The Case for Spatial Filtering CHARA Classic

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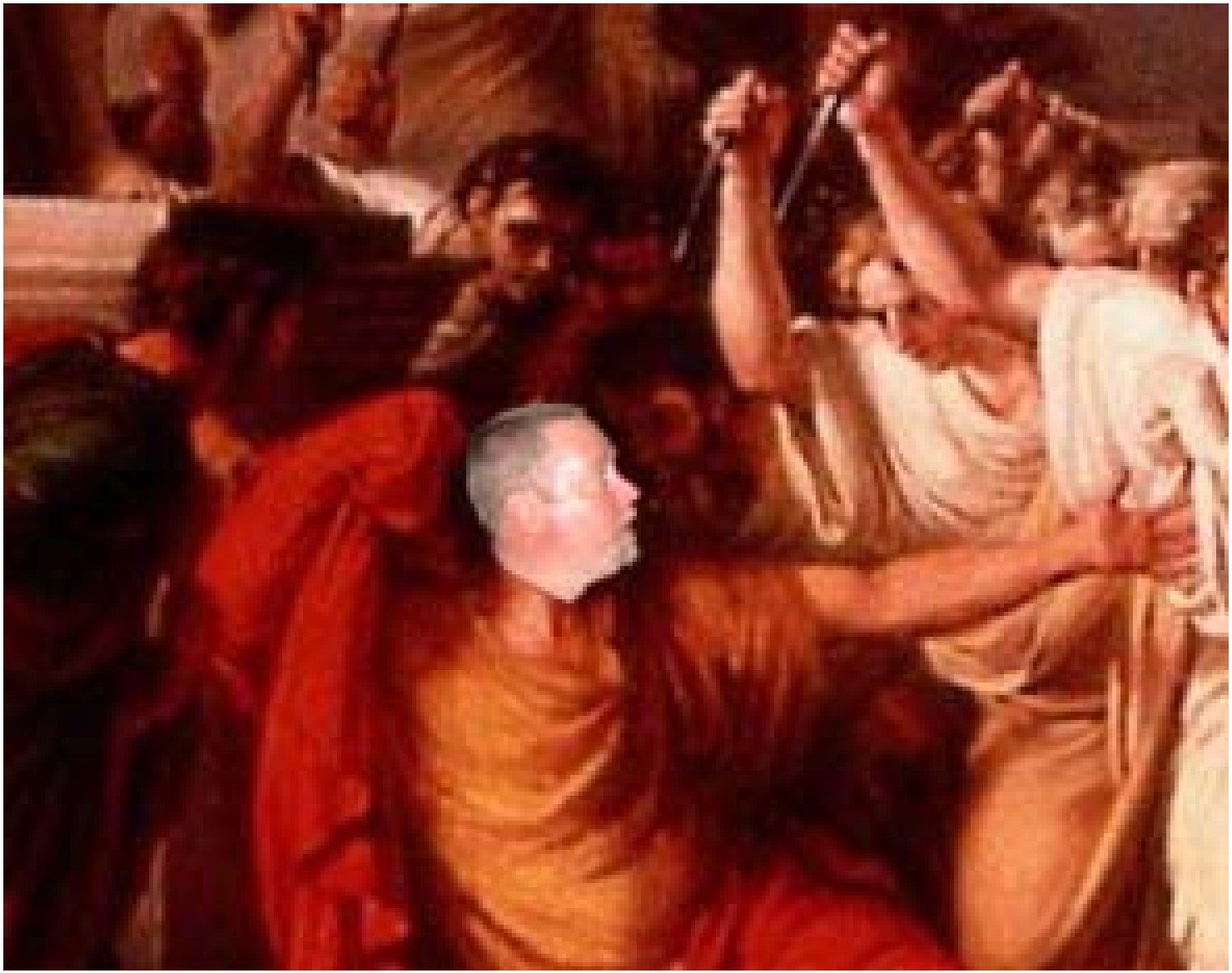


PTI Combination Scheme

- PTI's combined beams are fed into a NICMOS detector dewar
- The *white light channel* is a combined beam fed directly into the can
  - Used for immediate fringe tracking
- The *spectrally dispersed channel* is routed through a prism first
  - Also sent through a single mode fiber
  - Used for group delay updates, and ultimately used for science
  - Detected flux is ~30% of the WL side
- This setup delivers both sensitivity and precision

PTI "Classic"

Reference: Colavita et al. 1999

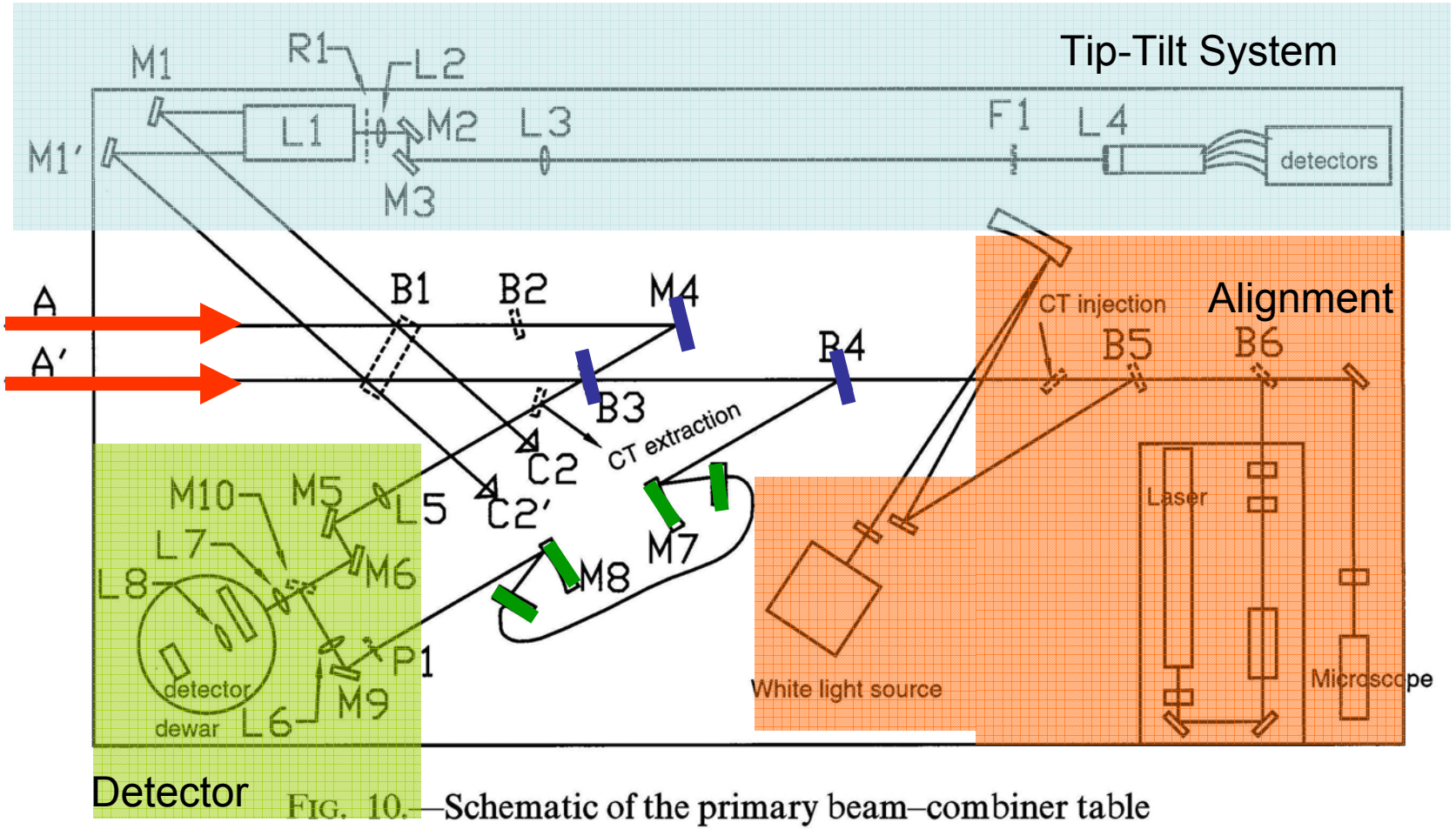
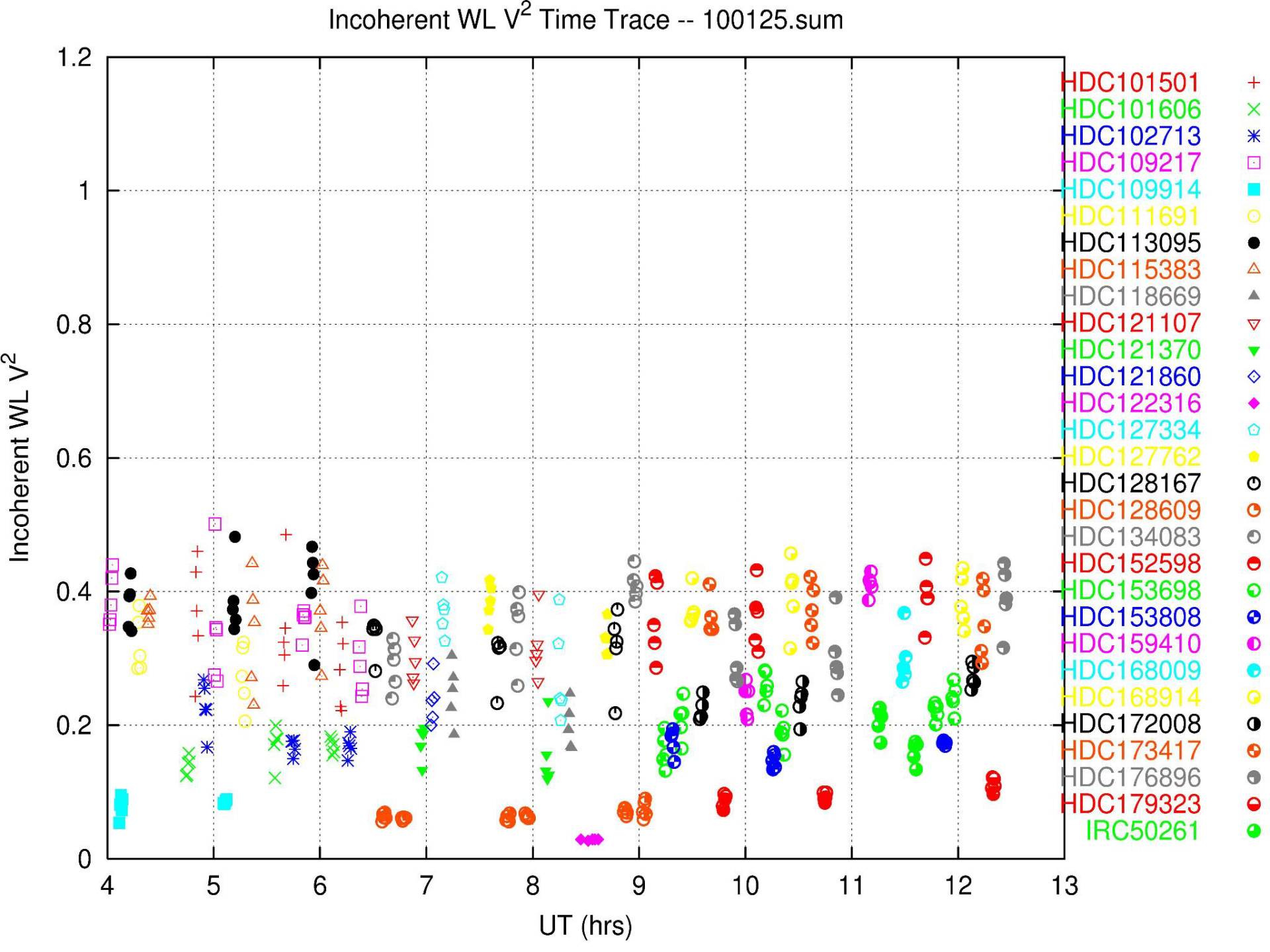


FIG. 10.—Schematic of the primary beam–combiner table

PTI Data on η Boo

- Recently published result (van Belle, Ciardi & Boden 2007 ApJ 657 1058)
- Spectral channel data used for the paper, but WL channel data preserved in the data stream
- Allows for a demonstration of the performance of the non-spatially filtered WL channel versus spectrometer channel


Incoherent WL V2 Time Trace -- 100125.sum
Incoherent WL V2
UT (hrs)
0
0.2
0.4
0.6
0.8
1
1.2
4
5
6
7
8
9
10
11
12
13
HDC101501
HDC101606
HDC102713
HDC109217
HDC109914
HDC111691
HDC113095
HDC115383
HDC118669
HDC121107
HDC121370
HDC121860
HDC122316
HDC127334
HDC127762
HDC128167
HDC128609
HDC134083
HDC152598
HDC153698
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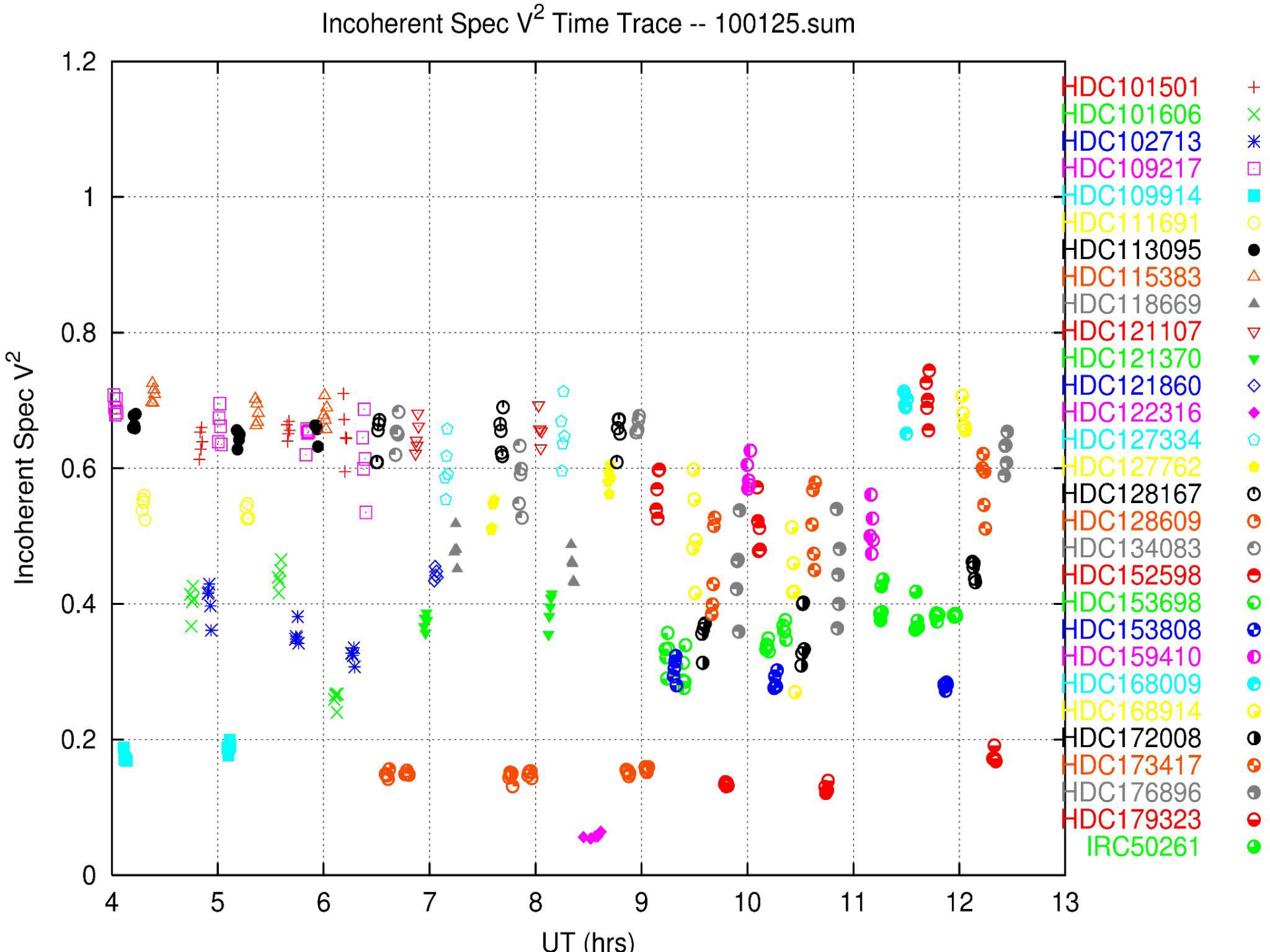
Incoherent Spec V2 Time Trace -- 100125.sum
Incoherent Spec V2
UT (hrs)
0
0.2
0.4
0.6
0.8
1
1.2
4
5
6
7
8
9
10
11
12
13
HDC101501
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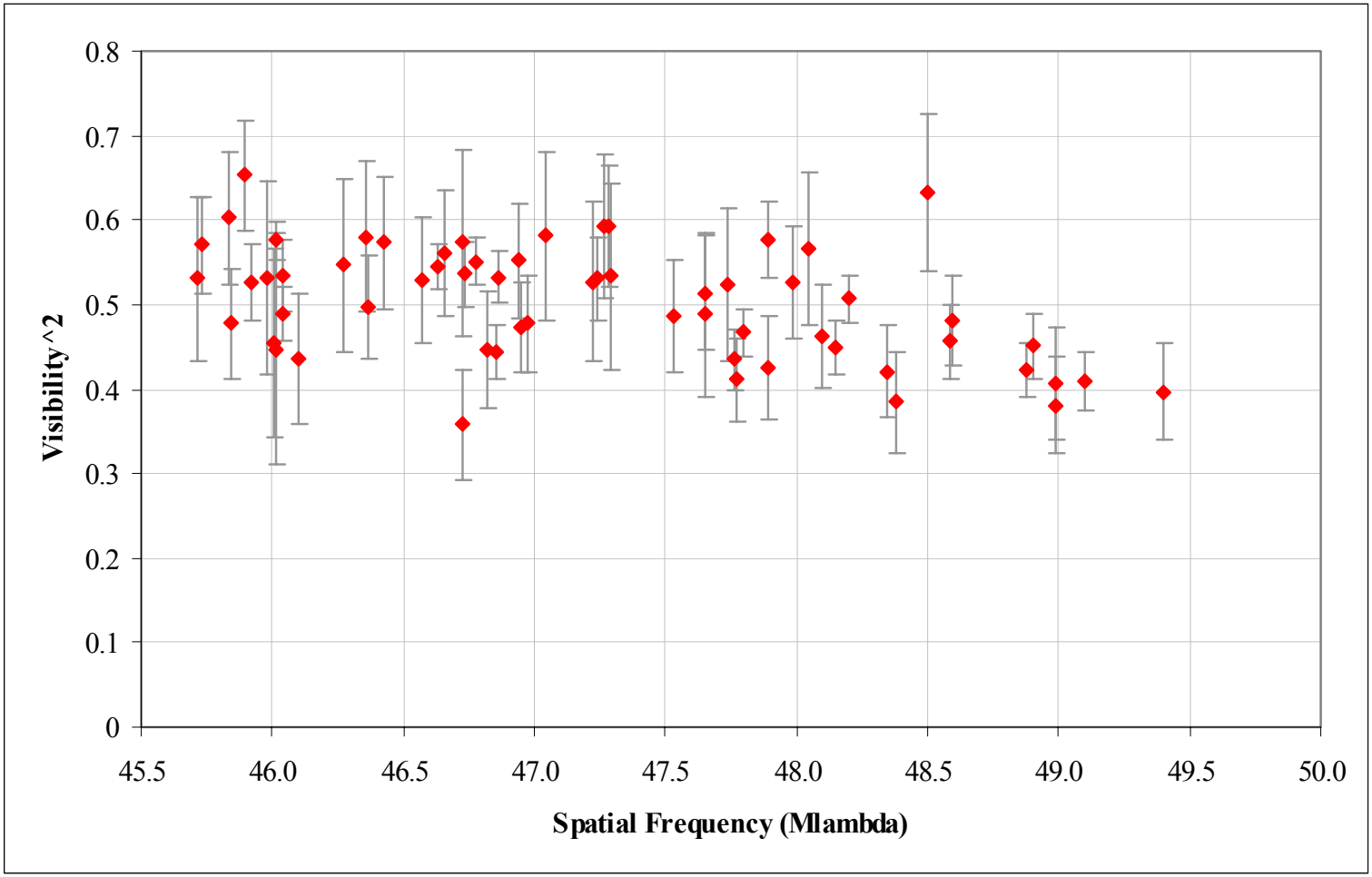
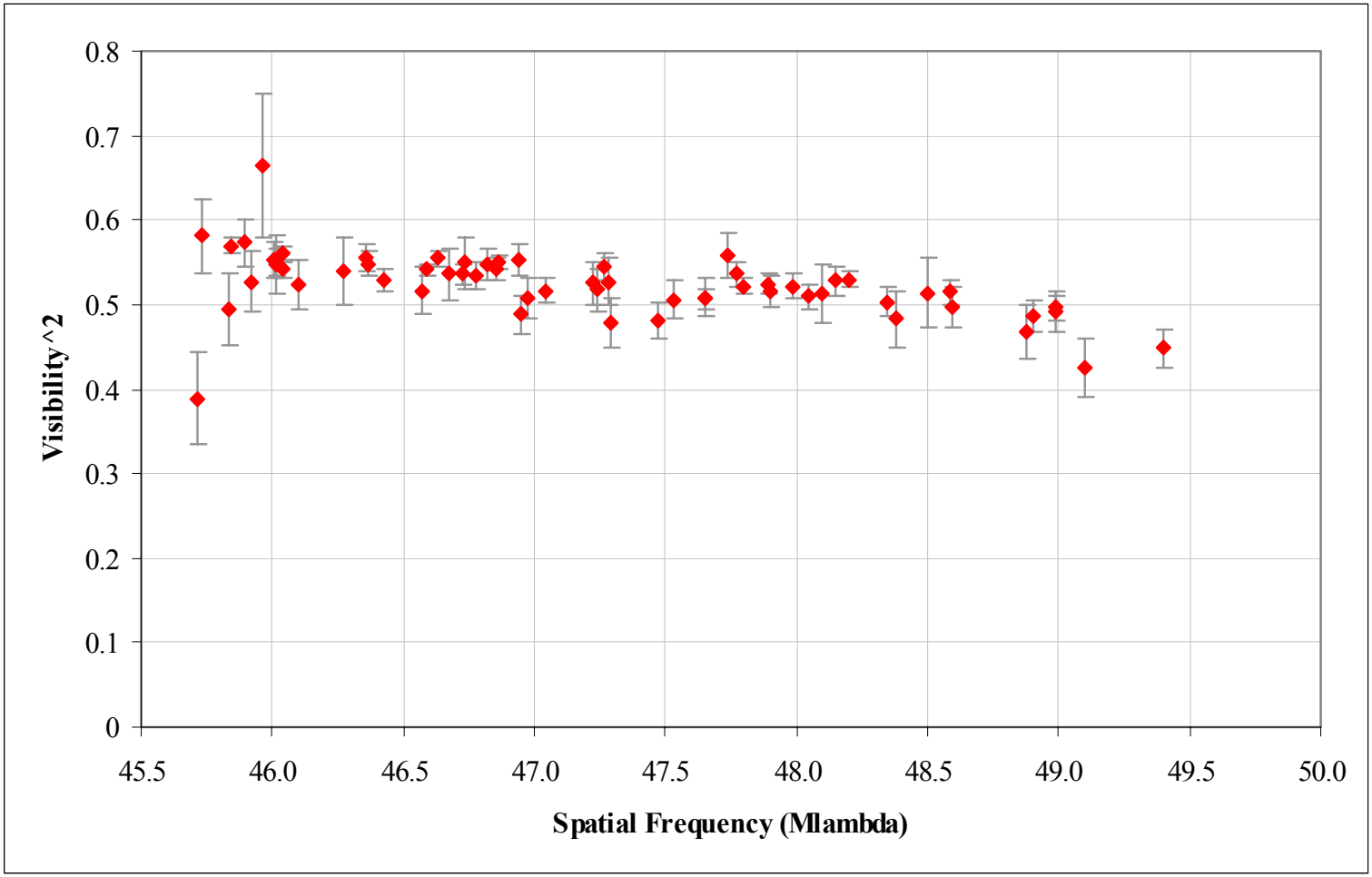
IRC50261

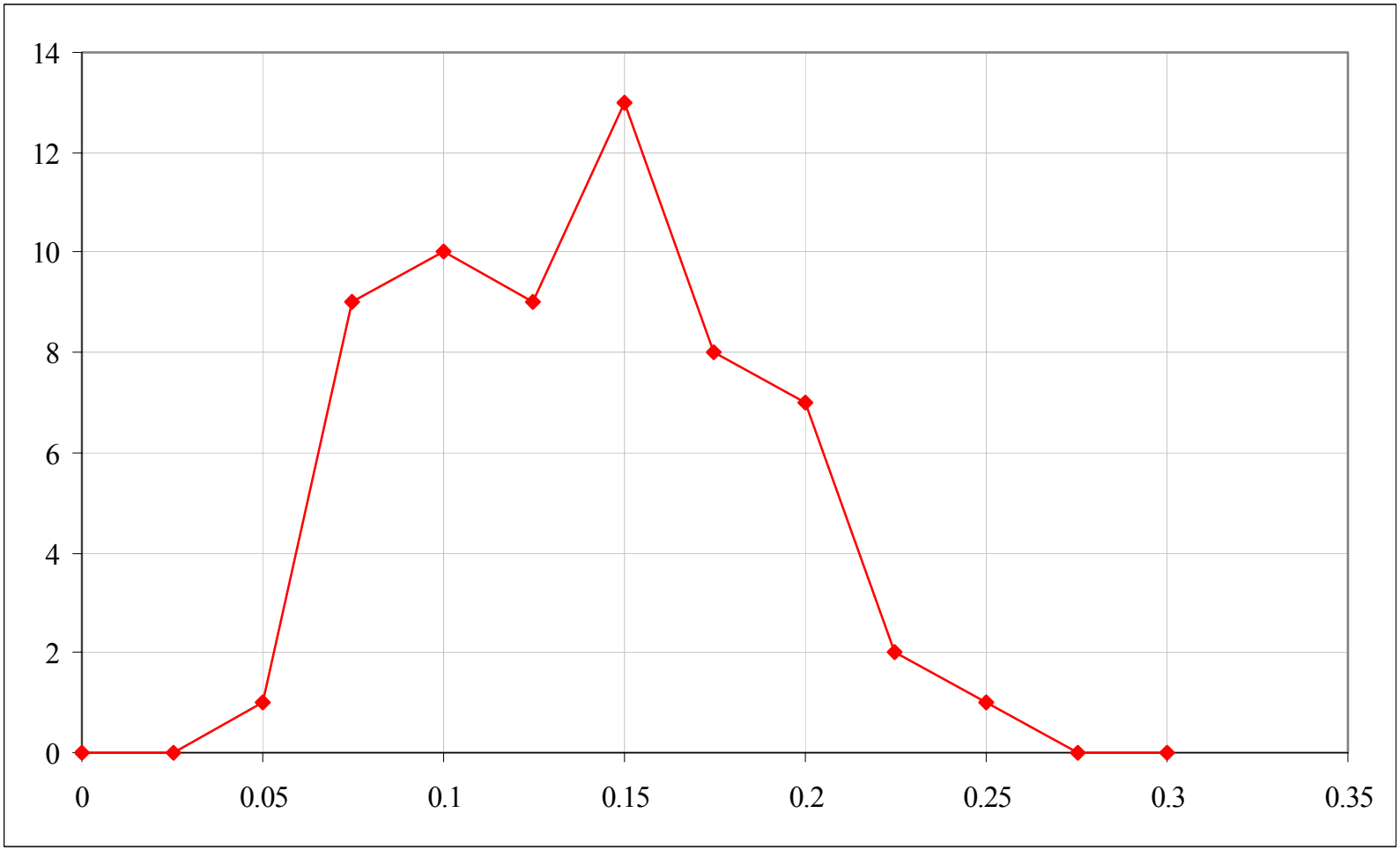
η Boo: Non-Spatially Filtered



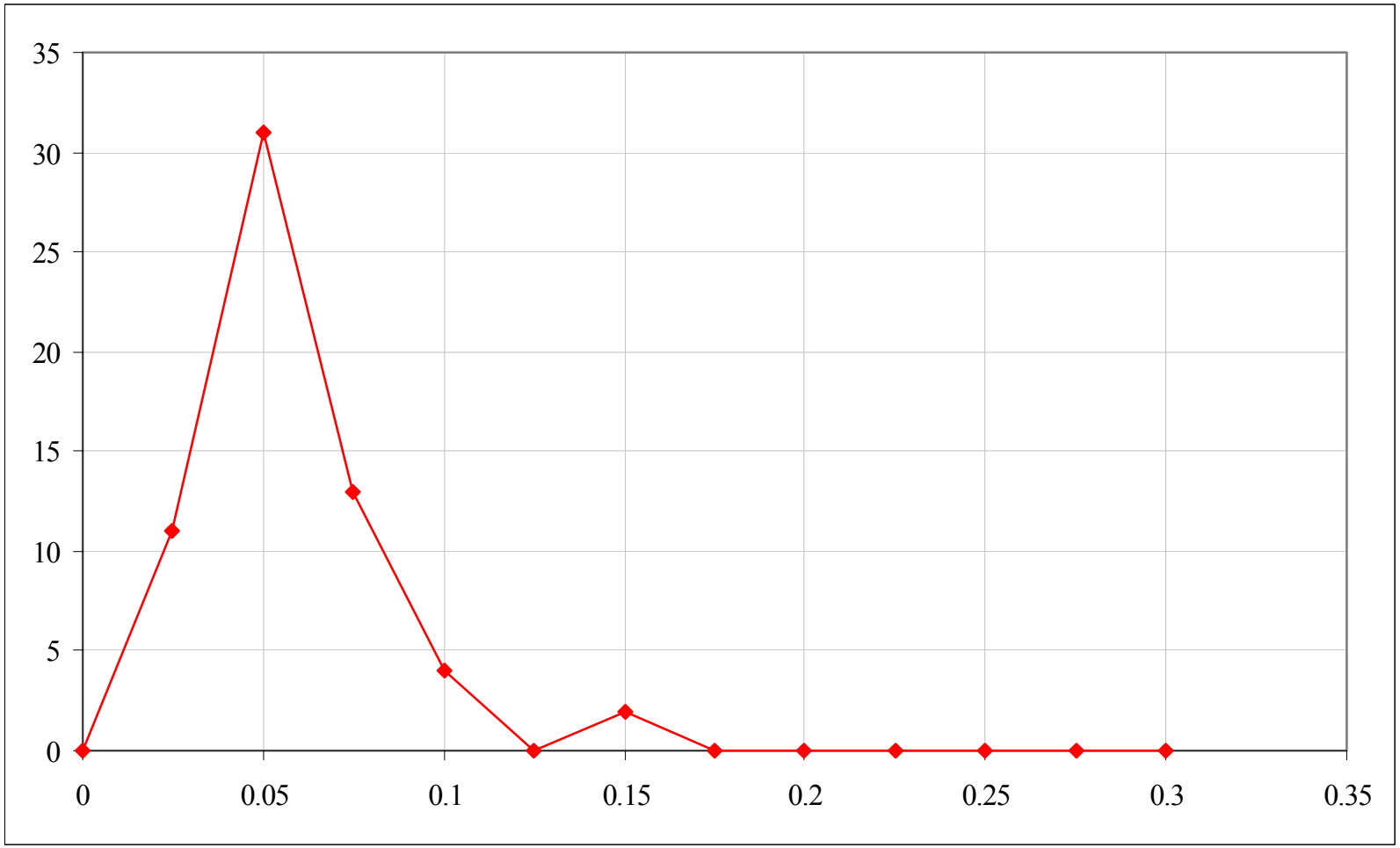
η Boo: Spatially Filtered



Error Histogram: Non-SF



Error Histogram: SF



Performance, Quantitatively

- Median individual V^2 measurement relative error (σ_{V2}/V^2): 0.039 (SF) versus 0.129 (non-SF)
- η Boo size: 2.154±0.048 mas (SF) versus 2.255±0.148 mas (non-SF)

The Downside

- Alignment
  - Possibly a challenge as a function of telescope pointing (wander of telescope beam on fiber head)
- Multi-r_0 Regime
  - Gains may not be as substantial as for PTI
  - Will throw away more 'bad photons'

Why CHARA Classic?

- Most sensitive beam combiner
- Most used beam combiner
- Easiest to use
- Possibly an only ‘slight’ modification to the existing beamtrain
- Can be done for near-term operations

The Exhortation

- Even within the context of the caveats, substantial gains in performance are possible
- Possibly no (or at least little) sacrifice in sensitivity