University of Sussex

Sensitivity improvements with hadronic energy fraction and remid binning

Numu group, Sep. 2016

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Version details

- Running in **S16-09-13**

- Using FD and ND numu decafs found here: /pnfs/nova/persistent/production/concat/R16-03-03-prod2reco.d/

Outline

- All Sensitivities shown made with the SA numu (non max mixing) oscillation parameters

- Review of last talk (DocDB – 16087)
  - hadronic energy fraction vs. reco. neutrino energy
  - No-extrap stats-only non-max. mixing sensitivity contour

- Sensitivity (no systs, full extrap) with fine remid binning

- Sensitivities (full systs, full extrap) with:
  - hadronic energy fraction binning
  - with 2D combination of remid and hadronic energy binning

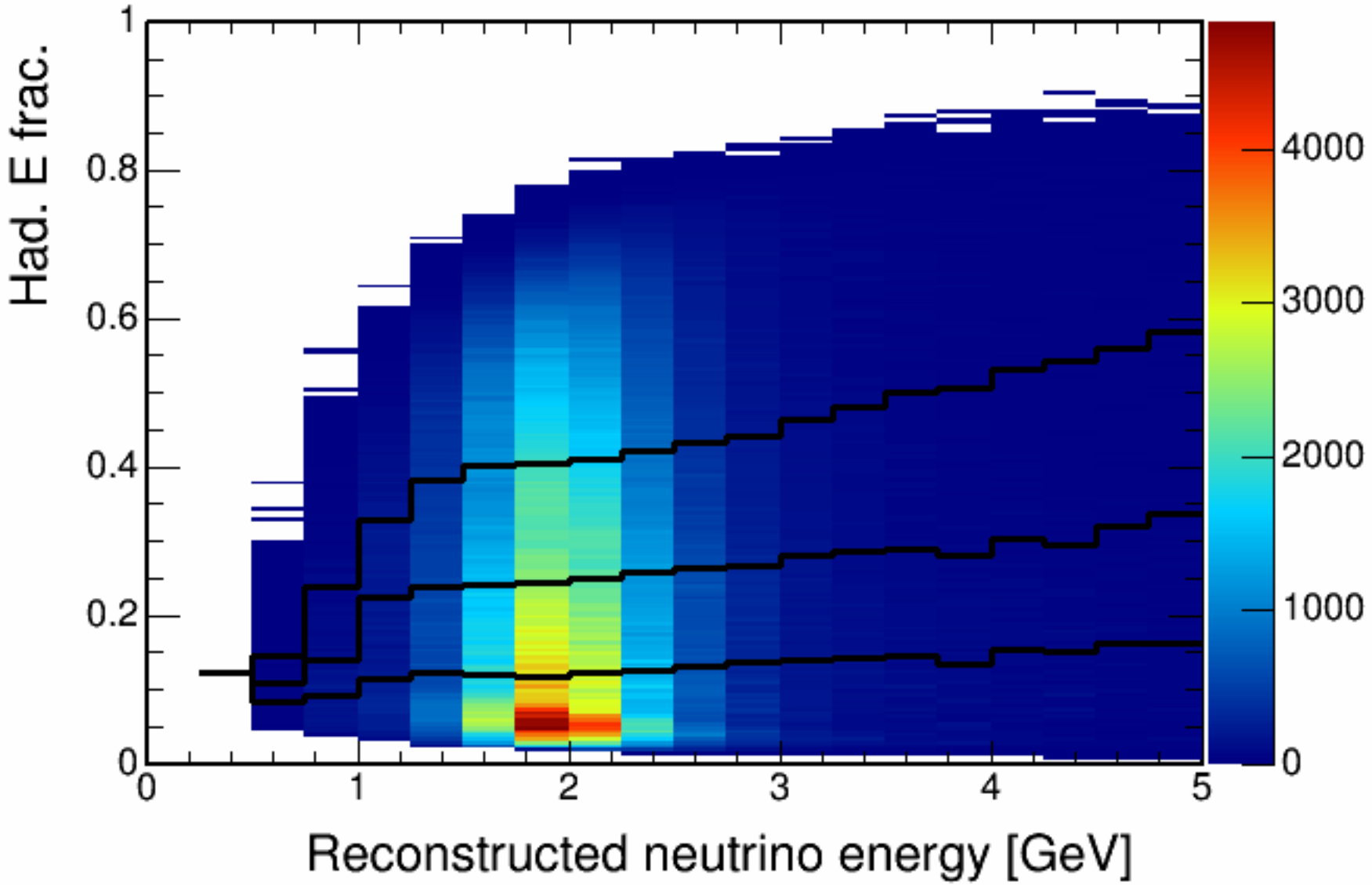
Oscillation parameters

```
SetL(810);
SetRho(0); // No matter effects
SetDmsq21(7.59e-5);
SetDmsq32(2.6746e-3);
SetTh12(.601);
SetTh13(.1567);
SetdCP(0);
SetTh23(0.68696);  // non max (ssqth23 = 0.4022)
```

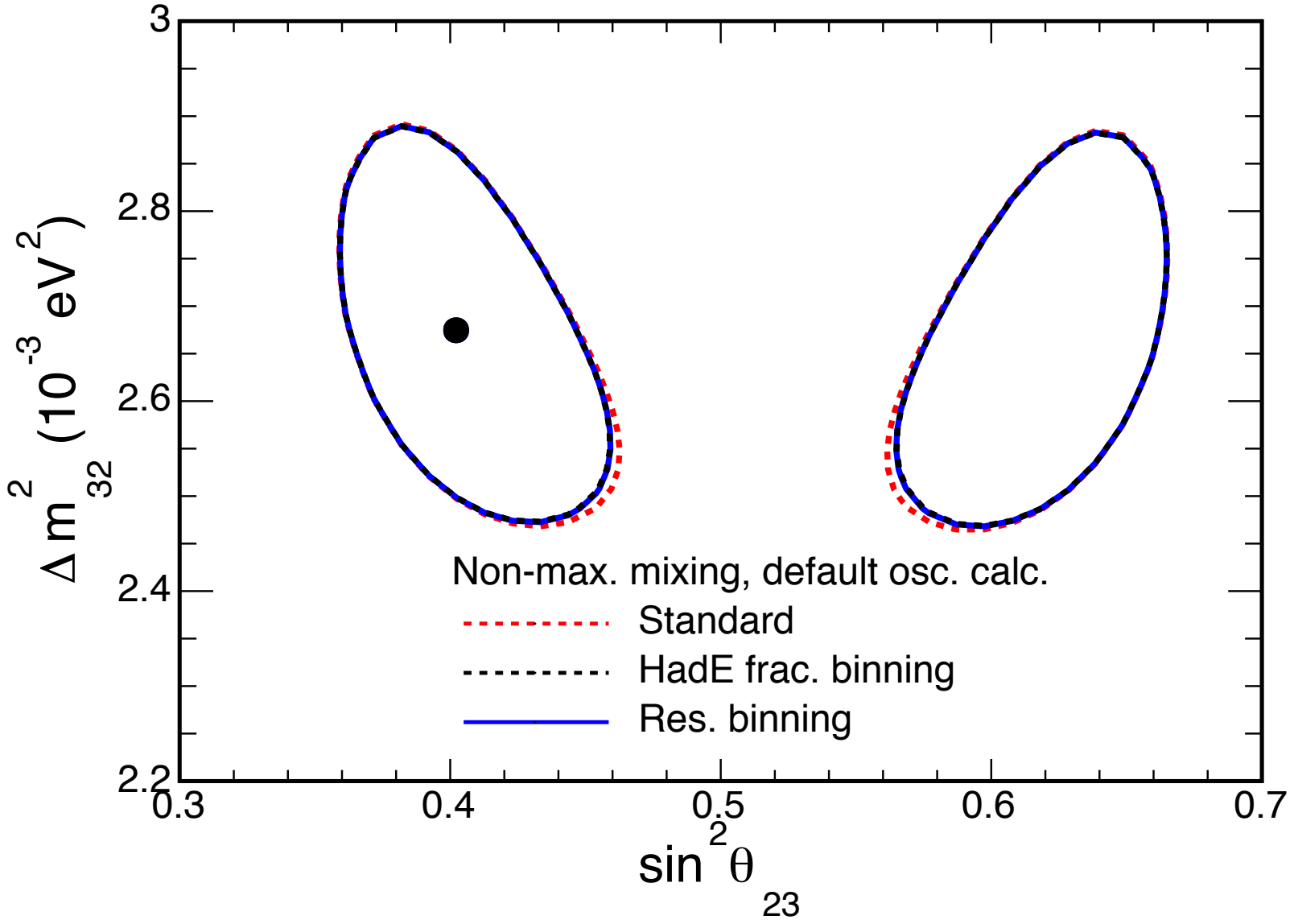
Recap

Following slides show the stats. only (and no extrap.) sensitivity with 4 hadronic energy fraction bins

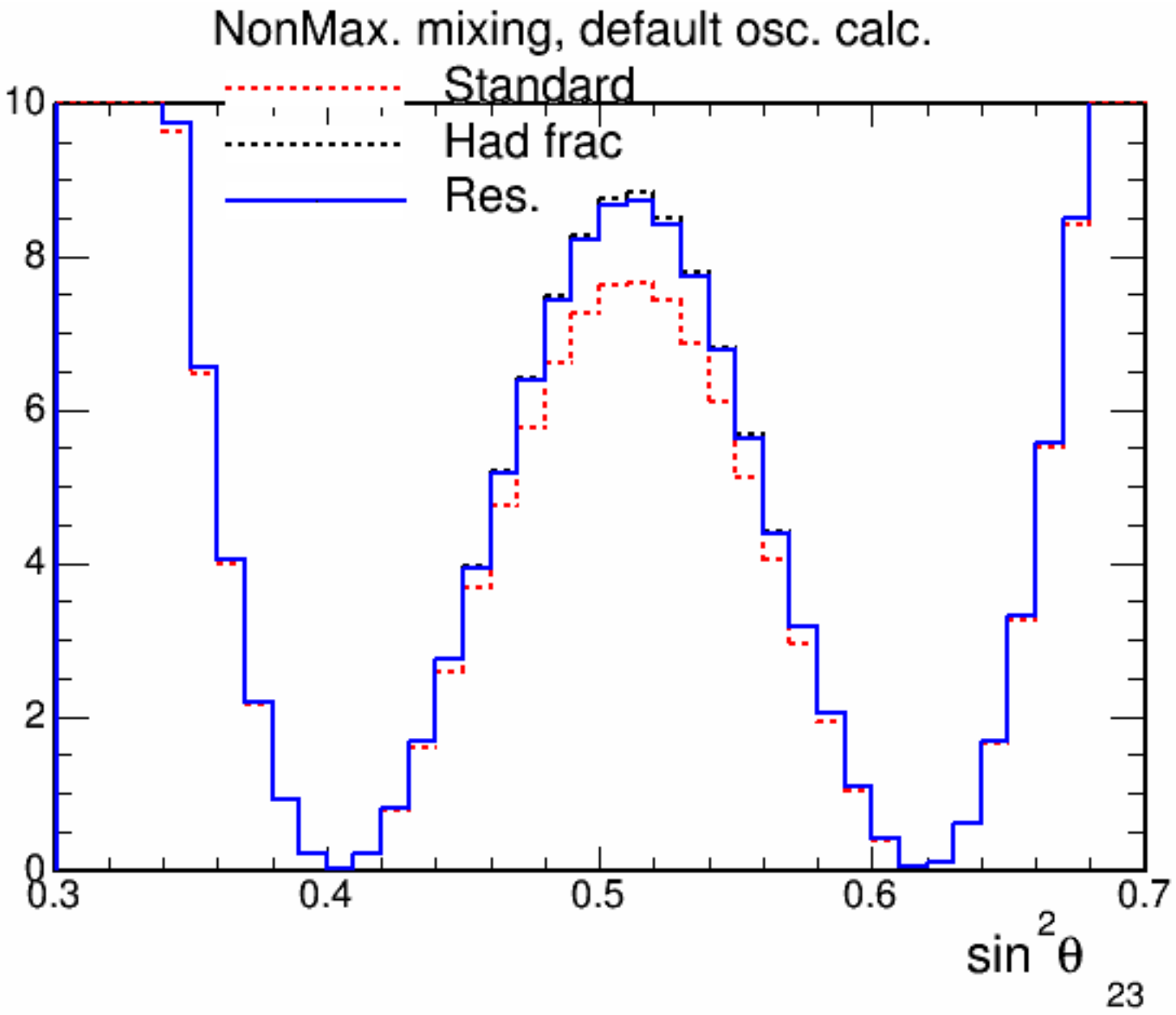
Hadronic energy fraction vs. reco. energy



SA numu result paramters (ssqth23 = 0.4022) sensitivity



SA numu result paramters (ssqth23 = 0.4022) sensitivity



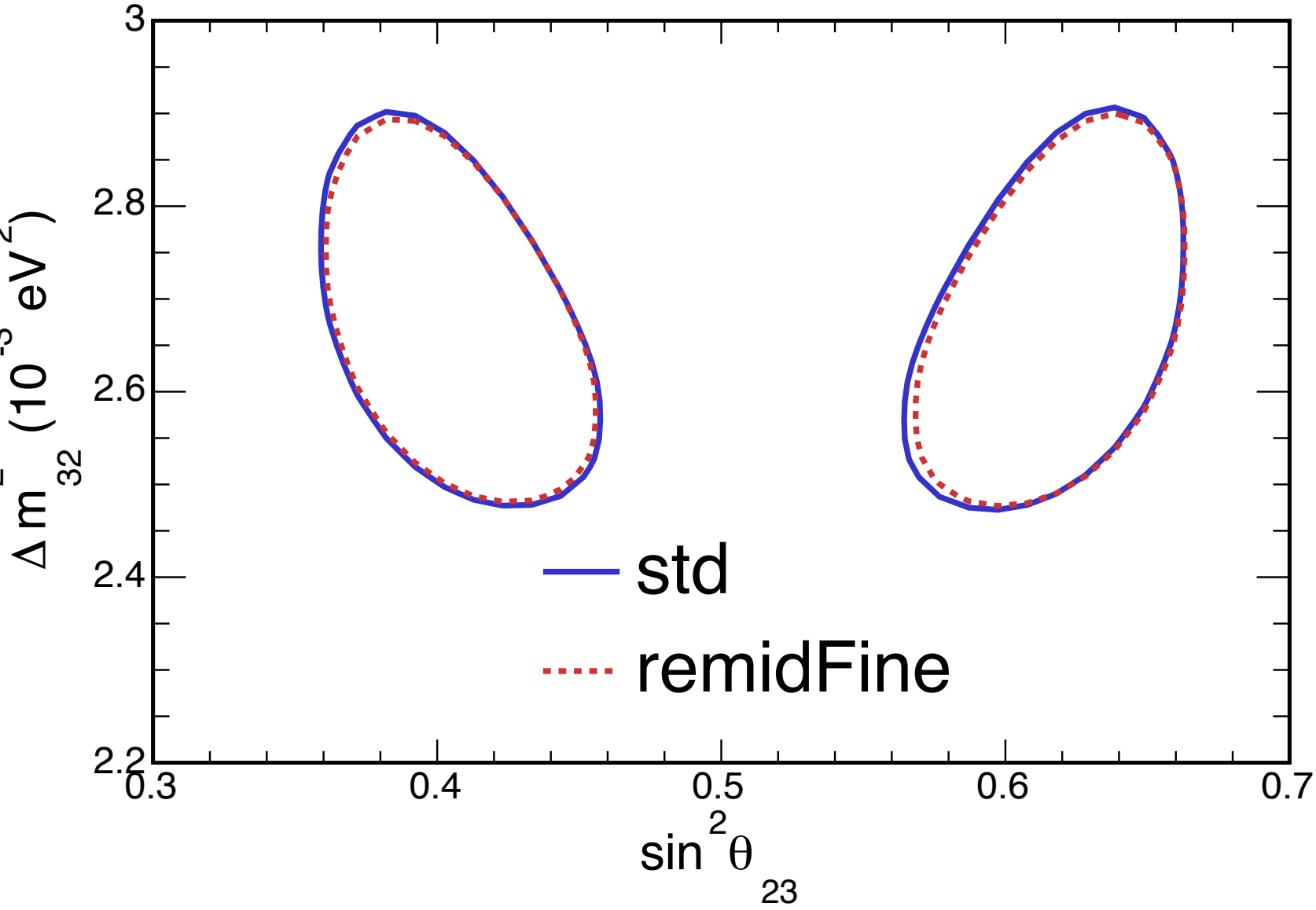
Fine ReMId binning

Binning scheme:

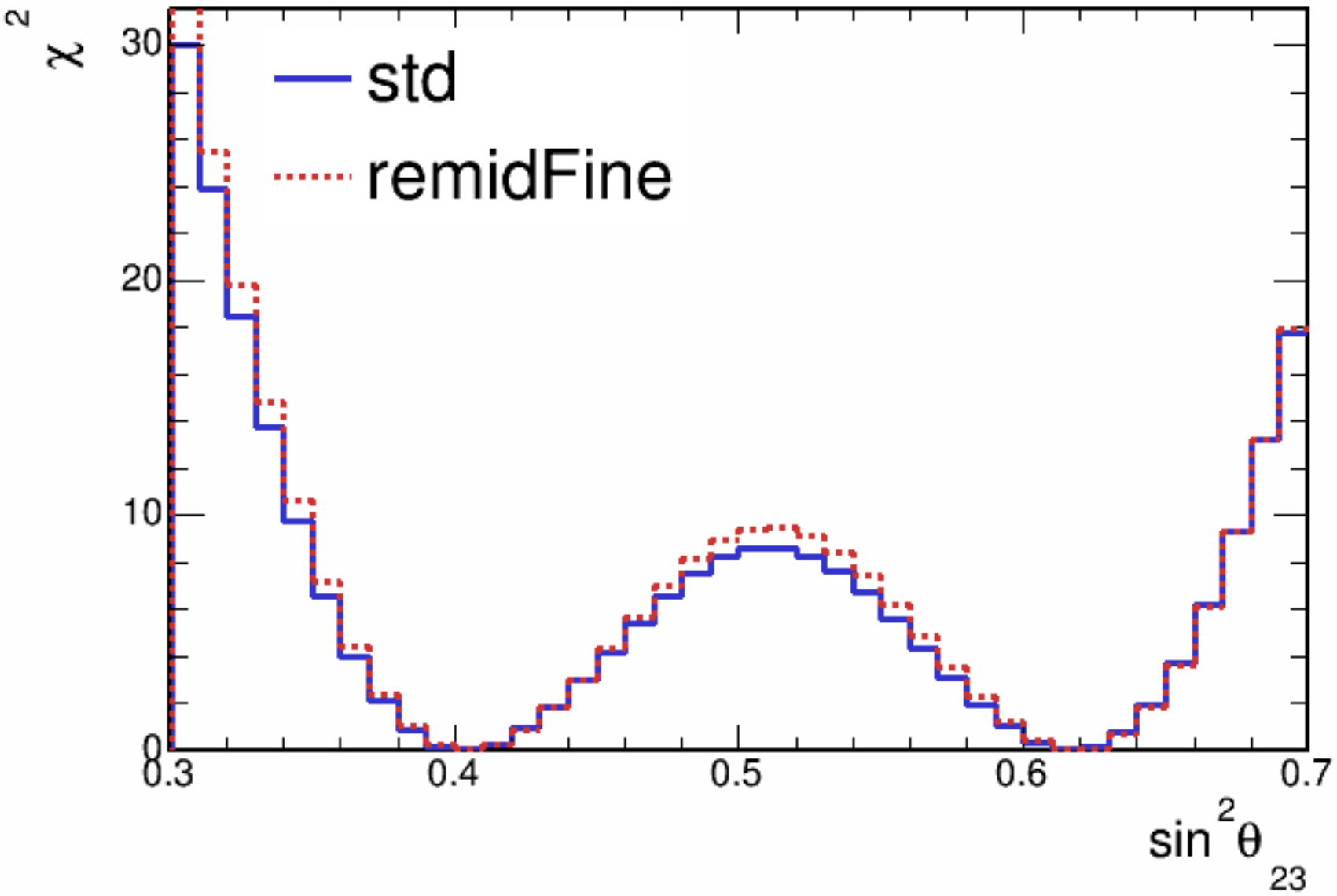
- split remid into 2 coarse bins below 0.9
  - 0.4 <= remid < 0.75
  - 0.75 <= remid < 0.9

- split into 8 fine bins above 0.9
  - 72/80 <= remid < 73/80
  - 73/80 <= remid < 74/80
  - …….. etc.
  - 80/80 <= remid

Stats only sensitivity with fine ReMId binning



Stats only sensitivity with fine ReMId binning



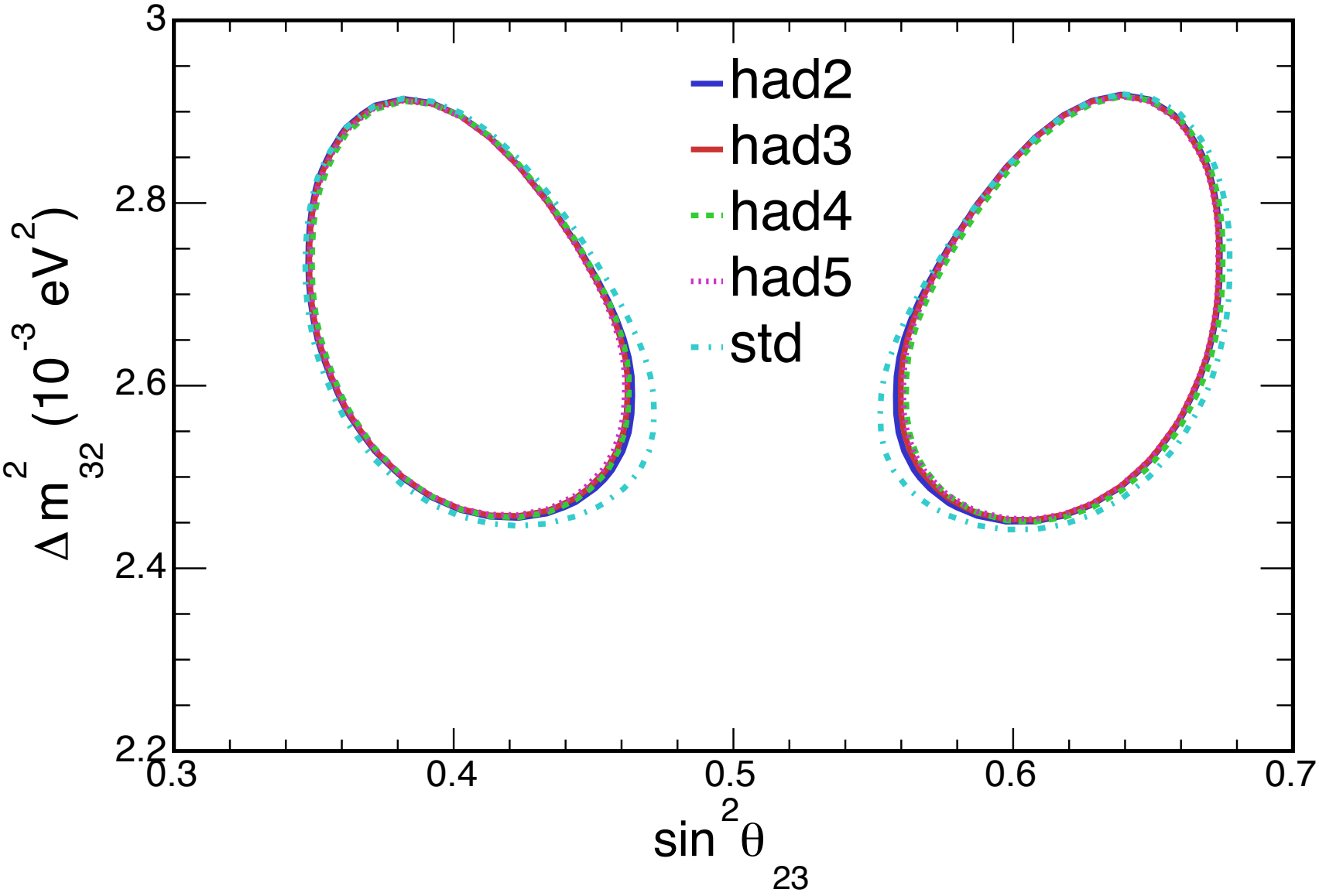
Hadronic energy fraction binning

Split events into hadronic energy quantiles

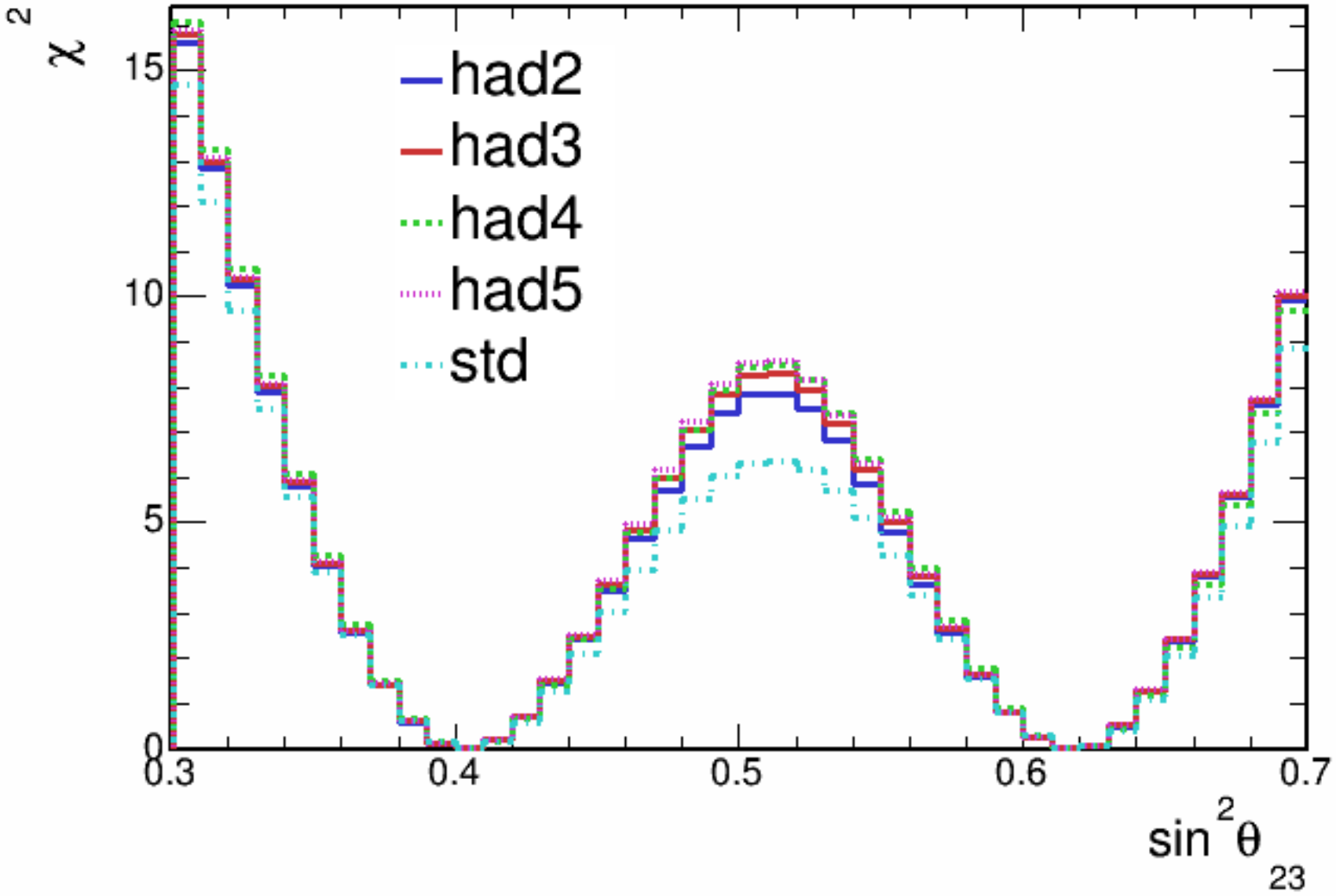
Quantiles made for each bin of reconstructed neutrino energy

Up next, sensitivities with events split into 2,3,4 and 5 hadronic energy fraction quantiles

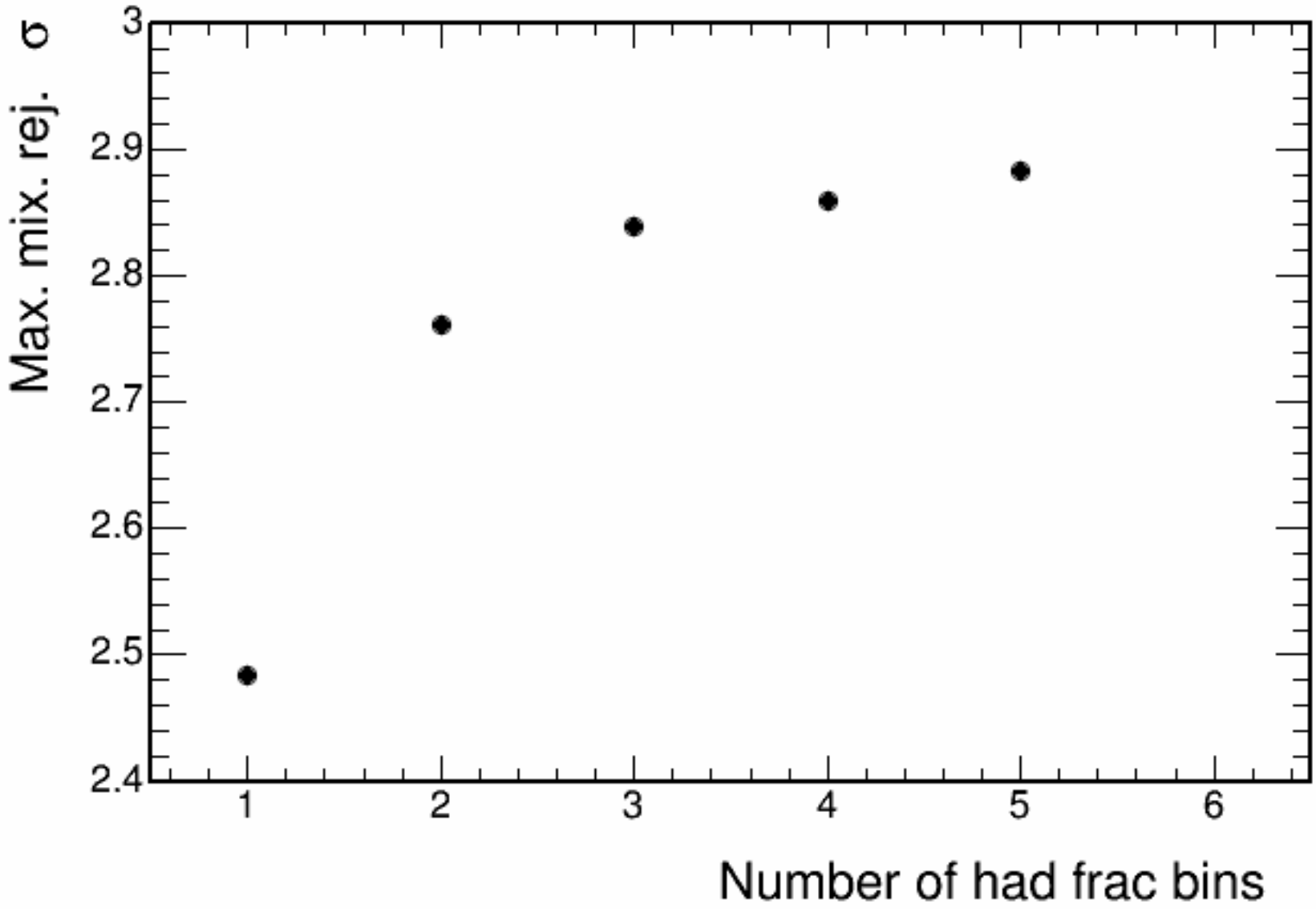
Sensitivity with hadronic energy fraction binning



Sensitivity with hadronic energy fraction binning



Sensitivity with hadronic energy fraction binning

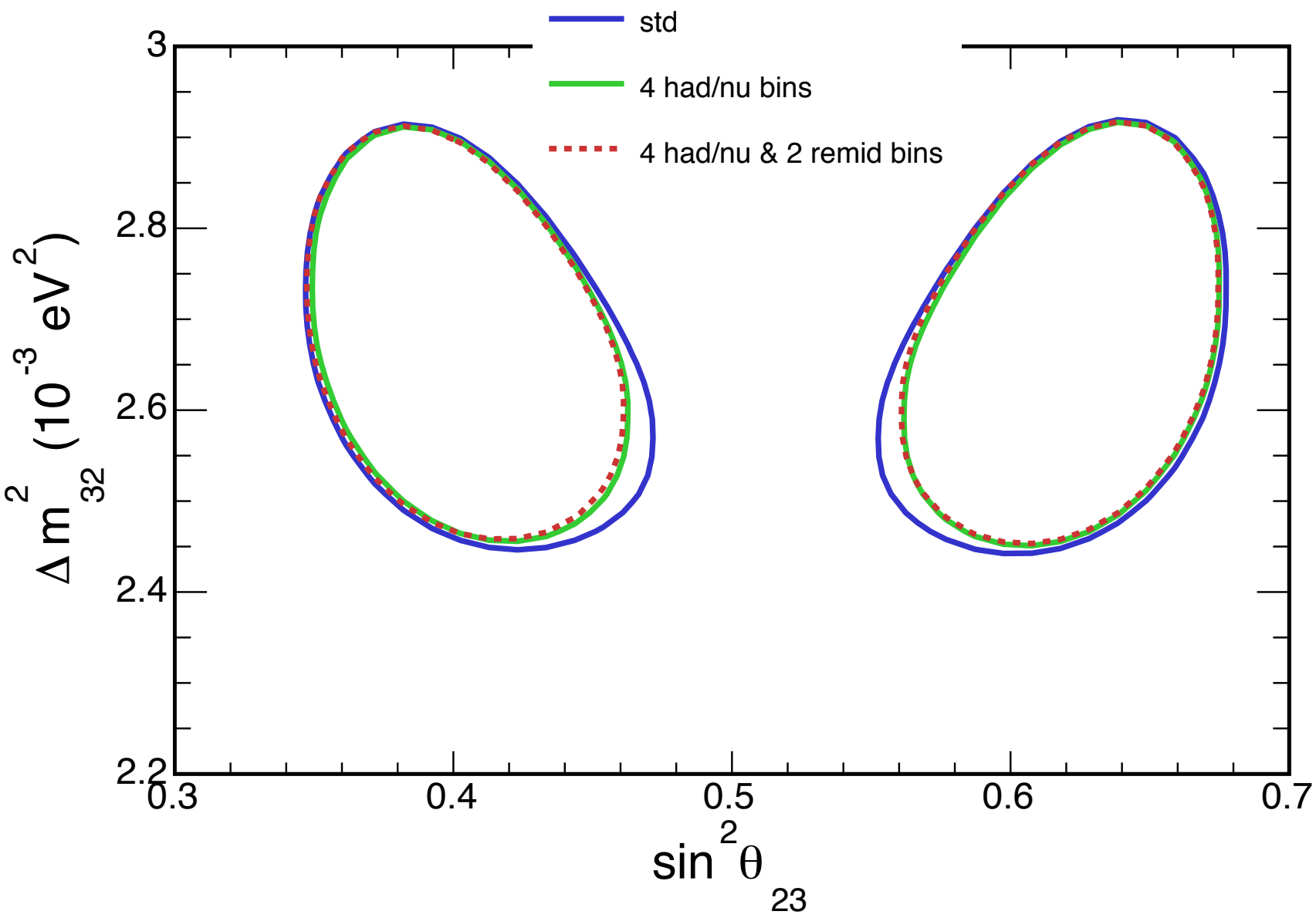


2D Hadronic energy fraction and remid binning

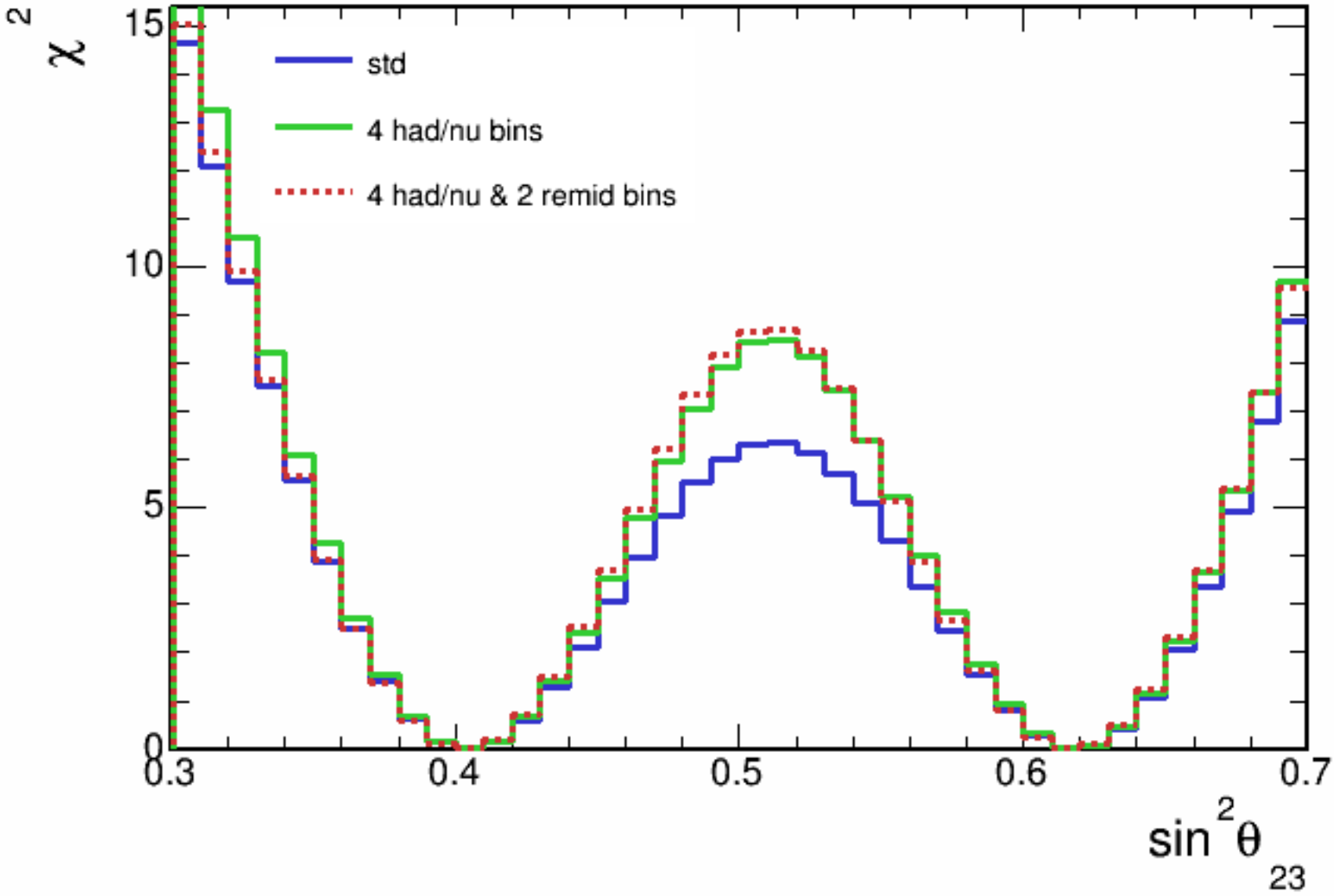
Split events into 4 hadE frac. quantiles and 2 remid bins (0.4-0.75, 0.75-1.0)

HadE frac. quantiles made for each bin of reconstructed neutrino energy and for each remid bin

Sensitivity with hadronic energy fraction binning



Sensitivity with hadronic energy fraction binning



Summary

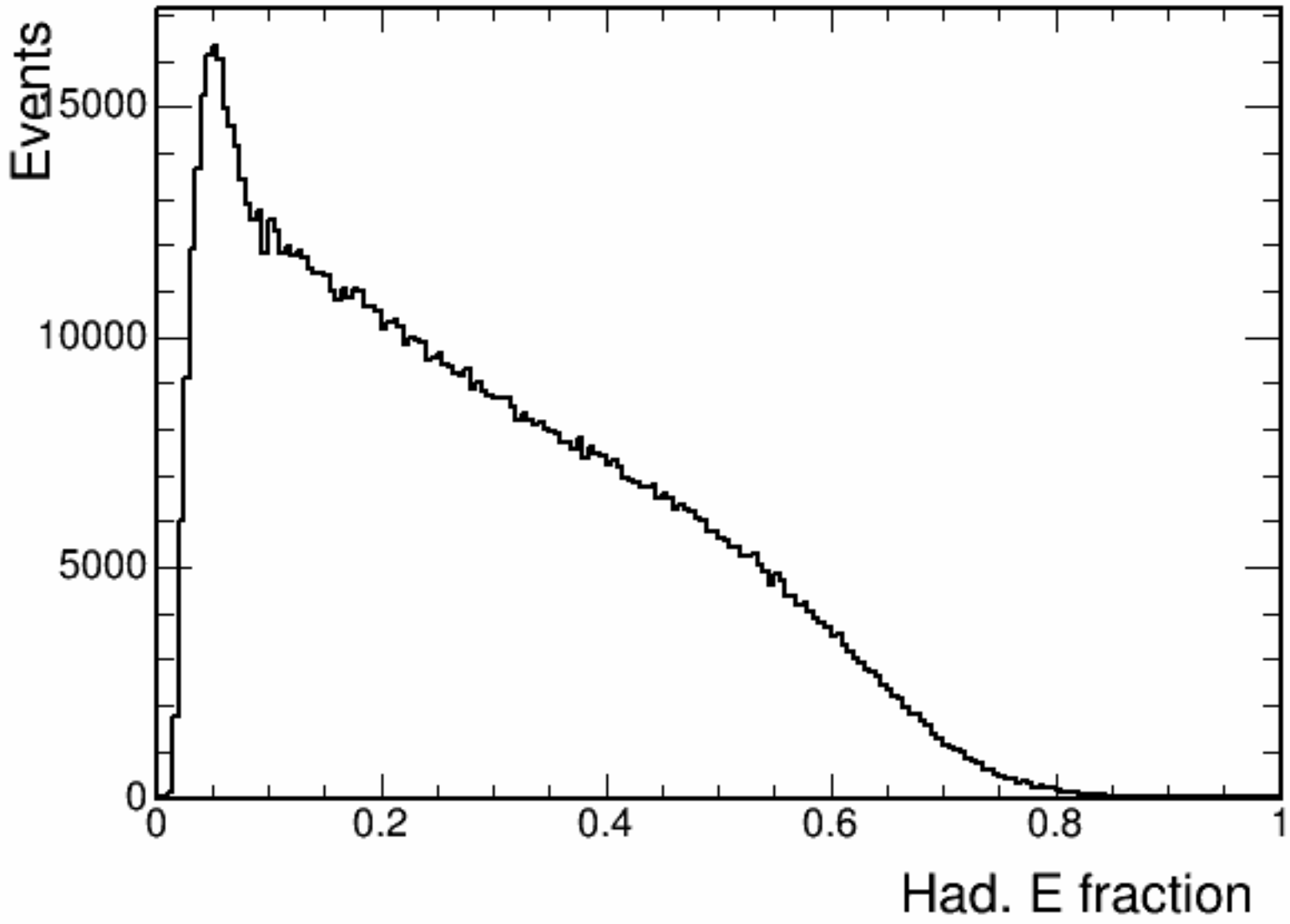
- Stats only sensitivity improves slightly when splitting events using fine remid binning

- Improvement of using hadE frac. binning over standard increases with addition of systematics and extrapolation
  - senstivity improves with the number of hadE frac bins. Sensitivity gain is less with each extra bin

- 2D binning in hadE frac and remid improves rejection of maximal mixing over just hadE frac binning
  - However there is some strange behaviour. The contour becomes larger in some parts. Most notably at sinSqTh_23 ~ 0.35

Backup

Hadronic energy fraction



Max. mixing paremeters sensitivity