Finalizing the Separated Fringe Packet Survey with the CHARA Array

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CHARA 2007
AMNH, NYC, NY
Agenda

- Basic Project Info
- Locating true position/completeness
- Overview of 2005
- Observing runs 2006/2007
- Observing this year
- Stars with SFPs
- What is left with the project?
The Project

- An update of Duquennoy & Mayor’s spectroscopic survey for multiplicity in solar type (F0-G9) stars
- To assume no personal selection bias, I started with the entire 291 system sample (some original targets found to be further than known)
  - Removed all targets south of -2° to remove atmospheric problems near horizon
  - Eliminated all targets dimmer than $V_k=5$ (at the time a reasonable sensitivity limit for the CHARA array)
  - Discarded all known giants (Lum class I-III)
  - Process resulted in 145 target stars
- Additionally, 28 double and single lined spectroscopic binaries were added that fell within the separation range predicted for this project
  - Of these 13 were already part of the original list, so 15 new targets were added to bring the total to 160
Vector Separation of Fringes

U,V RESULTS

HD181655 W1S1 - October 05 2005
Ideal Case

True Position

B1

B2
Realistic Case (1 baseline)

Nightly baseline rotation varies:
10-60°

First run in fall 2005:
Rotation of 2-3° through 3 data files
Not good enough

Summer run 2006:
Average of 35° each night
In addition to second baseline ≈60°
Completeness

\[
\Lambda_{\text{coh}}
\]

Box Area = \% area searched
Total A

Scan Length = 86.94\mu m
\Lambda_{\text{coh}} = 18.15\mu m

1D Single scan completeness: 79%
Area Not searched:

\[
\frac{(\Lambda_{\text{coh}})^2}{\sin(\theta)}
\]

Completeness for orthogonal: 95.6%
### SFP Resolution Limits

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Max B</th>
<th>Min B</th>
<th>Wide on Max B</th>
<th>Close on Max B</th>
<th>Wide on Min B</th>
<th>Close on Min B</th>
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<tbody>
<tr>
<td>E2-S2</td>
<td>248.13</td>
<td>155.56</td>
<td>103.58</td>
<td>13.28</td>
<td>165.22</td>
<td>21.18</td>
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<tr>
<td>W1-S2</td>
<td>249.39</td>
<td>144.66</td>
<td>103.06</td>
<td>13.21</td>
<td>177.68</td>
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<tr>
<td>W1-E2</td>
<td>251.34</td>
<td>113.45</td>
<td>102.26</td>
<td>13.11</td>
<td>226.54</td>
<td>29.04</td>
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<tr>
<td>W1-S1</td>
<td>278.50</td>
<td>172.80</td>
<td>92.29</td>
<td>11.83</td>
<td>148.74</td>
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<tr>
<td>E2-S1</td>
<td>278.77</td>
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<td>11.82</td>
<td>151.78</td>
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<tr>
<td>E1-S2</td>
<td>302.34</td>
<td>202.89</td>
<td>85.01</td>
<td>10.90</td>
<td>126.68</td>
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<tr>
<td>W1-E1</td>
<td>313.54</td>
<td>134.27</td>
<td>81.97</td>
<td>10.51</td>
<td>191.42</td>
<td>24.54</td>
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<tr>
<td>E1-S1</td>
<td>330.67</td>
<td>215.92</td>
<td>77.73</td>
<td>9.96</td>
<td>119.03</td>
<td>15.26</td>
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</tbody>
</table>

Conservative estimate of limits for SFP surveys (dependant on proj baseline):

- **E1-S1**: 10-110 mas
- **W1-S1**: 15-150 mas
List Components

<table>
<thead>
<tr>
<th>Type</th>
<th>Total</th>
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<tr>
<td><strong>Multiple systems</strong></td>
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<tr>
<td>Dbl/Mult Visual</td>
<td>20</td>
</tr>
<tr>
<td>DSB</td>
<td>13</td>
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<tr>
<td>SSB</td>
<td>16</td>
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<tr>
<td>Spec Binary</td>
<td>15</td>
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<tr>
<td>RS CVn Variable</td>
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<tr>
<td>W UMa Eclipsing</td>
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<tr>
<td><strong>Single Systems</strong></td>
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<tr>
<td>Flare star</td>
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<tr>
<td>High Proper Motion</td>
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<tr>
<td>Star</td>
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<tr>
<td>T Tauri</td>
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<tr>
<td>Variable</td>
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<tr>
<td>BY Draconis Var</td>
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<tr>
<td><strong>totals</strong></td>
<td>160</td>
</tr>
</tbody>
</table>

Total:  
Single: 92 systems: 57%  
Multiple: 68 systems: 43%

Of all 160 targets:  
40% (64 objects) have  
0-1 speckle observations  
Twelve SFPs observed  
Two possibles  
One unknown companion
Fall 2005

- Of the 160 targets, 73 were available in Sept-Oct 2005
  - At least one baseline: 51 targets
  - Two baselines: 39 of those the 51
  - Unobserved: 22 targets

- Of these 73, eighteen have never been observed with interferometry of any kind.
- Data collected: 267 files
Observing 2006

• Since Tucson, allotted 3 observing runs
  – First two weeks in April (rained out)
    • Obviously no data
  – Four days in June
    • Twenty targets (all observed on both baselines, 84 files)
    • Mostly DSB and SSB (6 show SFP behavior)
  – Two weeks in September
    • Only 7 nights of data due to fires and ash
    • 75 targets available, some additional data on previously observed targets from 2005.
    • Observed 68 targets: 25 on both baselines, 43 on one
      – 25 objects that had not been observed in 2005
  – Remote observing during October MIRC run
    • Mostly for testing with not much coverage.
    • Made way for Jan – March Grad Observing
Previous SFPs (2005)

HD 4676

HD 198084

HD 184467

HD 181655
Additional SFPs 2006/2007

HD 170153

HD 101606

Others needing better seeing:
HD 9021
HD 24546
HD 48682
HD 58946
HD 107700
HD 202275

HD 131511
Totals So Far (including AROC)

- Both baselines: 61 (38%)
  - Does not include non-concurrent observations.
- At least one: 118 (73.5%)
- Still left: 42 (26.5%)
- Total Objects with SFPs: 12
- New companions: 1
- Data files (individual observations): 501
Observing 2007

• Single night baseline switching
  – Target finished on one night
  – Working on shared nights with Deepak

• Time allotted in 2007
  – 15 nights spread over 4 months to cover remaining missing objects
What’s left?

- Observing 2007
- Mass data reduction
- Fringe modeling
- Writing as much as possible in addition to observing for CHARA
- Freak out
- Graduate