

Updates to Stellar Imaging & Modeling

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Parks+2015

EXETER

 λ And

Revisiting old 2010 and 2011 data •











New image reconstructions for λ And

- ROTIR (ROTational Image Reconstruction Baron+in progress)
 - model dependent image reconstruction
 - 3D temporal surface imaging
 - Temporal data splitting
 - Optimpack (using quasi-Newton methods)
 - Regularizations: positivity, L2 norm, total variation
- Problem: high latitudes oversampled
- Issues:
 - Stellar orbital parameters (inclination, position angle, etc.)
 - How many spots are there? 3? 5?
 - For 2010 data, correct for a binary calibrator





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Narrowing down stellar parameters

Polar Gravi

Healpix sub

Position an R pole

Rotation zero poin

0.00

0.2

LDL -

Rotational period

▼ Shader

 Feature Delta
Phi
Radiu:

alpha

Delta Phi Radiu: Theta Feature

Delta Phi Radius Theta Feature

Radiu

- SIMTOI surface modeling with Bayesian model selection
 - Multinest (MCMC based on priors)
- 4 dimensional search for stellar parameters
 - Inclination
 - Rotational period
 - Position angle
 - Angular radius
- 4 dimensional search PER spot
 - $\Delta T, \phi, \theta$, radius of spot

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Animation Minimizati



2011Sep02.lam And prepped.oifits V2: 360 T3: 432

2011Sep06.lam And prepped.oifits V2: 392 T3: 37

2011Sep10.lam And prepped oifits V2: 360 T3: 432

2011Sep14.lam_And_prepped.oifits V2: 864 T3: 110 2011Sep19.lam_And_prepped.oifits V2: 808 T3: 112

11Sep24.lam And prepped.oifits V2: 200 T3: 240



1.6500

1 0000

🗘 λ (um)

2 Rate (dav/tic

2455806.8902 1.6128

2455810.8519 1.6086

2455814.8538 1.6121

455823.8053 1.6090

2455828.8579 1.6063

Remove Data





Differences in temperature maps

• ROTIR

$$\min\{\chi^2 + \mu \mathbf{R}(\mathbf{x})\}\$$

Change of weights in L2 and TV





ETER

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L-curve

 Selection of regularization weight



Georgia<u>State</u>University





Differential Rotation

- ROTIR Simple version doing differential rotation
 - $\Omega = \Omega_{eq} \Delta \Omega \sin^2 \theta$ $\Delta \Omega = \Omega_{eq} \Omega_{pole}$
- Estimate for λ And
 - $\Delta \Omega \approx 0.26?$

GeorgiaStateUnivers

(based on Henry+1995)

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Light-curve inversion

- Now has capabilities for lightcurve inversion
- **Problems:**
 - Inclination is assumed
 - Spots at any given latitude can be equally probable
- Use photometry to bridge gap from interferometric data



Martinez+in progress •

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Provided by E. Lincoln



ROTIR modeling

- Can do pure surface modeling of: ullet
 - Rapid rotators































ROTIR modeling

- Can do pure surface modeling of:
 - **Rapid rotators**
 - Roche-lobe (adapted from Leahy & Leahy 2015)
- Ready for image reconstruction stars other than "sphericallyshaped" stars

























VR applications of CHARA imaging

Outreach to demonstrate interferometric capabilities



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Movie made by C.

Abbott



Future work

- Get all MIRC 2010 data for lambda Andromedae & reduce
- Add in visibilities and closure phases for binary reconstructions
- Implement work for rapid rotators
- Work on occlusion problem for binaries
- Multi-band light curve inversion
- Doppler imaging? (maybe...)



















