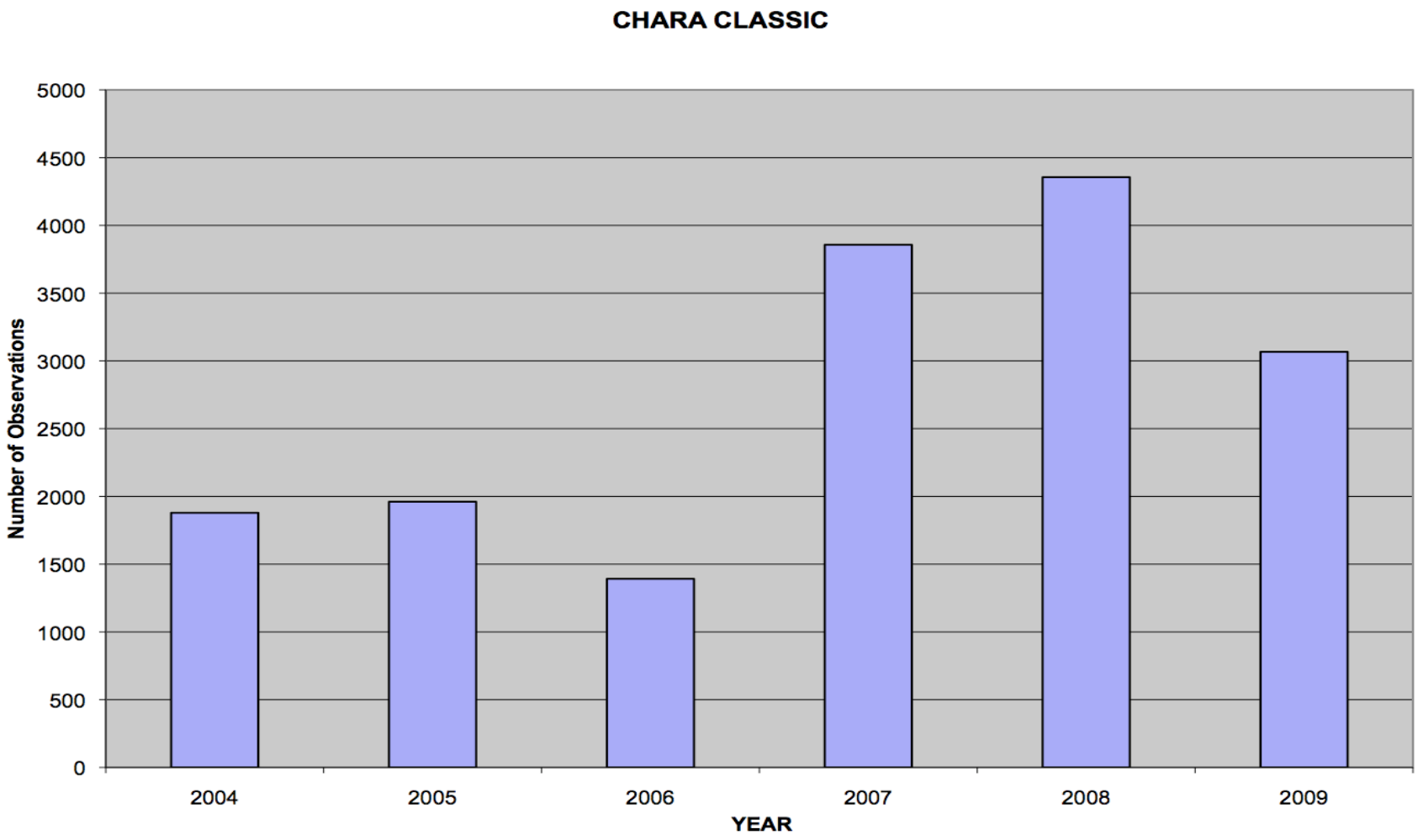
CHARA Classic Throughput

Theo ten Brummelaar

Data Pool: All 2004/5/6/7/8/9 Data

- Automated editing – Fringe > 1.1 Noise Power
- Took approximately 180 minutes to crunch.
- V < 0 and V > 1 thrown away.
- Not reliable for science.
- K magnitudes extracted from 2MASS.
- Stars without 2MASS data thrown away.

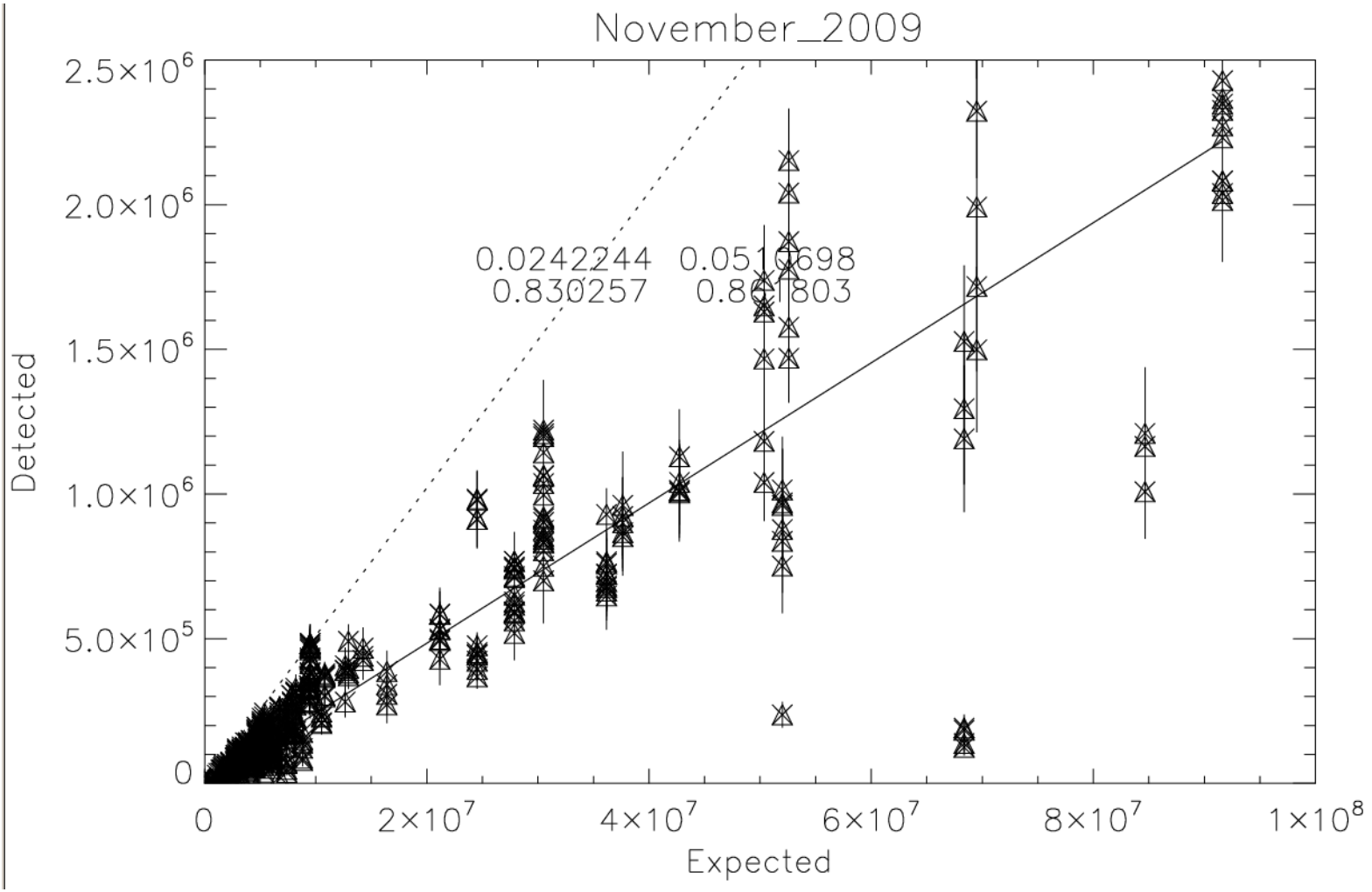
Amount of Data

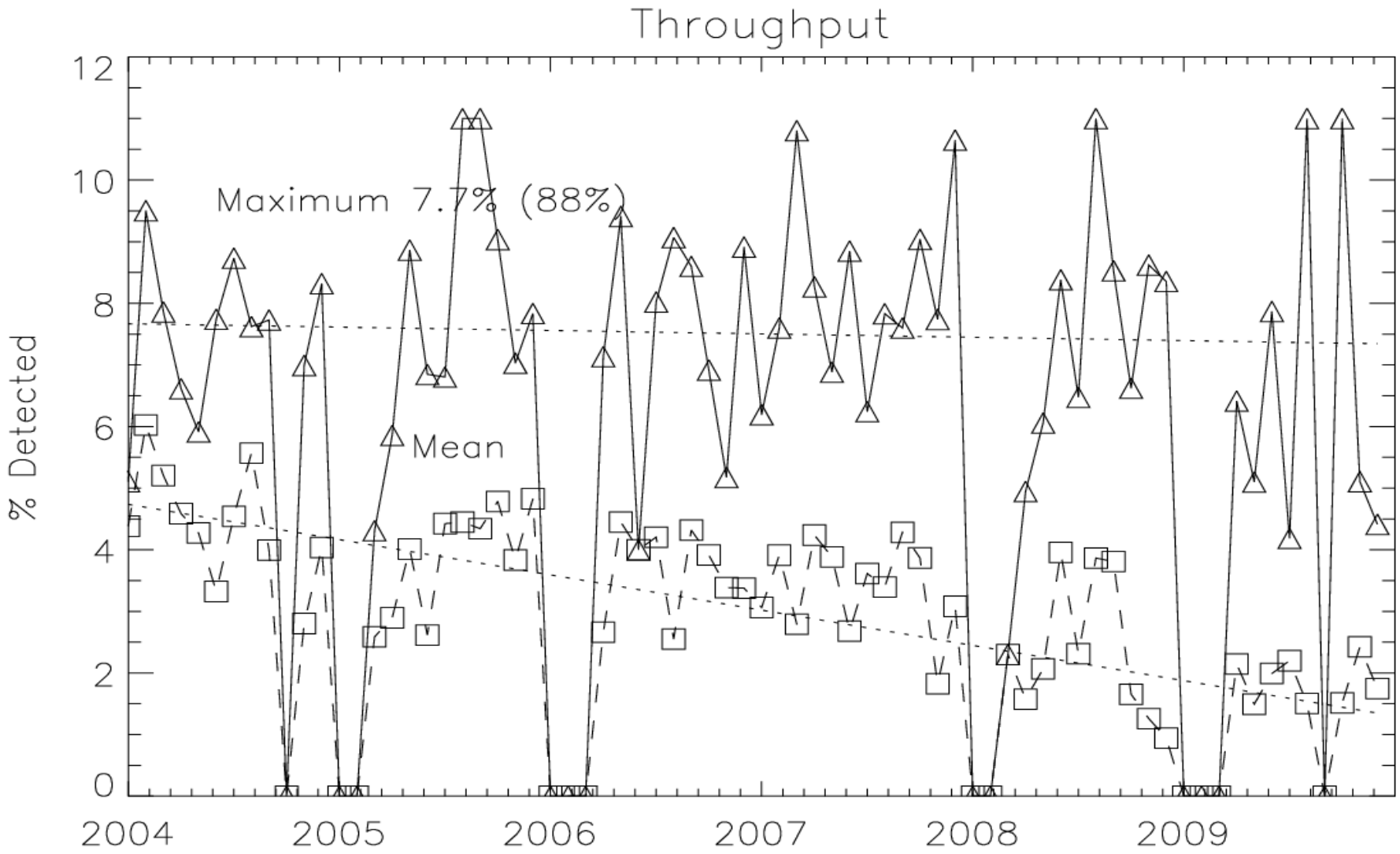


K Mags are converted to a photon count.

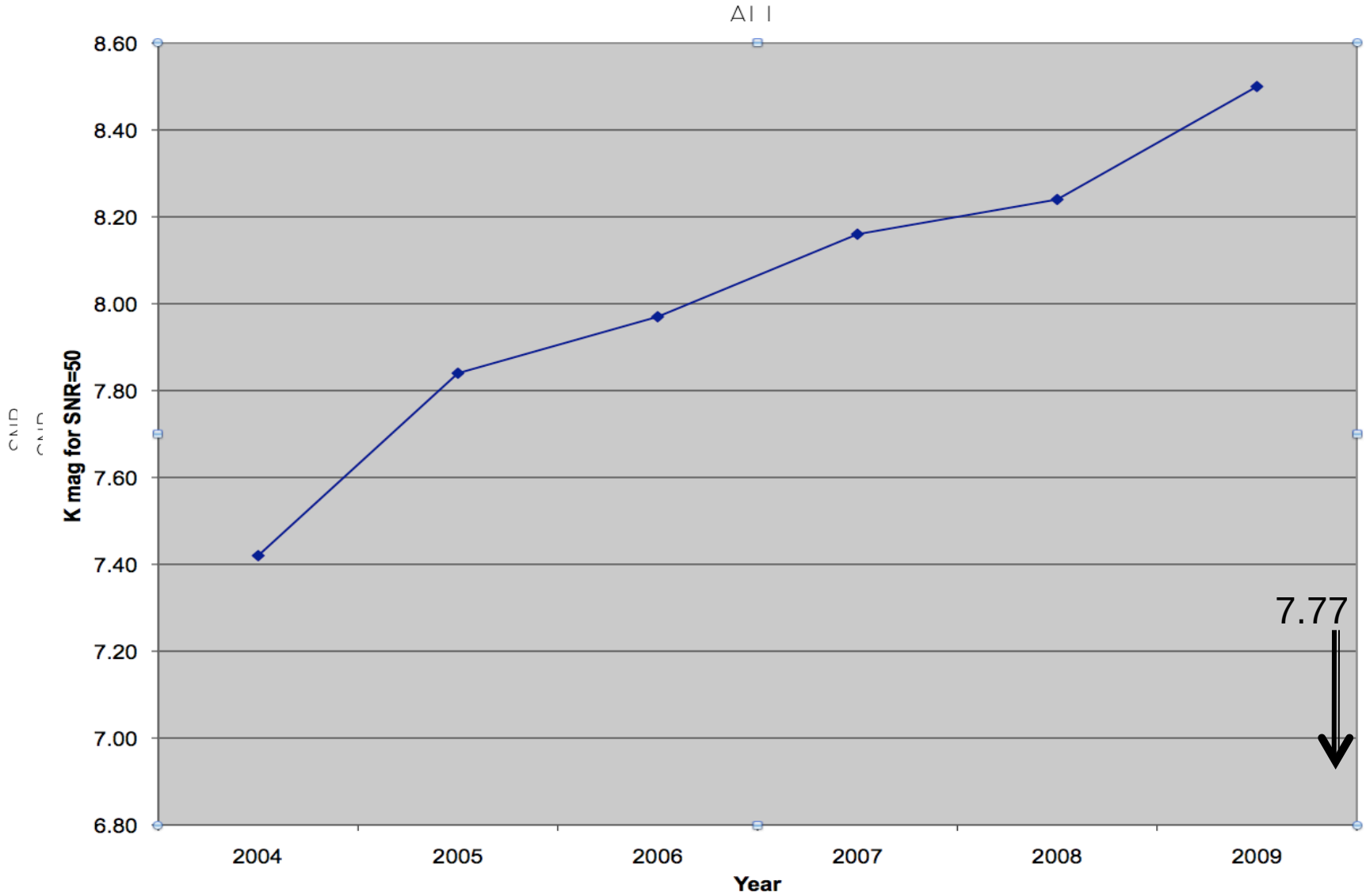
- In K band there are 4.31 x 10^{9} Photons m^{-2} $s^{-1}um^{-1}$
- Two 1m telescopes: 2 x π x 0.25 = 1.57 m^{2}
- All data calibrated to 1 second.
- This assumes the NIRO readout mode behaves.
- K band is 0.35 um wide.
- All of this results in Nph = 2.37 x $10^{(9- M/2.5)}$
- Camera Gain = 0.3, DQE = 60%.

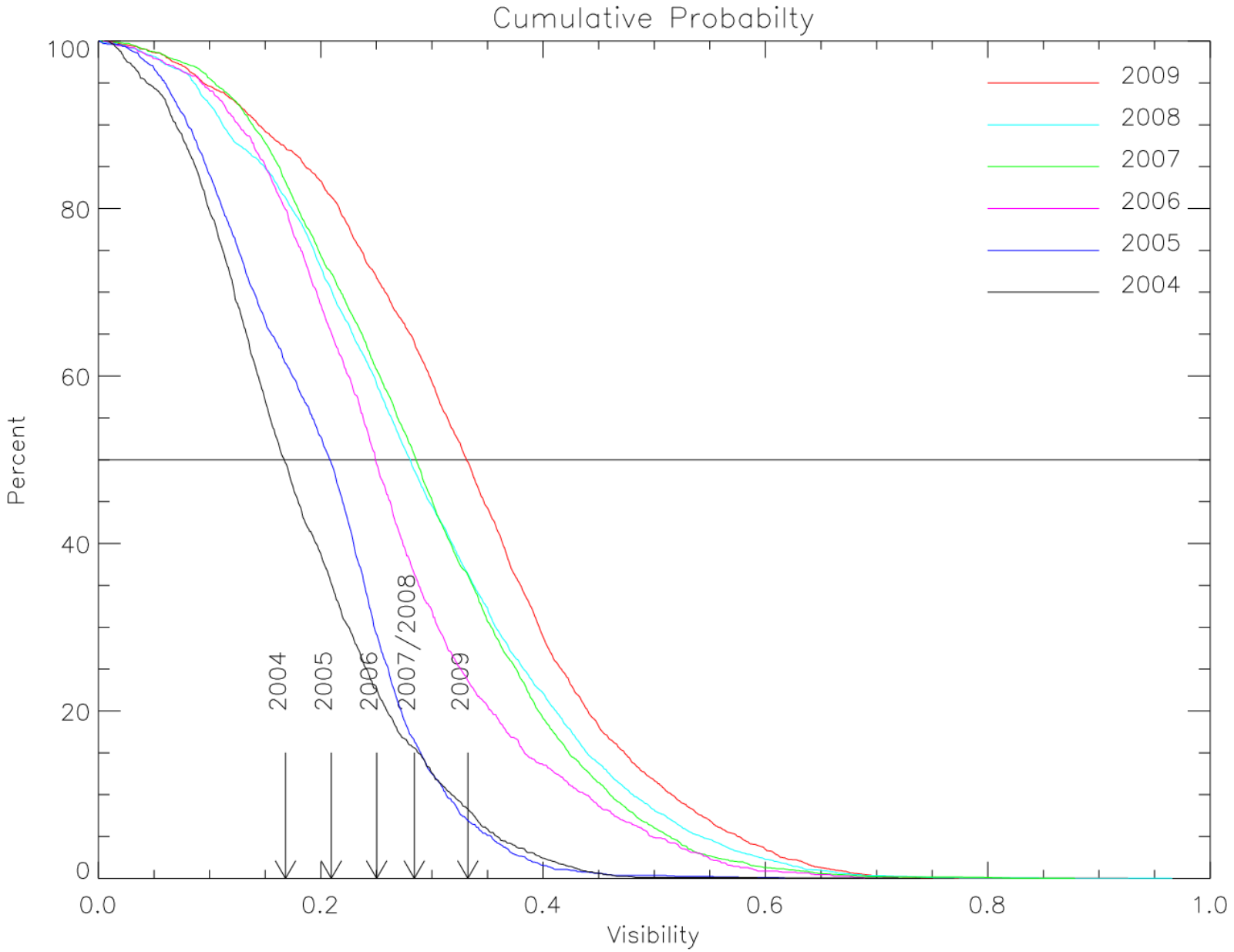
Some Example Data




Throughput
Maximum 7.7% (88%)
Mean
% Detected
0
2
4
6
8
10
12
2004
2005
2006
2007
2008
2009

SNR ~ V * sqrt(N)


All
8.60
8.40
8.20
8.00
7.80
7.60
7.40
7.20
7.00
6.80
K mag for SNR=50
2004
2005
2006
2007
2008
2009
Year
7.77


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

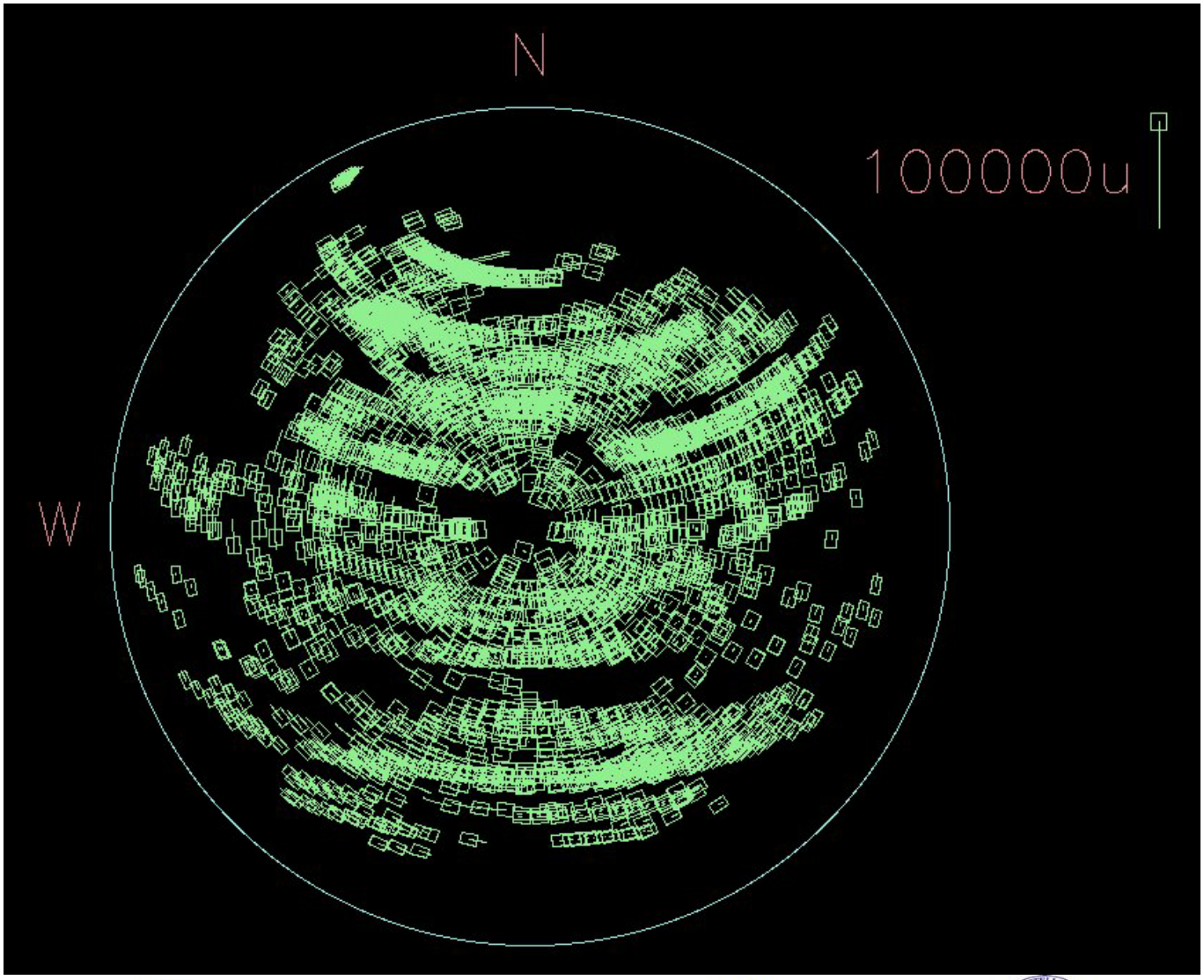
The Bottom Line

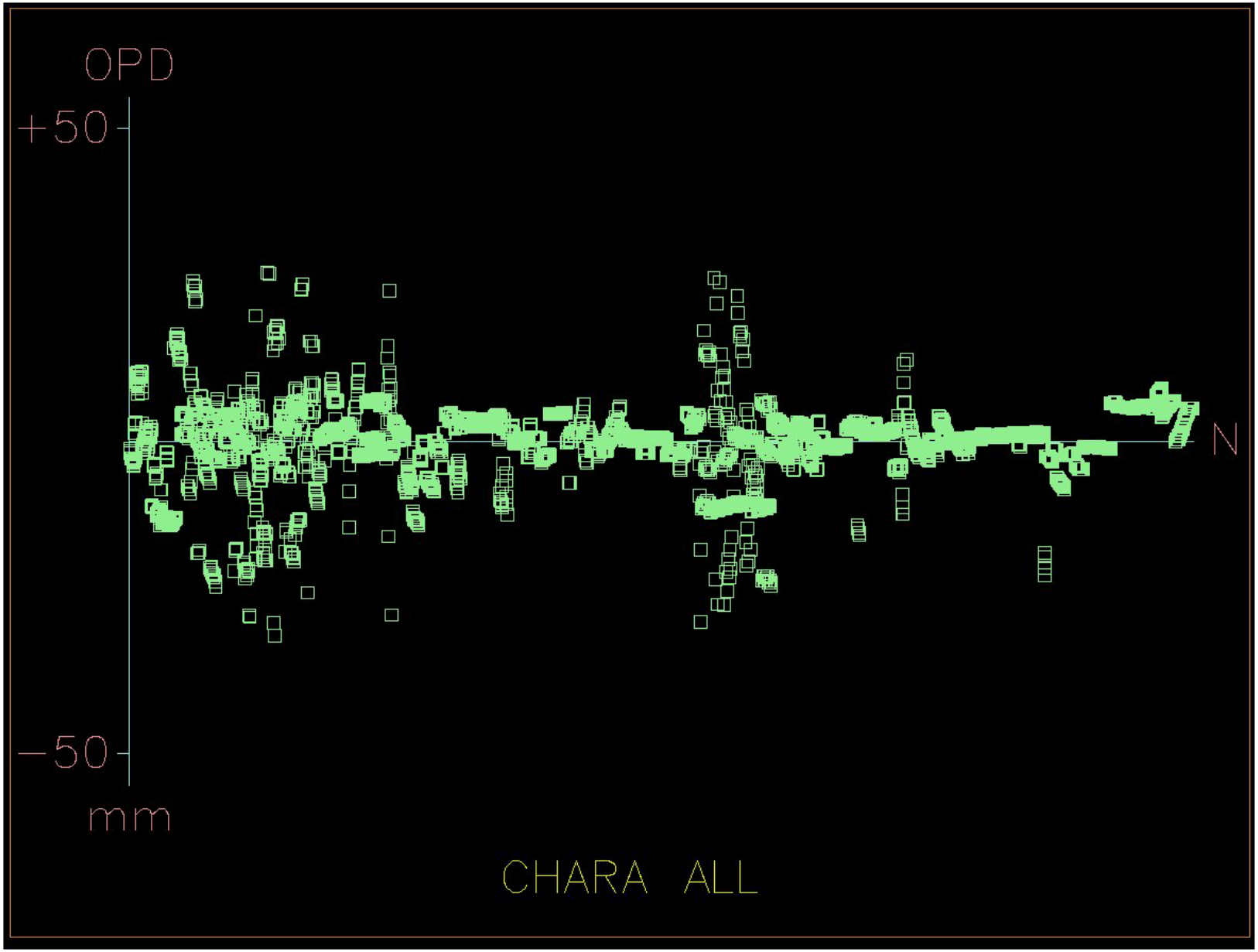
- K Band throughput is 7.7% (88% reflectivity)
- SNR, Raw visibility and Magnitude limits went up in 2005, 2006 and 2007. In 2008 they remained the same, or worse, than 2007. They improved in 2009.
- Current record for finding fringes is K=7.767 while the predicted limit is K=8.5.
- We expect improvements to the NIRO readout software, irises, and scope alignment to give us another 0.5 magnitudes of sensitivity. Beyond that we need AO.

New Baseline Solution

- The system now records OPLE demand positions and current Alt/Az when fringes are found.
- This is automated for CLASSIC and CLIMB. Other beam combiners need to implement this as multiple baselines are bound to be better.
- The demand position is better for modeling than the measured position.
- The height of a scope is degenerate with its internal path.
- 4507 data points from 2009.
- We use the program Iphase by Patrick Wallace.

Sky Coverage




OPD
+50
−50
mm
N
CHARA ALL

Resulting Fit

- Required separate internal path for each POP configuration.
- Scope heights and internal paths changed most significantly.
- Clock errors don't seem to be such a problem anymore.
- Internal paths tweaked so that the positions at zenith match the current model for default POPs.
- PW suggests adding a coefficient for time of year.
- Sigma at the few mm level, of the same order as delay from alignment errors.
- NOT TRIED ON SKY.

	coeff	change	value	sigma
1	S1.X		+0.0	
2	S1.Y		+0.0	
3	S1.Z		+0.0	
4	S2.X	-0.00	+5743281.2	869.30
5	S2.Y	-0.00	-33585749.7	942.63
6	S2.Z	-0.00	+616480.3	2807.99
7	S1-S2.A	-0.00	+4658523.2	2691.34
8	E1.X	+0.00	-125330516.1	404.69
9	E1.Y	+0.00	-305928516.6	443.79
10	E1.Z	-0.00	-5913616.3	1219.21
11	S1-E1.A	-0.00	+15504275.1	1022.49
12	E2.X	+0.00	-70390697.8	1141.13
13	E2.Y	-0.00	-269714168.6	913.86
14	E2.Z	-0.00	-2792757.0	3737.63
15	S1-E2.A	+0.00	+26374754.2	3142.03
16	W1.X	+0.00	+175068518.1	489.75
17	W1.Y	-0.00	-216320180.4	502.54
18	W1.Z	-0.00	-10781144.8	1427.08
19	S1-W1.A	+0.00	+29135637.0	1236.46
20	W2.X	+0.00	+69085287.1	750.29
21	W2.Y	-0.00	-199332626.1	800.84
22	W2.Z	-0.00	+434733.4	2349.27
23	S1-W2.A	-0.00	-8456232.8	1884.69
24	S2-E1.A	+0.00	+10836603.1	2507.50
25	S2-E2.A	+0.00	+21703789.8	3674.65
26	S2-W1.A	+0.00	+24480036.4	2311.86
27	S2-W2.A	+0.00	-13156943.8	2144.35
28	E1-E2.A	+0.00	+10861690.2	3373.13
29	E1-W1.A	+0.00	+13622821.1	1280.13
30	E1-W2.A	-0.00	-23991559.9	2081.79
31	E2-W1.A	-0.00	+2791659.3	3730.96
32	E2-W2.A	-0.00	-34862284.3	3776.91
33	W1-W2.A	-0.00	-37622717.3	1996.17

OPD RMS = 5661.45 microns
Popn SD = 5680.97 microns