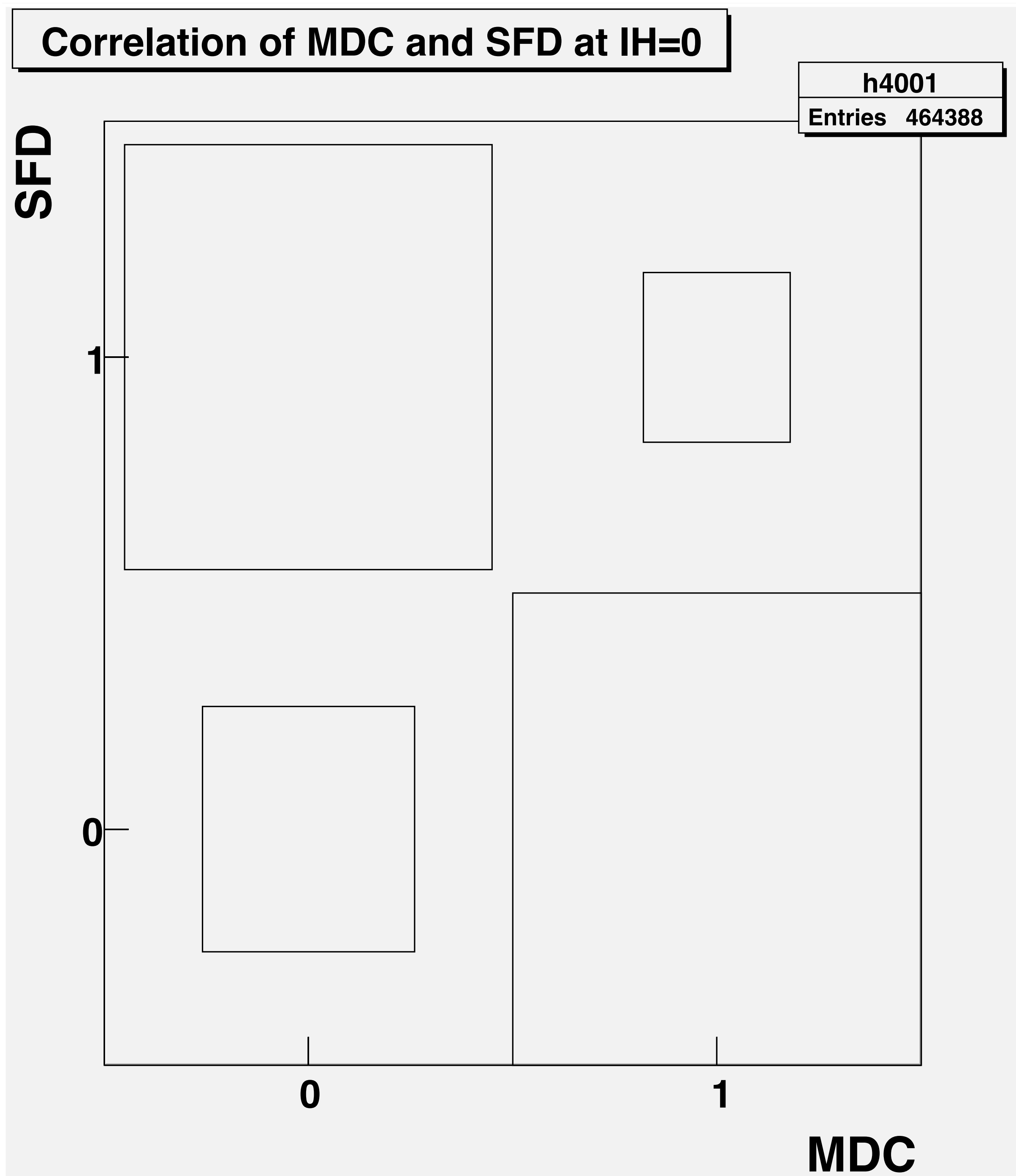

Figure 1: *Correlated background for short tracks. The correlation between tracks in MDC and SFD (0 means no hits and 1 means the presence of hits) when there is no hits in IH(IH=0).*

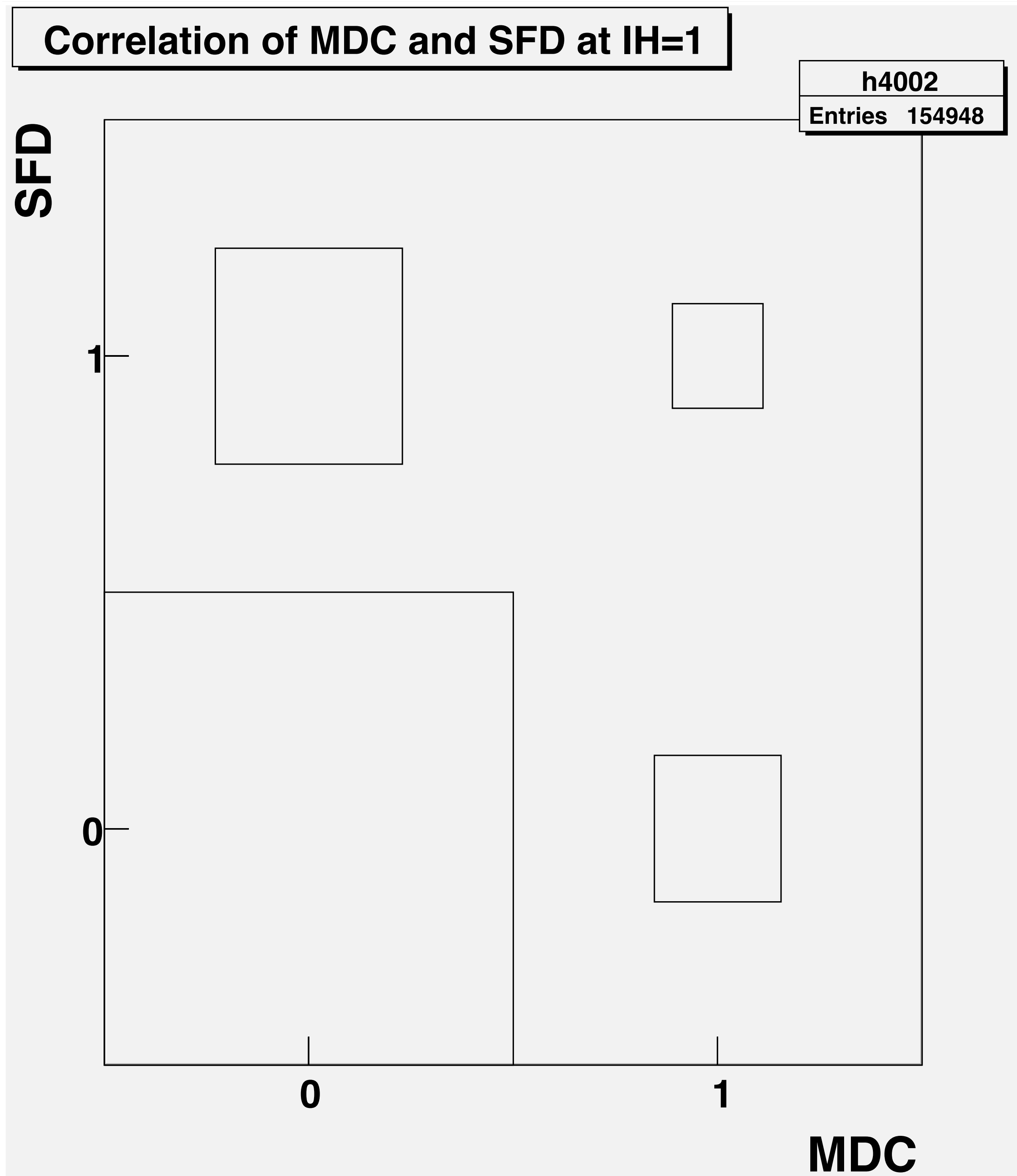

Figure 2: *Correlated background for short tracks. The correlation between tracks in MDC and SFD (0 means no hits and 1 means the presence of hits) when there is a hit in IH(IH=1).*

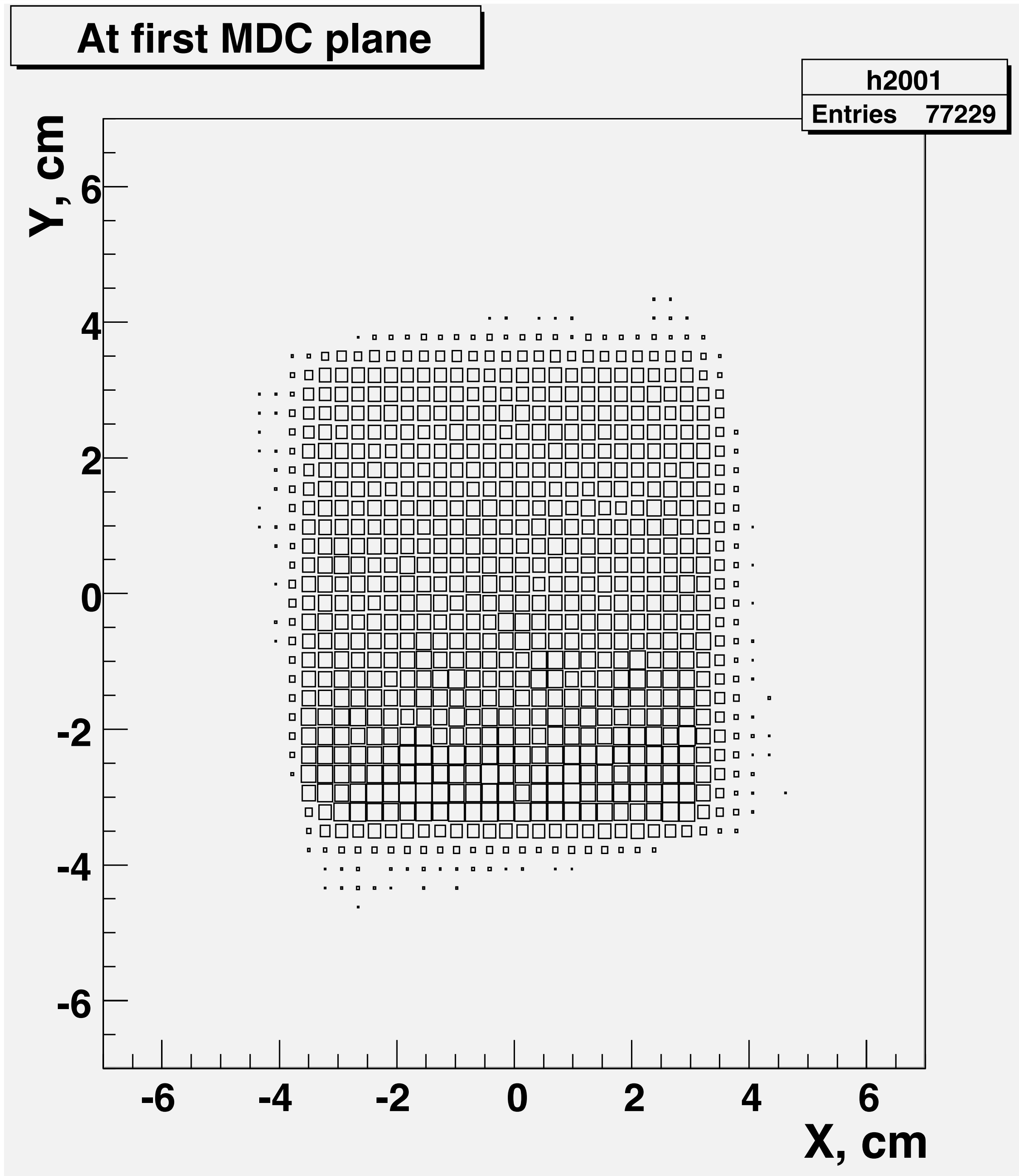

Figure 3: *Correlated background. The two-dimensional distribution of X and Y coordinates where the long tracks cross the first plane of MDC.*

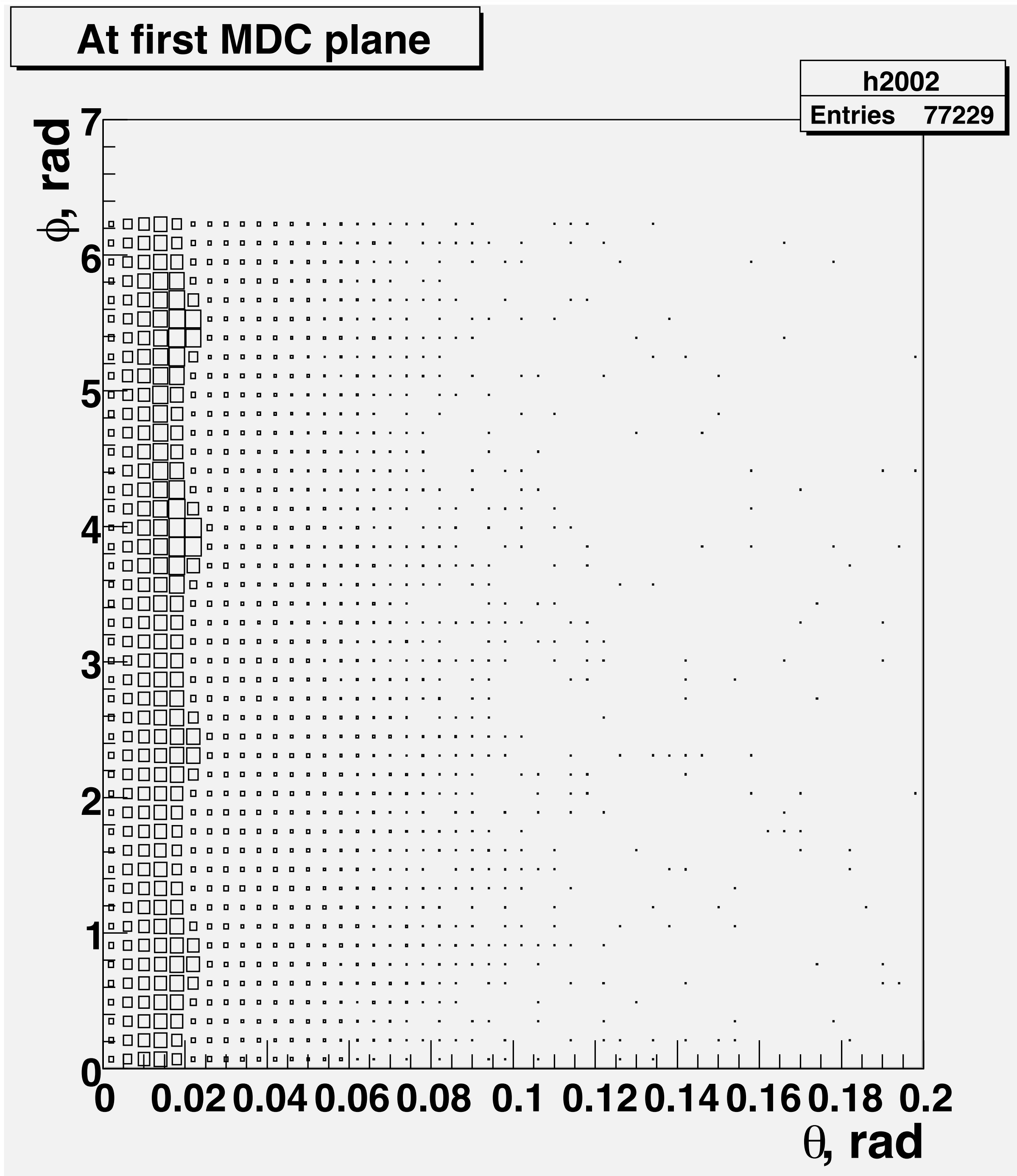

Figure 4: *Correlated background. The distribution of space angles(θ and ϕ) of long tracks .*

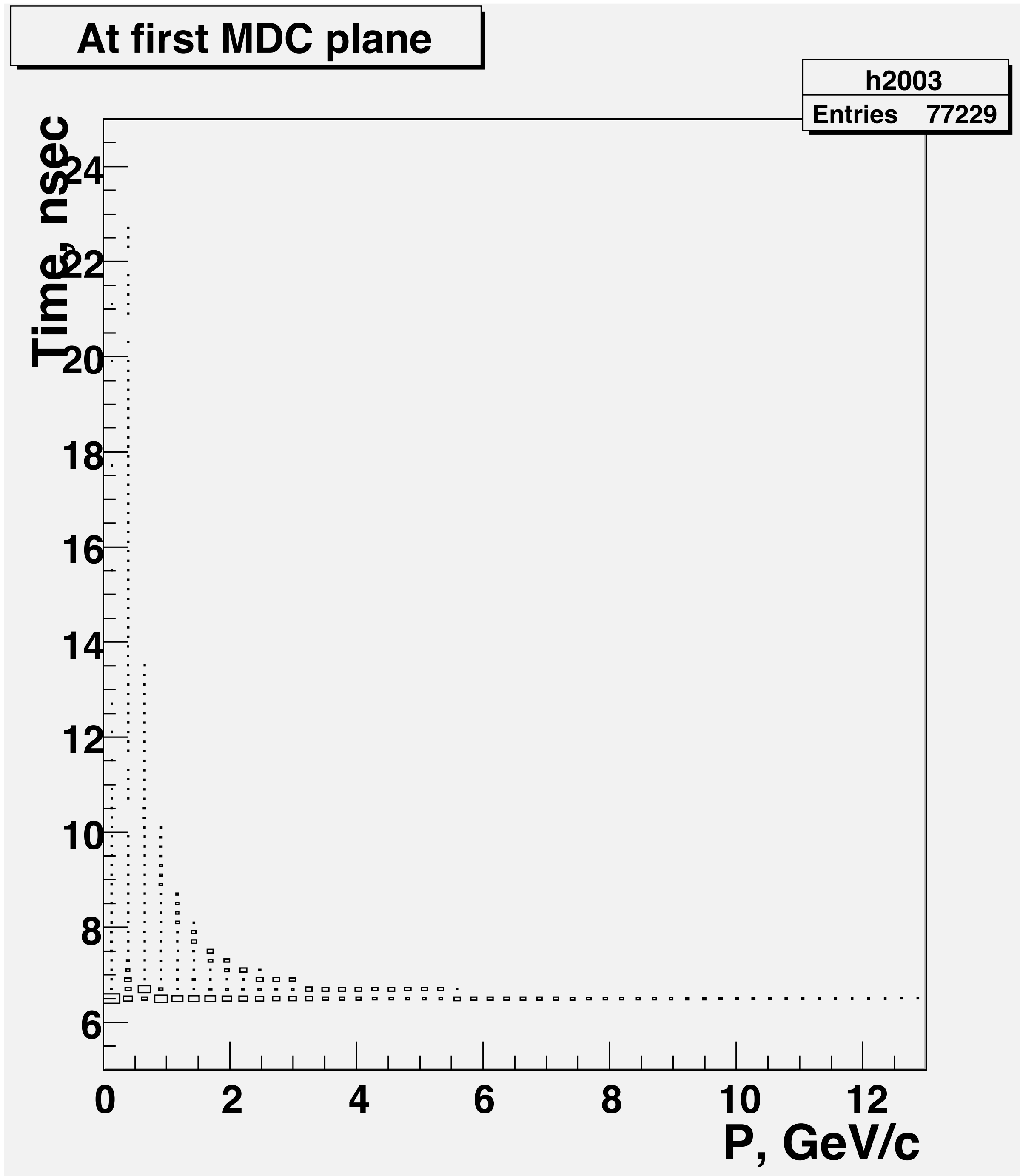

Figure 5: *Correlated background. The two-dimensional distribution of momentum and time for the long tracks when they cross first plane of MDC.*

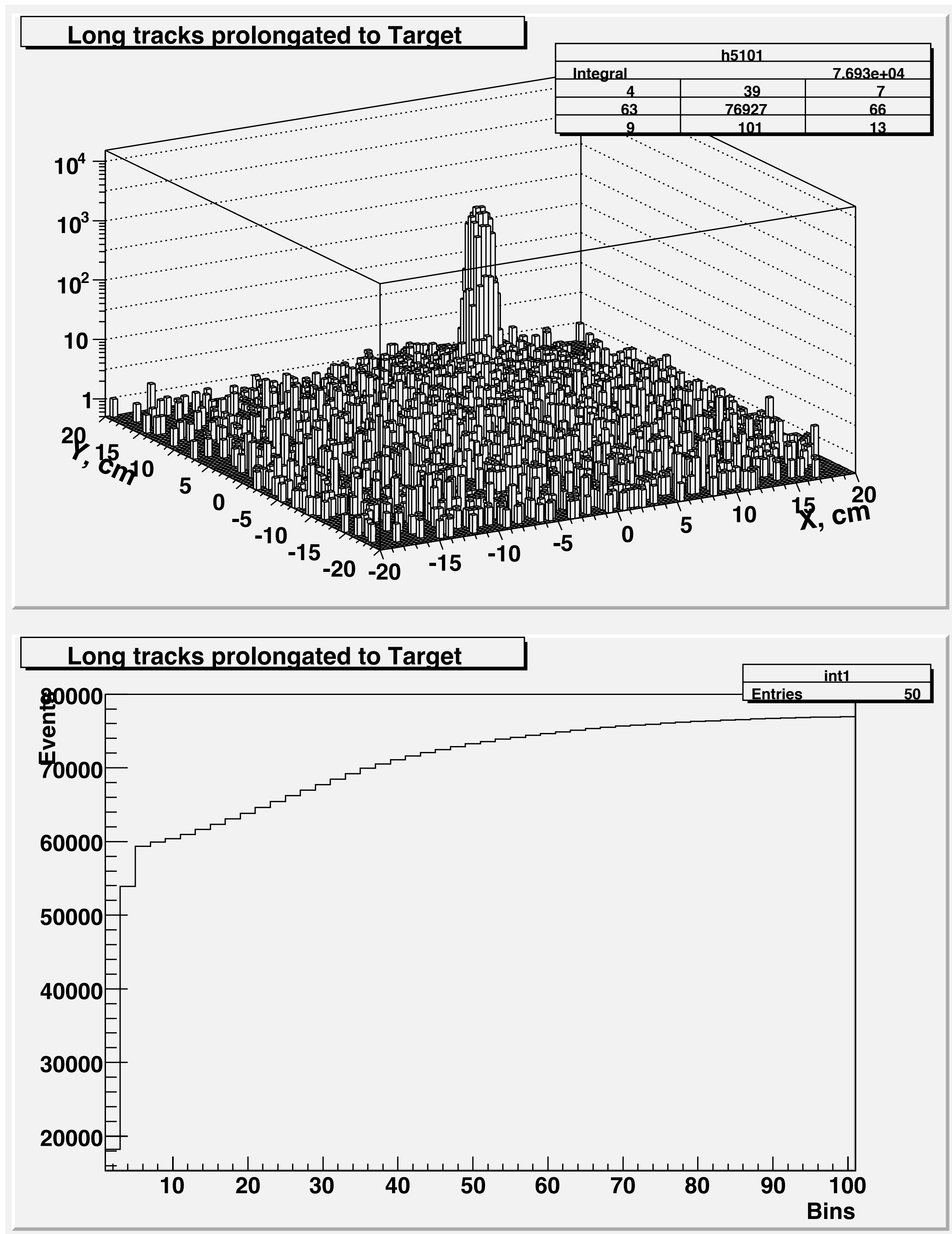

Figure 6: *Correlated background. Top: the two-dimensional distribution of X and Y coordinates where the extrapolated long tracks cross the target plane. Bottom: the running sum of central bins(2x2,4x4,6x6,...100x100).*

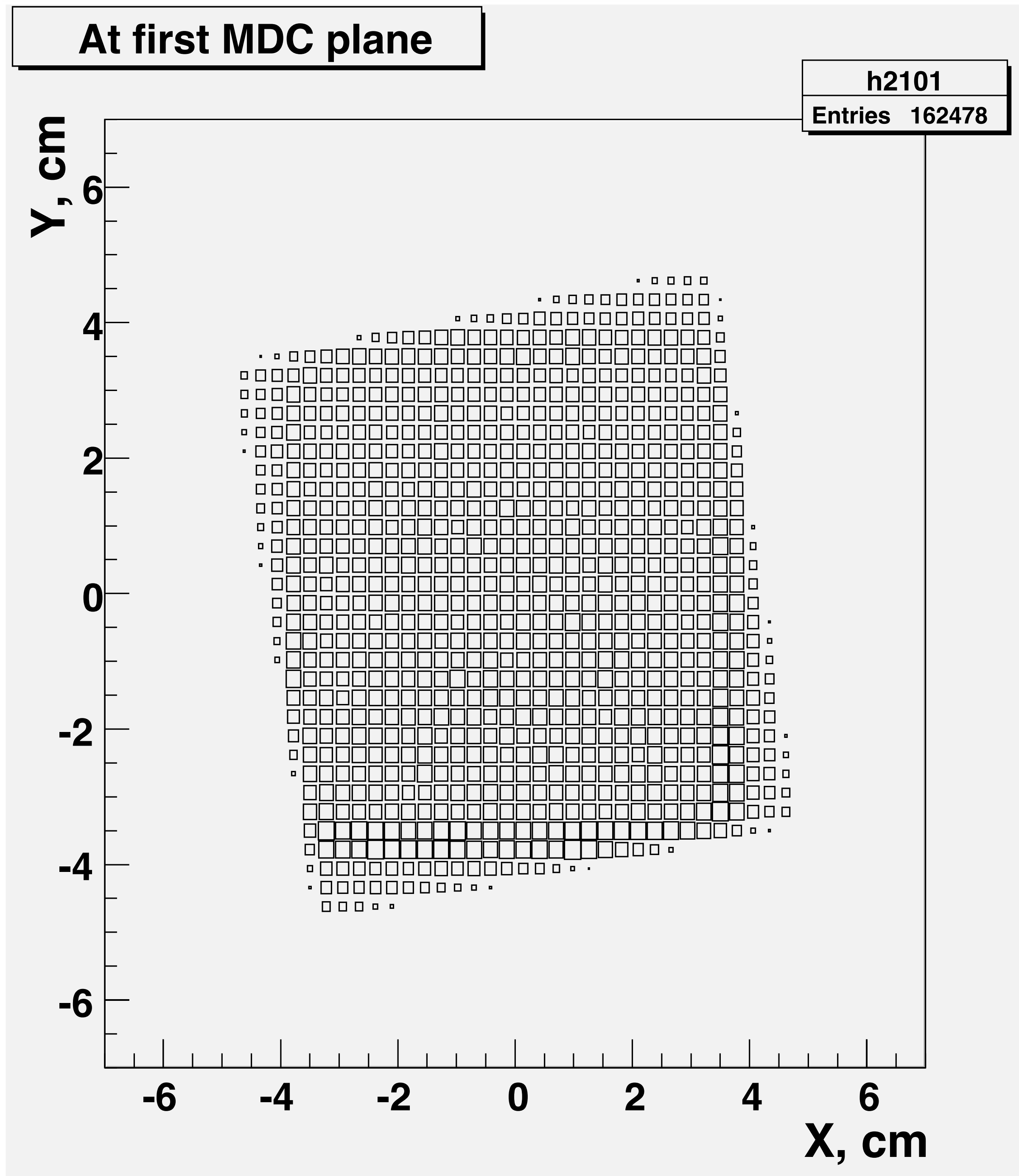

Figure 7: *Correlated background. The two-dimensional distribution of X and Y coordinates where the short tracks cross the first plane of MDC.*

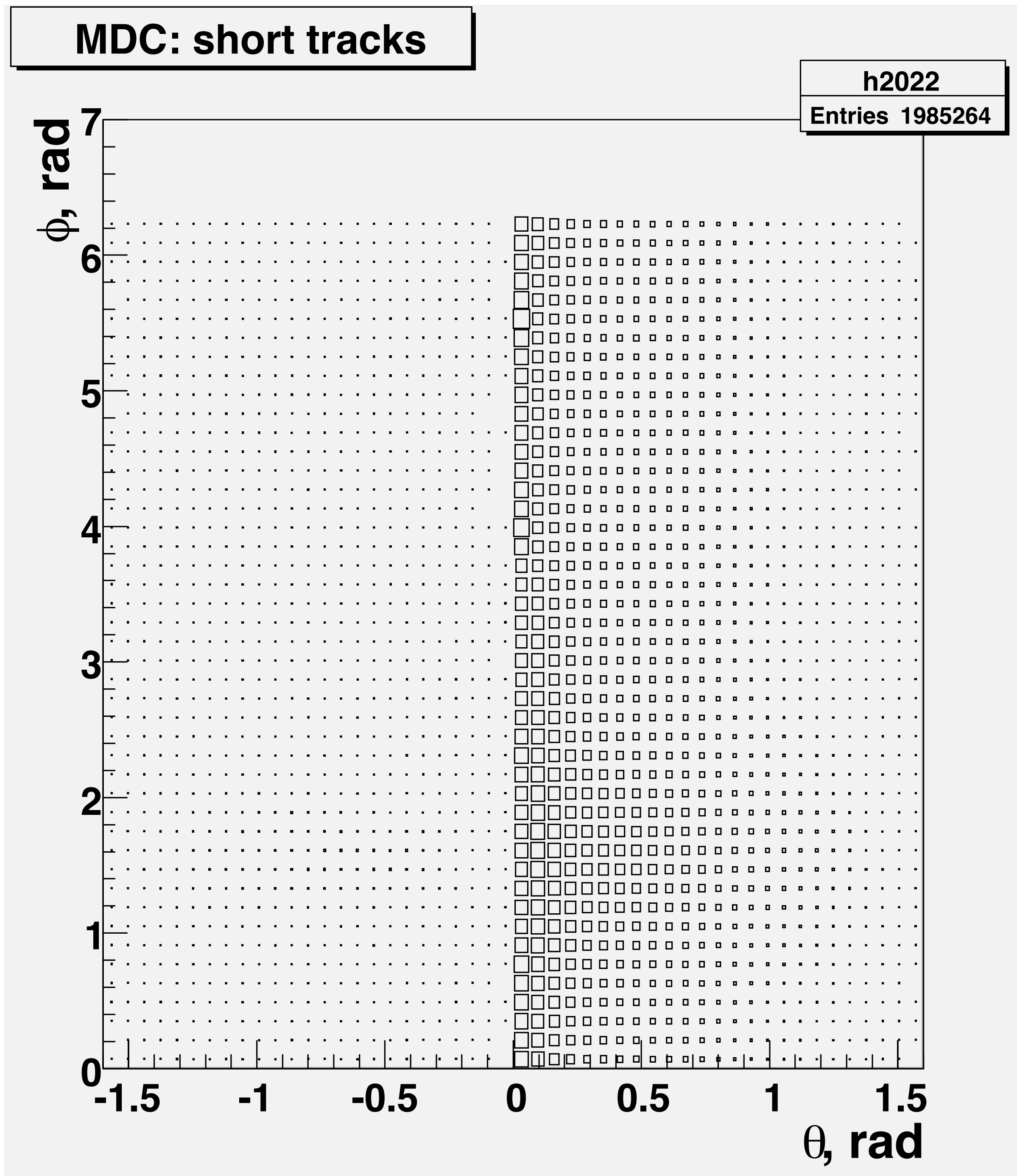

Figure 8: *Correlated background. The distribution of space angles(θ and ϕ) of short tracks*
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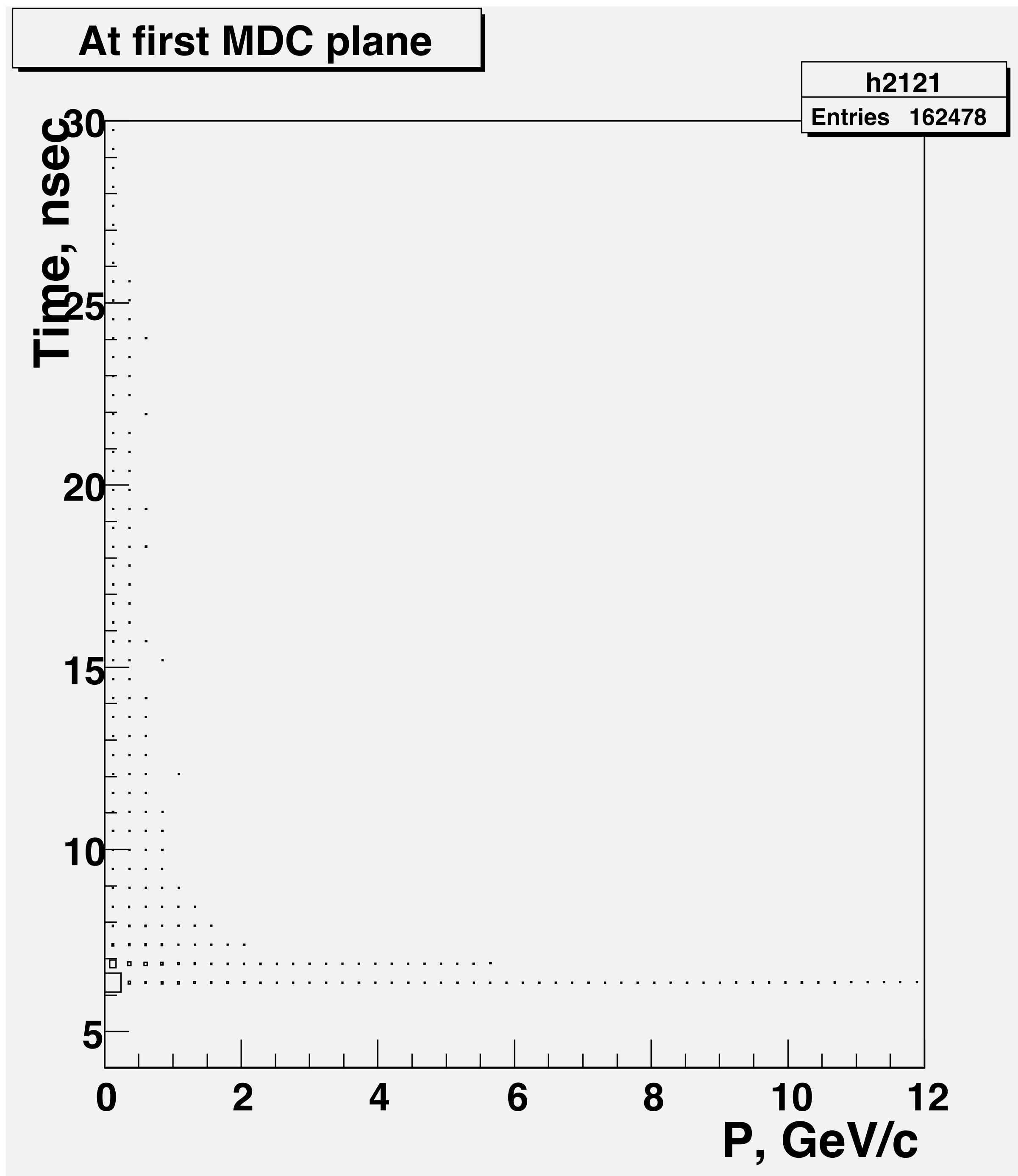

Figure 9: *Correlated background. The two-dimensional distribution of momentum and time for the short tracks when they cross first plane of MDC.*

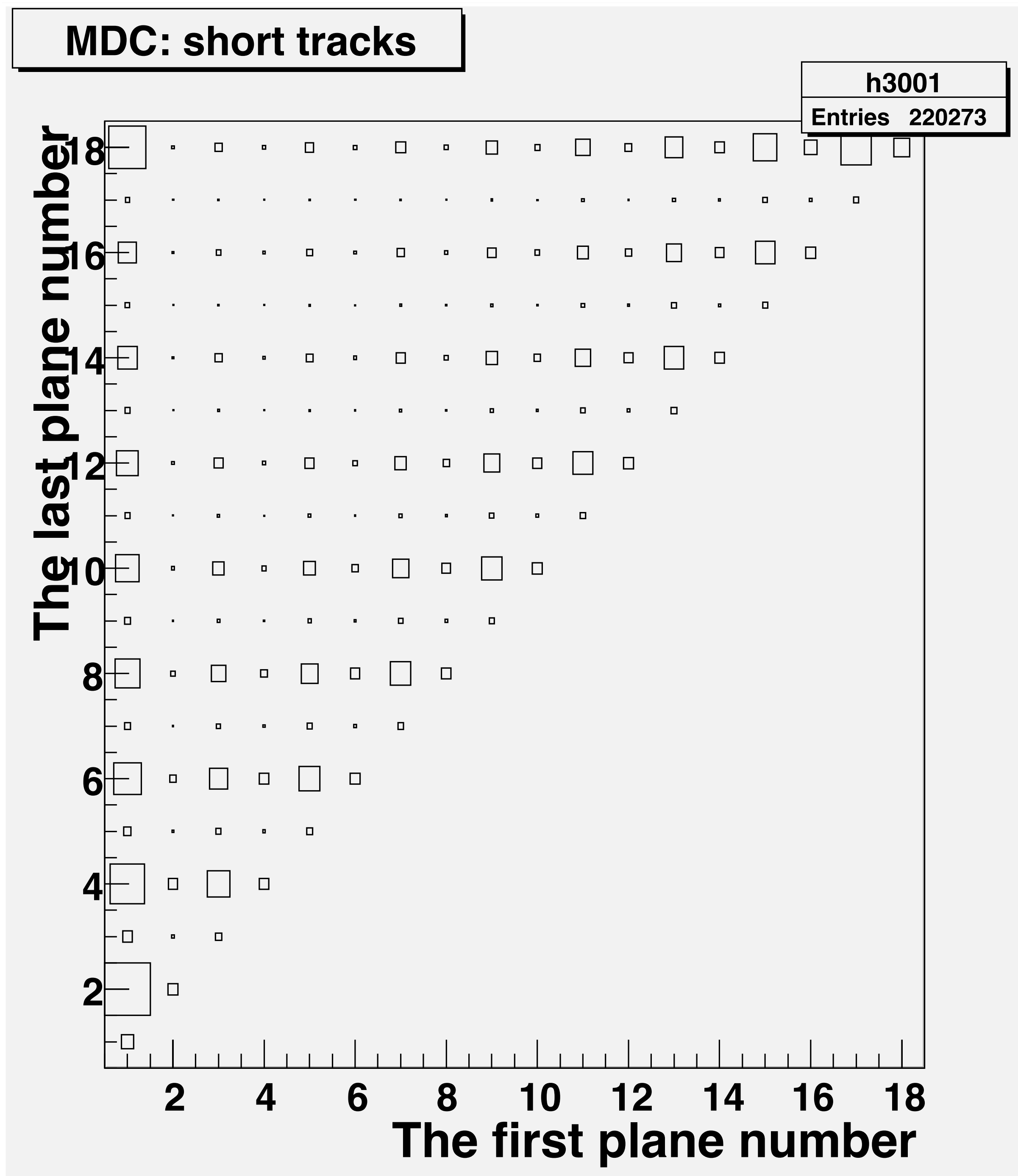

Figure 10: *Correlated background. The plot of first plane hitted and last plane for MDC.*

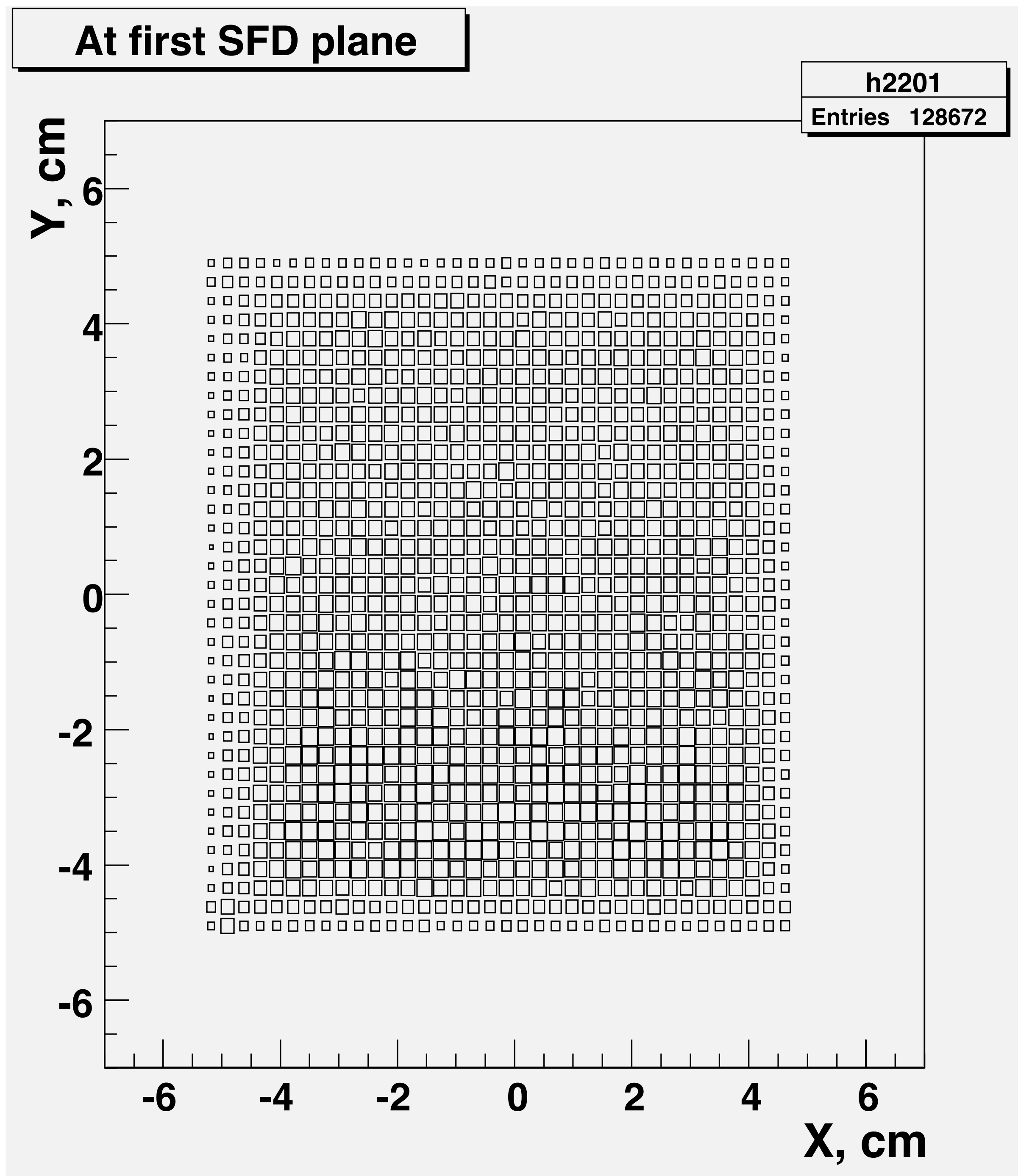

Figure 11: *Correlated background. The two-dimensional distribution of X and Y coordinates where the short tracks cross the first plane of fiber detector.*

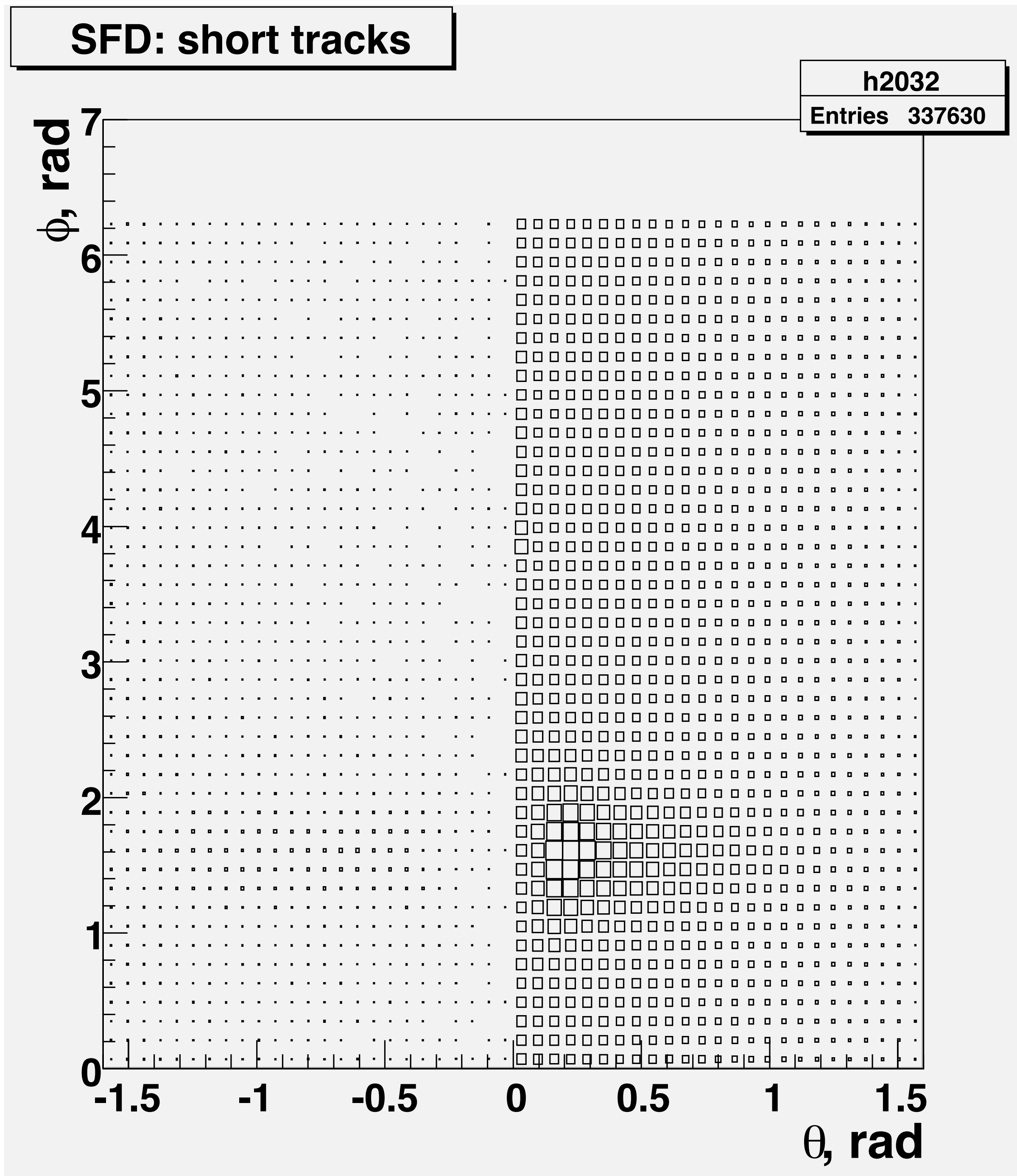

Figure 12: *Correlated background. The distribution of space angles(θ and ϕ) of short tracks .*

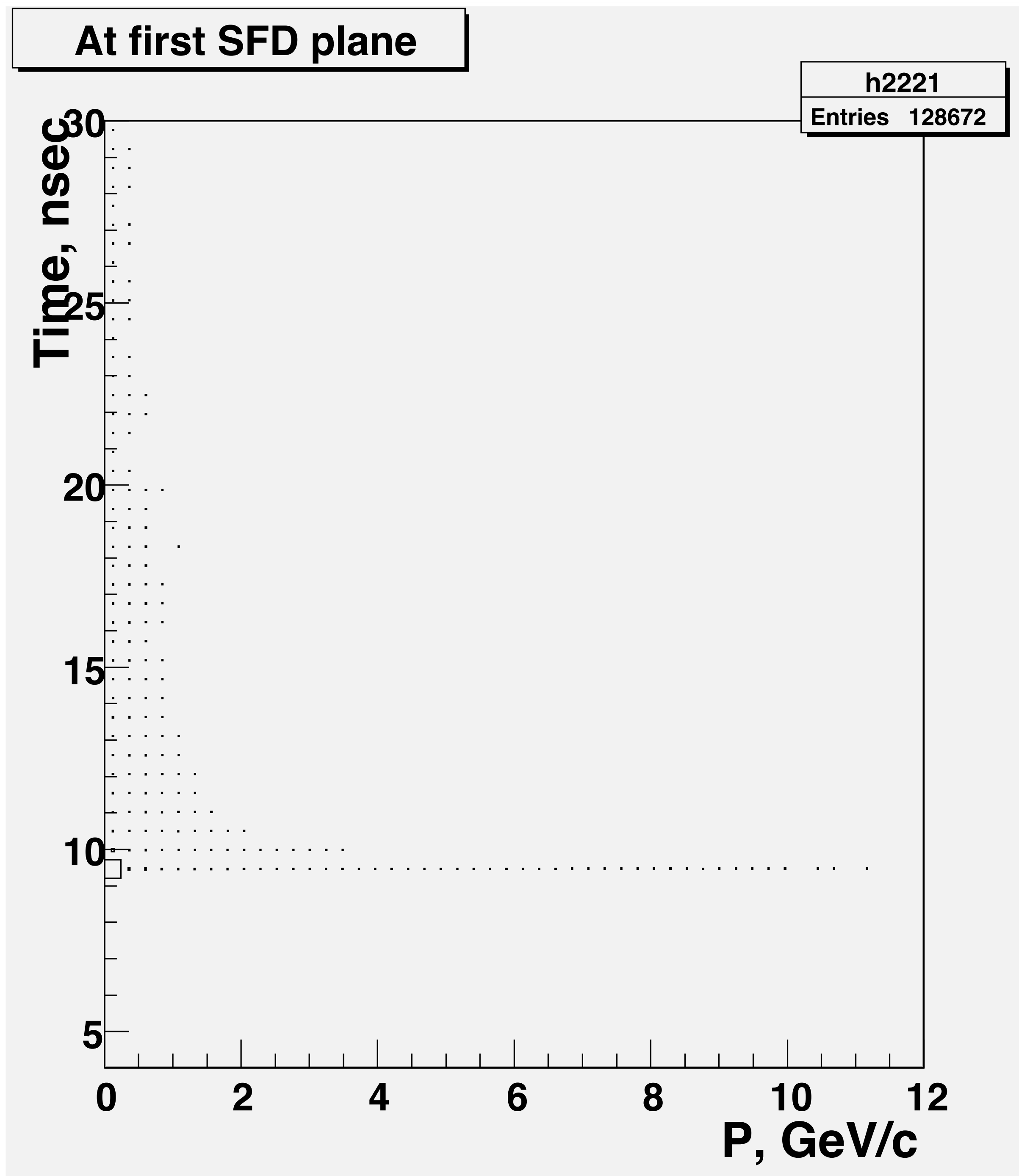

Figure 13: *Correlated background. The two-dimensional distribution of momentum and time for the short tracks when they cross first plane of fiber detector.*

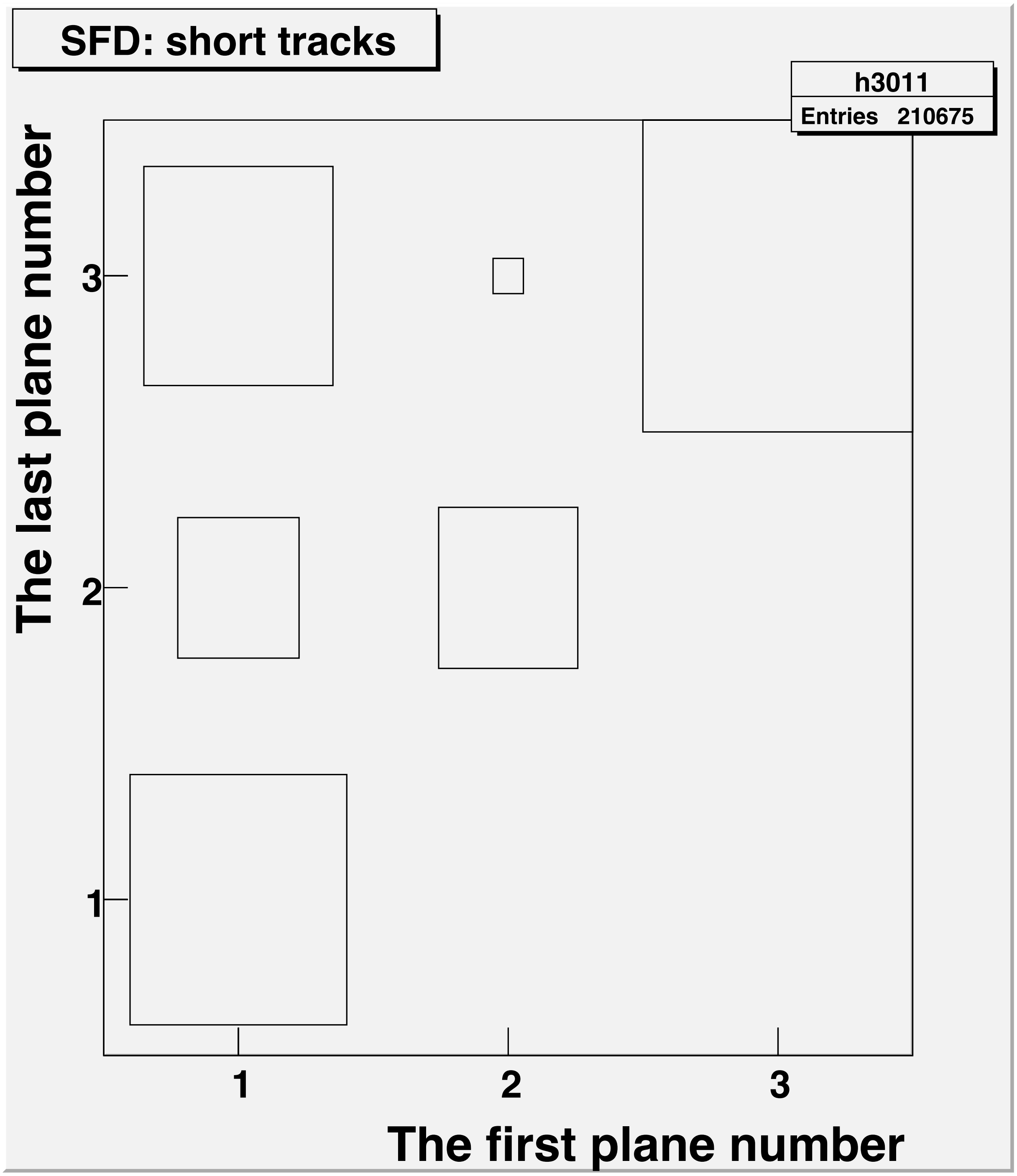

Figure 14: *Correlated background. The plot of first plane hitted and last plane for fiber detector.*

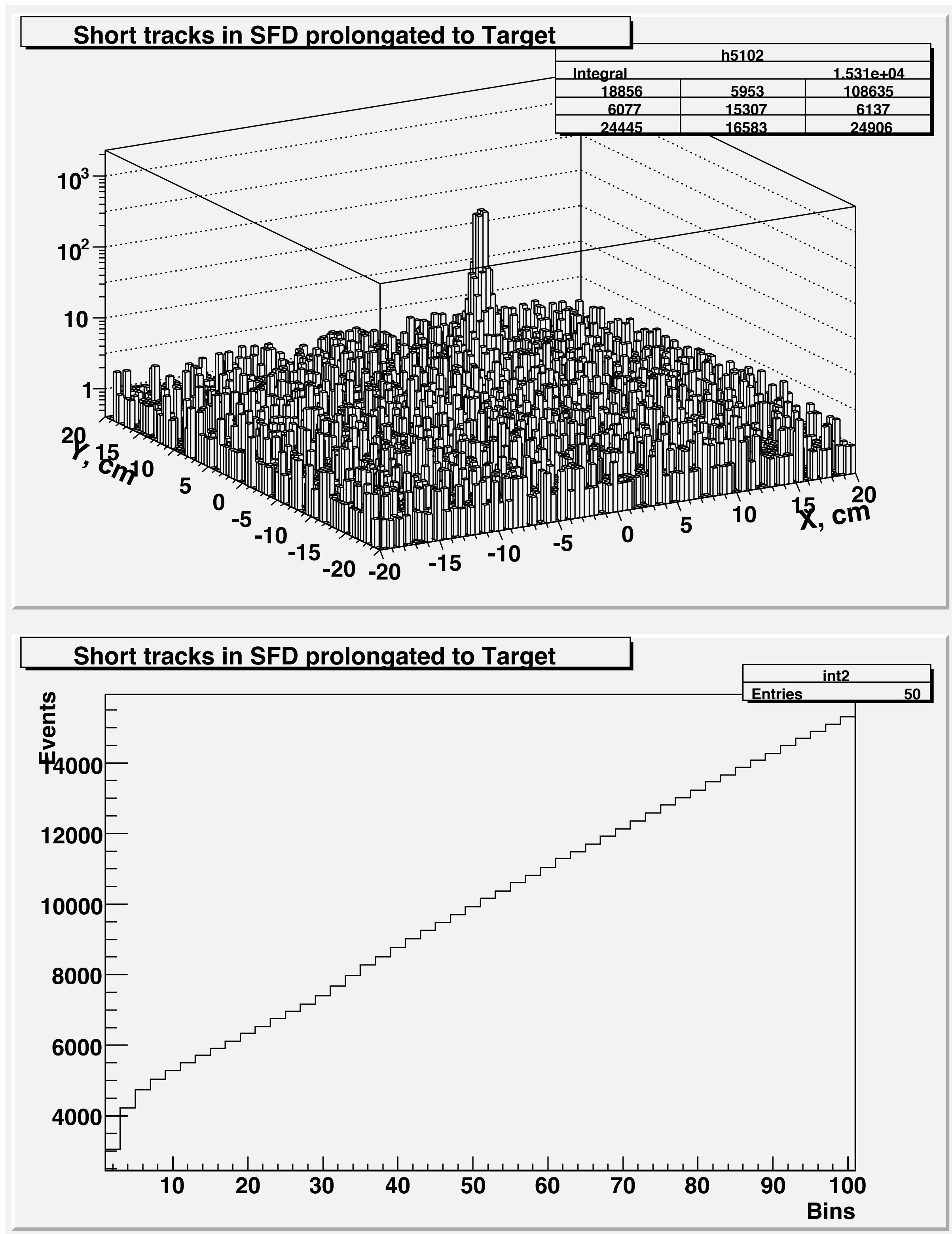

Figure 15: *Correlated background. Top: the two-dimensional distribution of X and Y coordinates where the extrapolated short tracks cross the target plane. Bottom: the running sum of central bins(2x2,4x4,6x6,...100x100).*

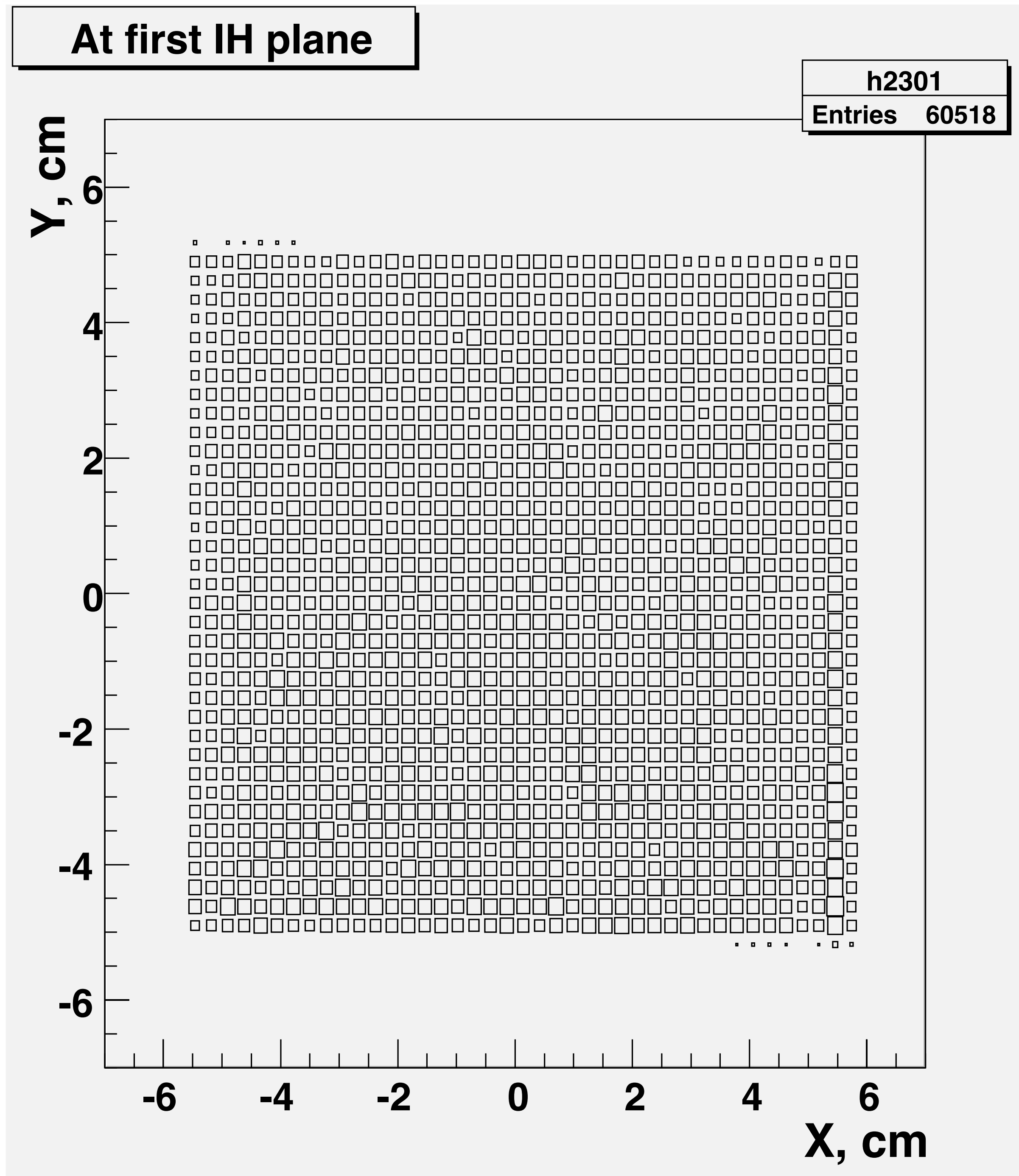

Figure 16: *Correlated background. The two-dimensional distribution of X and Y coordinates where the short tracks cross the first plane of IH.*

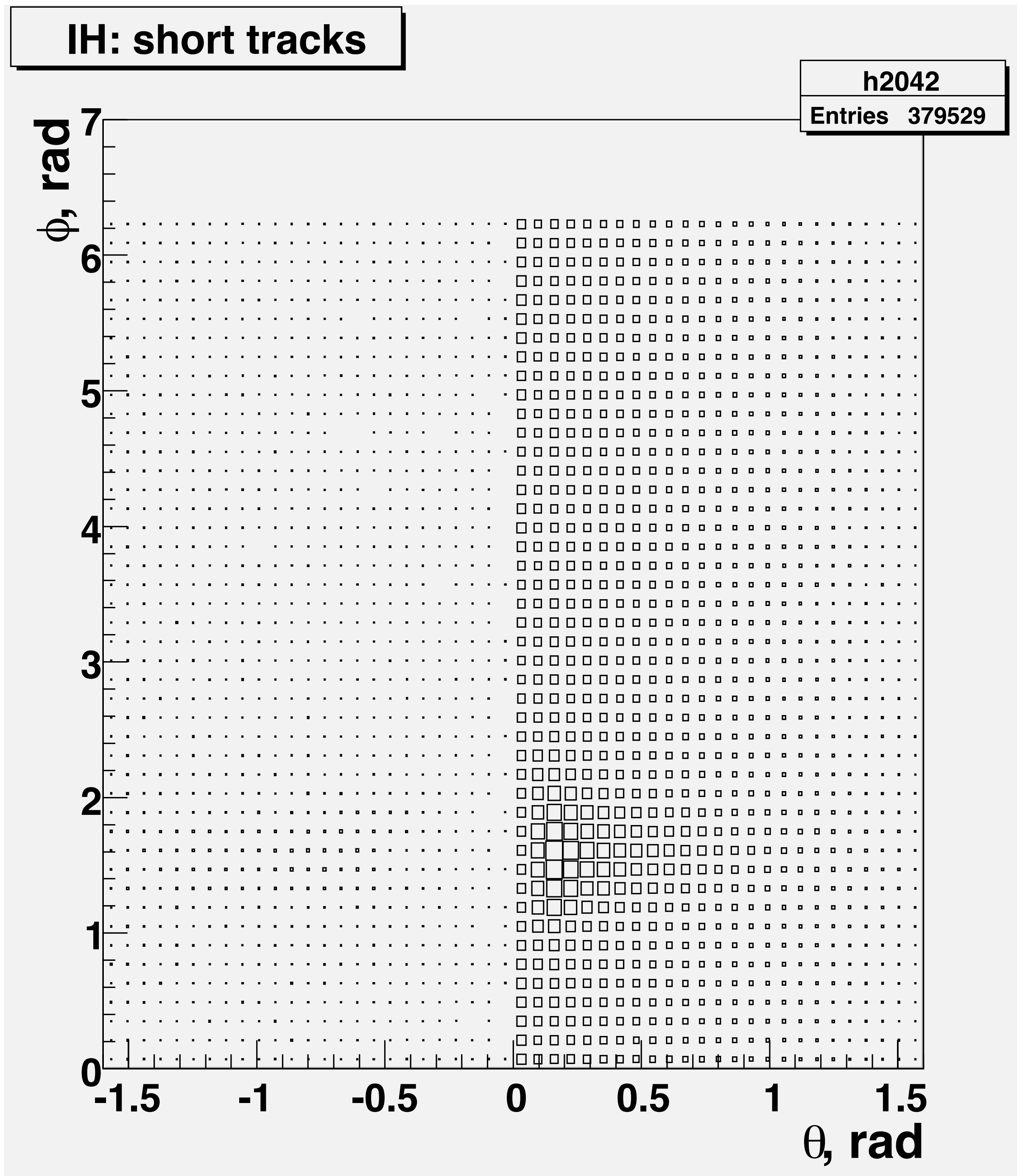

Figure 17: *Correlated background. The distribution of space angles(θ and ϕ) of short tracks .*

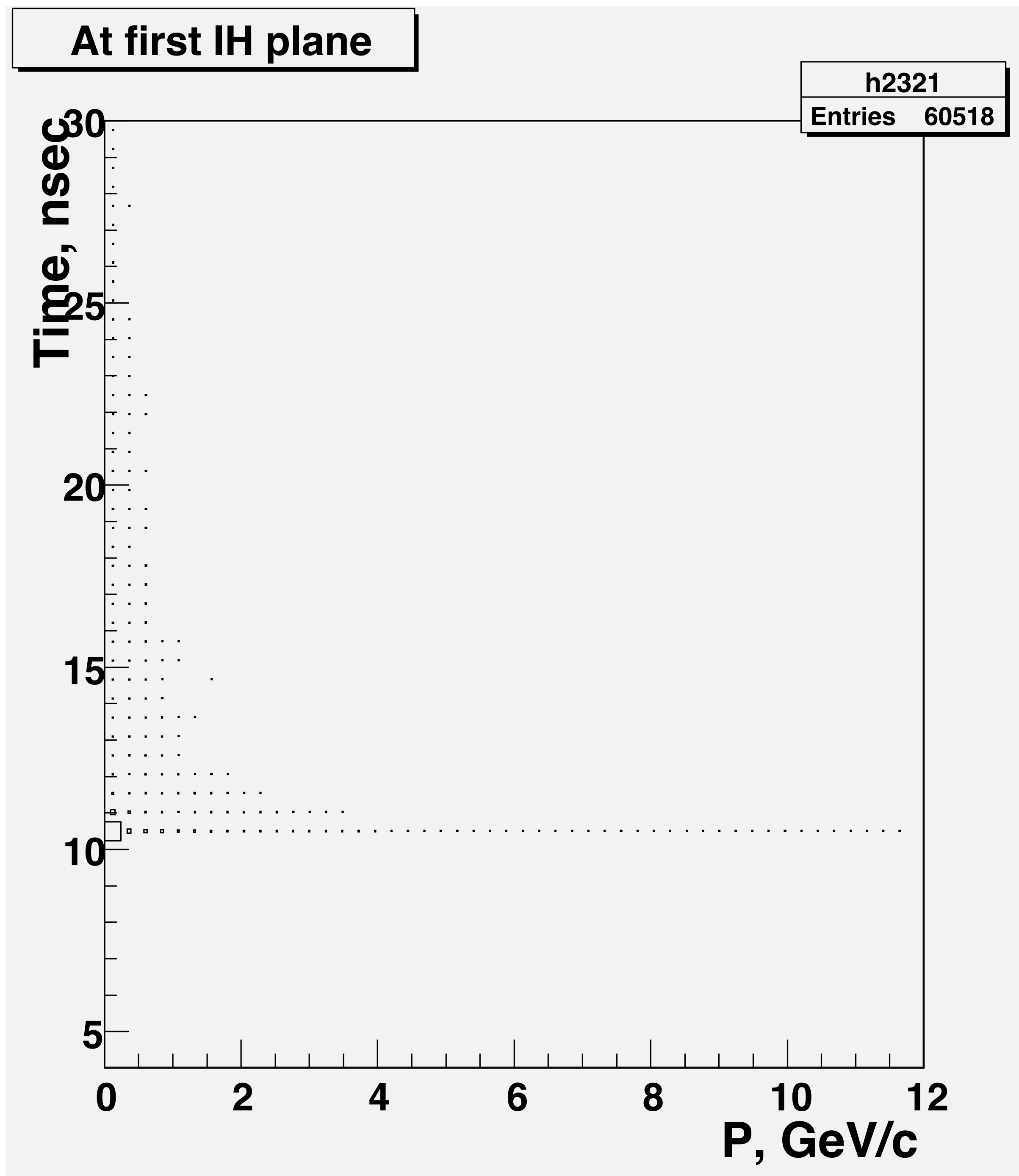

Figure 18: *Correlated background. The two-dimensional distribution of momentum and time for the short tracks when they cross first plane of IH.*

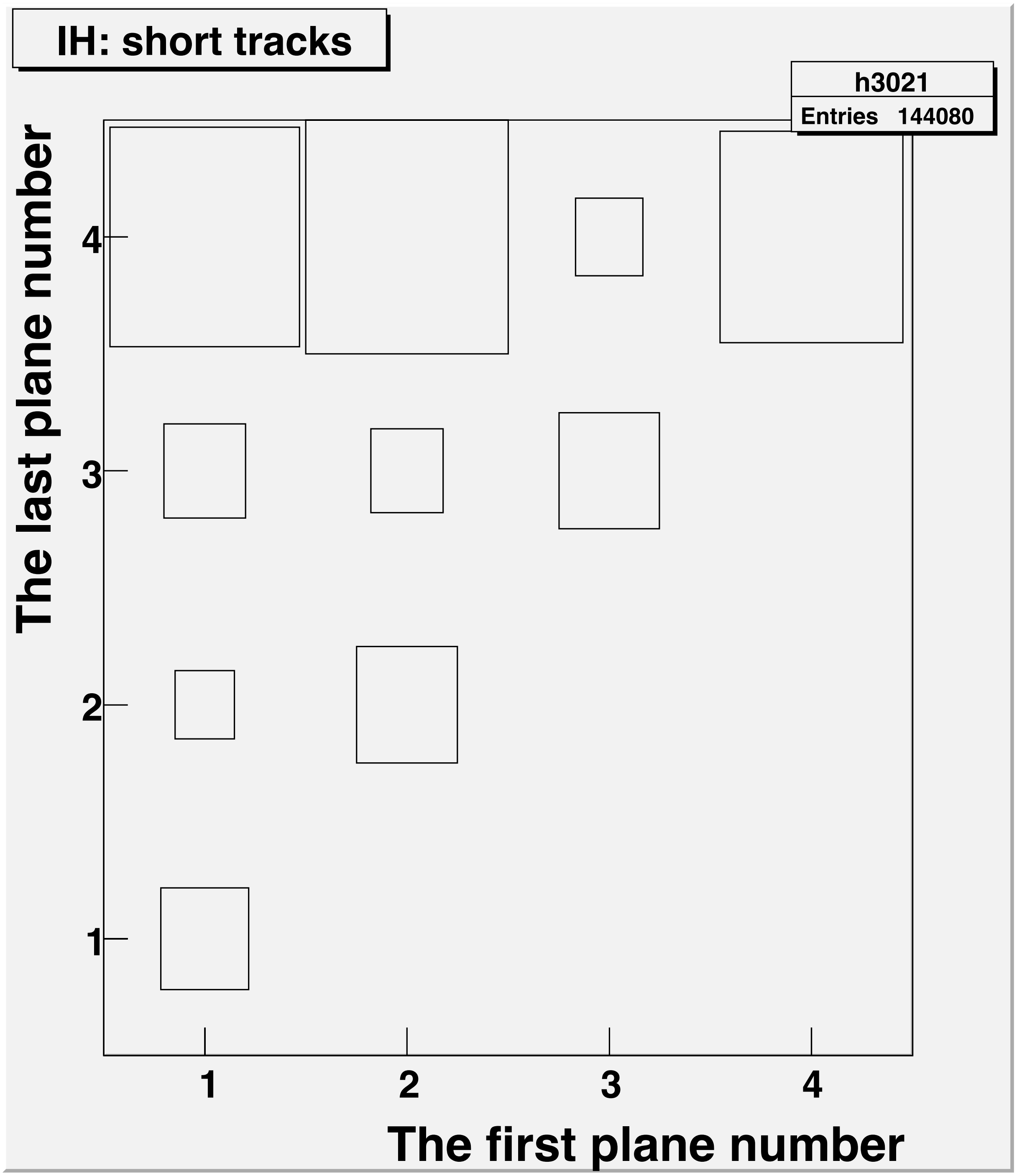

Figure 19: *Correlated background. The plot of first plane hitted and last plane for IH.*

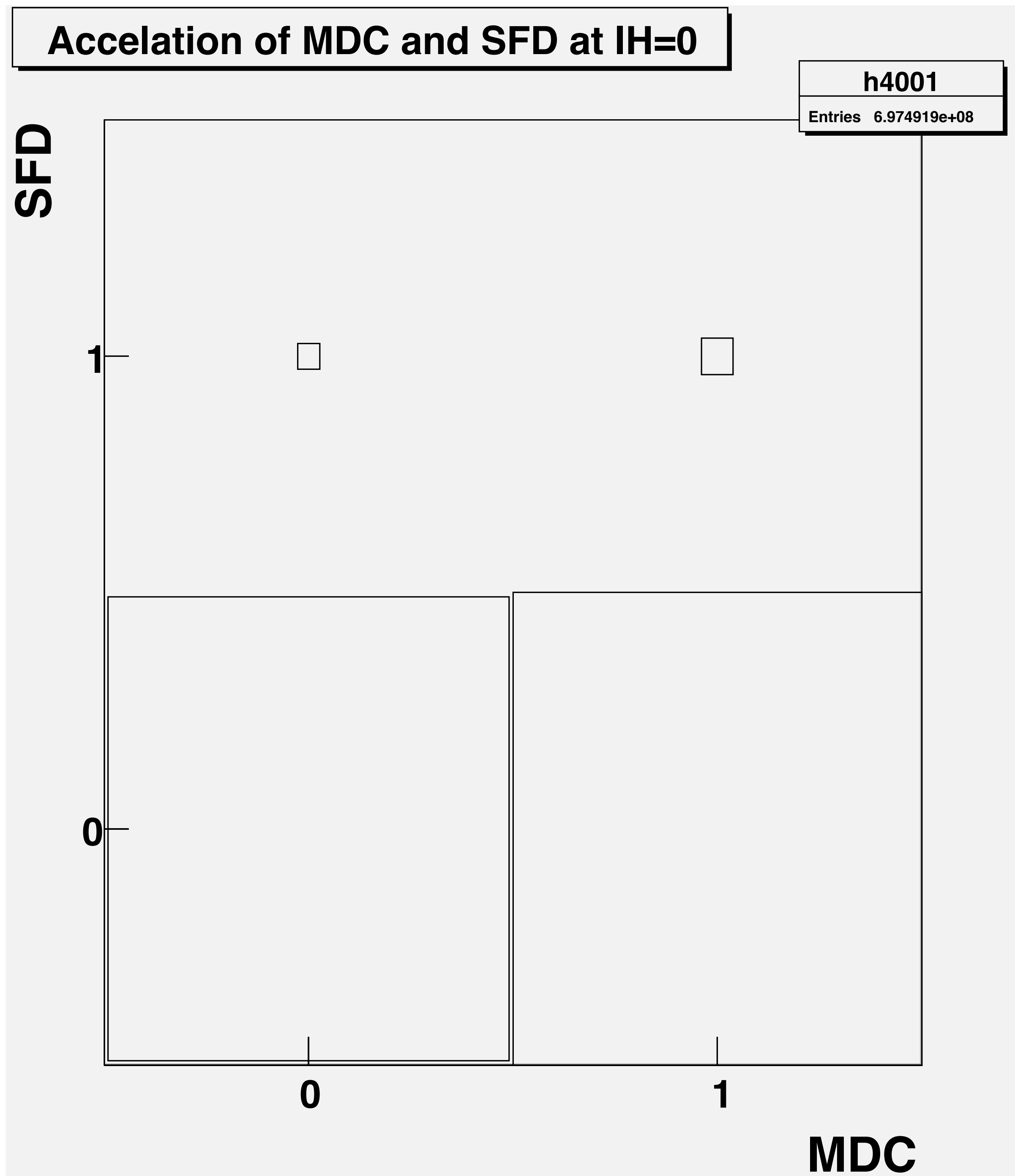

Figure 20: *Accidental background. The correlation between tracks in MDC and SFD (0 means no hits and 1 means the presence of hits) when there is no hits in IH(IH=0).*

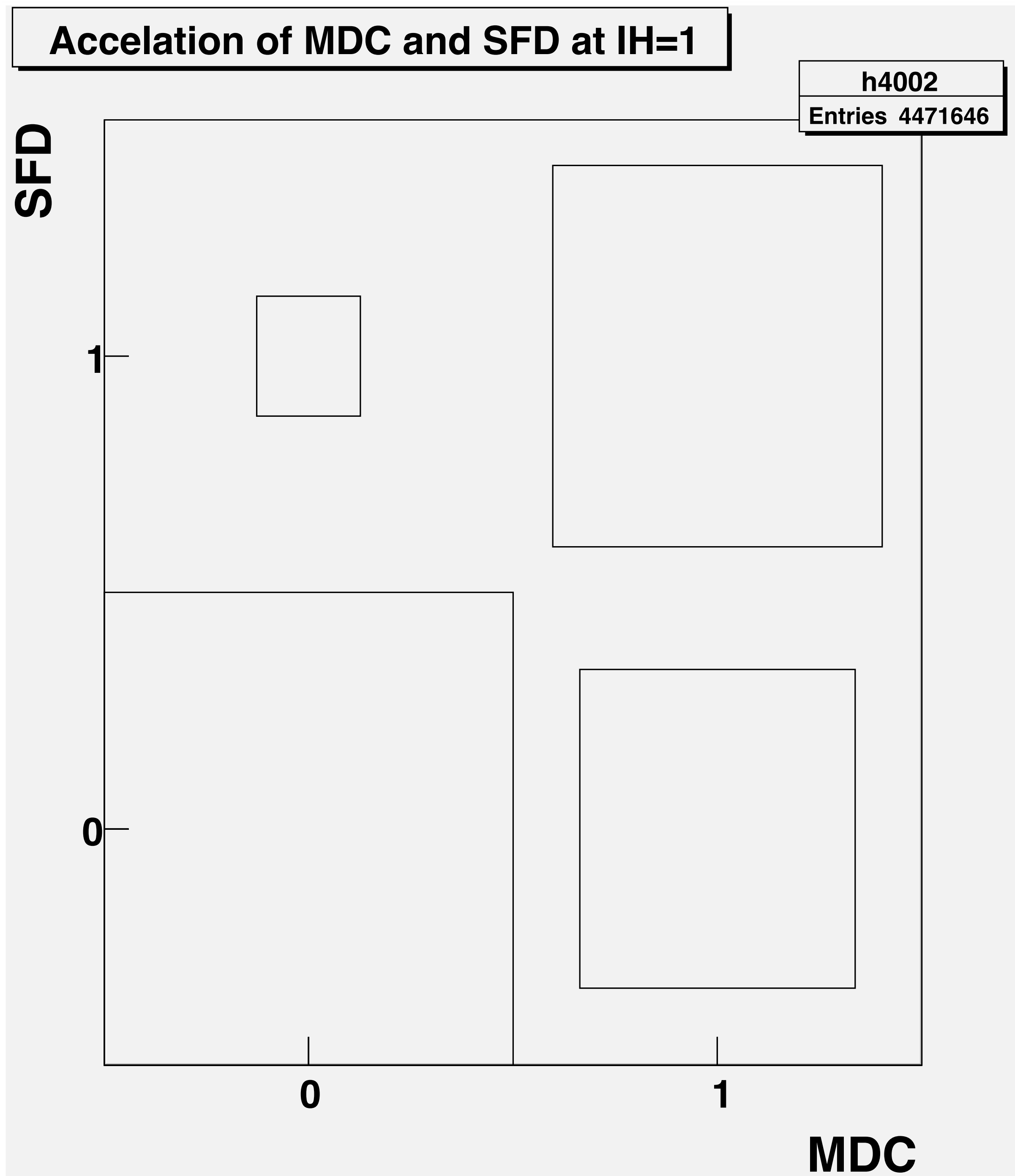

Figure 21: *Accidental background. The correlation between tracks in MDC and SFD (0 means no hits and 1 means the presence of hits) when there is a hit in IH(IH=1).*

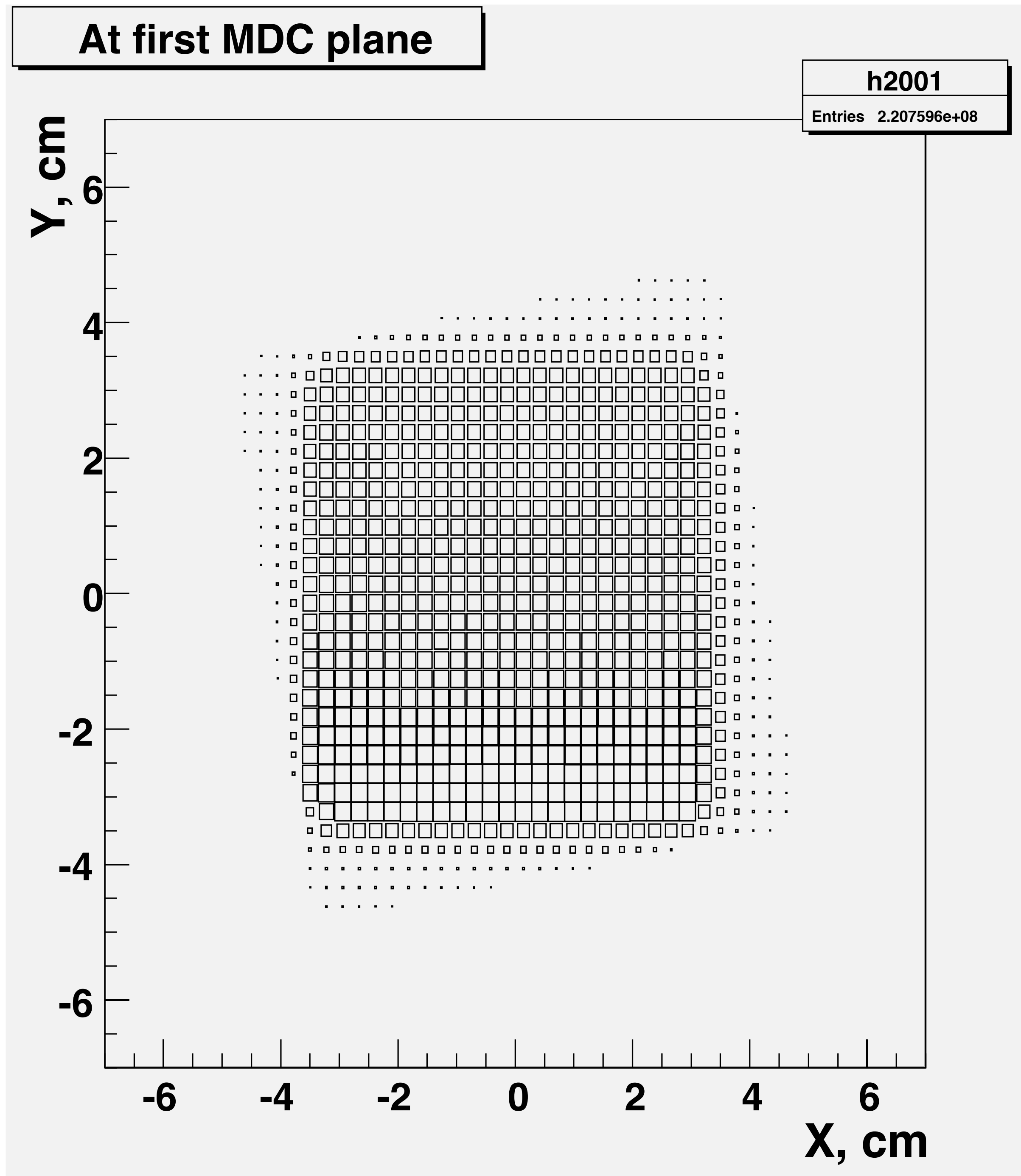

Figure 22: *Accidental background. The two-dimensional distribution of X and Y coordinates where the long tracks cross the first plane of MDC.*

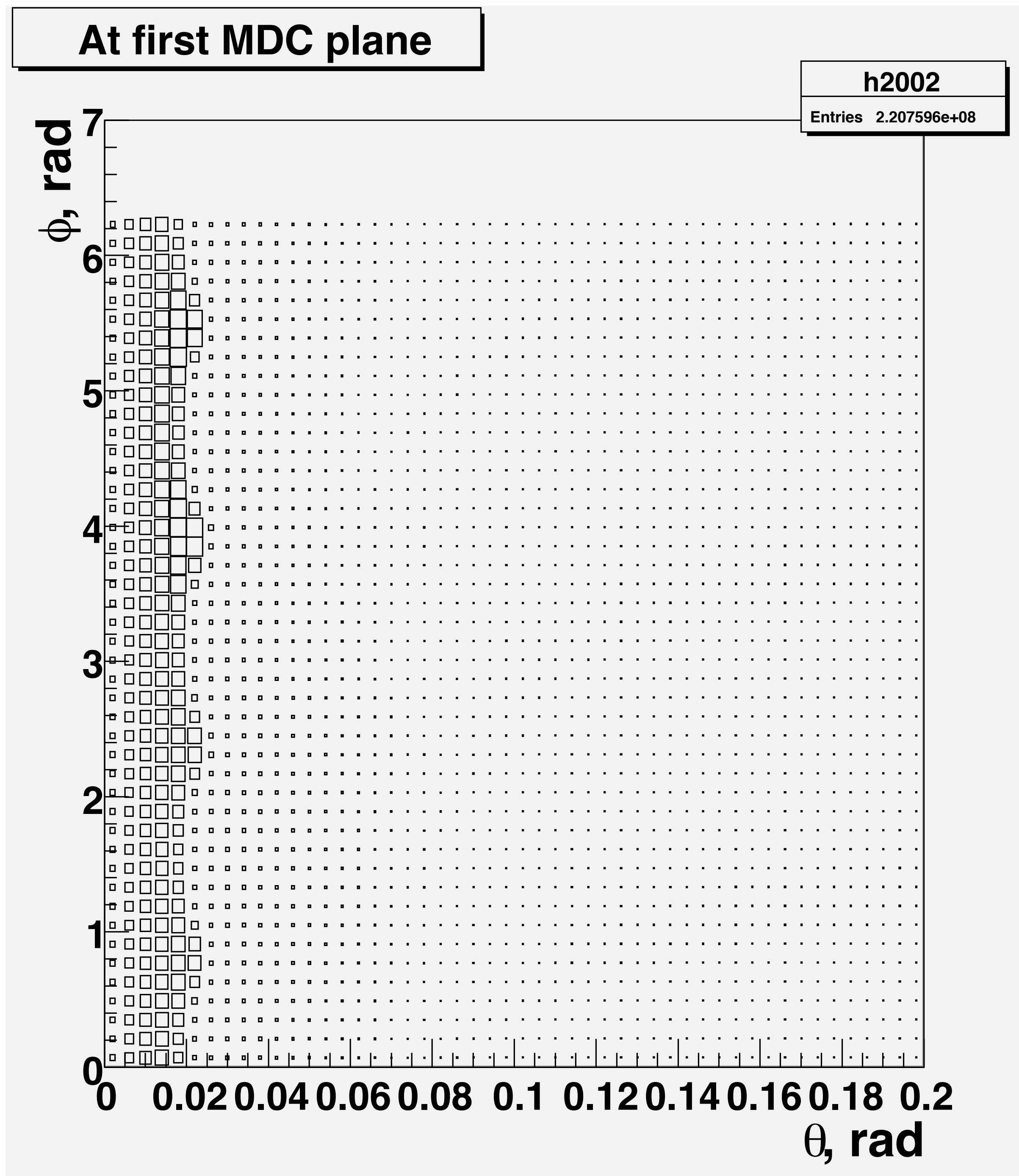

Figure 23: *Accidental background. The distribution of space angles(θ and ϕ) of long tracks*
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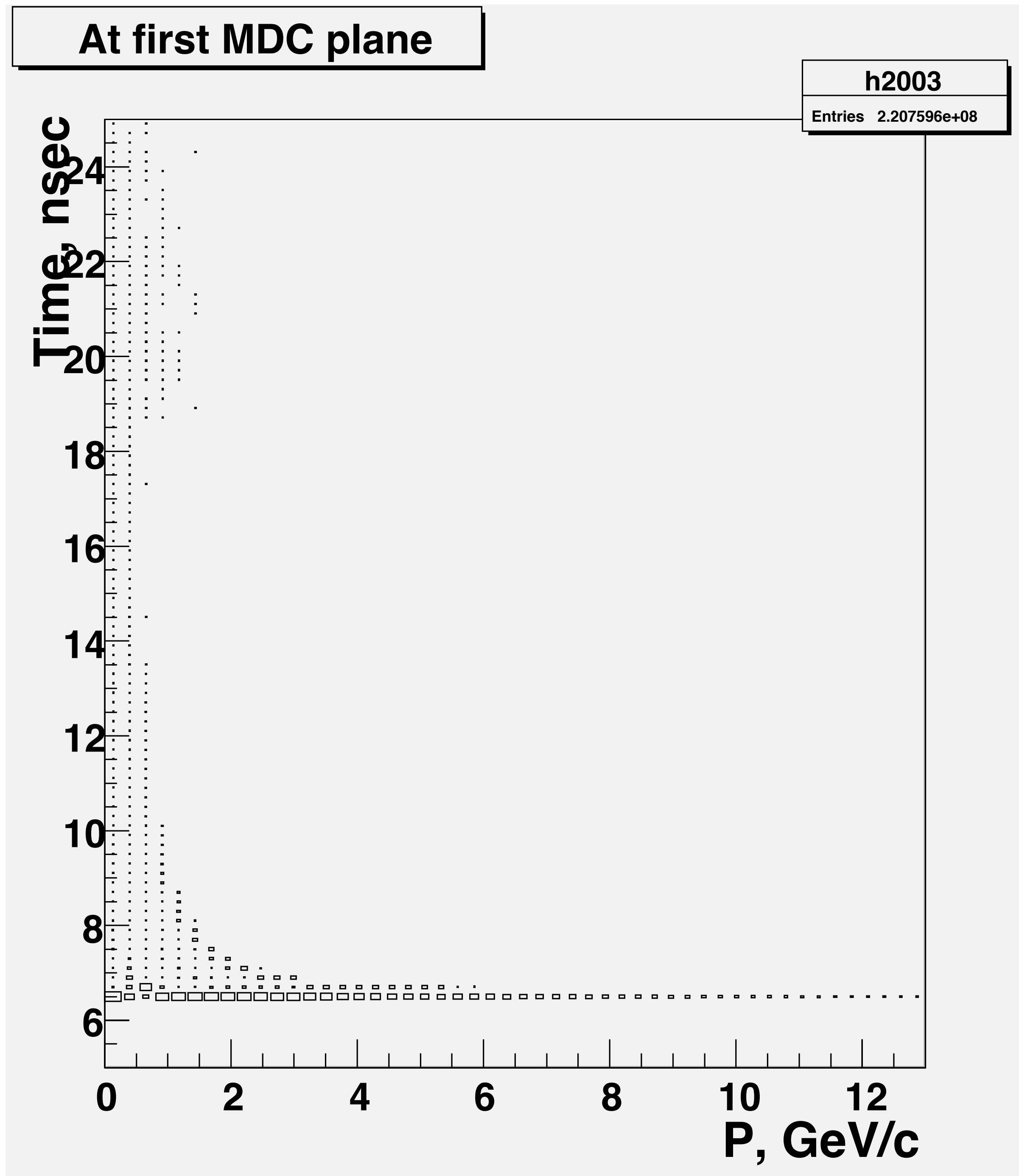
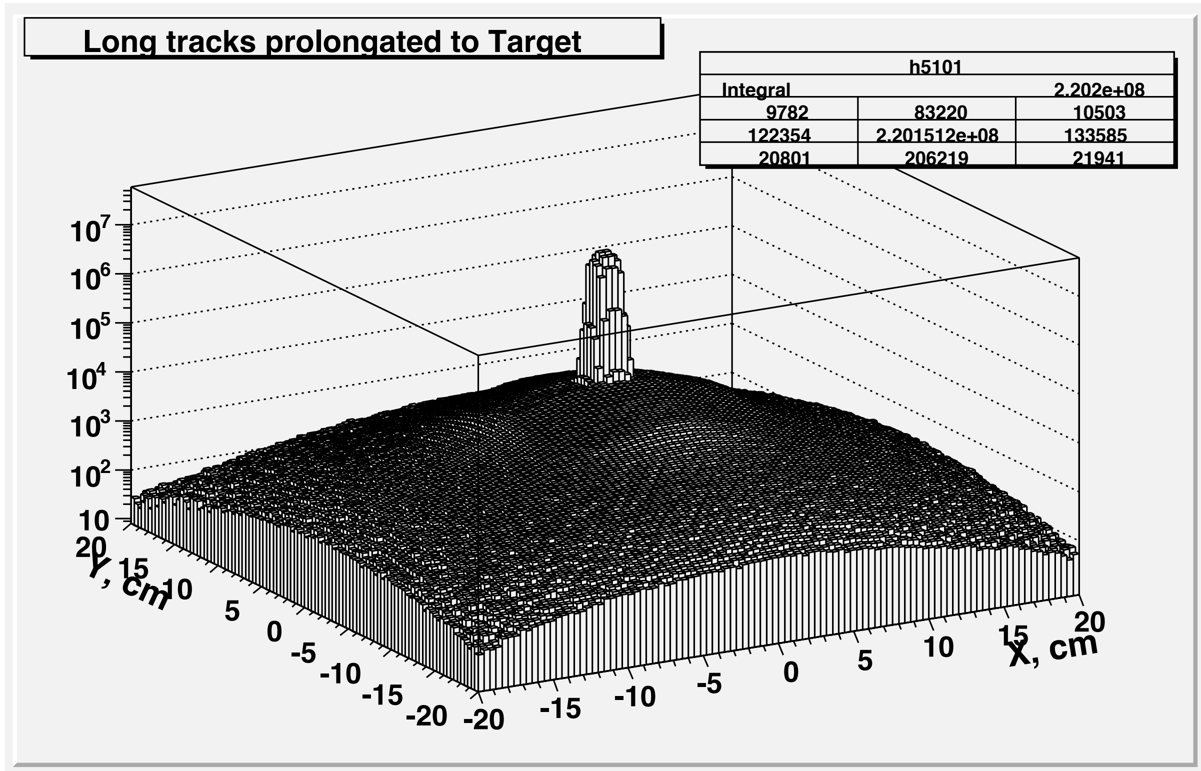


Figure 24: *Accidental background. The two-dimensional distribution of momentum and time for the long tracks when they cross first plane of MDC.*



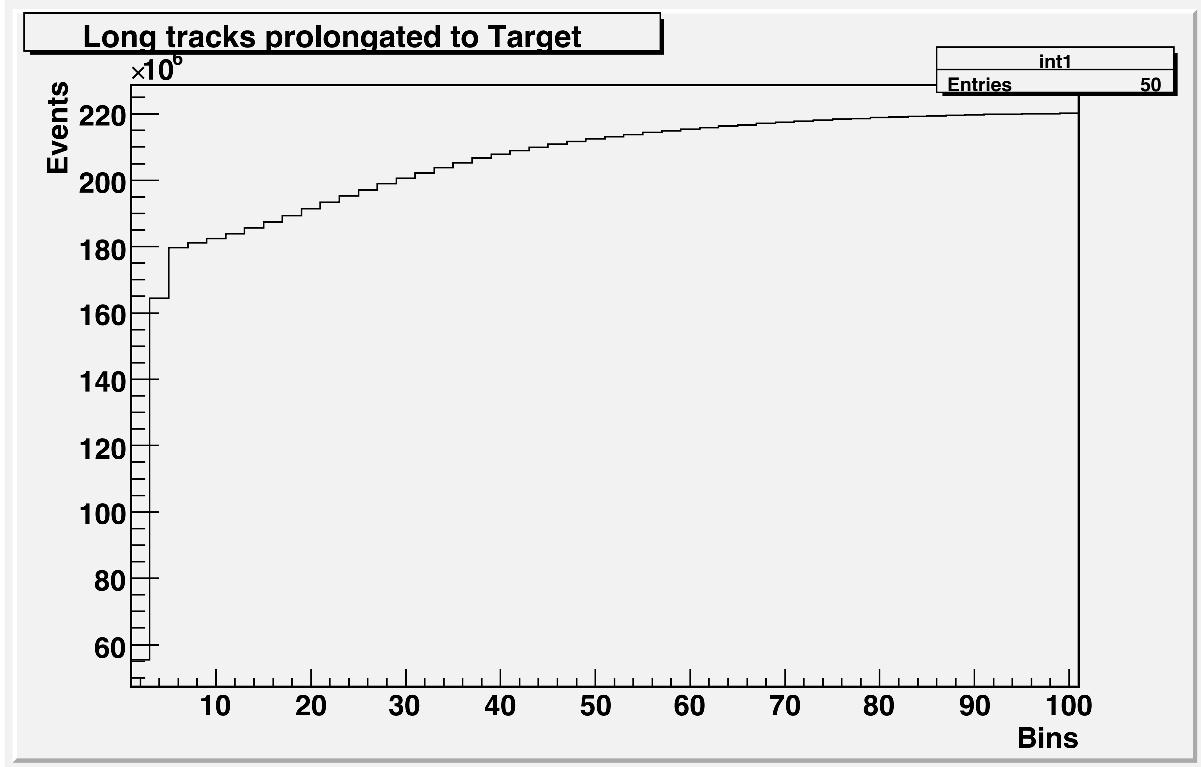


Figure 25: *Accidental background. Top: the two-dimensional distribution of X and Y coordinates where the extrapolated long tracks cross the target plane. Bottom: the running sum of central bins(2x2,4x4,6x6,...100x100).*

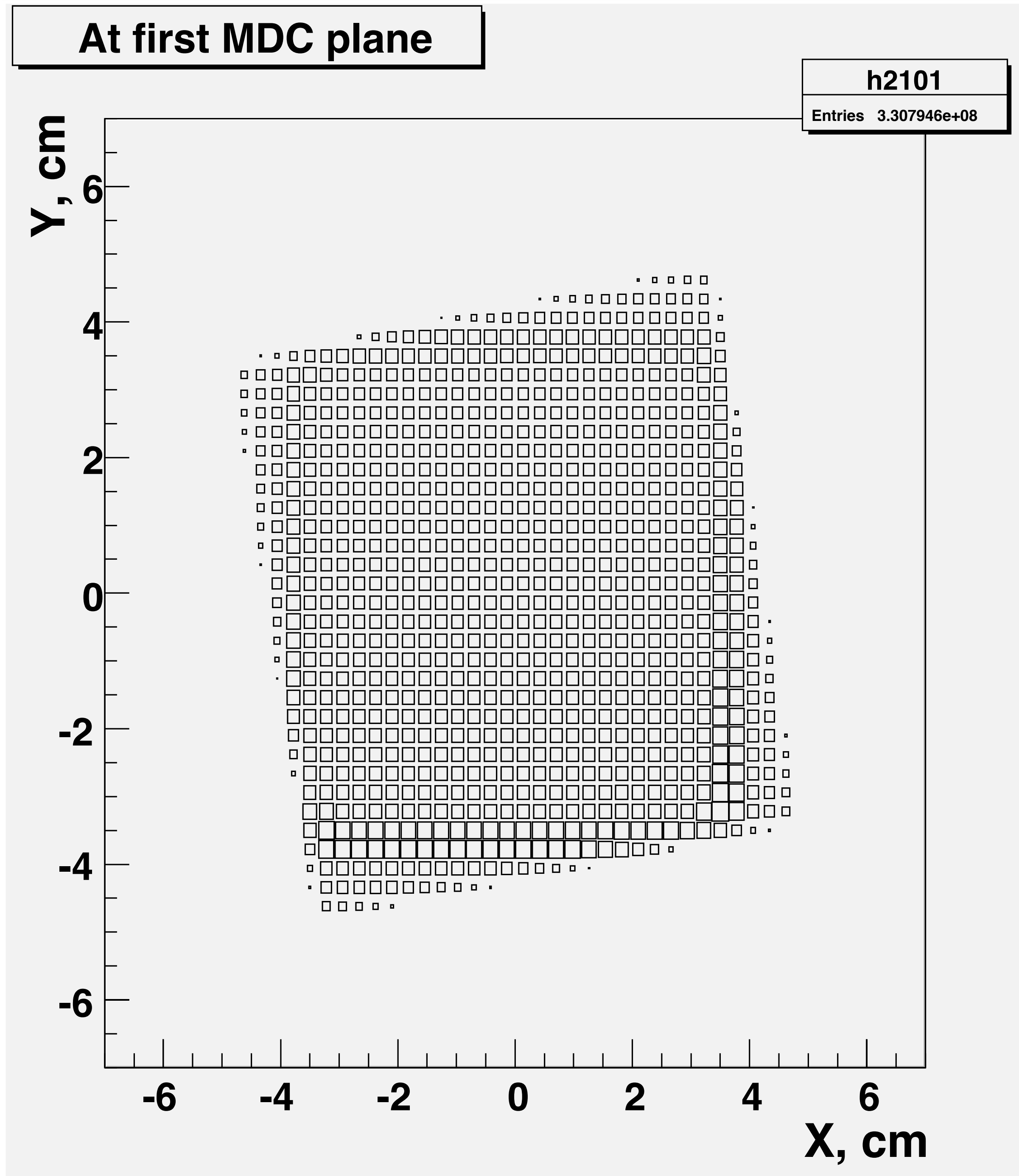


Figure 26: *Accidental background. The two-dimensional distribution of X and Y coordinates where the short tracks cross the first plane of MDC.*

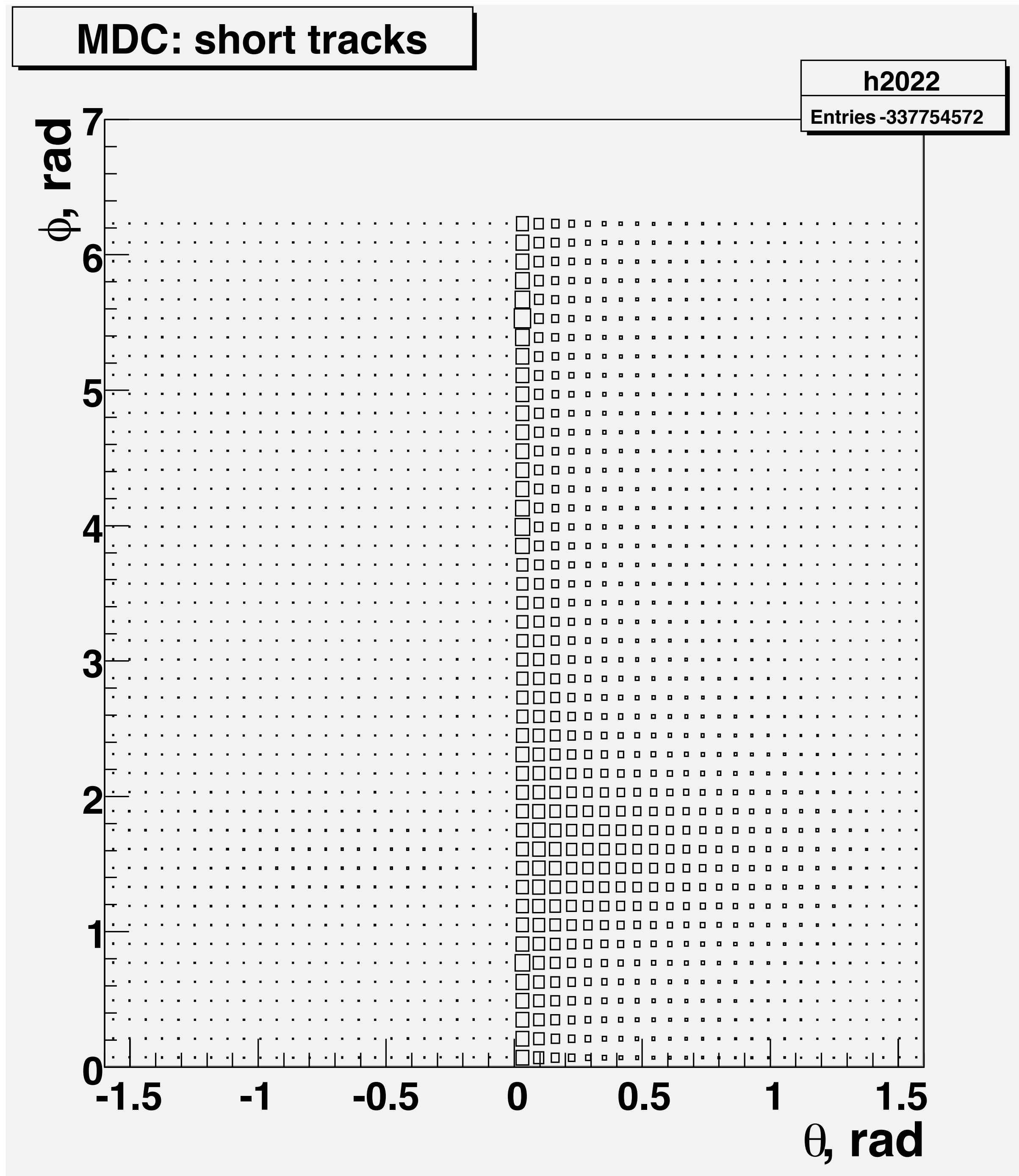


Figure 27: *Accidental background. The distribution of space angles(θ and ϕ) of short tracks .*

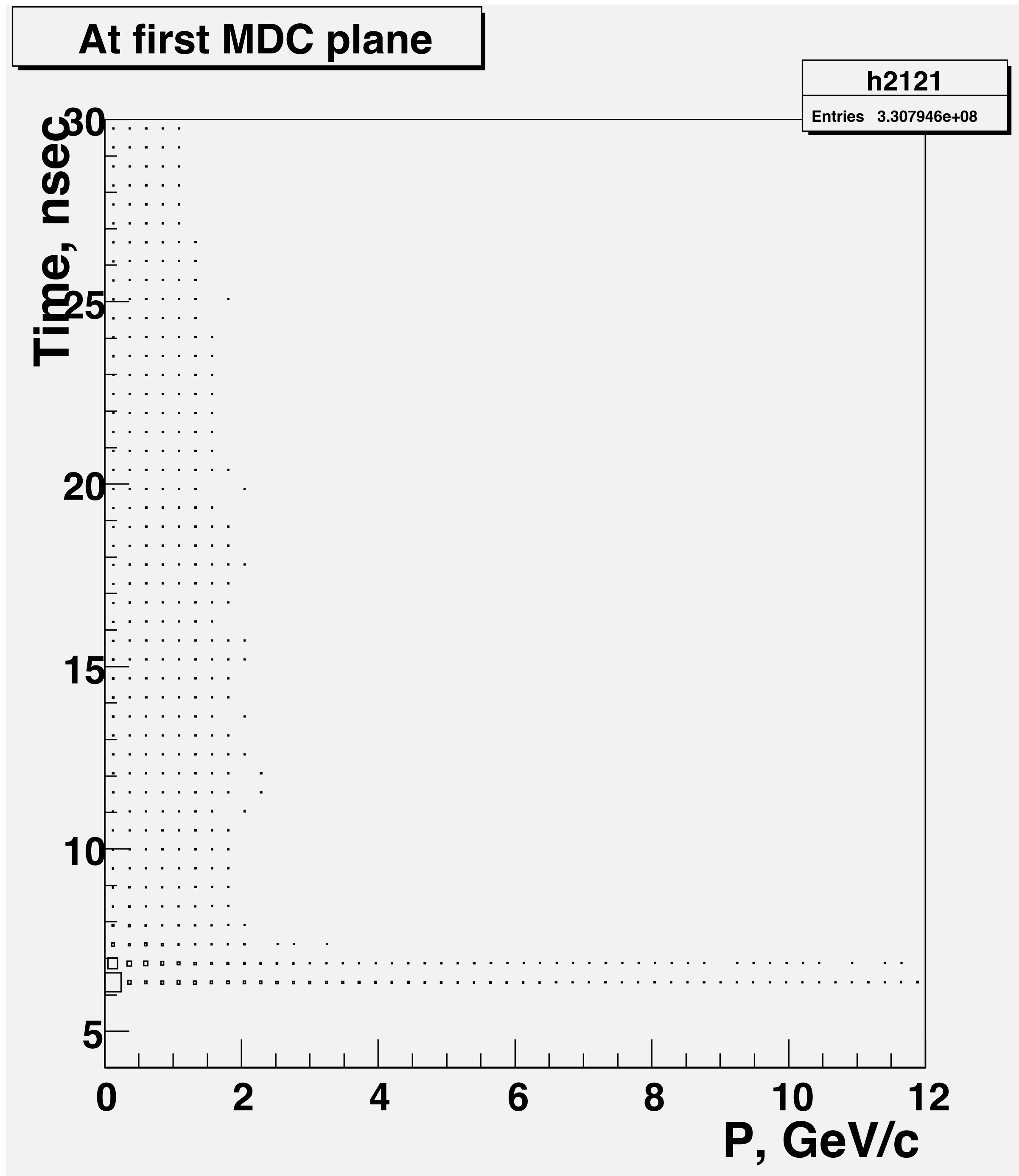


Figure 28: *Accidental background. The two-dimensional distribution of momentum and time for the short tracks when they cross first plane of MDC.*

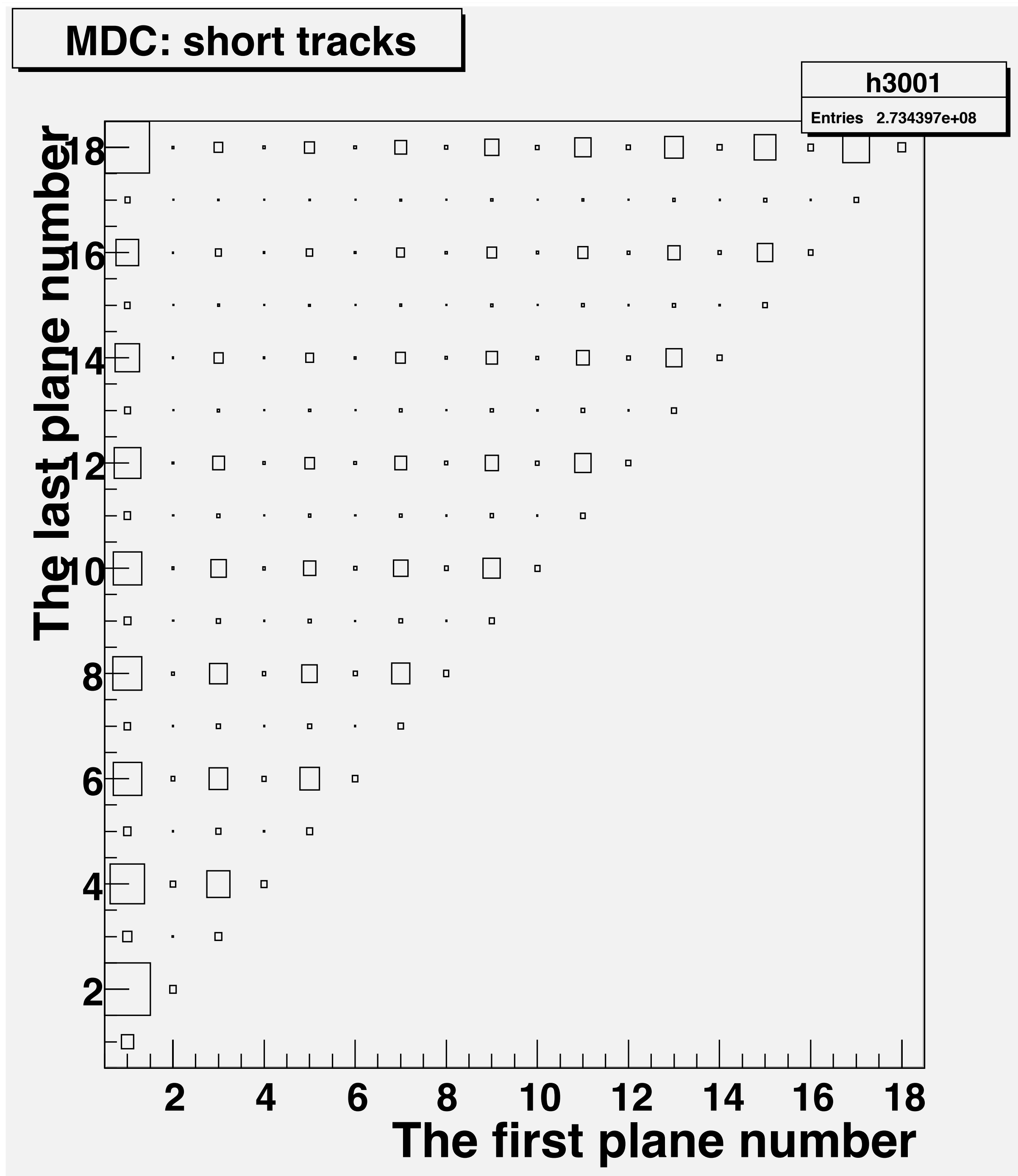


Figure 29: *Accidental background. The plot of first plane hitted and last plane for MDC.*

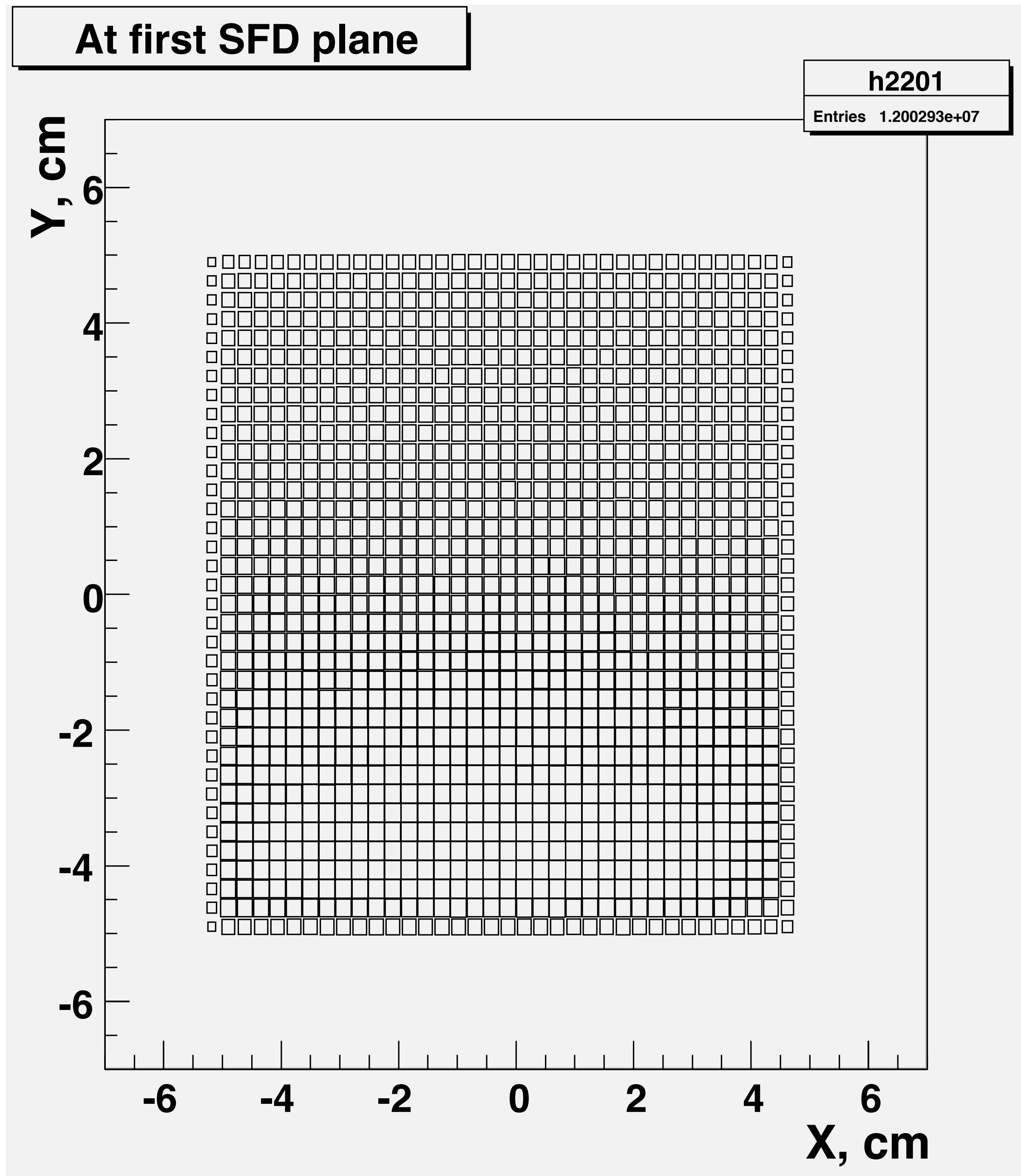


Figure 30: *Accidental background. The two-dimensional distribution of X and Y coordinates where the short tracks cross the first plane of fiber detector.*

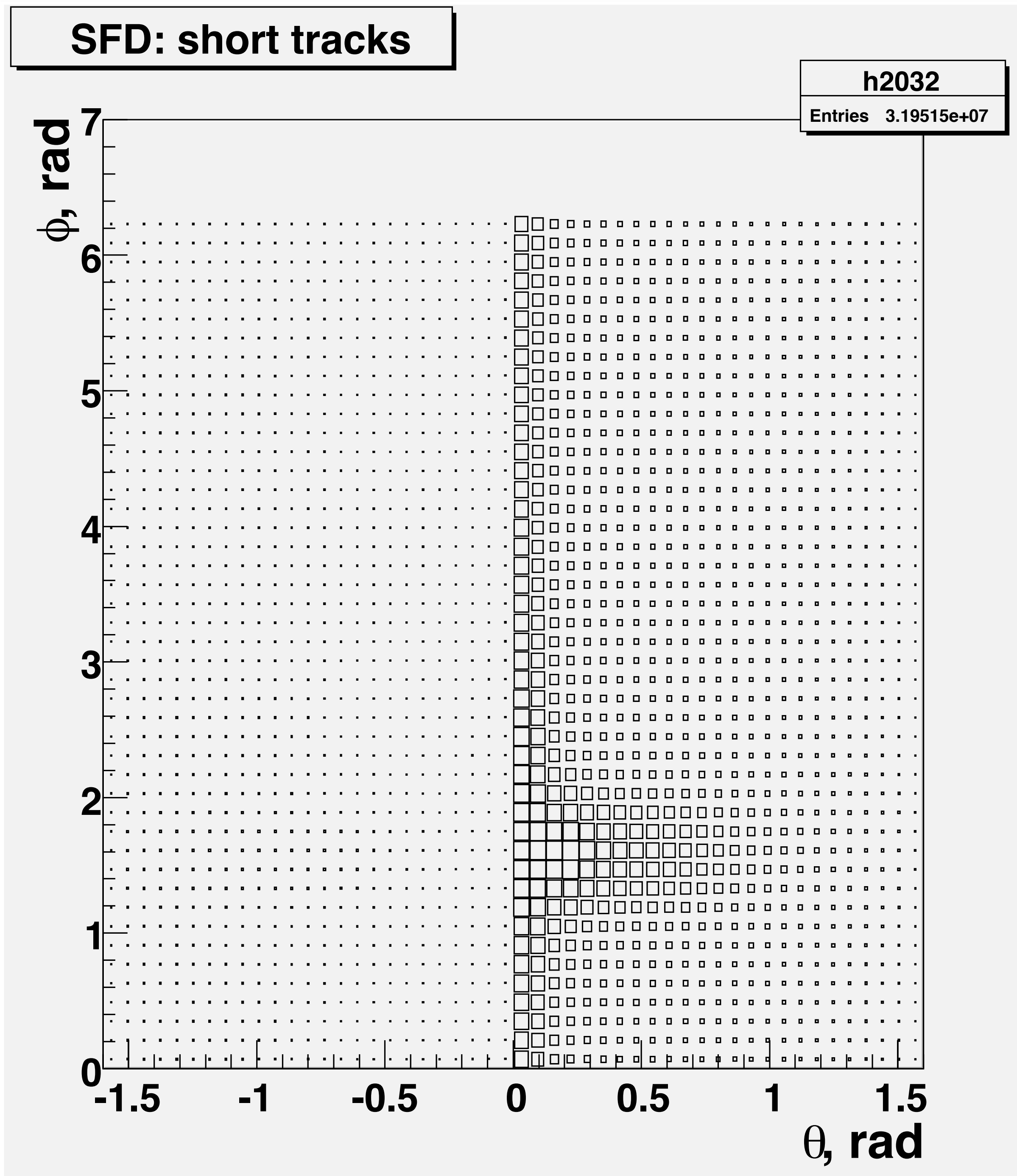


Figure 31: *Accidental background. The distribution of space angles(θ and ϕ) of short tracks .*

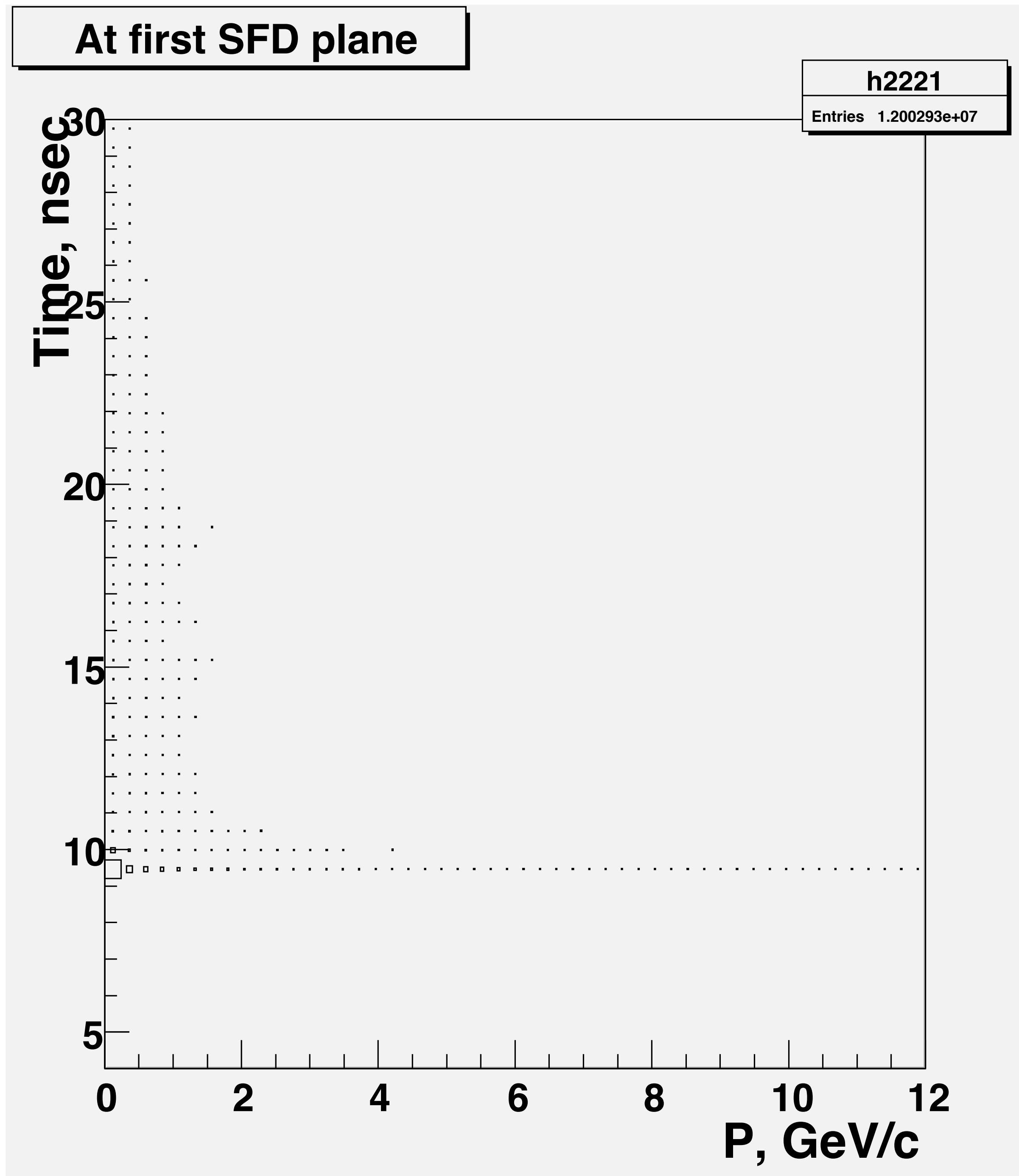


Figure 32: *Accidental background. The two-dimensional distribution of momentum and time for the short tracks when they cross first plane of fiber detector.*

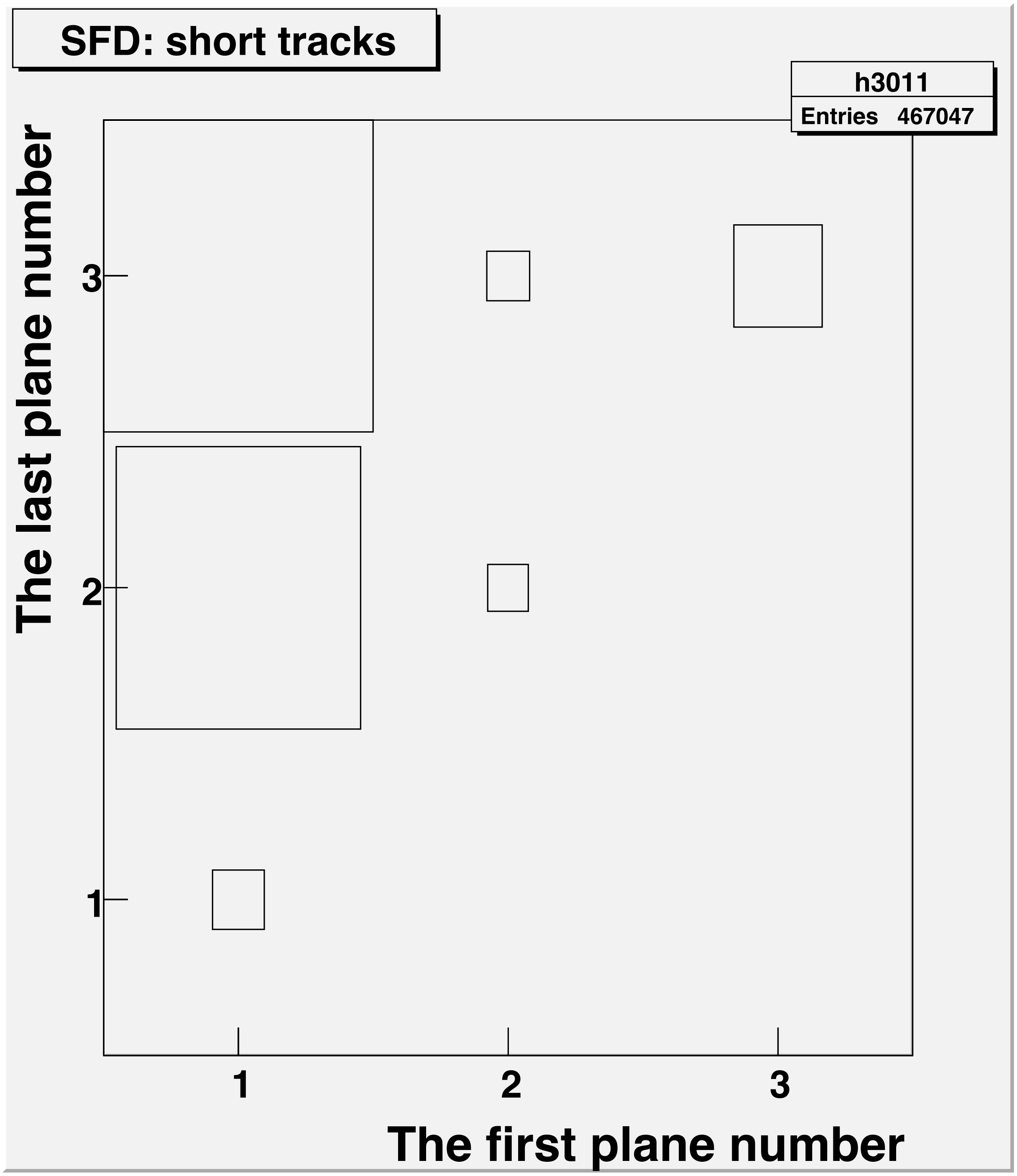
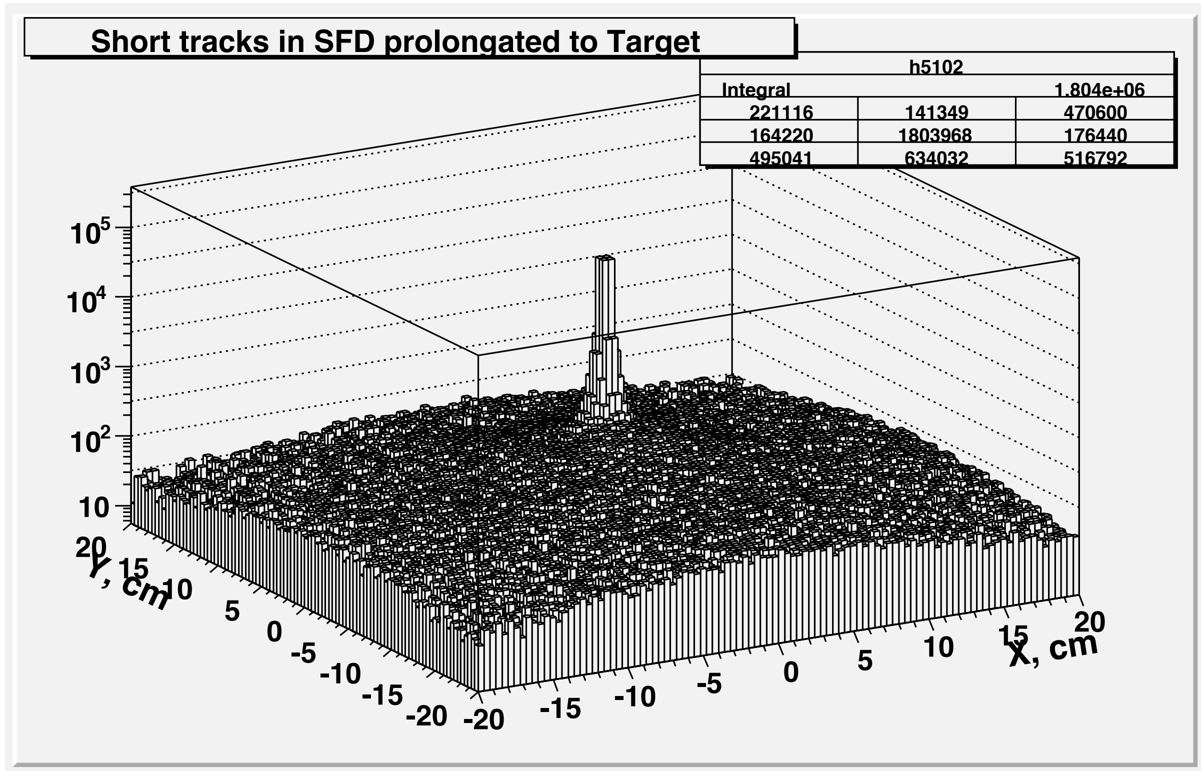


Figure 33: *Accidental background. The plot of first plane hitted and last plane for fiber detector.*



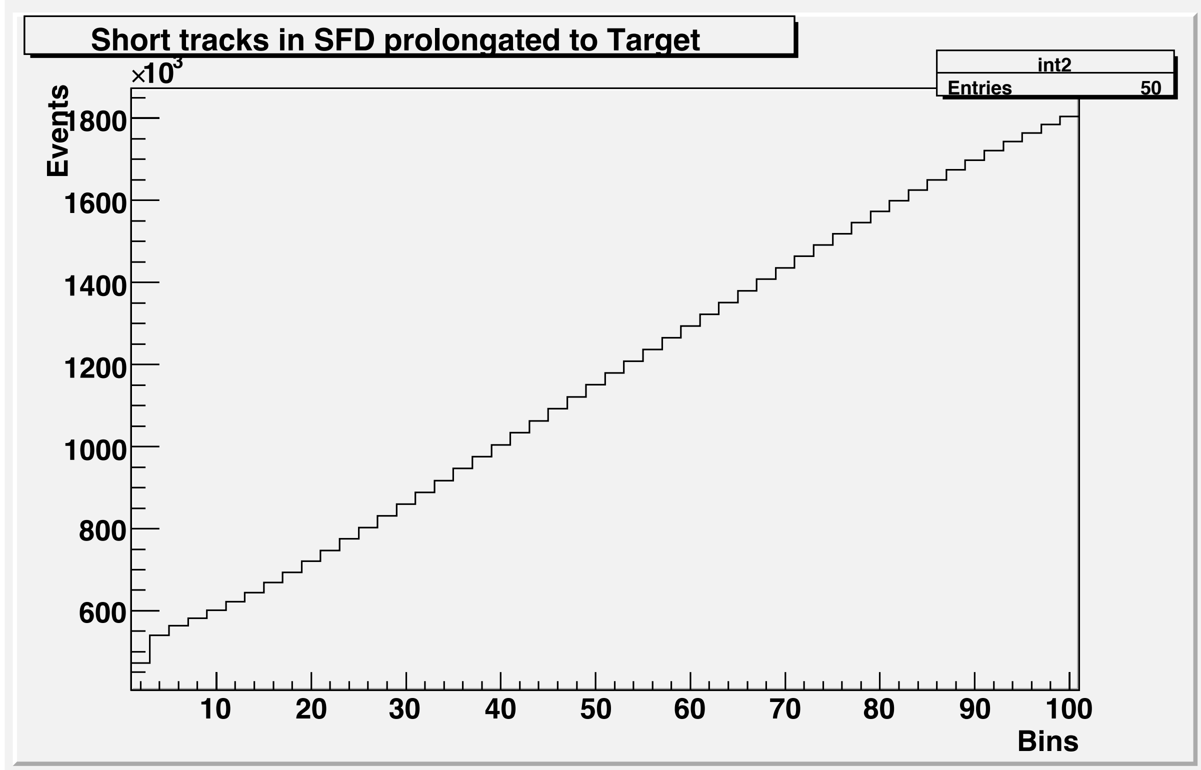


Figure 34: *Accidental background. Top: the two-dimensional distribution of X and Y coordinates where the extrapolated short tracks cross the target plane. Bottom: the running sum of central bins(2x2,4x4,6x6,...100x100).*

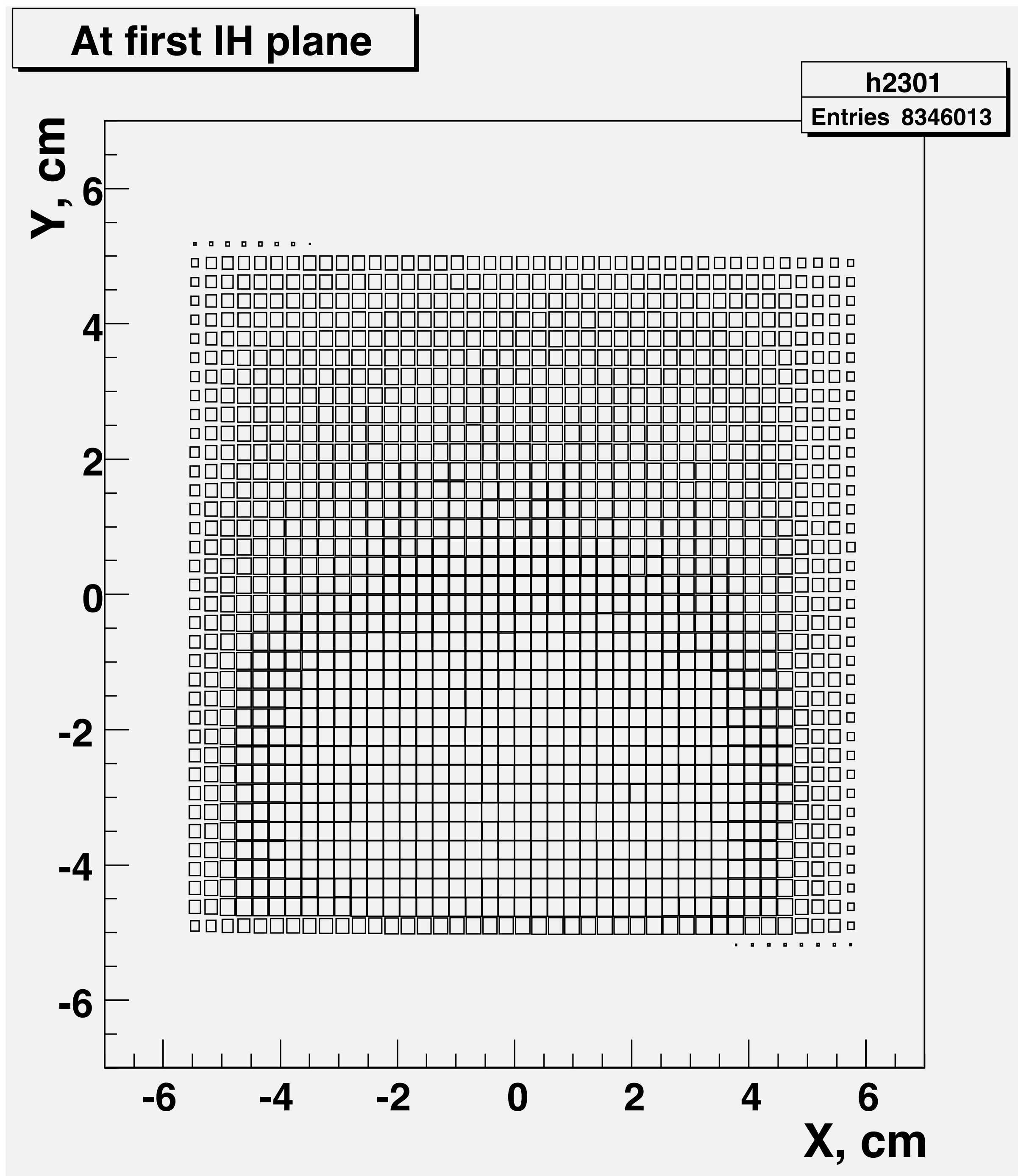


Figure 35: *Accidental background. The two-dimensional distribution of X and Y coordinates where the short tracks cross the first plane of IH.*

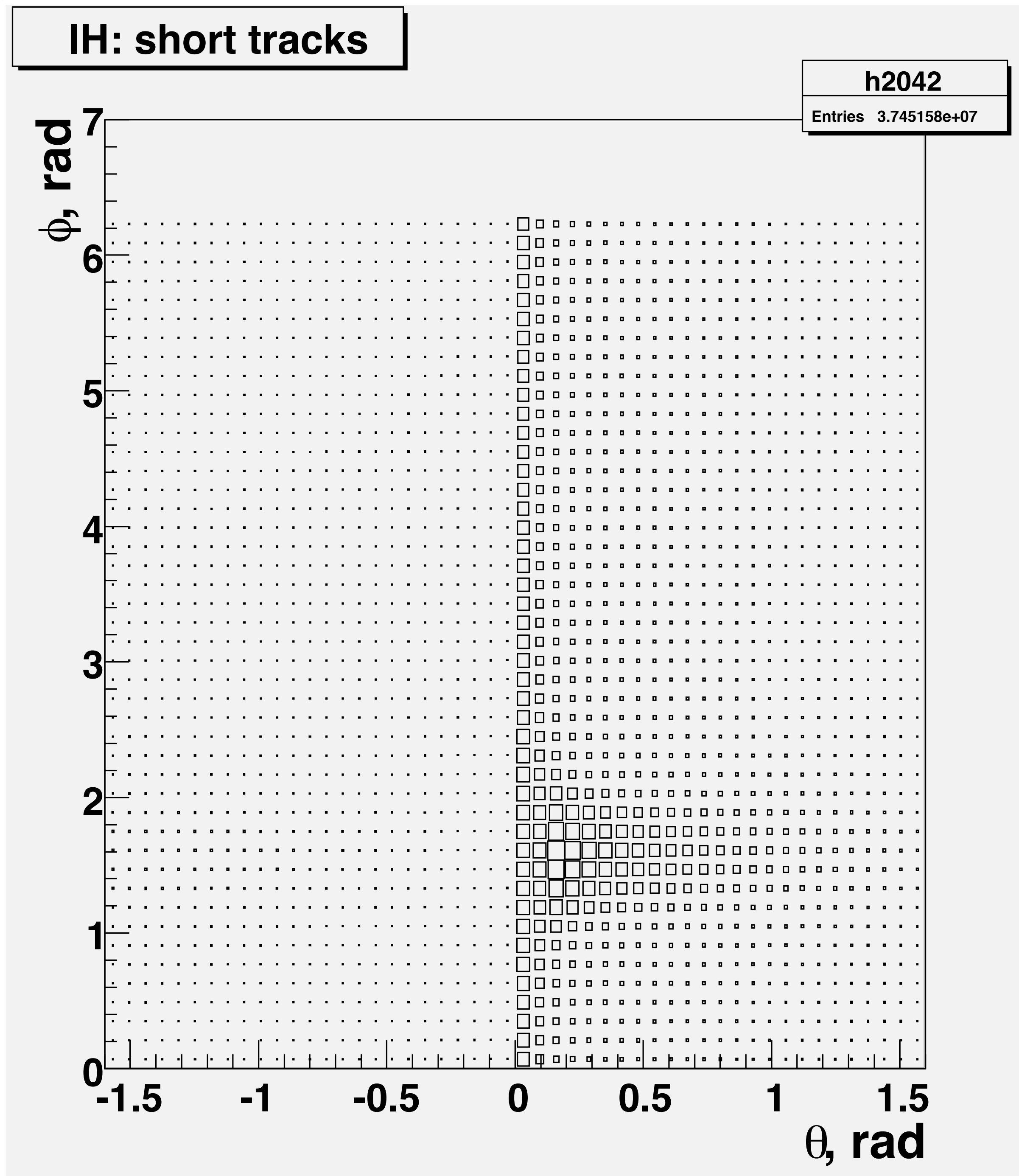


Figure 36: *Accidental background. The distribution of space angles(θ and ϕ) of short tracks .*

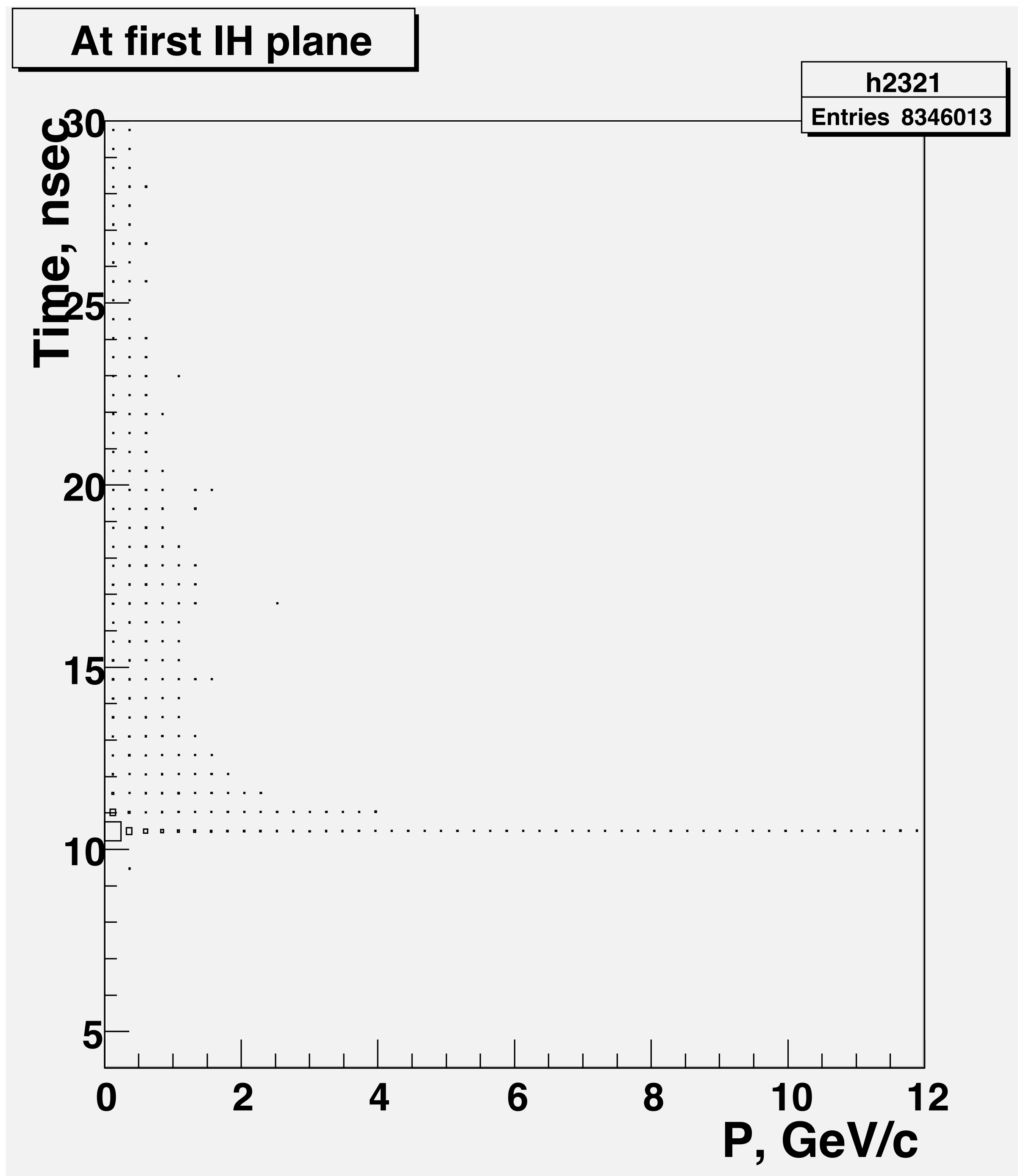


Figure 37: *Accidental background. The two-dimensional distribution of momentum and time for the short tracks when they cross first plane of IH.*

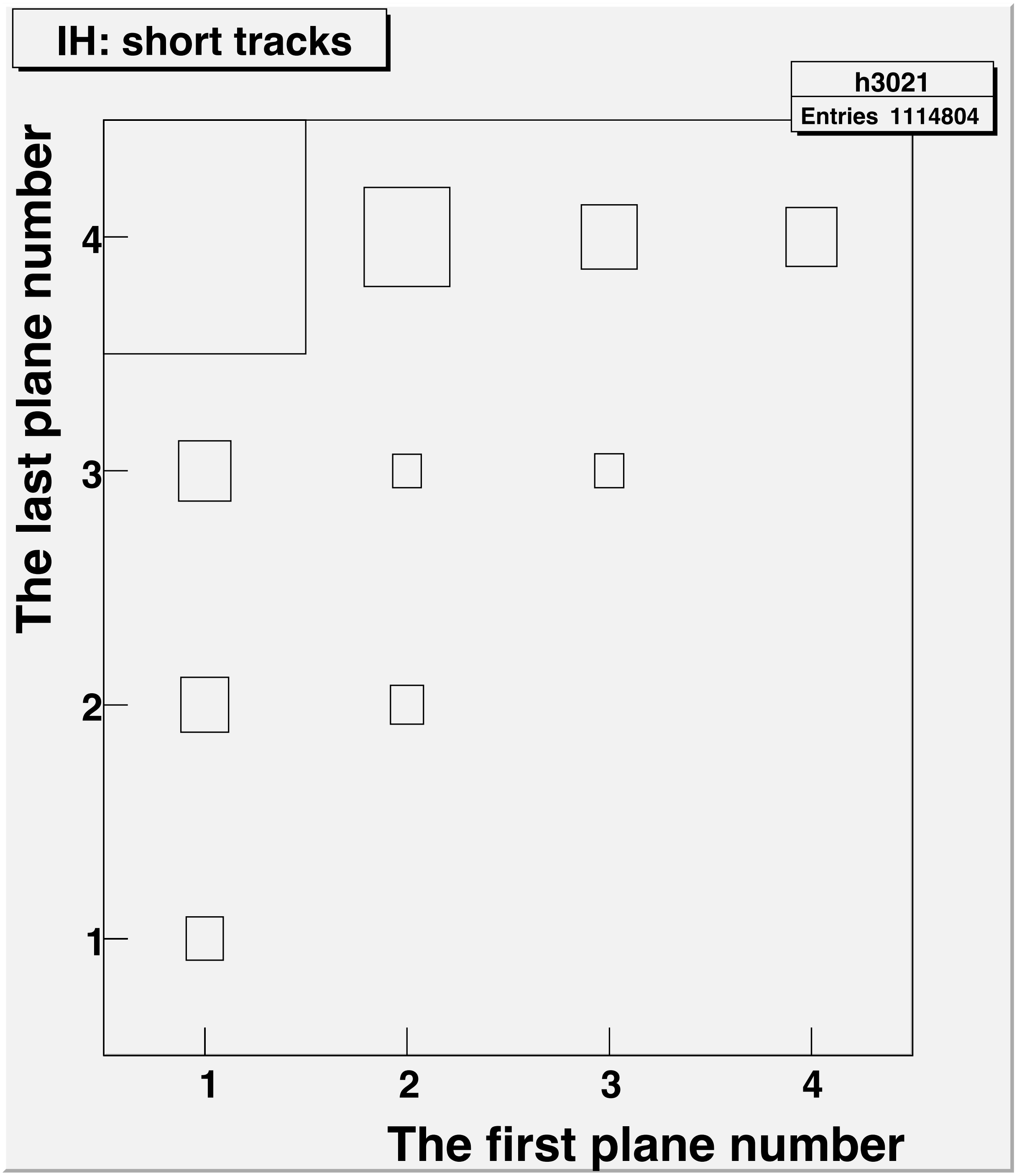


Figure 38: *Accidental background. The plot of first plane hitted and last plane for IH.*