Separated Fringe Packet Analysis
Probes Unexplored Regimes for Stellar Companions

CHARA Collaboration Meeting
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Deepak Raghavan
Graduate Student, GSU
The Motivation: Understanding Stellar Families

Do Sun-like stars have... Companions?

<table>
<thead>
<tr>
<th>Do they have...</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children?</td>
<td><img src="54x103" alt="Image" /></td>
<td><img src="130x103" alt="Image" /></td>
</tr>
</tbody>
</table>

You are here
Almost ¼ of the planetary systems reside in multiple star environments
Defining the Sample

Select Parallax ≥ 40 mas, error < 5%
Select luminosity classes IV, V, VI
Select “solar-type” stars (2.35 ≤ M_v ≤ 7.35)

Apply B-V filter

462 stars

Final sample = 455 primaries (including the Sun)


Data from the Hipparcos Catalog
Comparison of Samples

- **Thesis Sample**: N = 455
  - Total: 305
  - 72 (44%) overlap with Duquennoy & Mayor (D&M) Sample
  - 164 overlap with D&M Criteria from HIP
- **Duquennoy & Mayor (D&M) Sample**: N = 164
  - Total: 18
  - 54 overlap with D&M Criteria from HIP
- **D&M Criteria from HIP**: N = 148
  - Total: 12
Three Pieces of the Effort…

Synthesize

Observe

Analyze
Synthesize

✔ Archival images: Common Proper Motion
✔ The Washington Double Star Catalog
✔ Fourth Interferometric Catalog
✔ Sixth Visual Orbit Catalog
✔ Ninth Spectroscopic Binary Catalog
✔ Hipparcos multiple star entries
✔ Catalog of Nearby Stars
✔ Exoplanet catalogs
Observe

• CHARA
• Speckle Interferometry
• Photometry
CHARA Observing

Twin Objectives using the SFP technique:
- Identify new stellar companions
- Fully characterize orbits of known binaries

• Targets observable with CHARA = 288 (63%)
  - $V \leq 9$, $K \leq 6$, $Dec \geq -10$

• Overlap with CF list = 92

• On my observing list = 196

Estimate 28 full nights for the survey + 12 nights for follow-up observations of binaries
CHARA Observation Status

- 30 targets observed to-date
- Only 1 separated fringe envelope found so far

HD 79096
Maximizing the Search Space

- **AO**
  - Sep ~ 0.5" – 10"
  - Δmag < 10

- **CHARA**
  - Sep ~ 10 – 120 mas
  - ΔK < 2 mag
  - K < 6 mag
  - For Separated Fringe Packets

- **RV**
  - Period < 20 yrs
  - a < 0.46"
  - * for 2 solar-mass stars at 20 pc

- **Speckle**
  - Sep ~ 0.035" – 2"
  - Δmag < 3

- **Visual, CPM, Astrometric**
  - Sep ~ 1” – 600”

Comprehensive Survey
## Progress Report

### Volume Limited Samples

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>D&amp;M 1991 (N = 164)</td>
<td>57/38/4/1</td>
</tr>
<tr>
<td>D&amp;M criteria subset (N = 92)</td>
<td>55/39/4/2</td>
</tr>
<tr>
<td>This Work (in progress, N = 455)</td>
<td>67/26/6/1</td>
</tr>
</tbody>
</table>

### Planetary Systems

<table>
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<th>Dataset</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raghavan et al. 2006 (N = 131)</td>
<td>77/21/2/0</td>
</tr>
<tr>
<td>Planet-hosts within 25 pc (N=32)</td>
<td>78/22/0/0</td>
</tr>
</tbody>
</table>
Peripheral Work

• Chara_Plan_B
  – Batch version of Chara_Plan
  – Useful for observation planning for surveys

• Online Observing Log
  – Accessed via CHARA password protected site

• Minor enhancements to
  – Chara_Plan
  – VisUVCalc: MathCAD reduction program
Number of days with observations

Note: CHARA Classic ONLY

- 2003d
- 2004d
- 2005d
- 2006d
Number of Observations

Note: CHARA Classic ONLY

- 2003
- 2004
- 2005
- 2006

Number of Observations

Jan    Feb    Mar    Apr    May    Jun    Jul    Aug    Sep    Oct    Nov    Dec

0      100    200    300    400    500    600    700    800    900   1000

Georgia State University
NSF
NOAO
Observatoire de Paris
LESIA
University of California
MSC
SUSI
Observatoire de la Côte d'Azur
Percent of obs with good seeing
(> 6cm)  Note: CHARA Classic ONLY