Constraining Stellar Evolutionary Tracks with Binaries

by Martin, Peter, Pedro & Jürgen

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Scientific Goal

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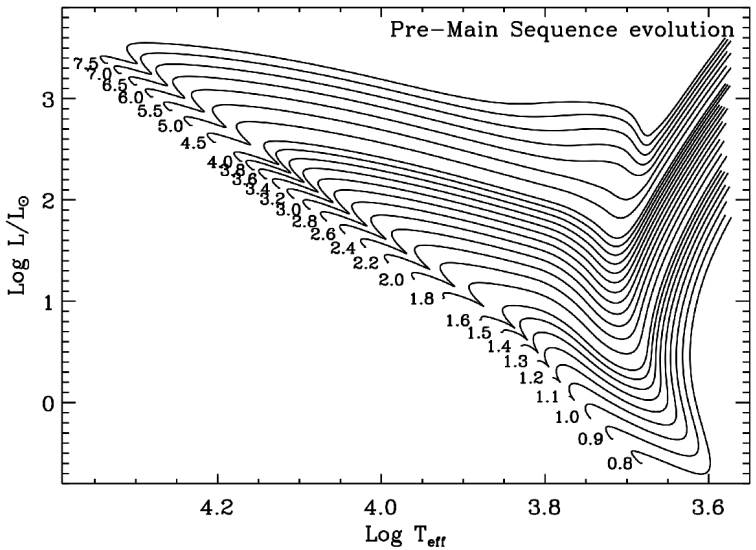

Monteiro et al. 2005

... and some problems!

- Evolutionary tracks depend on model used
- Several different models exist
- ... and give only a rough estimate of the mass

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and a solution ?

Of course! - our proposal (for at least a fraction of the problem...)

The Road to Reality...

Constrain and calibrate the evolutionary tracks of Pre-Main-Sequence-Stars.

Main Steps

- Spectroscopic survey of possible candidates by Guenther et al. (2007)
- Interferometry contributes accurate values for:
  - Position Angle
  - Binary Separation
- Combine spectroscopic and interferometric data to extract accurate mass

Science Object

Spectroscopic survey by Guenther et. al. lists 13 objects suitable for possible VLTI observation.

	spec type type	m_K [mag]	RA (2000.0)	Dec (2000.0)	type	period [days]
HIP50796	K5/WTTS	7.66 ± 0.03	10 22 18.0	-10 32 15	SB1	570
CS Cha	K4/CTTS	8.20 ± 0.03	11 02 26.3	-77 33 36	SB1	$\geq$ 2482
HD97131	F2	7.70 ± 0.02	11 10 34.2	-30 27 19	ST3	134
RXJ1220.6-7539	K2/WTTS	7.93 ± 0.02	12 20 34.4	-75 39 29	SB1	613
MO Lup	K7/WTTS	8.64 ± 0.02	15 24 03.5	-32 09 51	ST3	$>$ 3000
RXJ1534.1-3916	K1/WTTS	8.55 ± 0.02	15 34 07.4	-39 16 18	SB1	$>$ 3000
RXJ1559.2-3814	WTTS	9.34 ± 0.03	15 59 16.1	-38 14 42	SB2	474
GSC 06209-00735	K2/WTTS	8.43 ± 0.02	16 08 14.8	-19 08 33	SB1	2045
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Haro 1-14c	K3/WTTS	7.78 ± 0.03	16 31 04.4	-24 04 33	SB2	591
NTTS162819-2423s	G8/WTTS	7.44 ± 0.02	16 31 20.0	-24 30 04	SB1	89
BS Indi	K0/WTTS	6.57 ± 0.02	21 20 59.8	-52 28 40	SB1	1222

Table from Guenther et al. (2007)

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But only BS Indi is actually observable with AMBER.

(Actually trinary, but two secondaries are not resolvable with the VLTI)

BS Indi

Features of BS Indi

- Primary: Spectral type K0V
- Secondary: 2 unresolvable M0V type stars
- Major separation: ≈ 30 mas
- Minor separation: ≈ 0.2 mas
- Period: 1223 ± 30 days
- Flux ratio: 0.5
- Distance: $43 \pm 3\mathrm{pc}$
- H Mag: 7.184
- K Mag: 6.574

Guenther et al. (2007)

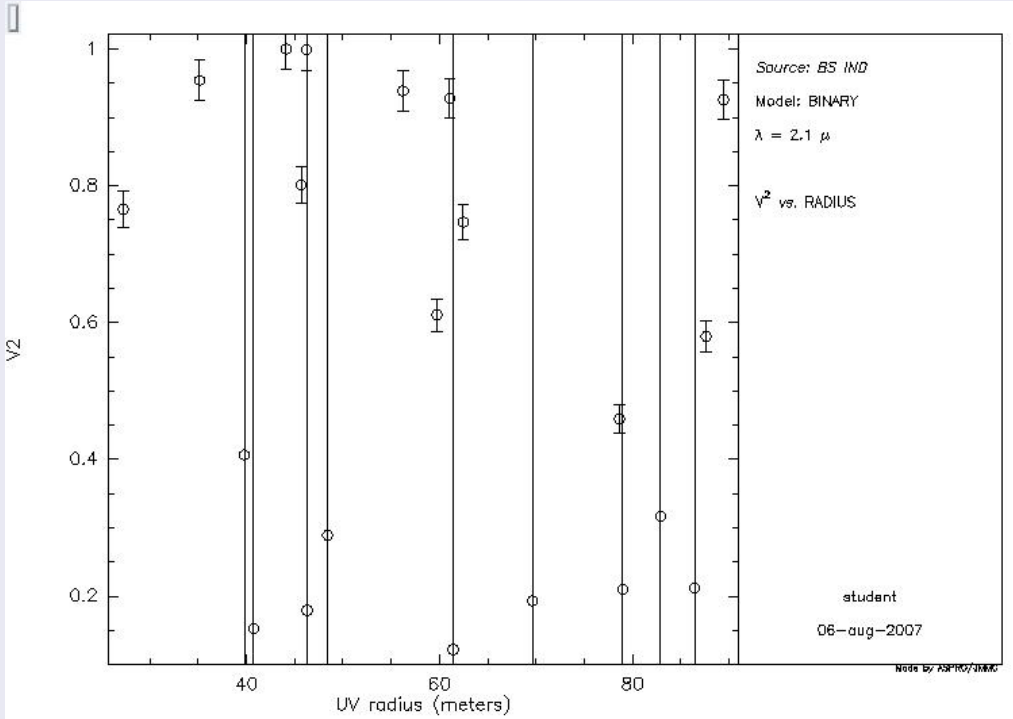
Observational Setup

Basic Parameters

Observation

- Date:
  Aug 6th, 2007
- Telescopes:
  U2 U3 U4
- Calibrator:
  HD 205935_M04

Estimate on Results



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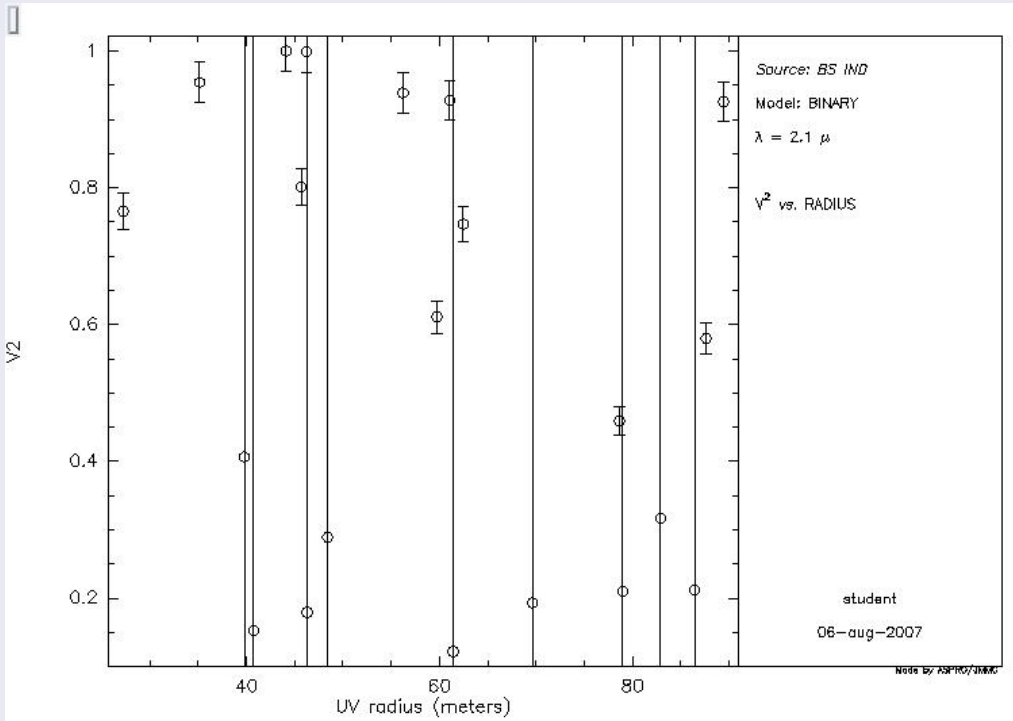
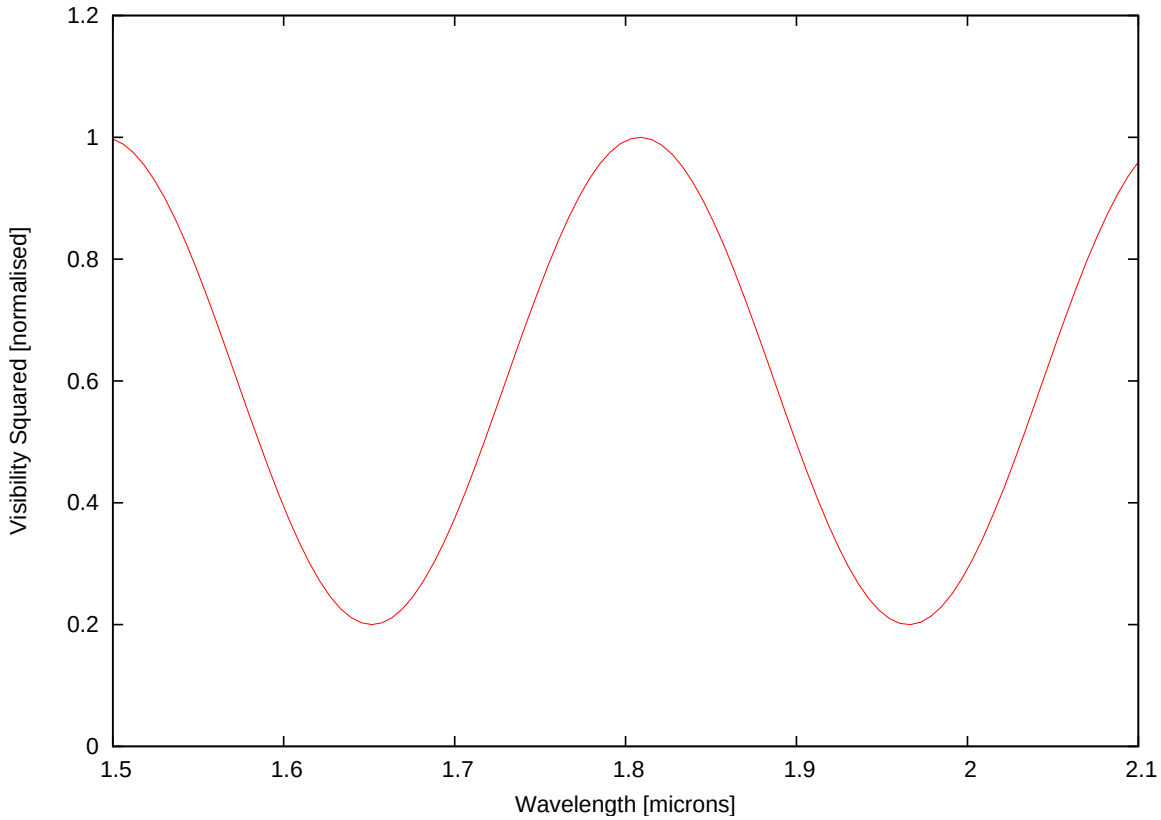


But...

Large time requirement to get adequate UV coverage with too many useless measurements points

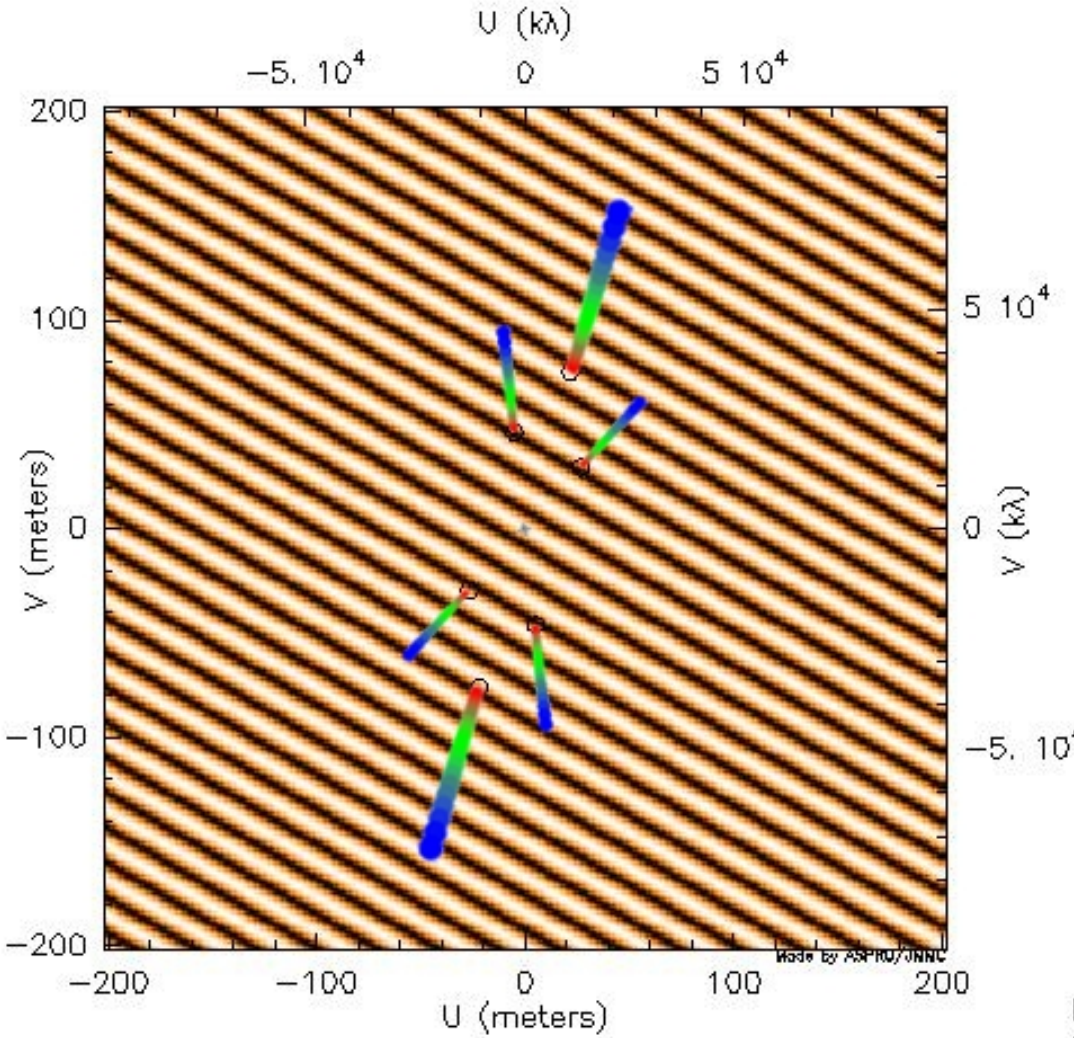
Alternative Observational Setup

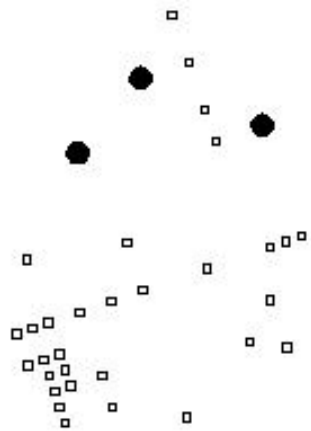
Get sufficient UV-Coverage using low resolution but with high bandwidth at only two short snapshots.



Visibility variations depend on angular separation and λ.

Alternative Observational Setup





Wavelength 2.108 μ
Declination −52.4 °
Model: BINARY
Source: BS IND
Config: UT/AMBER/Low/25ms

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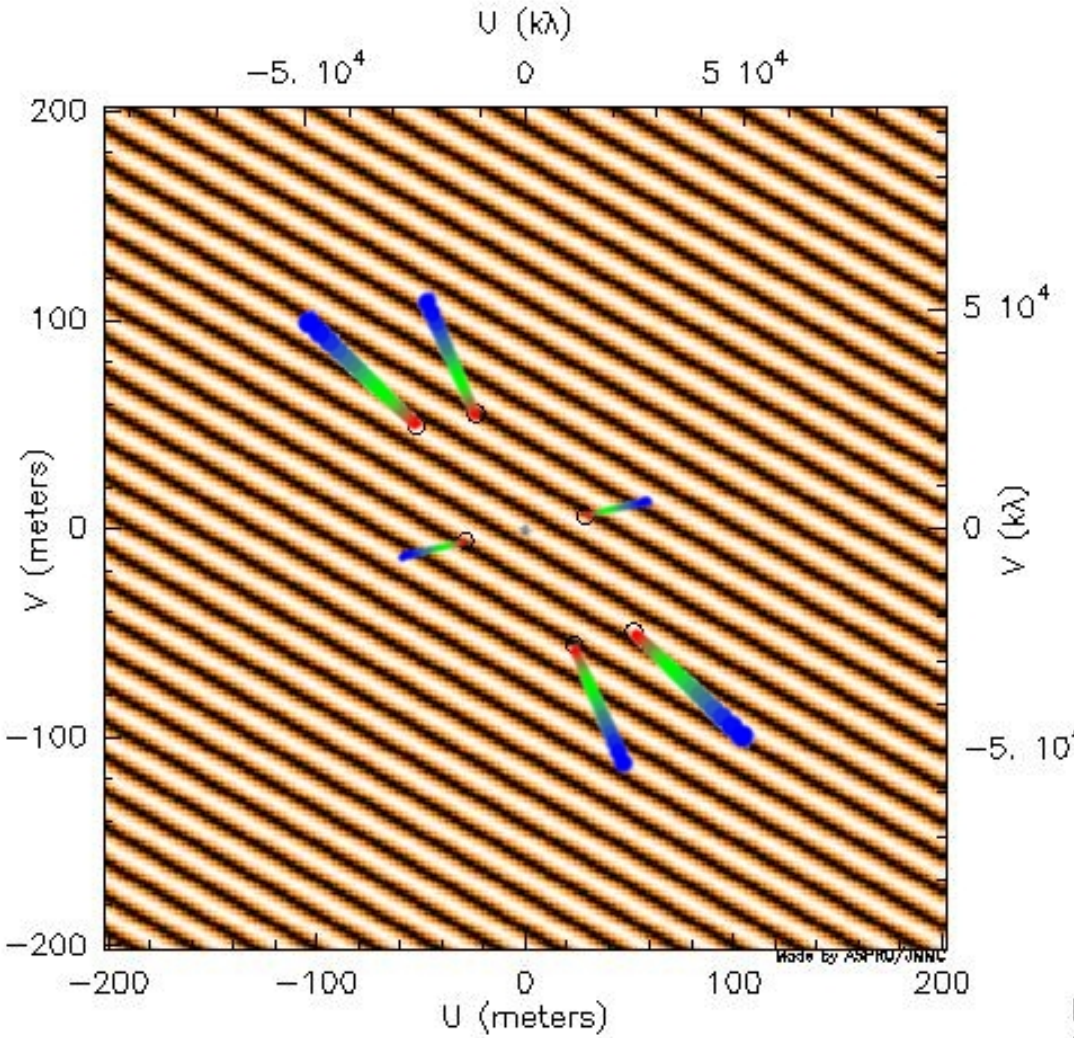

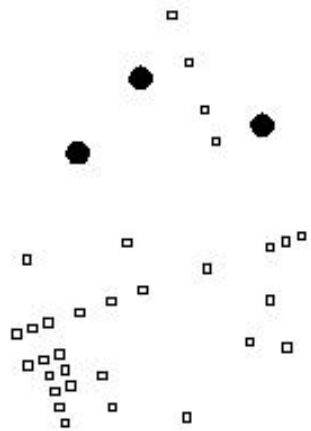

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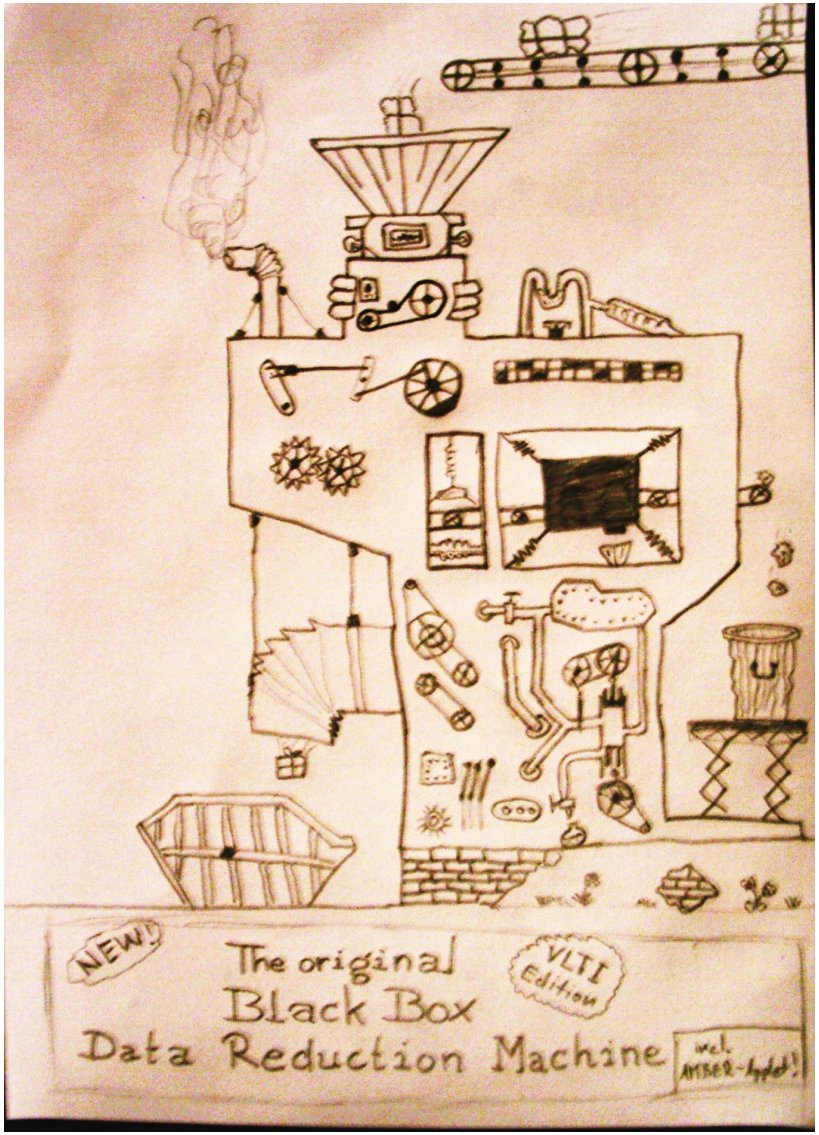
Operational Requirements

Requirements

- 5 Minutes integration time per snapshot
- 2 Calibration Observations
- 2 Science Observations
- Total: 200 Minutes of telescope time
- Visitor Mode

Data Analysis



Expected Outcome

From the reduced data we can constrain

- Binary Separation
- Position Angle

Thus get, together with inteferometric data, the masses of BS Indi with

$$m = f(P.A., \rho, \text{spectroscopic data})$$