Low Mass Eclipsing Binaries in Sparsely Sampled Time Domain Surveys: SDSS Stripe 82

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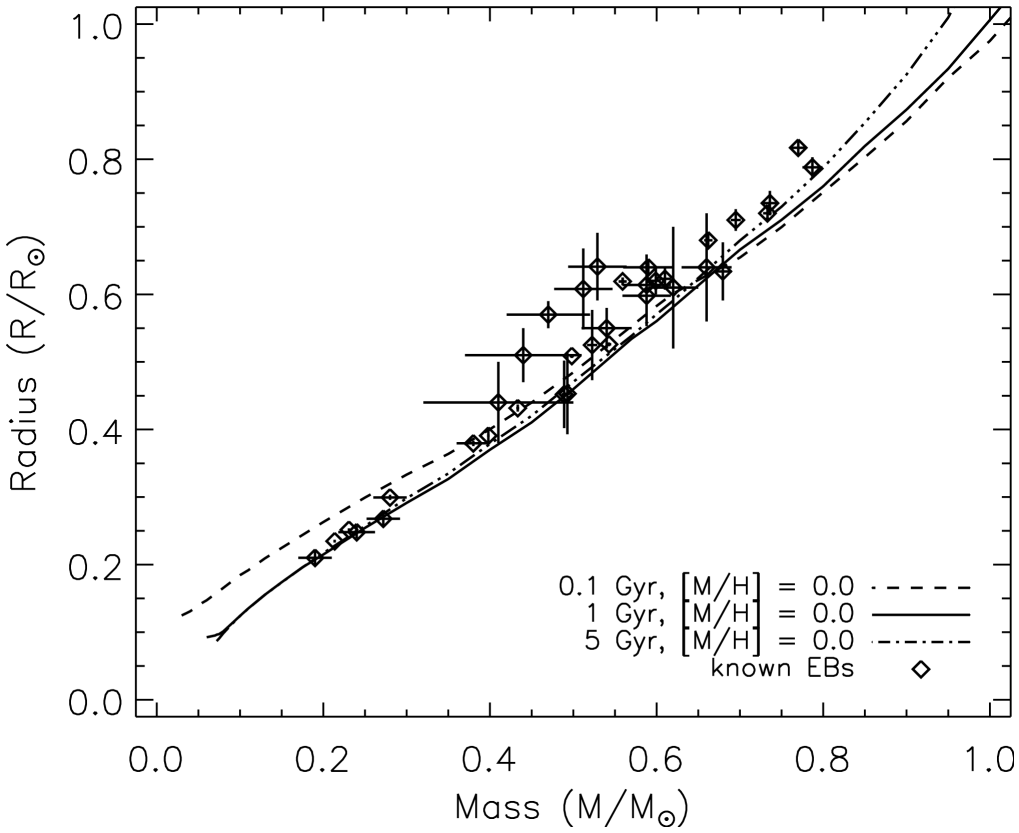
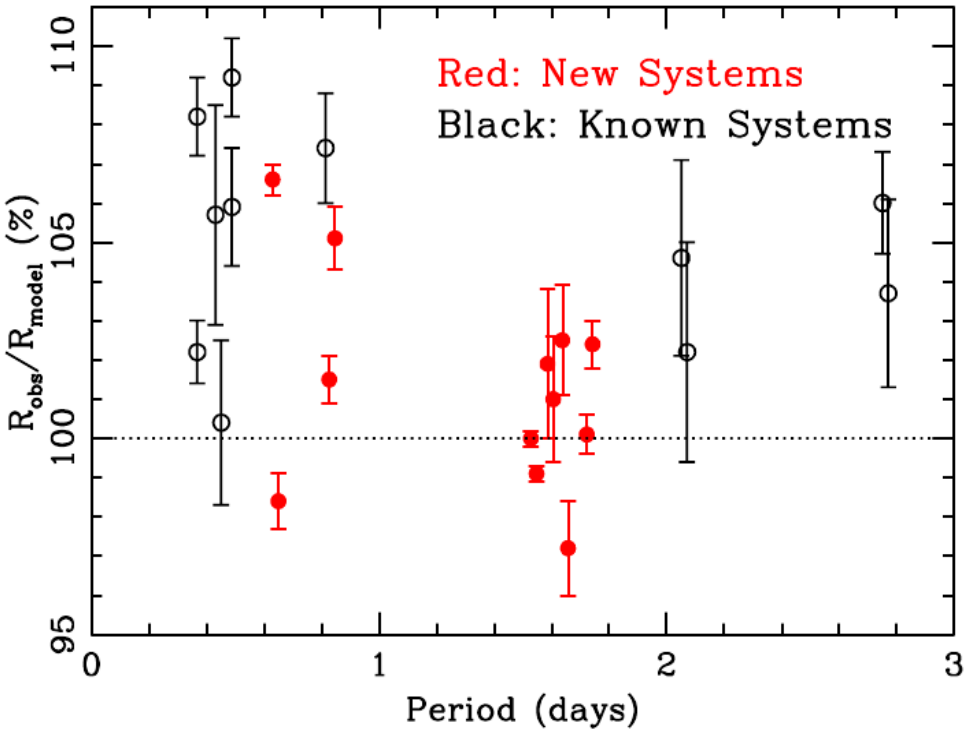
Introduction

- Eclipsing binaries are direct probes of fundamental properties of low mass stars: mass, radius, luminosity, surface temperature
- Observed and expected mass-radius relations of low mass EBs do not agree
- Interesting: possible relationship between orbital period and radius discrepancy?



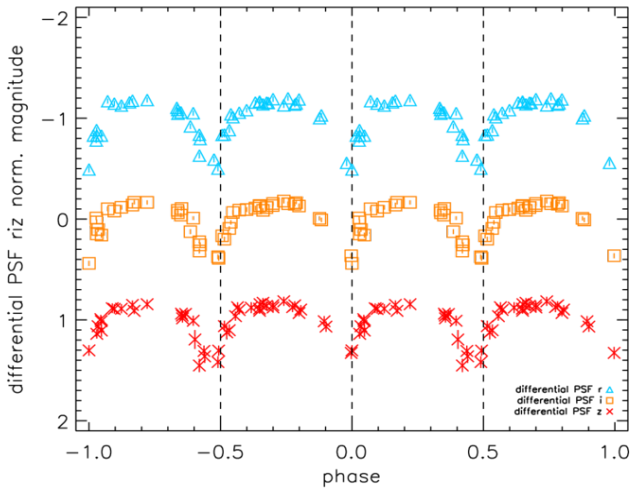


From Kraus et al. 2010

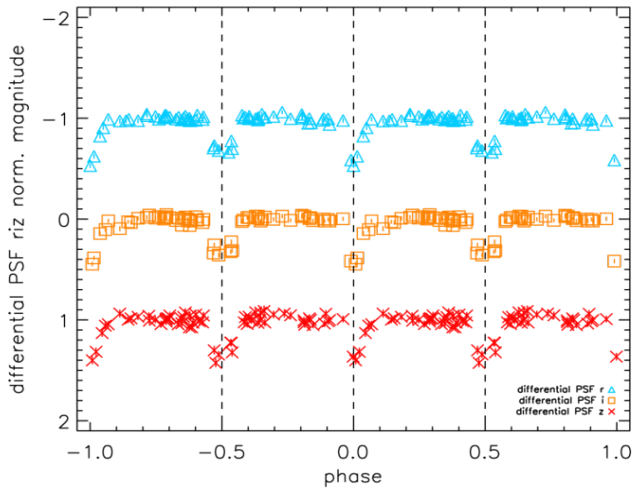
Variables from SDSS Stripe 82

- Light-curve catalog of ~ **1.3 million** point sources
- Inhomogeneous ensemble differential photometry (Honeycutt 1992)
- **16,796** variable objects
- Classification by SDSS colors and light-curve shapes
- **620** periodic variables found so far:
- **282** eclipsing binaries
- **260** RR Lyrae
- **41** high amplitude Delta Scuti
- **48** unclassified

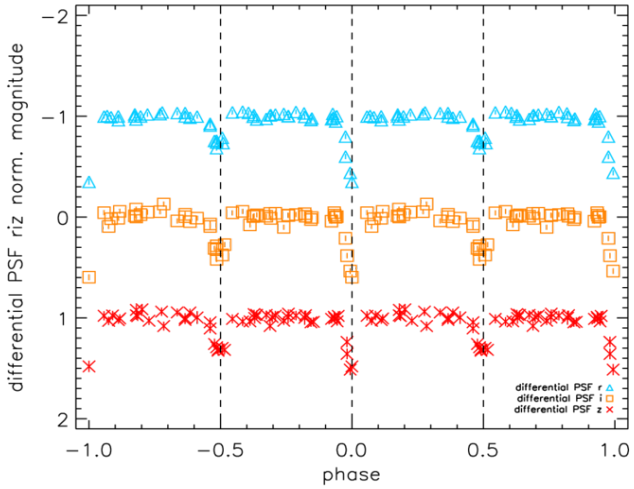
MB7350, M1, P = 0.223 d



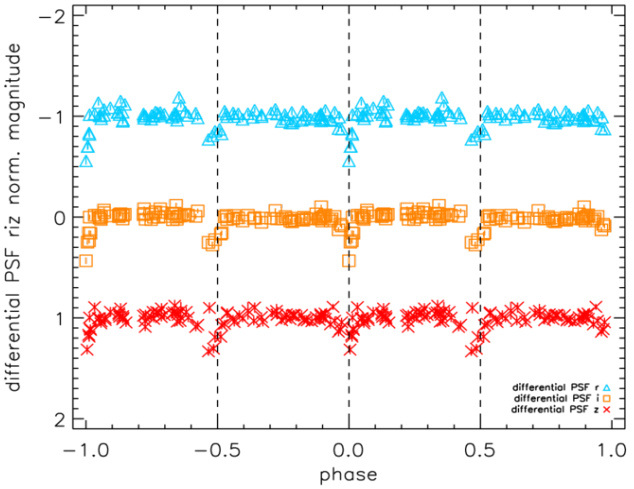
MB18759, M0, P = 0.484 d



MB4189, M0, P = 0.680 d



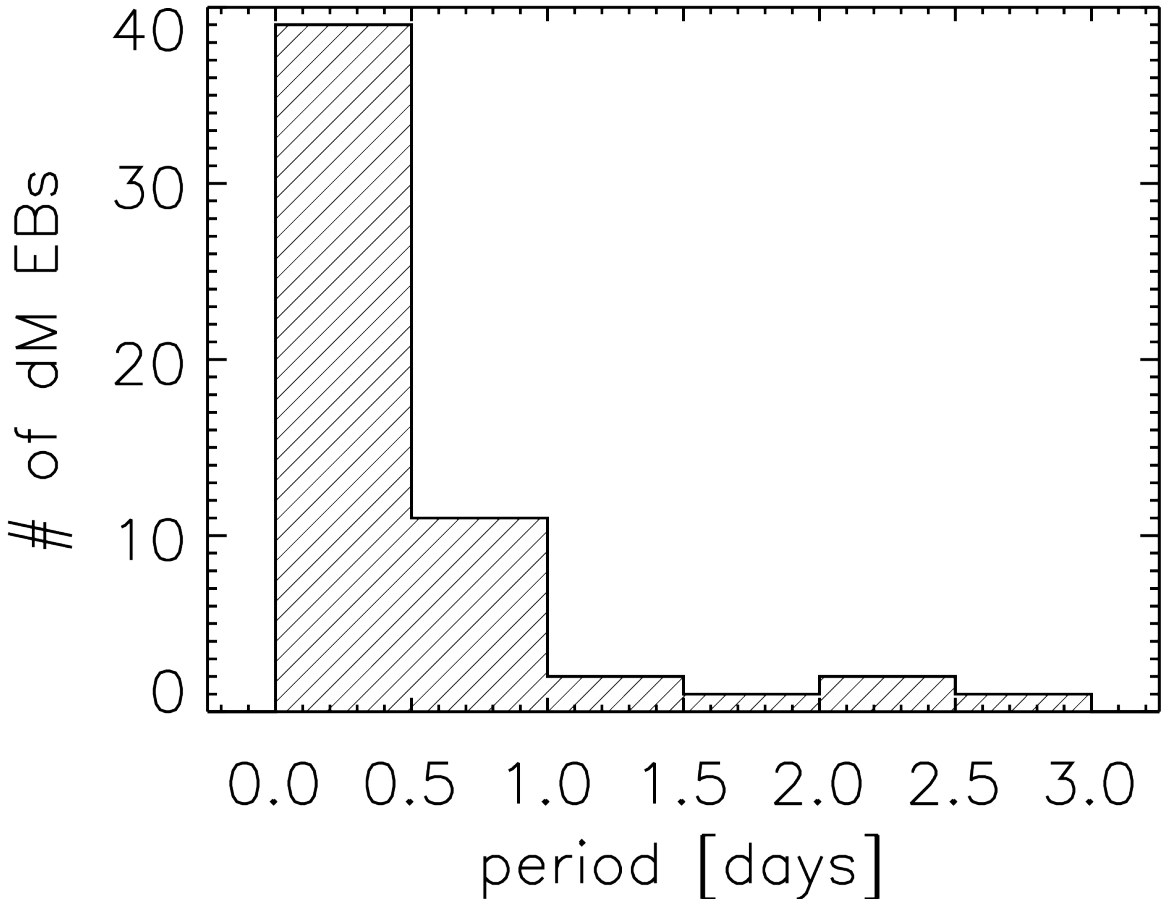
MB22575, M2, P = 0.899 d



triangles = SDSS *r*, squares = SDSS *i*, x's = SDSS *z*

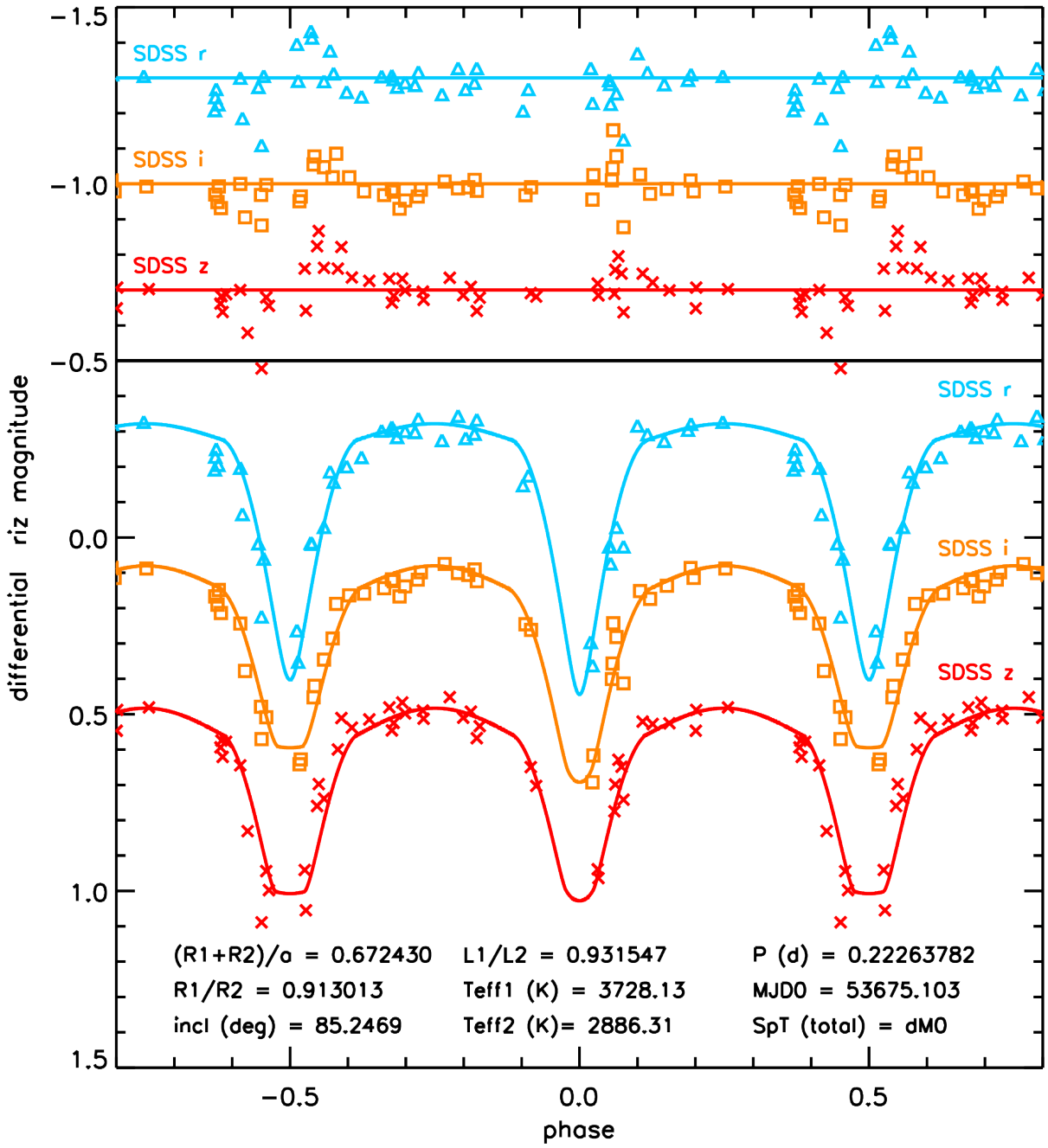
M-dwarf Eclipsing Binaries

- **104** dM EBs in total
- **56** dM EBs with secure orbital periods
- 16.9 < SDSS *r* < 21.3
- **28** dM EBs with sufficient phase coverage for light-curve modeling
- Fit light-curve models to these objects



Light-curve Modeling

- Use differential SDSS *riz* light-curves, estimated periods, and ephemerides
- Assuming:
  - $e = 0$
  - no third bodies
  - no spots
- Fit:
  - $(R_1+R_2)/a$
  - R_1/R_2
  - L_1/L_2
  - inclination
  - T_1 and T_2



Summary

- Used SDSS Stripe 82 photometry to generate a light-curve catalog for ~ 1.3 million point sources
- Get the data at: http://shrike.pha.jhu.edu/stripe82-variables
  - Bhatti et al. (2010) and Bhatti et al. (in prep, ETA March 2011)
- Found ~17,000 variable objects in this sample
  - 620 periodic variables identified
  - ~ 60 M-dwarf EB candidates with secure periods
  - ~ 30 suitable for further light-curve analysis
- Modeled EB light-curves to obtain initial estimates of relative parameters
- Conducting follow-up observations to measure the masses and radii of the 5 brightest M-dwarf EB candidates