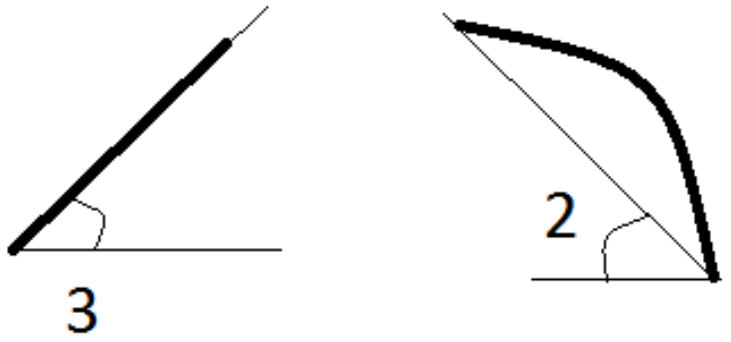
Positioning and Non Uniformity of the DiRC Geometry

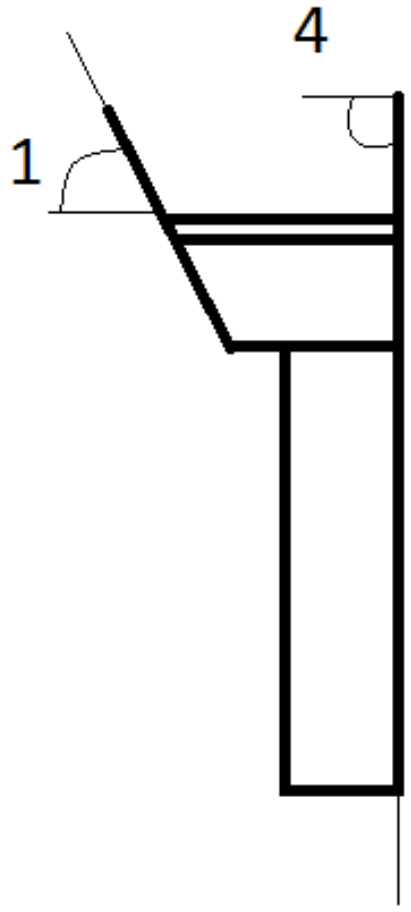
Errors and Reconstruction

- Need to study effects of errors on reconstruction
- 2 Types of errors
  - Errors we know and errors we don't
  - That is, measured deviation from nominal to and the error on this calibration

Method

- Used the method of generating pdfs on the fly presented last week
- Perpendicular tracks w/ 160k generated photons per pdf – 4.5 GeV
- Checked 4 different angles
- Evaluated by comparing ROC curve to Gaussian spread curves to get mrads of separation

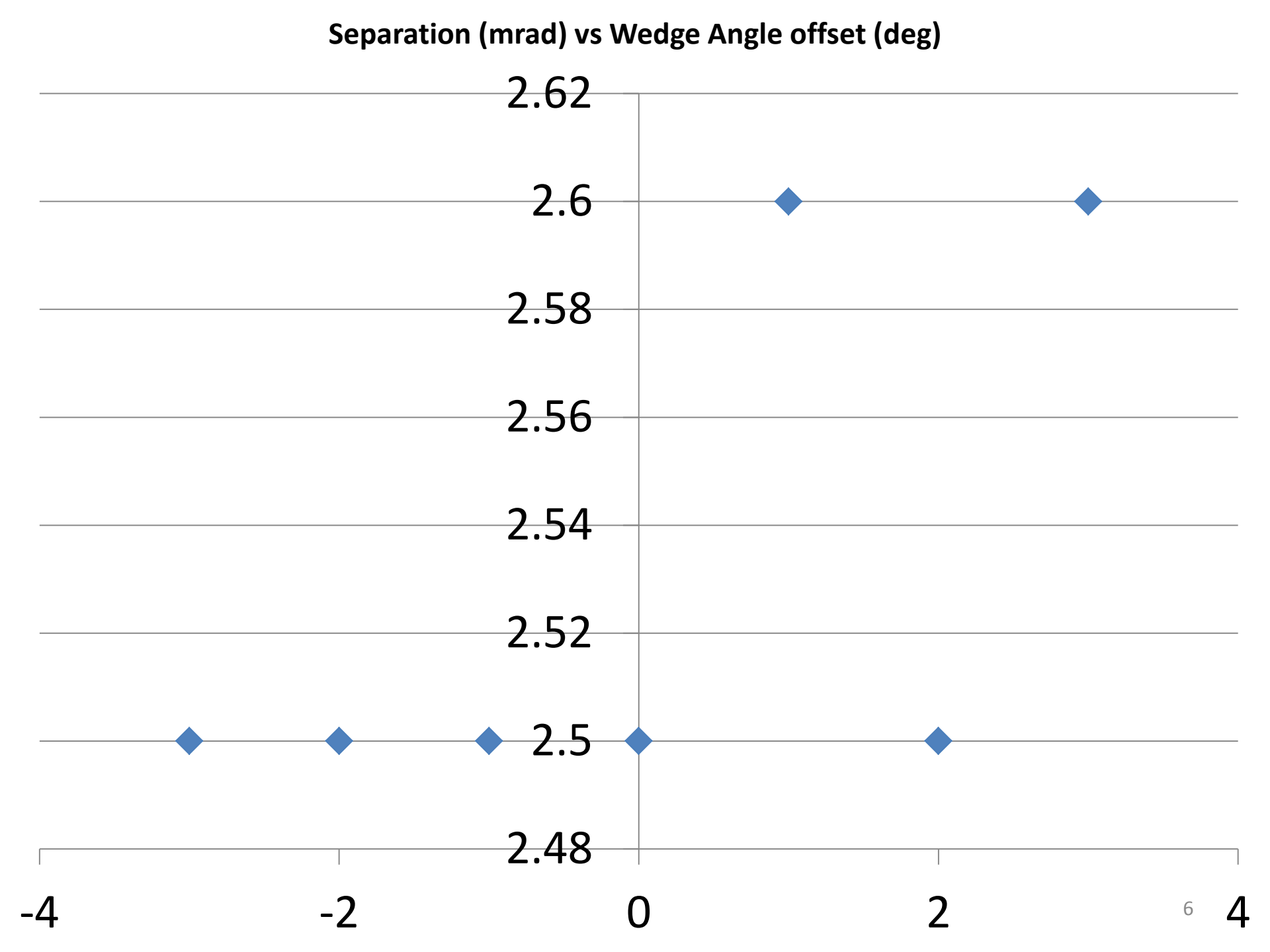


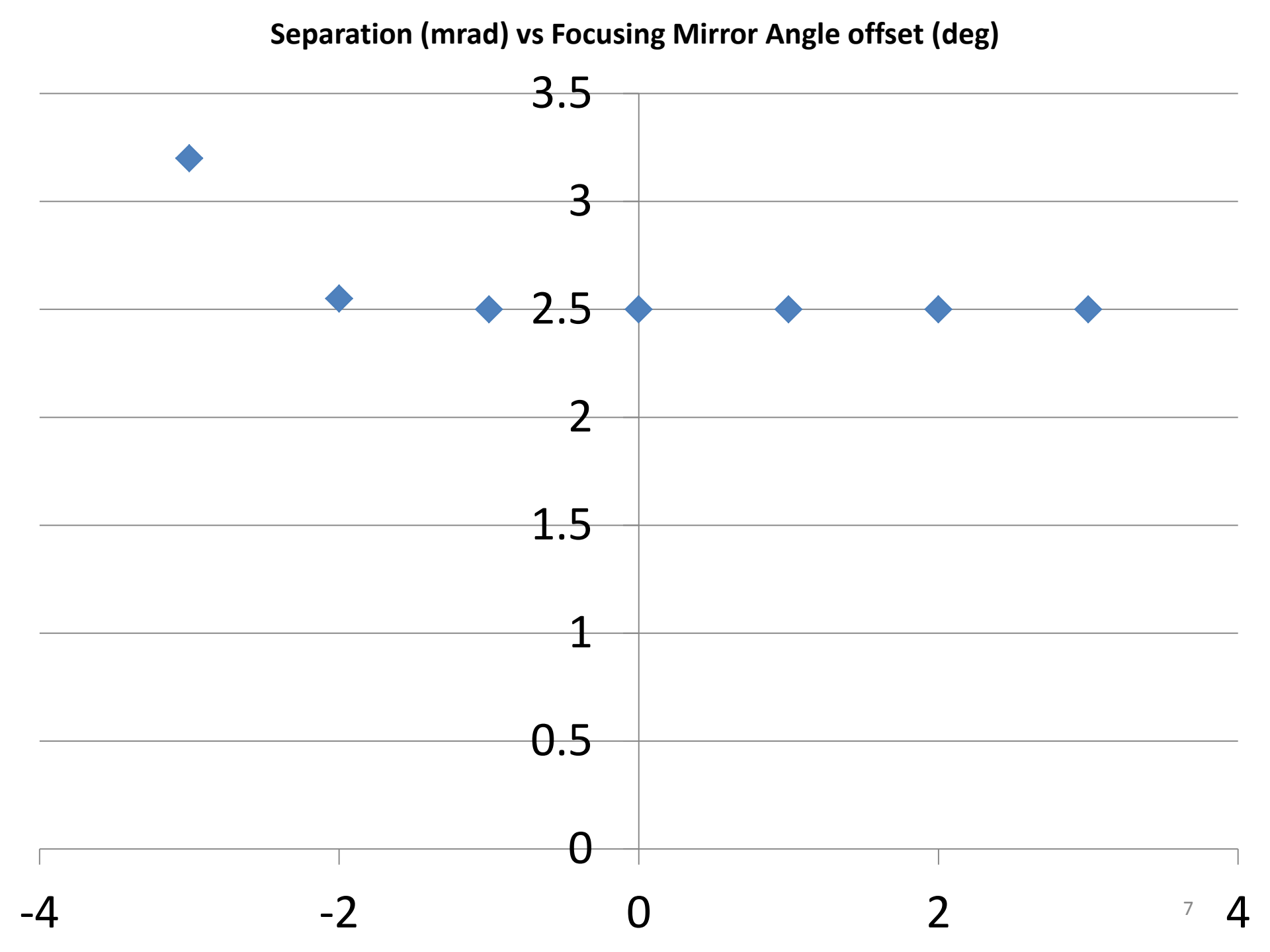


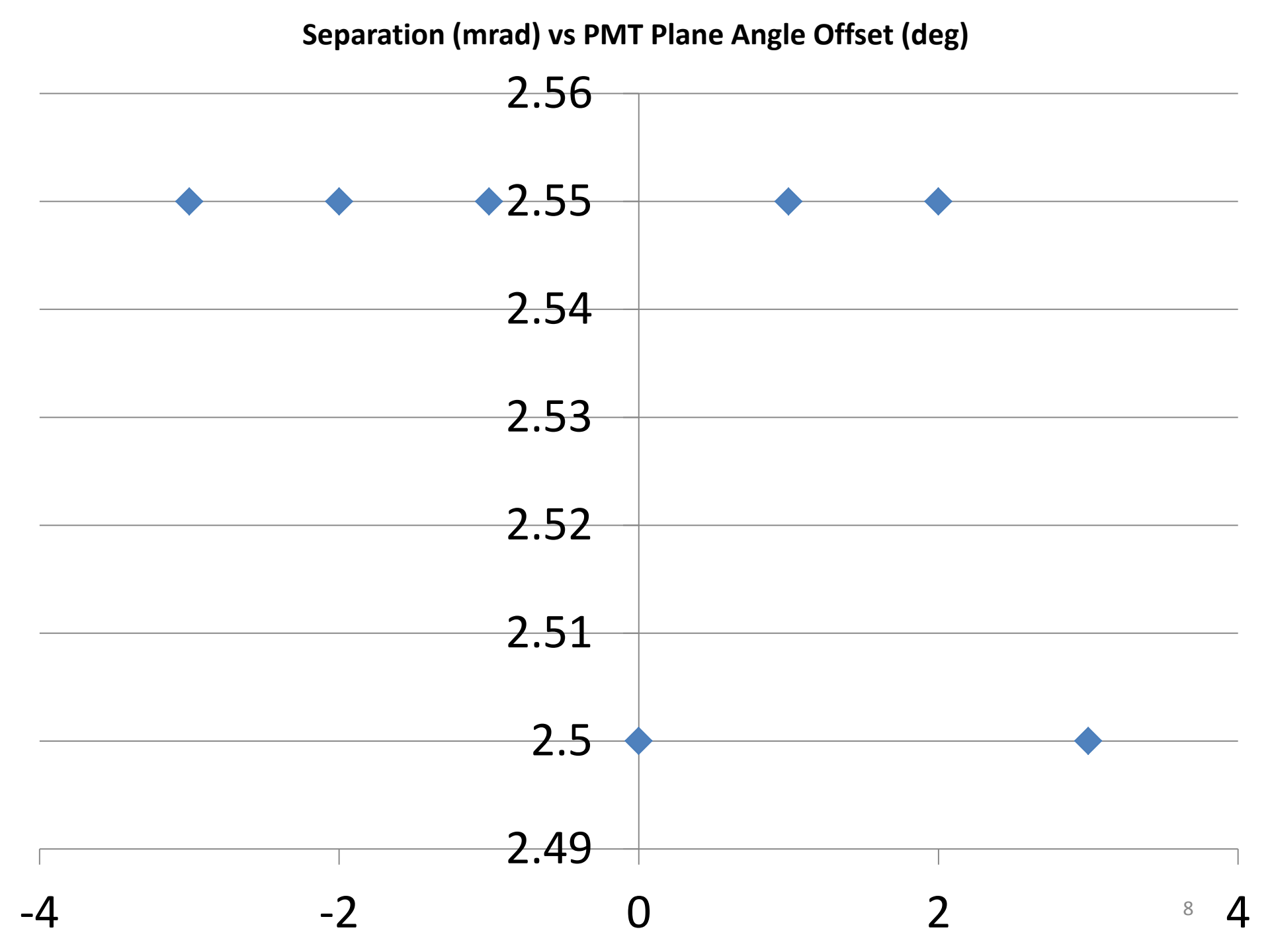
1 - Upper Wedge Angle
2 - Focusing Mirror Angle
3 - PMT plane Angle
4 - Readout Box Angle

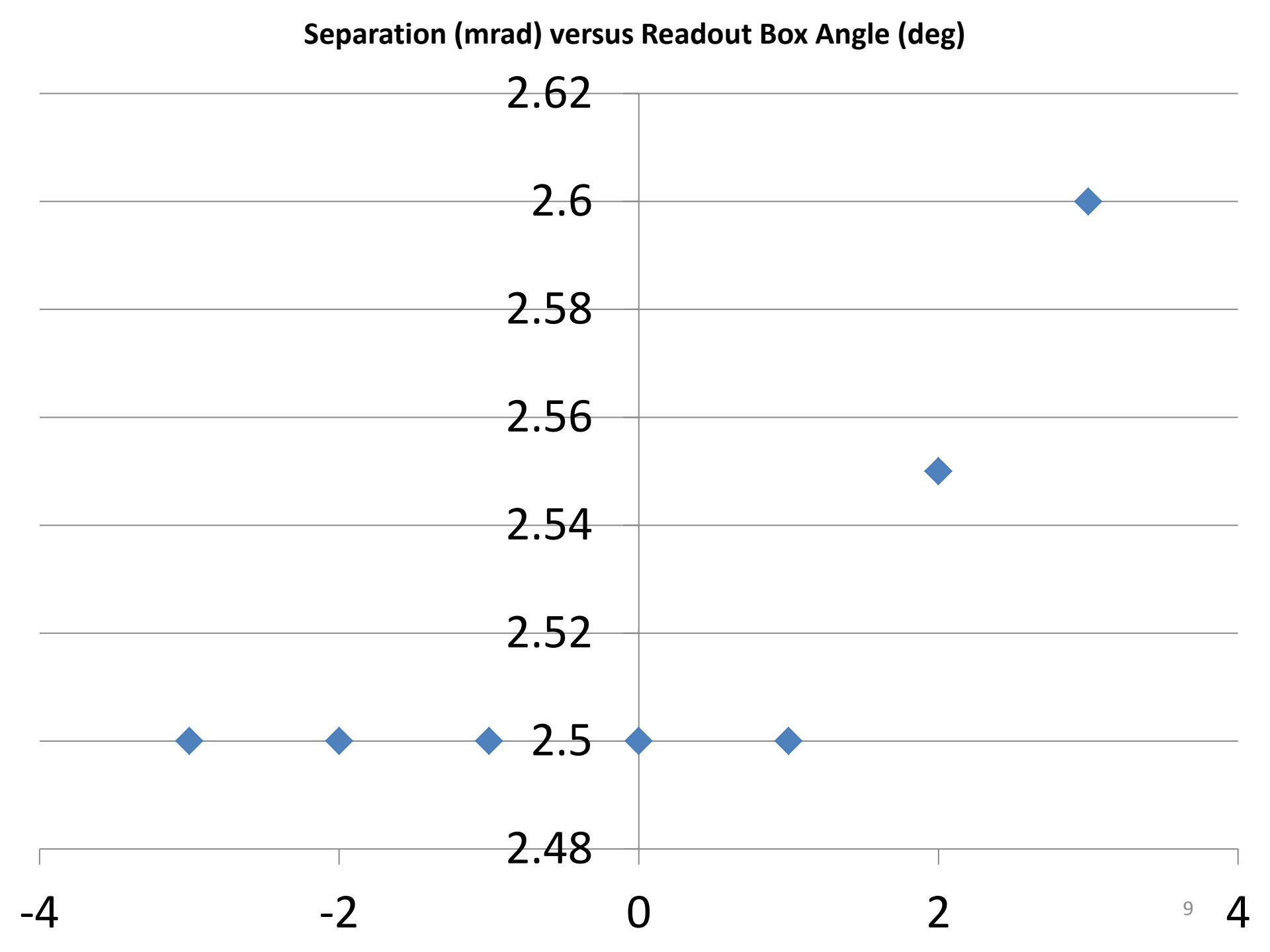
Check Misalignment

- Check what happens if the angles are wrong
- Assume we know where they are to infinite precision, but off of the design by some amount of degrees
- Very small effects unless the acceptance changes


Separation (mrad) vs Wedge Angle offset (deg)
2.62
2.6
2.58
2.56
2.54
2.52
2.5
2.48
-4
-2
0
2
4

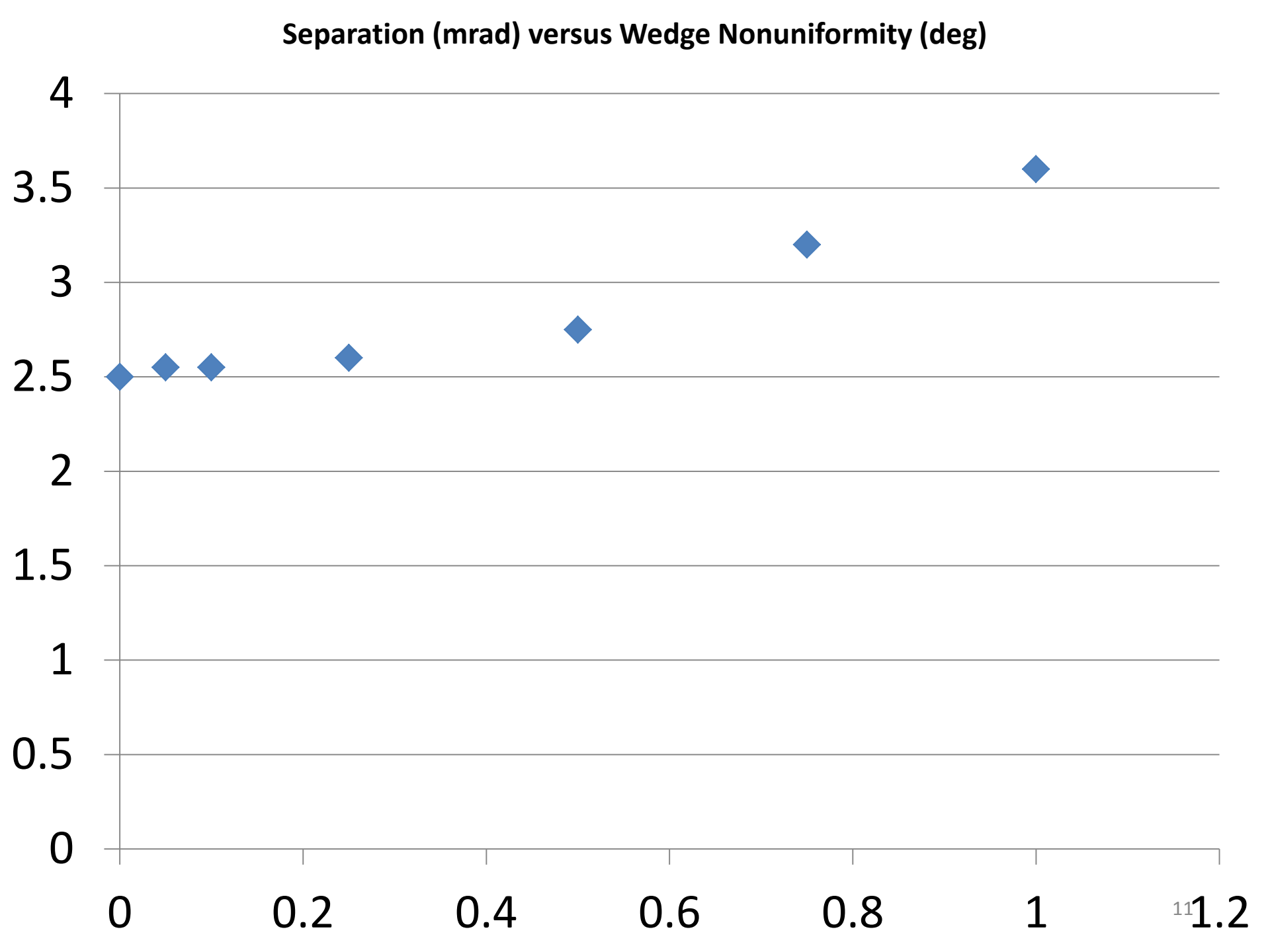

Separation (mrad) vs Focusing Mirror Angle offset (deg)
3.5
3
2.5
2
1.5
1
0.5
0
-4
-2
0
2
4

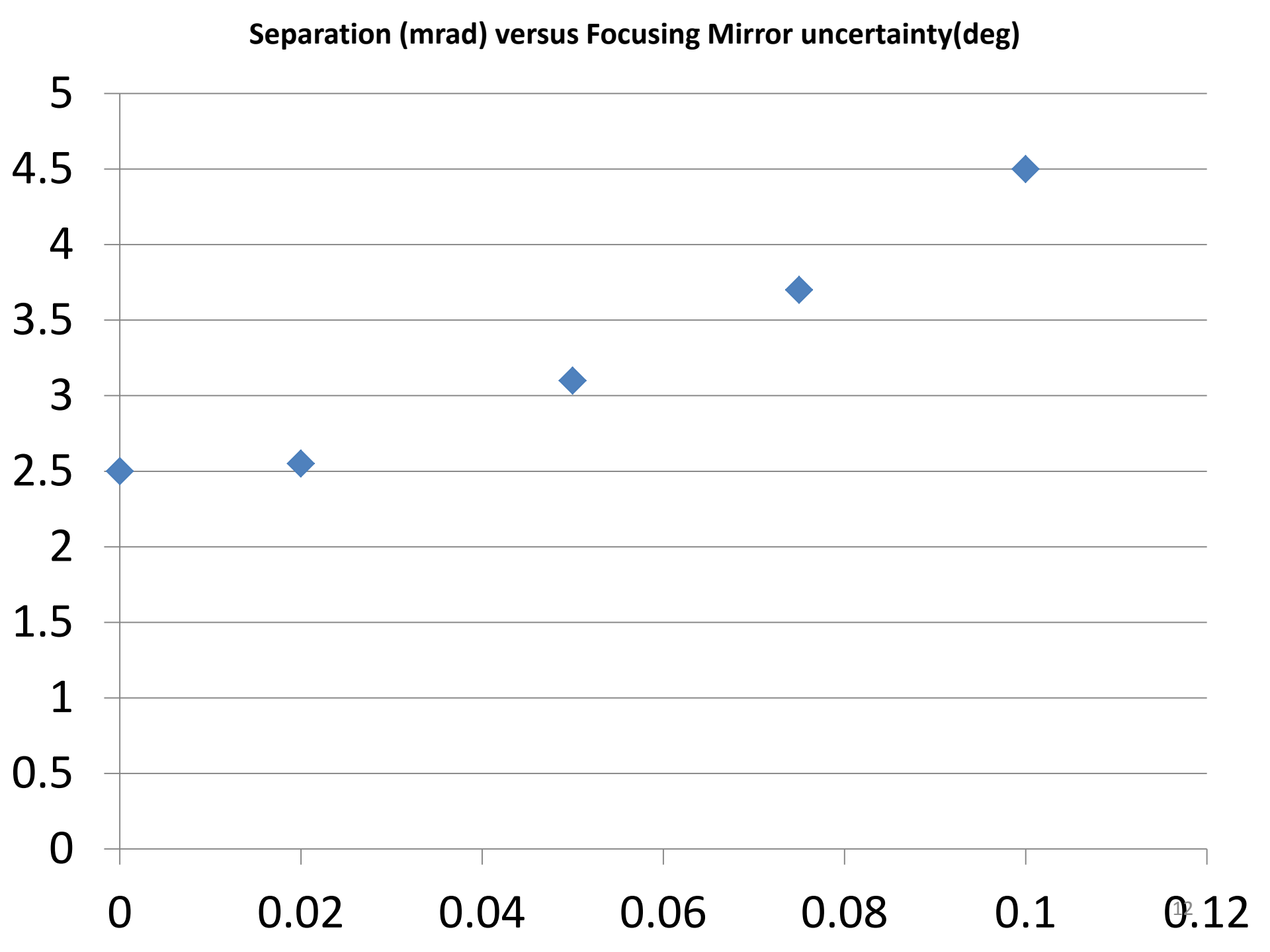

Separation (mrad) vs PMT Plane Angle Offset (deg)
2.56
2.55
2.54
2.53
2.52
2.51
2.5
2.49
-4
-2
0
2
4

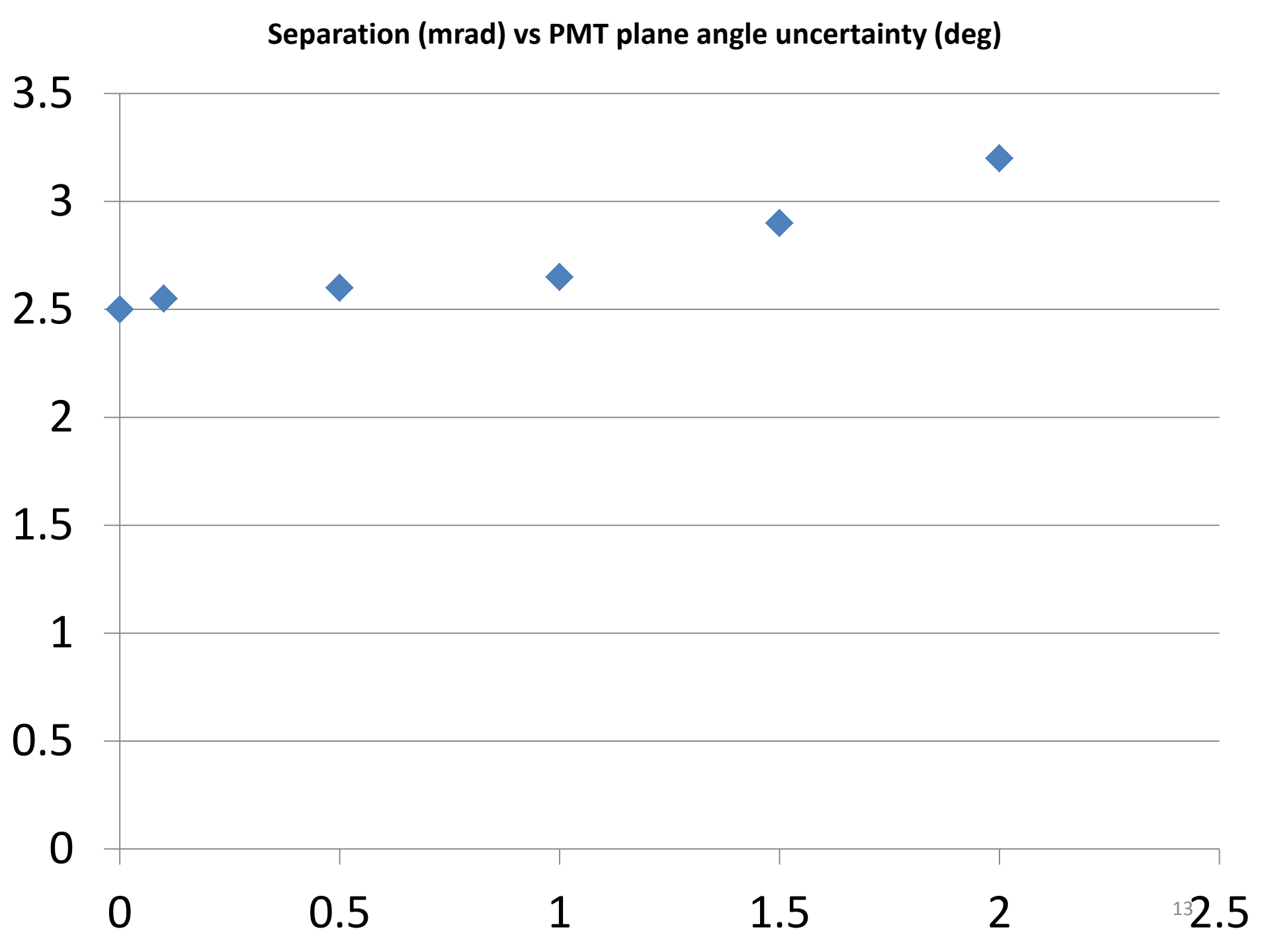

Separation (mrad) versus Readout Box Angle (deg)
2.62
2.6
2.58
2.56
2.54
2.52
2.5
2.48
-4
-2
0
2
4

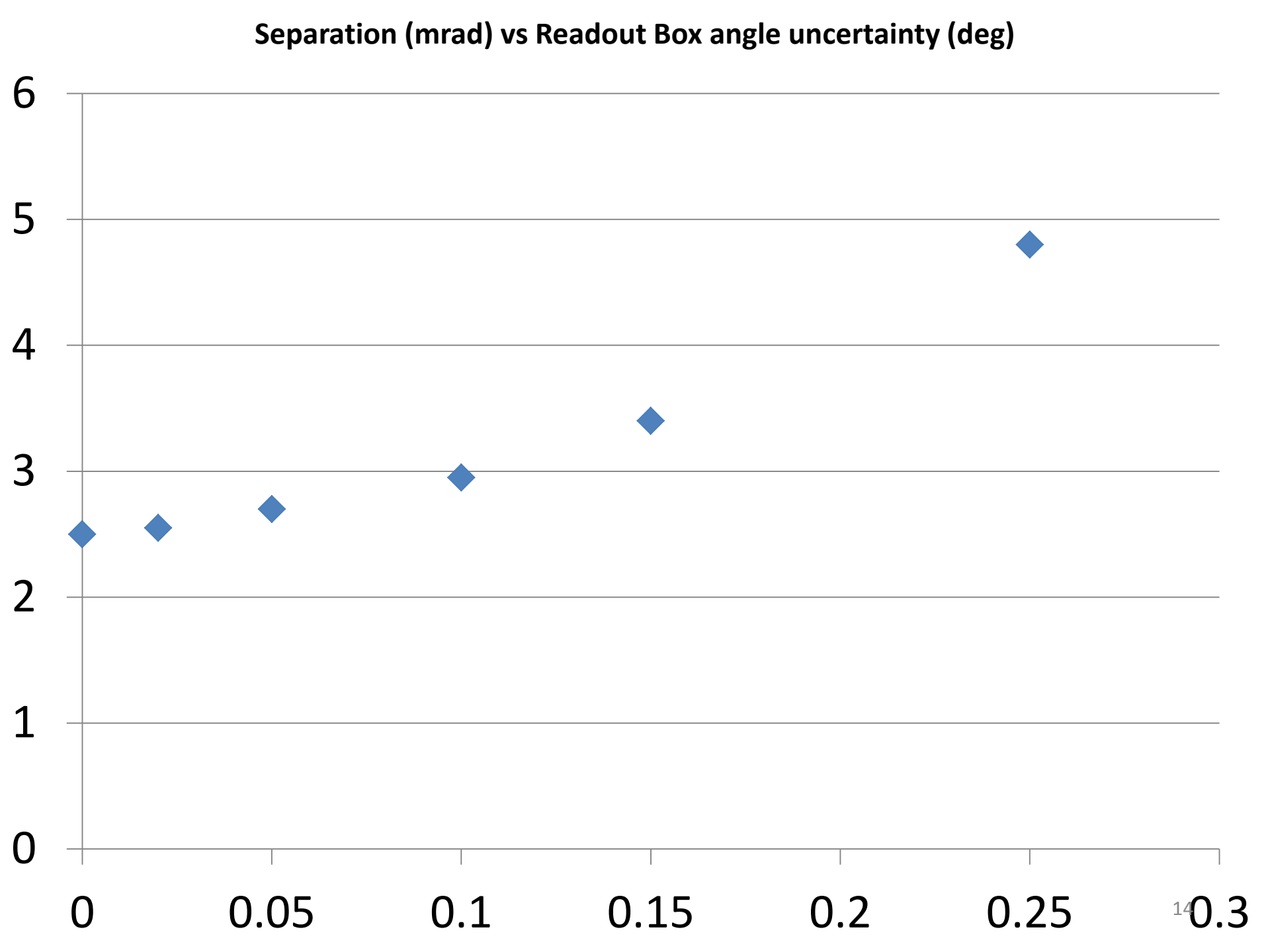
Non uniformity

- Assume that we don’t know the geometry perfectly
- Generate the pdfs from the perfect geometry
- Simulate each event with a geometry slightly different (changed by a Gaussian with some spread)
- Plot the separation versus this spread
  - Much more sensitive


Separation (mrad) versus Wedge Nonuniformity (deg)
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.2
0.4
0.6
0.8
1
1.2

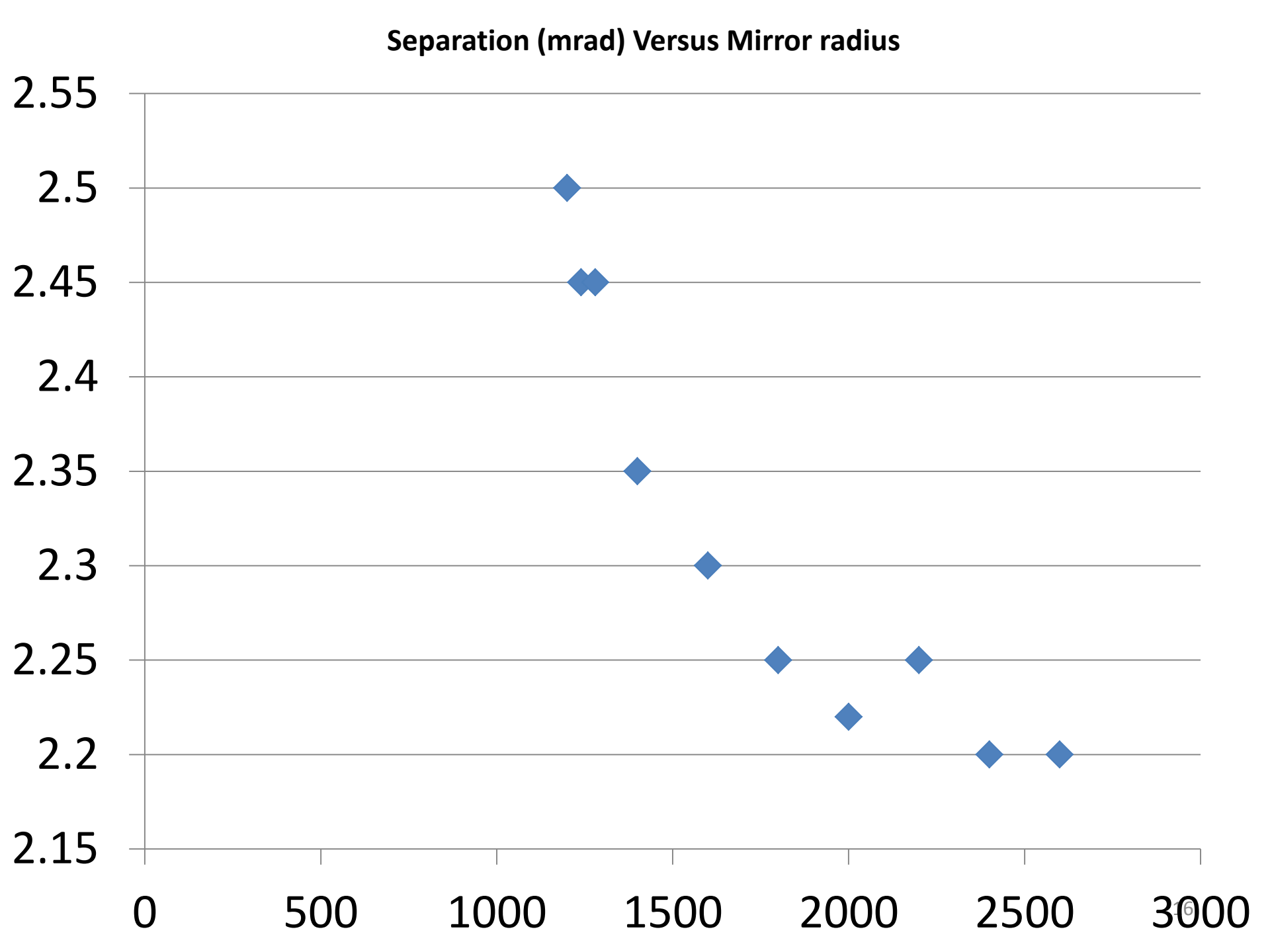

Separation (mrad) versus Focusing Mirror uncertainty(deg)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.02
0.04
0.06
0.08
0.1
0.12

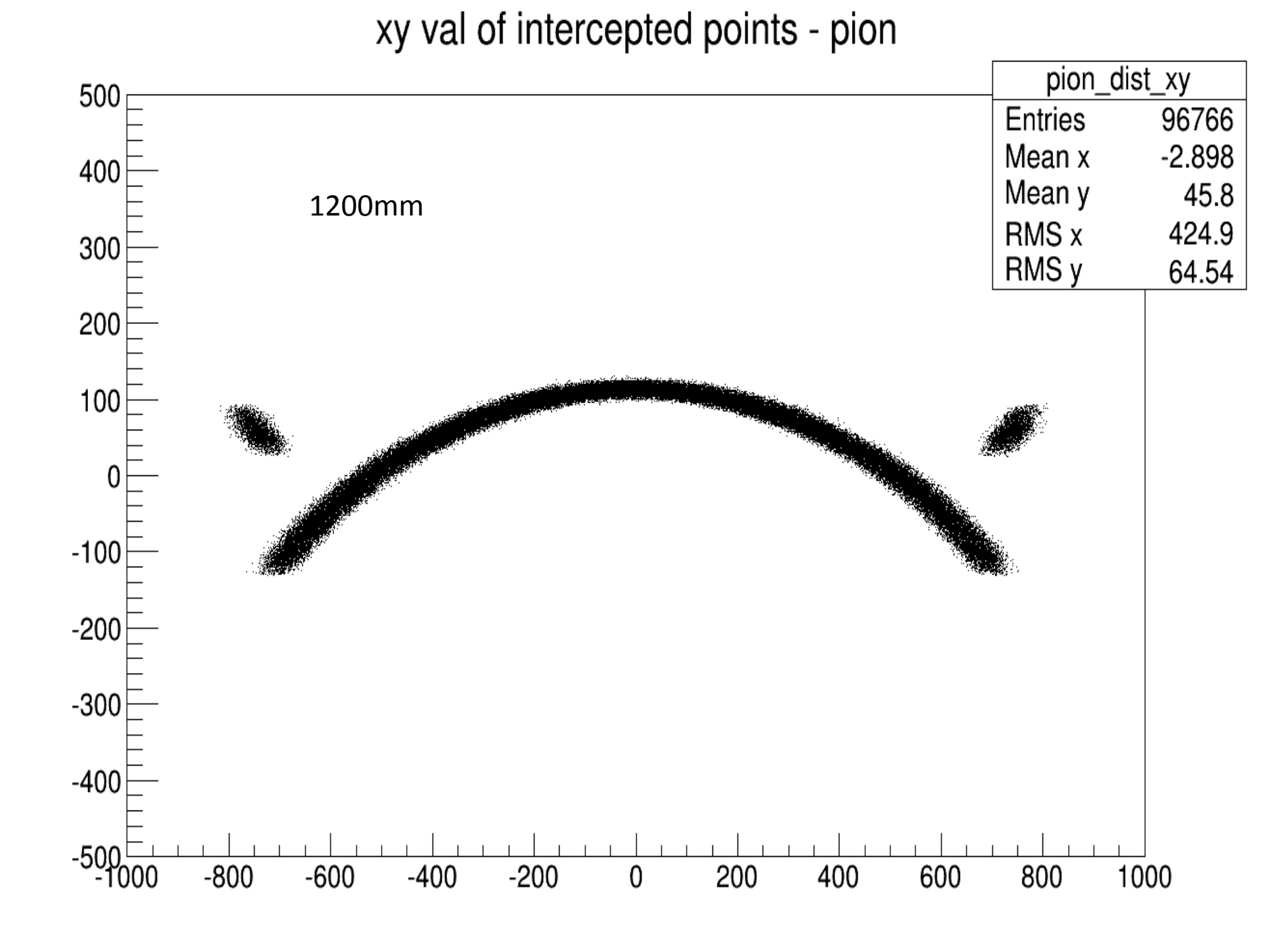

Separation (mrad) vs PMT plane angle uncertainty (deg)
3.5
3
2.5
2
1.5
1
0.5
0
0
0.5
1
1.5
2
2.5

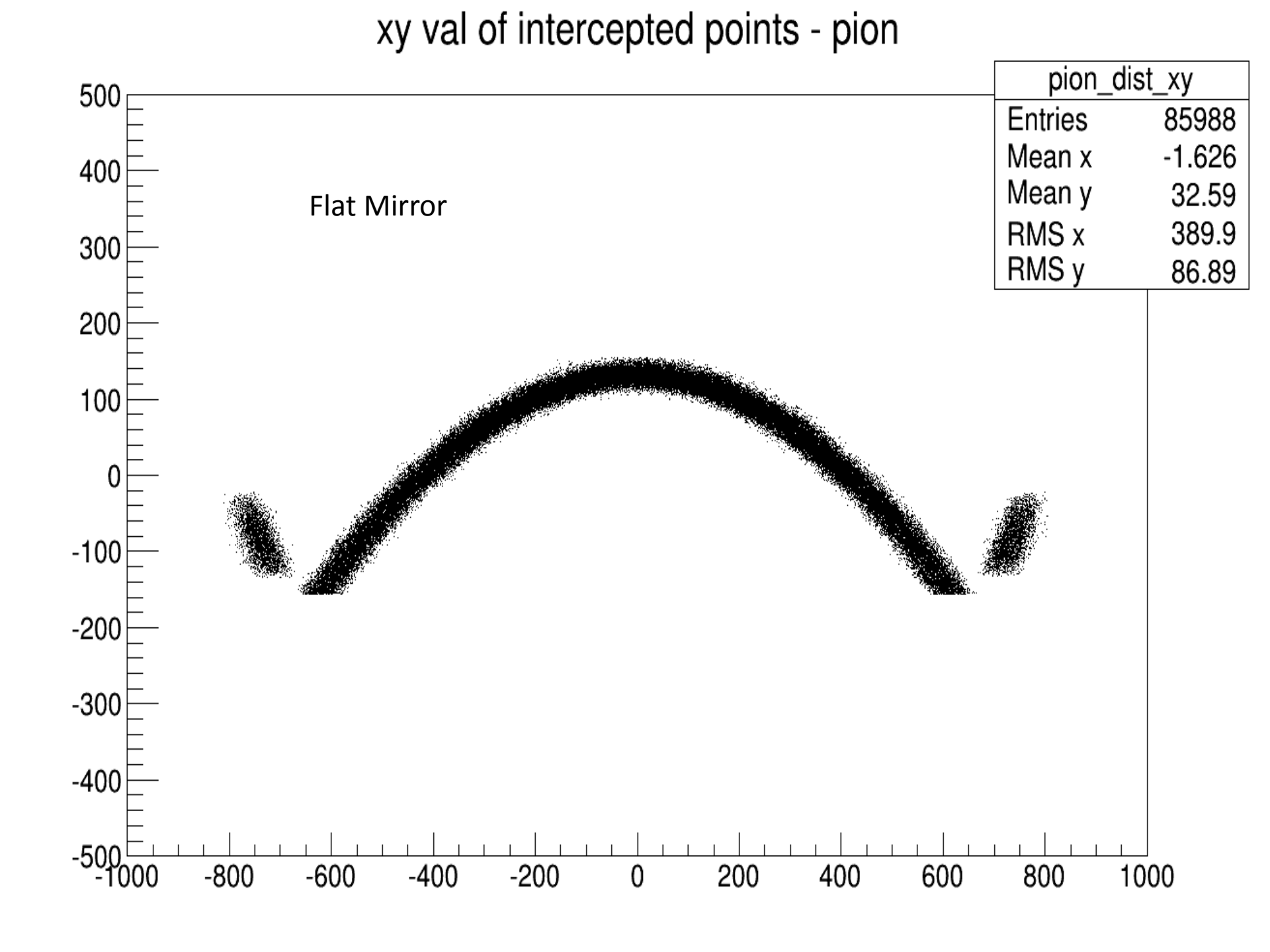

Separation (mrad) vs Readout Box angle uncertainty (deg)
6
5
4
3
2
1
0
0
0.05
0.1
0.15
0.2
0.25
0.3

Mirror Radius

- Also tried changing the mirror radius
- A flatter mirror improved reconstruction slightly
- Also vastly increased instrumentation area
  - ~2/3 increase over the focusing mirror (1200mm)


Separation (mrad) Versus Mirror radius
2.55
2.5
2.45
2.4
2.35
2.3
2.25
2.2
2.15
0
500
1000
1500
2000
2500
3000


xy val of intercepted points - pion
pion_dist_xy
Entries 96766
Mean x -2.898
Mean y 45.8
RMS x 424.9
RMS y 64.54
1200mm
500
400
300
200
100
0
-100
-200
-300
-400
-500
-1000
-800
-600
-400
-200
0
200
400
600
800
1000


xy val of intercepted points - pion
pion_dist_xy
Entries 85988
Mean x -1.626
Mean y 32.59
RMS x 389.9
RMS y 86.89
Flat Mirror
500
400
300
200
100
0
-100
-200
-300
-400
-500
-1000
-800
-600
-400
-200
0
200
400
600
800
1000