# pXp analysis

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# Overview

- new logic for the 4 pions mass distributions:
  pion-pair mass distributions

- using PID

- 4-track 2015 sample

- displacements: VZeroFinder class

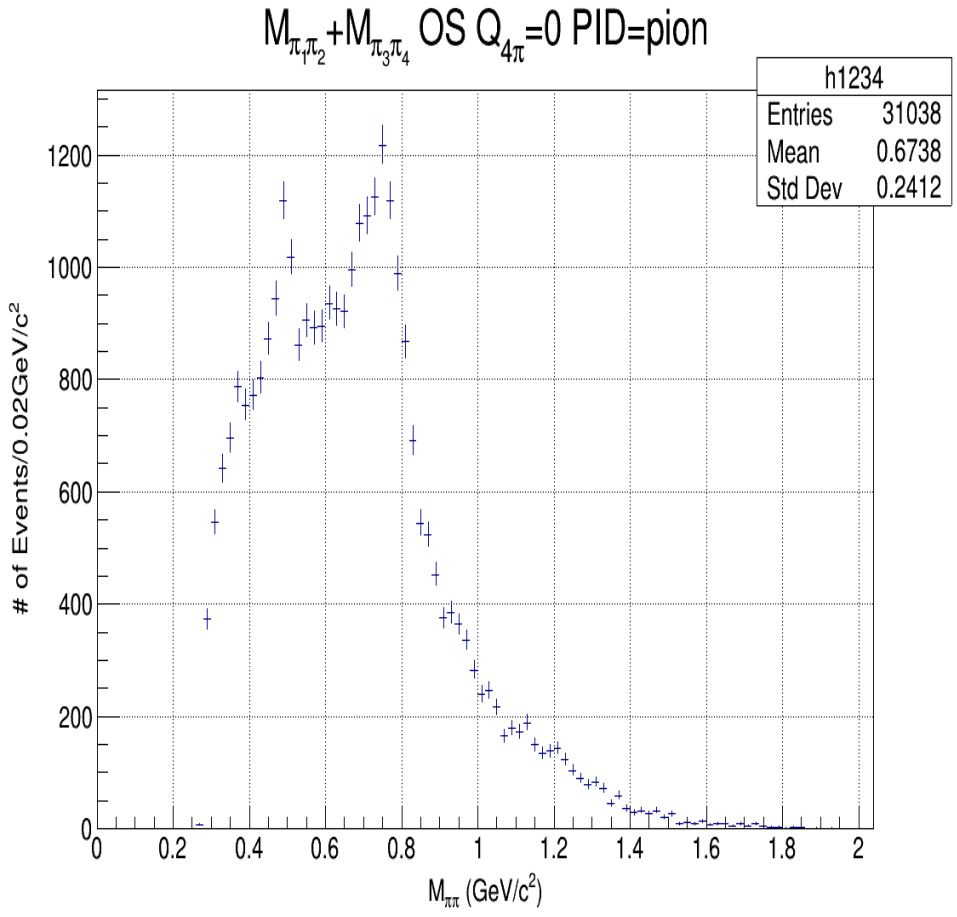
new logic

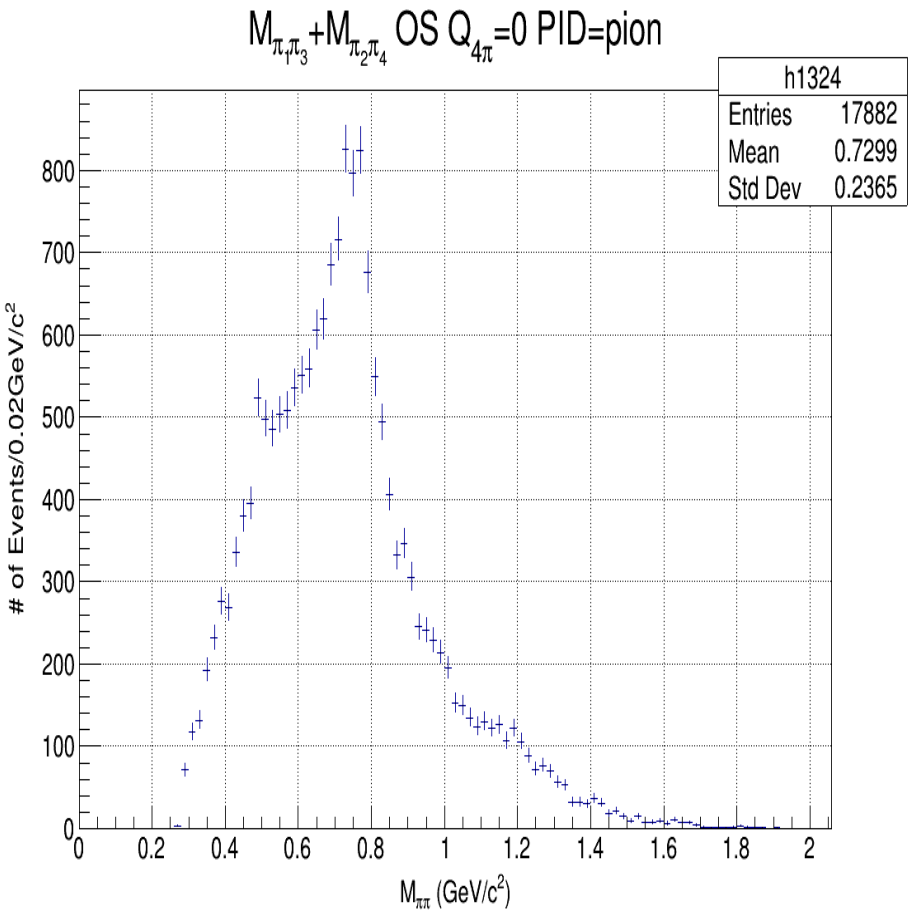
```
if(pidarray[0]==pidPion && pidarray[1]==pidPion &&
                pidarray[2]==pidPion && pidarray[3]==pidPion)
            {
             if(charray[0]+charray[1] == 0)
                 {
            histosTH1F["hm2rec2OS_pi1pi2"]->Fill(mrecpi1pi2);
            histosTH1F["hm2rec2OS_pi3pi4"]→Fill(mrecpi3pi4);

             }else{

              if(charray[0]+charray[2] == 0)
                 {
             histosTH1F["hm2rec2OS_pi1pi3"]->Fill(mrecpi1pi3);
             histosTH1F["hm2rec2OS_pi2pi4"]->Fill(mrecpi2pi4);}
             }
            }
```

```
definitions pi1, pi2, pi3, pi4
pairs: pi1pi2, pi3pi4, pi1pi3, pi2pi4

if(ntrk==0) pi1 = trk_lorentz;
if(ntrk==1) pi2 = trk_lorentz;
if(ntrk==2) pi3 = trk_lorentz;
if(ntrk==3) pi4 = trk_lorentz;

if(ntrk==0 || ntrk==1) pi1pi2Rec += trk_lorentz;
if(ntrk==2 || ntrk==3) pi3pi4Rec += trk_lorentz;
if(ntrk==0 || ntrk==2) pi1pi3Rec += trk_lorentz;
if(ntrk==1 || ntrk==3) pi2pi4Rec += trk_lorentz;

EPID pid2 = GetPIDSafe2(itTrack->p, itTrack->harmonic2_dEdx);

if(ntrk==0){
  charray[0]=charge;
  chi2array[0]=chi2;
  d0array[0]=d0;
  dzarray[0]=dz;
  pidarray[0]=pid2;
}
  ...etc
```

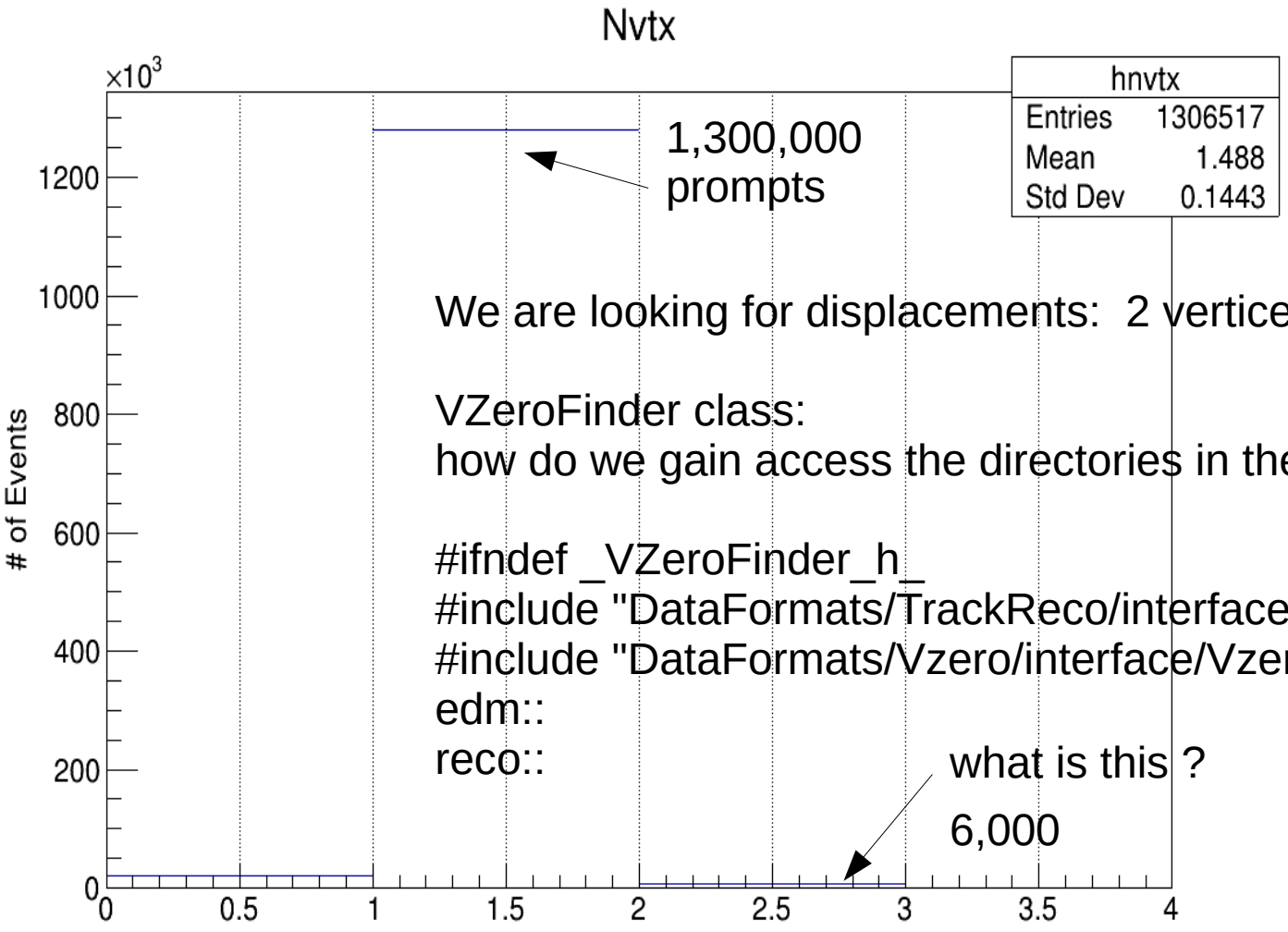
if Q1+Q2=0 → Q3+Q4=0

else
if Q1+Q3=0 → Q2+Q4=0



# Number of vertices




We are looking for displacements:  2 vertices

VZeroFinder class:
how do we gain access the directories in the header?

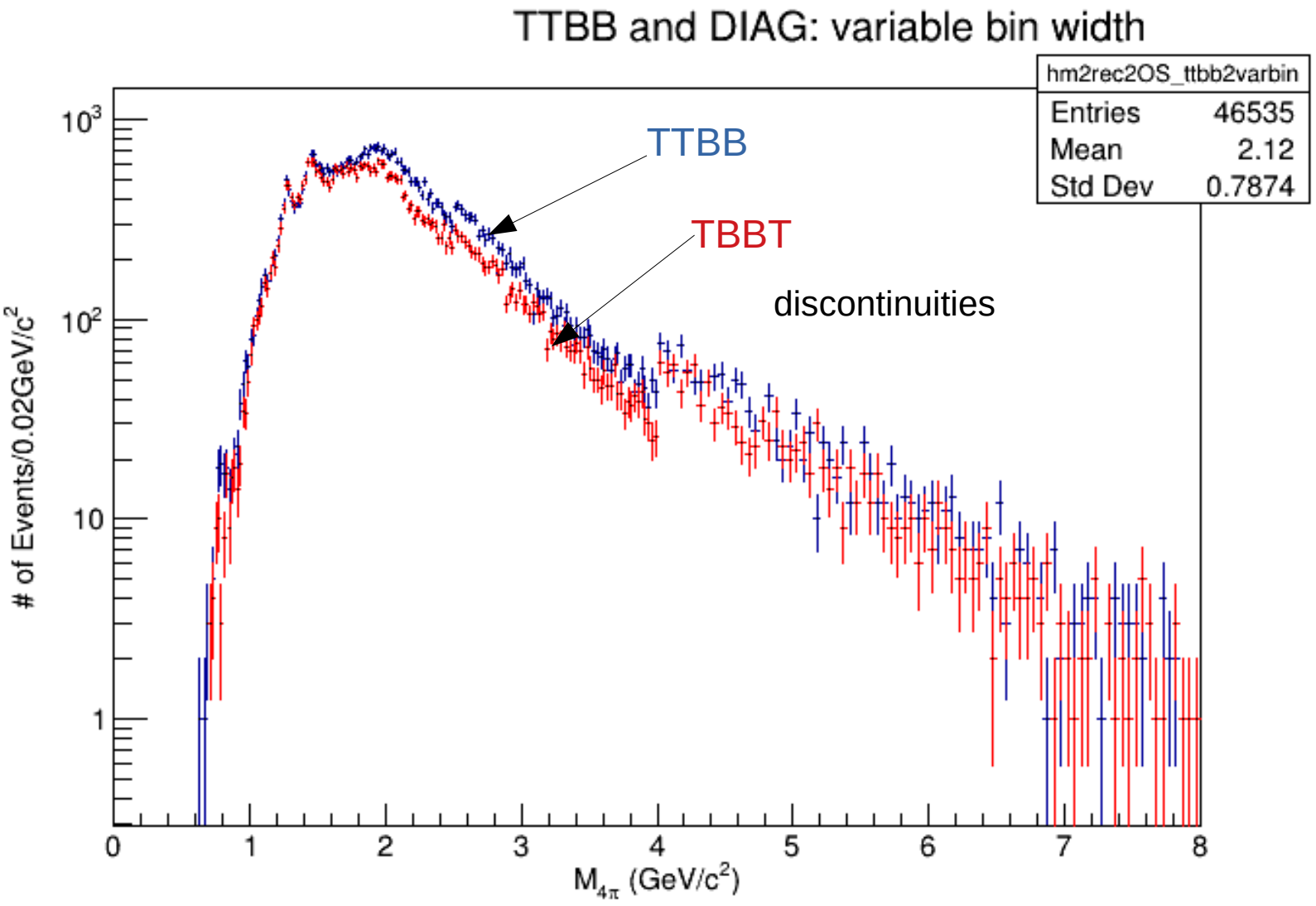
```
#ifndef _VZeroFinder_h_
#include "DataFormats/TrackReco/interface/Track.h"
#include "DataFormats/Vzero/interface/Vzero.h"
edm::
reco::
```

what is this ?

6,000

cut 2, Q=0

125 bins: 0.0 to 2.5 GeV/c²
60 bins: 2.5 to 4.0 GeV/c²
80 bins: 4.0 to 8.0 GeV/c²



to do:

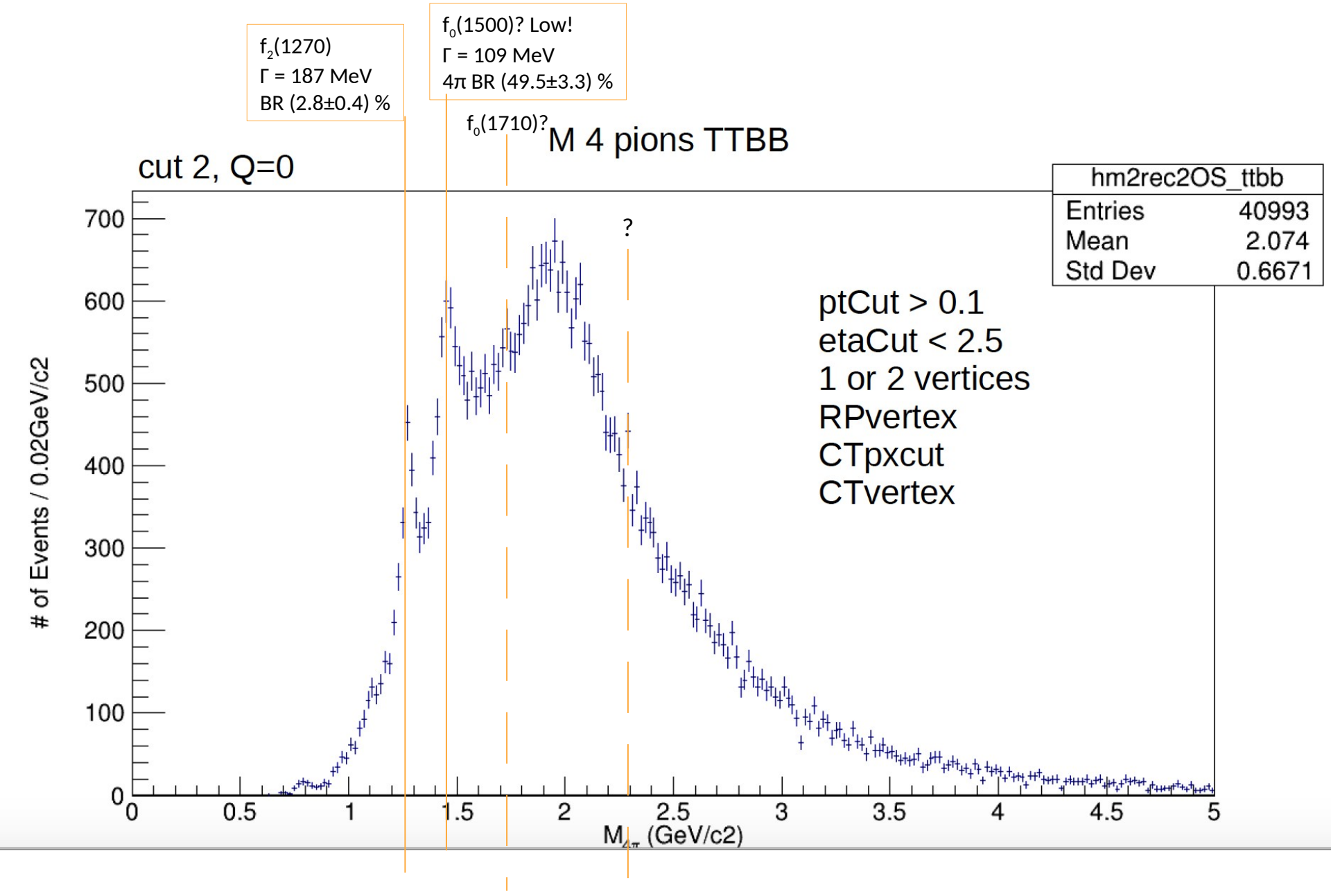
1. fits

2. t1 and t2

3. slices of delta_phi

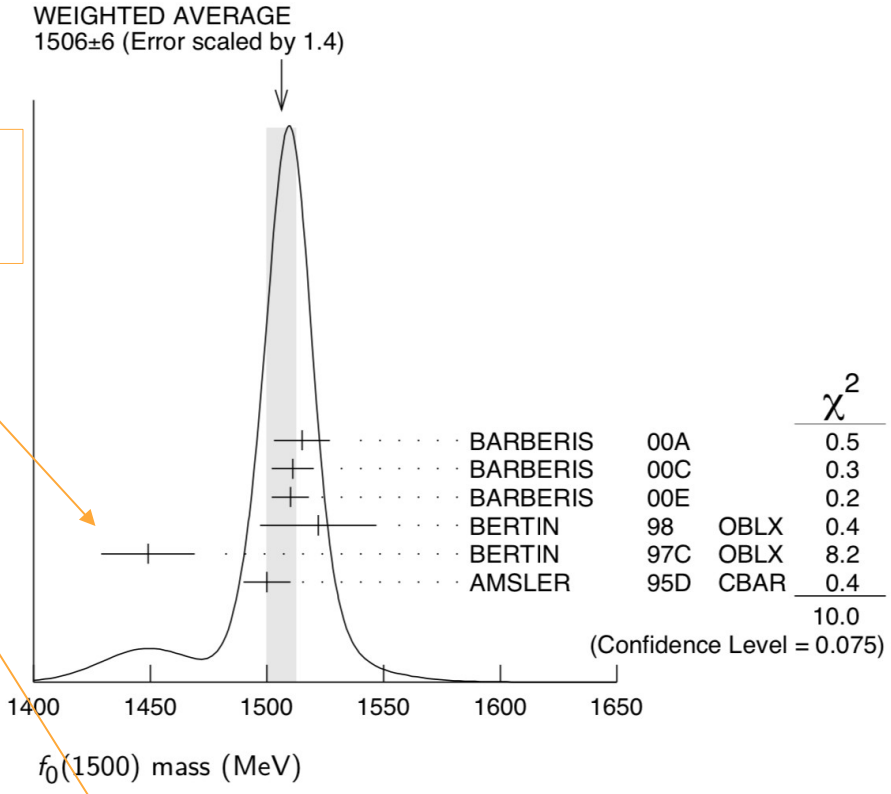
4. pt = sqrt($px^2+py^2$)

from here I will keep Mike’s slides


f2(1270)
Γ = 187 MeV
BR (2.8±0.4) %
f0(1500)? Low!
Γ = 109 MeV
4π BR (49.5±3.3) %
f0(1710)?
M 4 pions TTBB
cut 2, Q=0
hm2rec2OS_ttbb
Entries 40993
Mean 2.074
Std Dev 0.6671
?
ptCut > 0.1
etaCut < 2.5
1 or 2 vertices
RPvertex
CTpxcut
CTvertex
# of Events / 0.02GeV/c2
M4π (GeV/c2)

From PDG 2018 big book on f0(1500)

Is this a bad measurement or a different state?




| | | | | | |
|---|---|---|---|---|---|
| 1505 | ±15 | [18] AMSLER | 95C | CBAR | 0.0 $\bar{p}p \rightarrow \eta\eta\pi^0$ |
| 1445 | ± 5 | [19] ANTINORI | 95 | OMEG | 300,450 $pp \rightarrow pp2(\pi^+\pi^-)$ |
| 1497 | ±30 | [11] ANTINORI | 95 | OMEG | 300,450 $pp \rightarrow pp\pi^+\pi^-$ |
| ~ 1505 | | BUGG | 95 | MRK3 | $J/\psi \rightarrow \gamma\pi^+\pi^-\pi^+\pi^-$ |
| 1446 | ± 5 | [11] ABATZIS | 94 | OMEG | 450 $pp \rightarrow pp2(\pi^+\pi^-)$ |

Superceded by Antinori's later paper

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# A further study of the centrally produced $\pi^+\pi^-$ and $\pi^+\pi^-\pi^+\pi^-$ channels in pp interactions at 300 and 450 GeV/c

WA91 Collaboration, F. Antinori [d], D. Barberis [d], A. Bayes [c], W. Beusch [d], J.N. Carney [c], S. Clewer [c], J.P. Davies [c], D. Di Bari [b], C.J. Dodenhoff [c], D. Evans [c], D. Elia [b], R. Fini [b], B.R. French [d], B. Ghidini [b], A. Jacholkowski [d], J.B. Kinson [c], A. I [d] ... M.F. Votruba [c]

## Abstract

An analysis of the centrally produced $\pi^+\pi^-$ and $\pi^+\pi^-\pi^+\pi^-$ mass spectra from the WA76 and WA91 experiments is presented, which shows that in the $\pi^+\pi^-\pi^+\pi^-$ channel there are two new states, the $f_0(1450)$ and $f_2(1900)$. There is another new state in the $\pi^+\pi^-$ channel with $M = 1497 \pm 30$ MeV and $\Gamma = 199 \pm 30$ MeV, which is compatible with the $f_0(1520)$ observed by the Crystal Barrel experiment. Another interpretation is discussed, where the 1450 and 1497 GeV structures are explained as being due to an interference effect between the $f_0(1365)$ and $f_0(1520)$.

Thanks for your kind help and attention !