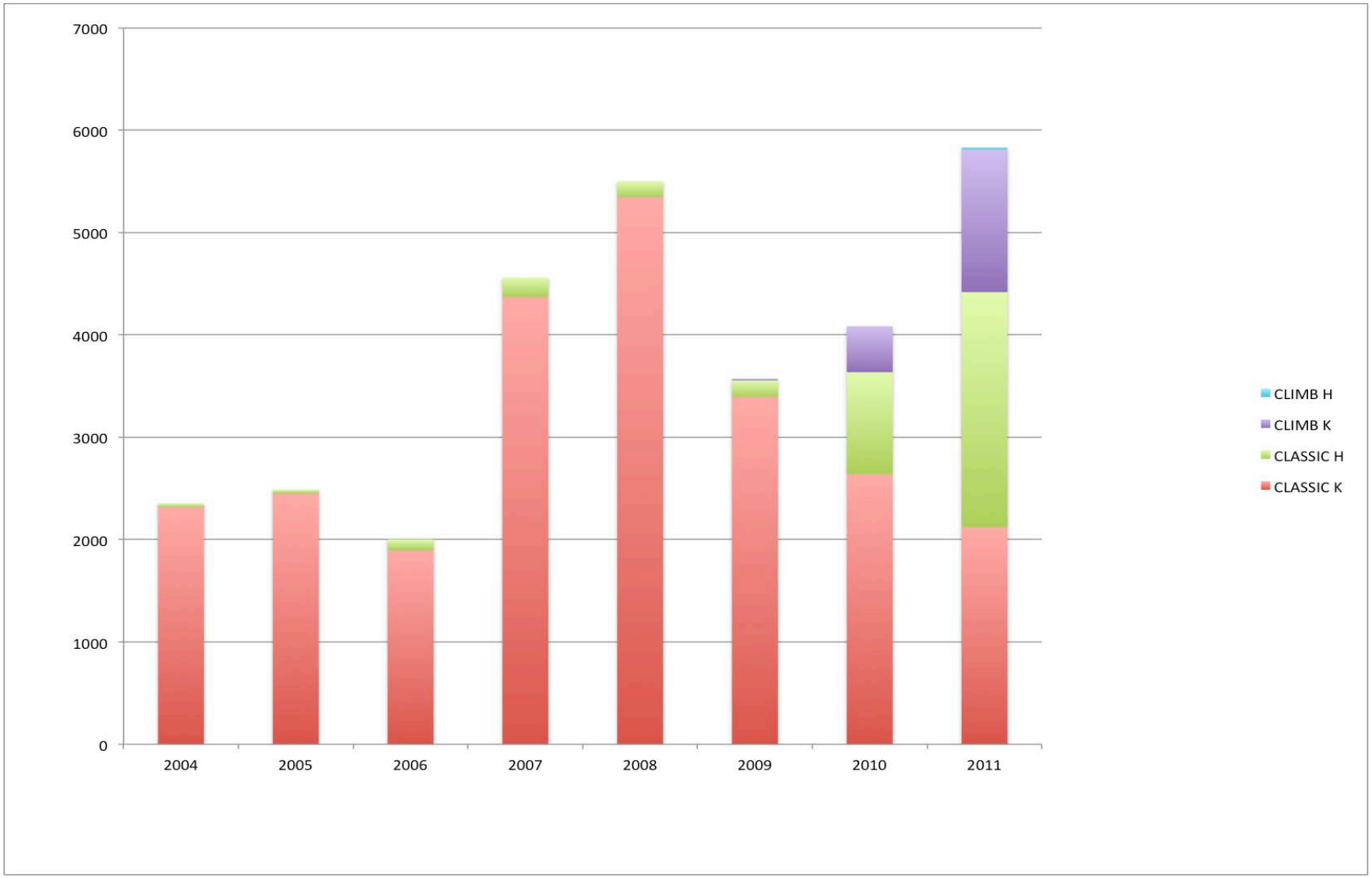
CHARA Classic/Climb Numbers.

Automated Data Reduction

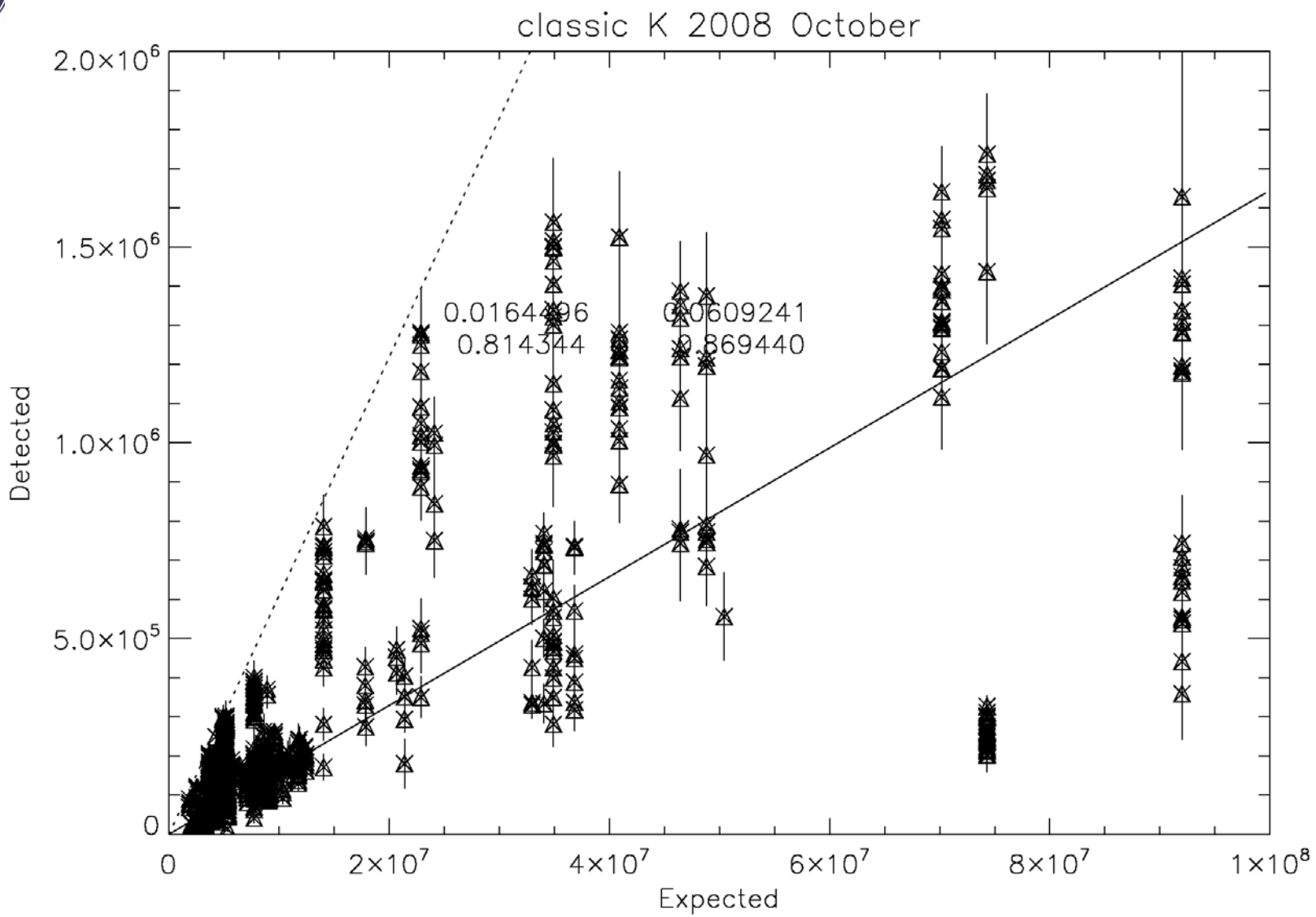
- Automated editing – Fringe > 1.1 Noise Power
- Took approximately 200 minutes to crunch.
- V < 0 and V > 1 thrown away.
- Not reliable for science.
- K&H magnitudes extracted from 2MASS.
- Stars without 2MASS data thrown away.
- Includes both calibrators and science targets.

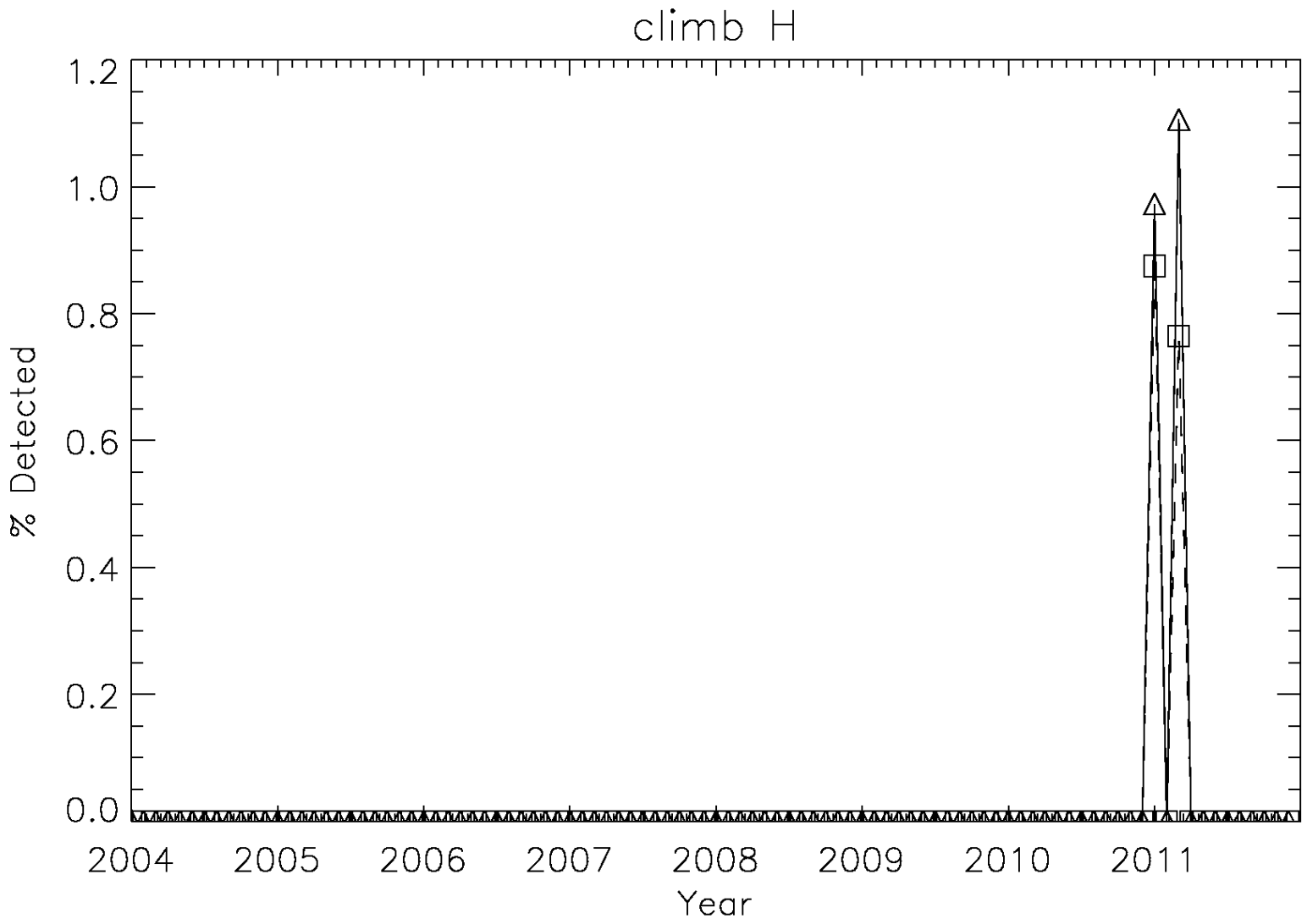
Amount of Data

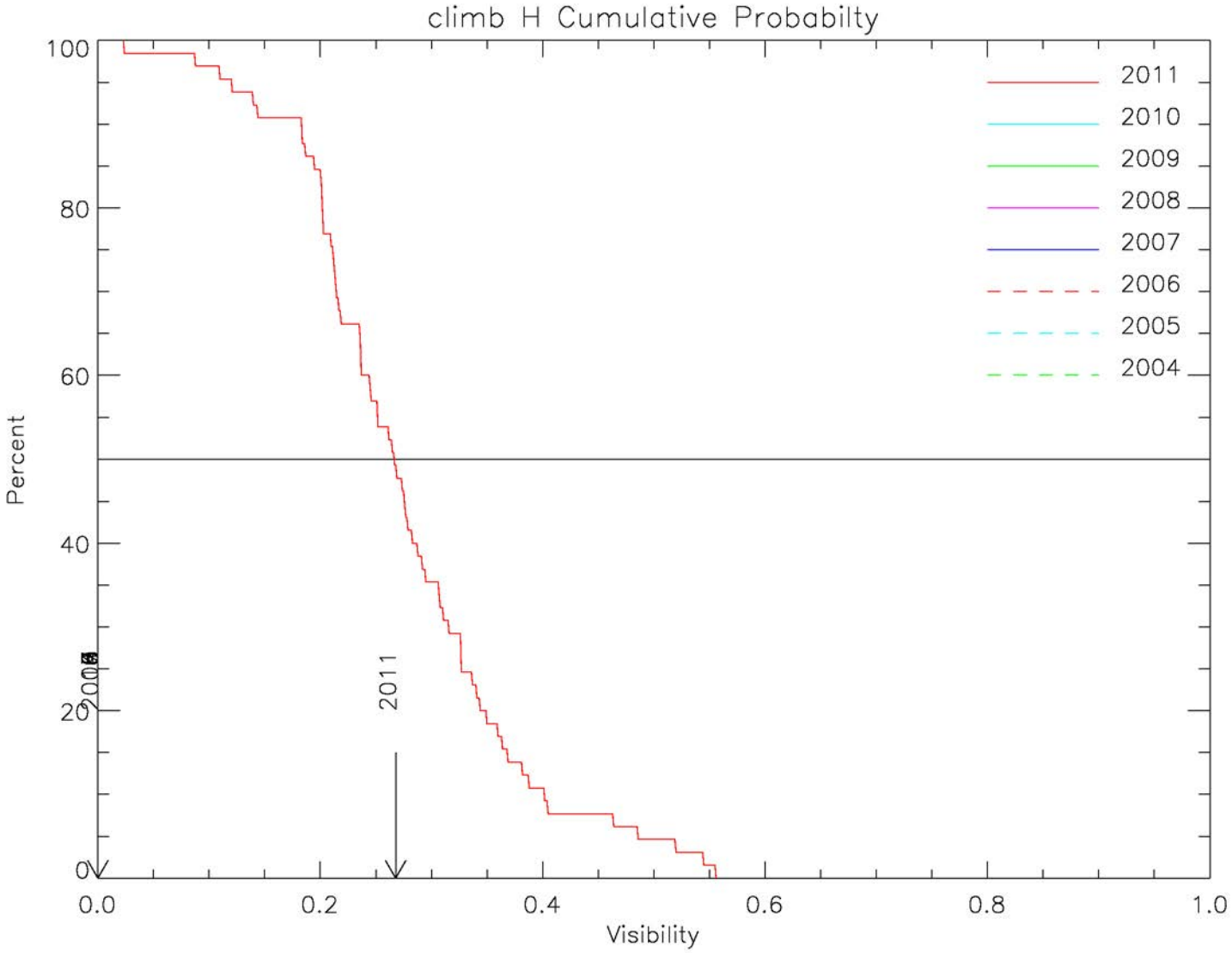


K/H Mags are converted to a photon count.

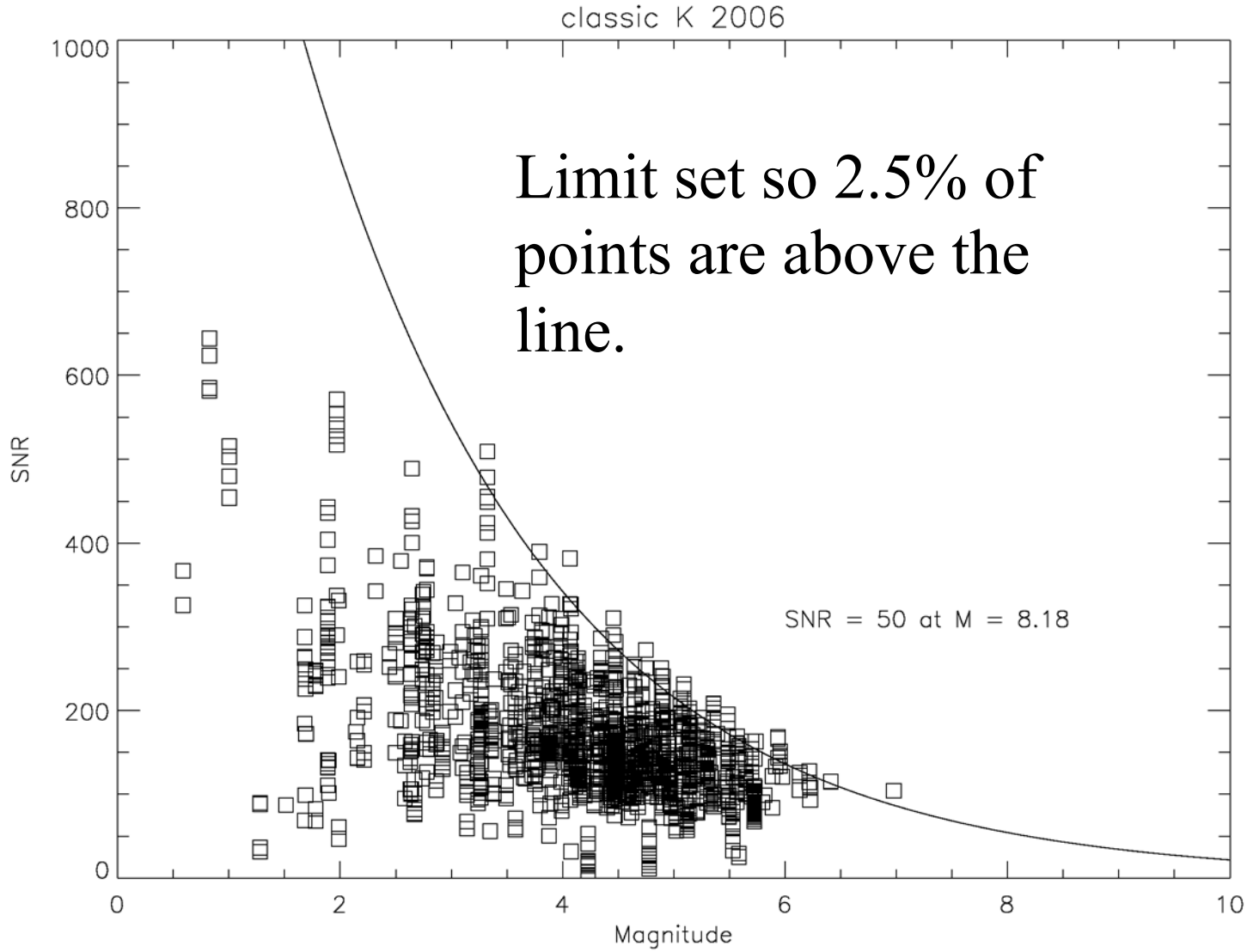
- Uses numbers from Camping, Rieke & Lebofsky PASP **90**, 896i (1995): For Mag 0 Star:
  - J Band 1.26 micron: 1603 Jy
  - H Band 1.60 micron: 1075 Jy
  - K Band 2.22 micron: 667 Jy
- 1 Jy = 1.51 x 10^7 Photons S^{-1} m^{-2} $(d\lambda/\lambda)^{-1}$
- All data are calibrated to 1 second.
- This assumes the NIRO readout mode behaves.
- Camera Gain = 0.3, DQE = 60%.


classic K 2008 October
2.0×10^6
1.5×10^6
1.0×10^6
5.0×10^5
0
Detected
0.0164496
0.814344
0.0609241
0.869440
0
2×10^7
4×10^7
6×10^7
8×10^7
1×10^8
Expected

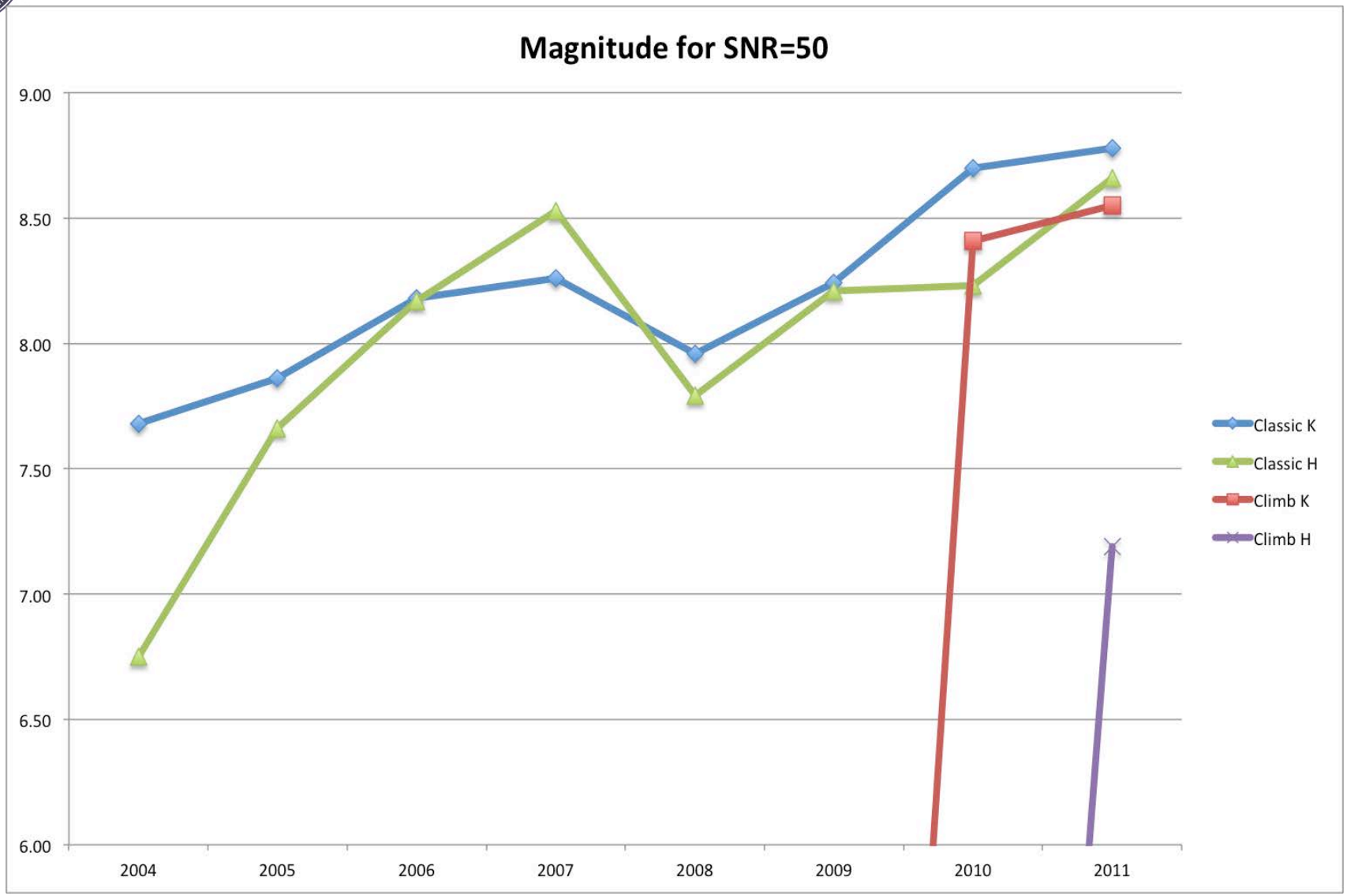

climb H
% Detected
1.2
1.0
0.8
0.6
0.4
0.2
0.0
2004
2005
2006
2007
2008
2009
2010
2011
Year


climb H Cumulative Probabilty
Percent
Visibility
2008
2011
2011
2010
2009
2008
2007
2006
2005
2004
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0

SNR ~ V * sqrt(N)



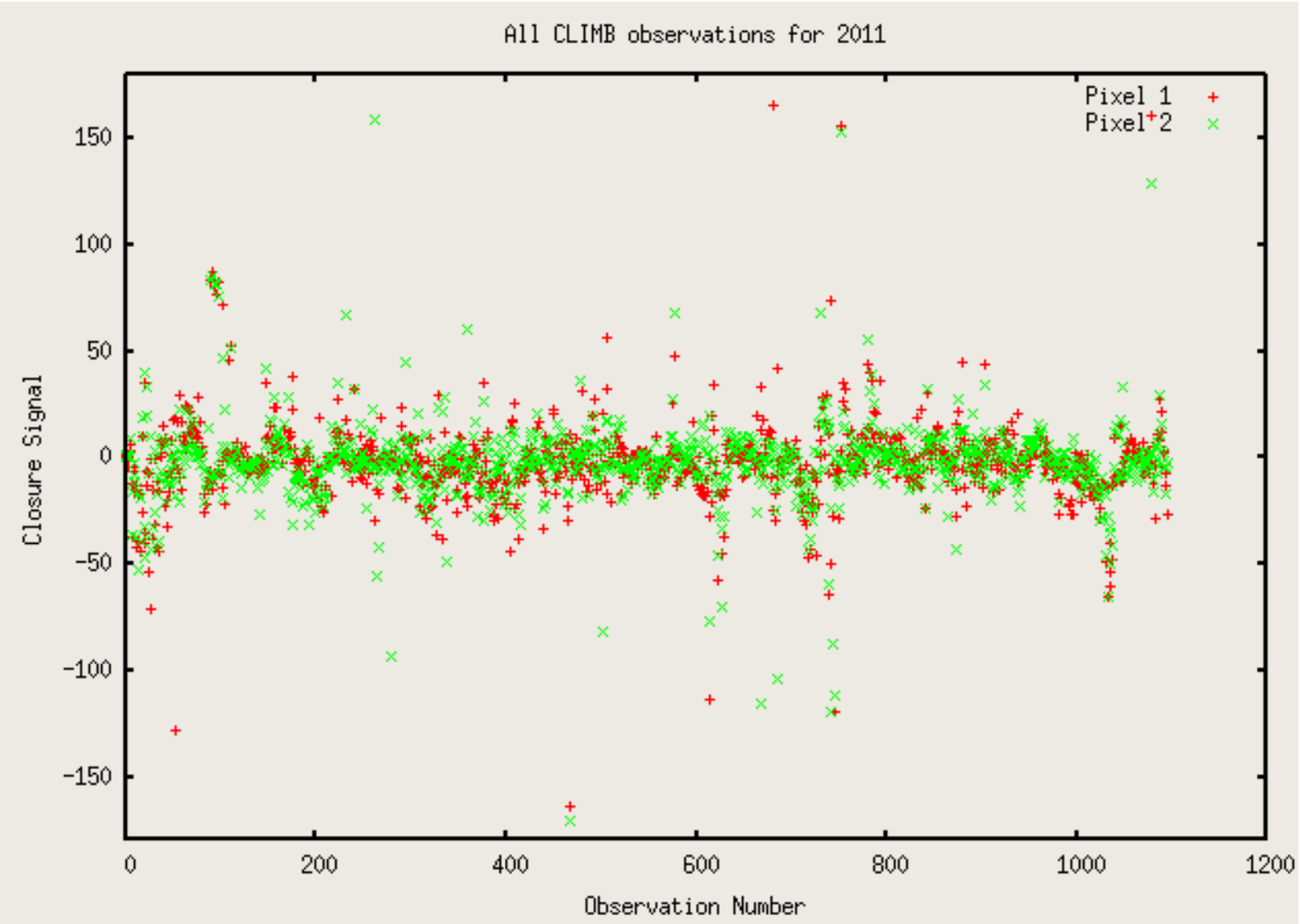
Limit set so 2.5% of points are above the line.


Magnitude for SNR=50
9.00
8.50
8.00
7.50
7.00
6.50
6.00
2004
2005
2006
2007
2008
2009
2010
2011
Classic K
Classic H
Climb K
Climb H

New Baseline Solution

- The system records the OPLE demand positions and current scope Alt/Az when fringes are found.
- This is now automated for all beam combiners.
- 31699 baseline solution data points were recorded.
- The demand position is better for modeling than the measured position.
- The height of a scope is degenerate with its internal path.
- We use a different internal path for each POP configuration to solve for telescope positions.
- We then do a separate solution for internal path.

```
# For telescope S1: value stddev delta (total delta 0.000)
XOFFSET          0.000     0.000     0.000
YOFFSET          0.000     0.000     0.000
ZOFFSET          0.000     0.000     0.000
LIGHT            0.000     0.000     0.000
# For telescope S2: value stddev delta (total delta 3060.526)
XOFFSET   -5747637.548    44.564  1016.041
YOFFSET   33580104.206    67.442    48.828
ZOFFSET     637531.263   117.932 -2886.537
LIGHT      4095442.423   839.398  6779.591
# For telescope E1: value stddev delta (total delta 942.329)
XOFFSET  125334244.254    31.598  -551.286
YOFFSET  305933013.215    47.664  -745.842
ZOFFSET   -5909006.219    80.913   166.693
LIGHT     11259858.369   684.971 -3591.416
# For telescope E2: value stddev delta (total delta 1204.619)
XOFFSET   70396362.110    46.729  -331.637
YOFFSET  269714400.028    54.623  -513.425
ZOFFSET   -2797738.552   102.564 -1038.036
LIGHT     22697645.383   799.156 -2488.115
# For telescope W1: value stddev delta (total delta 2275.876)
XOFFSET -175073120.219    39.053   713.525
YOFFSET  216321086.470    44.869 -2142.241
ZOFFSET  -10790791.538    85.156   285.127
LIGHT     27288923.917   647.980 -2364.878
# For telescope W2: value stddev delta (total delta 1475.716)
XOFFSET  -69093010.726    40.184   181.981
YOFFSET  199335211.518    47.672 -1364.519
ZOFFSET     467094.485    90.817  -531.704
LIGHT    -10867459.137   836.655 -2401.186
```


All CLIMB observations for 2011
Pixel 1
Pixel 2
Closure Signal
Observation Number
150
100
50
0
-50
-100
-150
0
200
400
600
800
1000
1200

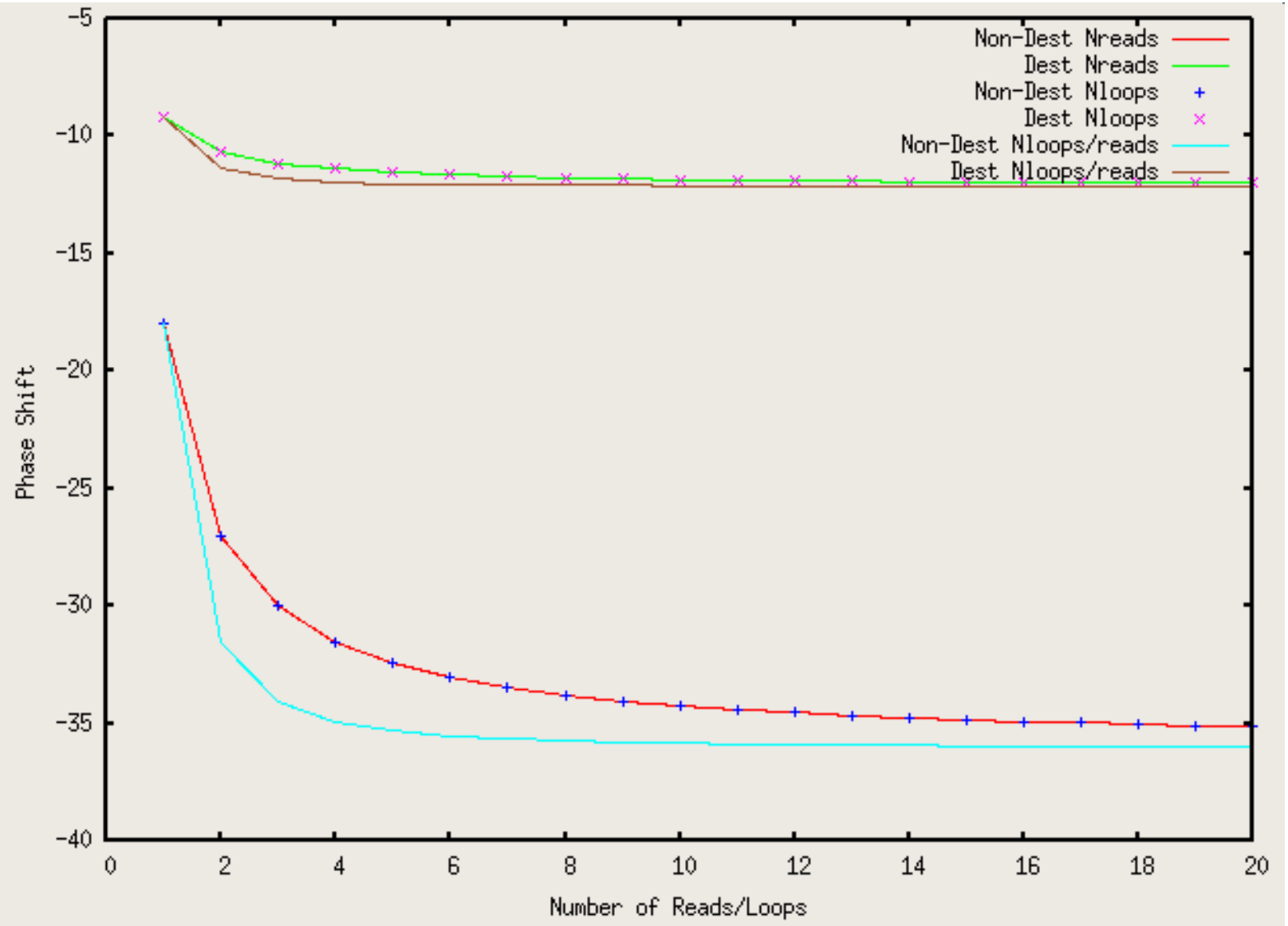
NIRO Readout Methods

$$\Delta C(\omega_i) = g \int_{\omega_{\mathrm{Reset}}}^{\omega_i} f(\omega) d\omega$$

$$f(\omega) = 1 \pm V \cos(\omega + \phi)$$

$$\Delta C(\omega_i) = g \left[\omega_i - \omega_{\mathrm{Reset}} \pm V \left(\sin(\omega_i + \phi) - \sin(\omega_{\mathrm{Reset}} + \phi)\right)\right]$$

1. The output of a single read is an integration of intensity from the time of the last reset to the time of the read.
2. This makes it relatively simple to model NIRO readout modes.
3. We have historically thought that more "loops" would result in less phase error. It turns out that this is not true…..
4. Yes, I know. I should have done this analysis a long time ago ;-)


Non-Dest Nreads
Dest Nreads
Non-Dest Nloops
Dest Nloops
Non-Dest Nloops/reads
Dest Nloops/reads
Phase Shift
-5
-10
-15
-20
-25
-30
-35
-40
0
2
4
6
8
10
12
14
16
18
20
Number of Reads/Loops

Conclusions

- We may be reaching the physical limits of sensitivity (9th magnitude) short of adding the full AO system.
- CLIMB performance, as expected, is almost as good as CLASSIC, with CLASSIC going a little fainter.
- The baseline solution seems to be under control.
- CLIMB is becoming quite popular.
- CLIMB closure phase is working.
- NIRO readout modes are better understood: Non-destructive reads, and looping, do not improve camera performance in any way.

CHARA Rocks!