Updates on Characterization of Stars (with and without Planets)

Kaspar von Braun

(Lowell Observatory)

with

T. Boyajian, A. Mann, G. van Belle, S. Kane, D. Ciardi, G. Schaefer, J. Jones, C. Farrington, T. ten Brummelaar, N. Scott, D. Gies, S. Ridgway, H. McAlister, and the CHARA Gang

CHARA Meeting 2017 -- Pasadena

Motivation

You only understand the exoplanet

if

you understand the parent star

(if you are lucky)

Understand the Parent Stars

Approach

- PAVO / Classic interferometry and limb darkening corrections: angular stellar diameter.
- 2+ nights, 2+ baselines, 2+ calibrators.
- Trigonometric parallax: physical stellar diameter.
- SED fit / spectrophotometry: stellar F_{BOL}.
- From angular diameter and F_{BOL}: T_{EFF} and L.
- From L, T_{EFF}: habitable zone.
- Stellar physics determine planetary physics.

Understand the (Parent) Stars: CHARA Survey of nearby stars

- Optimal allocation of observing resources.
- Observation and reduction methods are identical.
- Data interpretations for any given system are identical.
- Exoplanet hosts' parameters constrain stellar physics.
- Observations of planet host candidates (surveys) and "by request".
- "Regular" stars may become exoplanet hosts.
- Interferometry particularly valuable for late-type stars (convective).

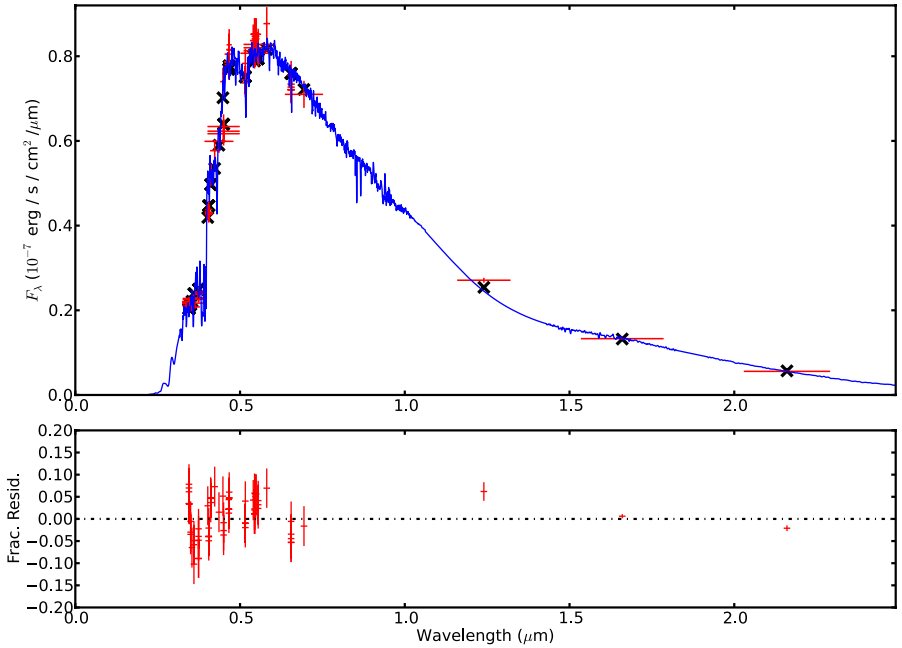
Update 1 – SED fitting

Random & Systematic errors:

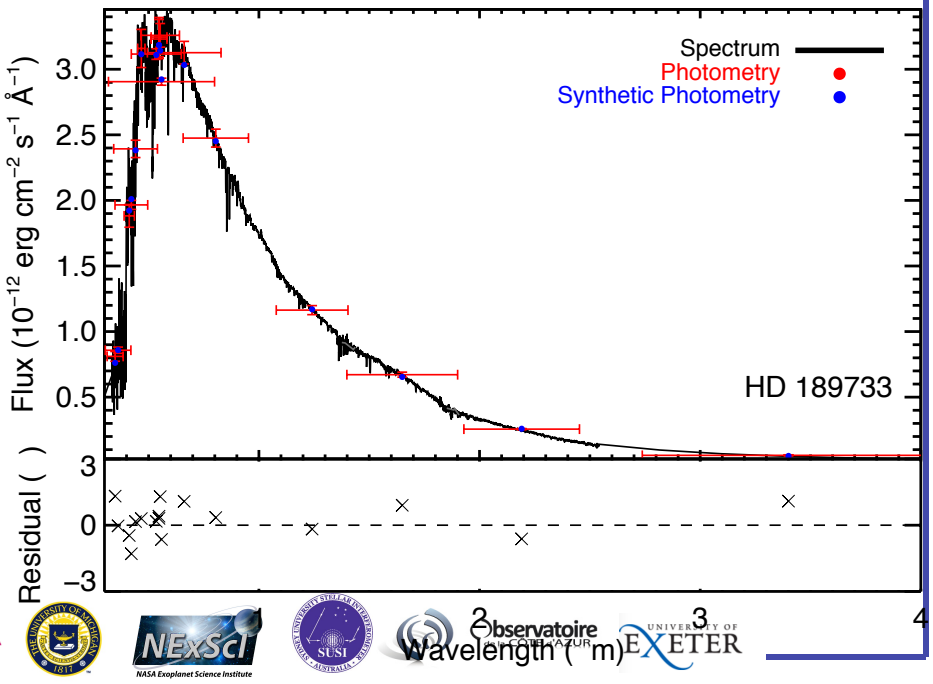
- Formal uncertainties in F_{BOL} very small, inflate by using Bohlin+2014 method (2% in quadrature)
- improvement in software (A. Boden, G. v. Belle)
- spectrophotometric data (A. Mann+)
- "a posteriori" correction of literature photometry (Mann & von Braun 2015)

Update 1 − SED fitting

Systematic errors: spectrophotometric data (A. Mann+)



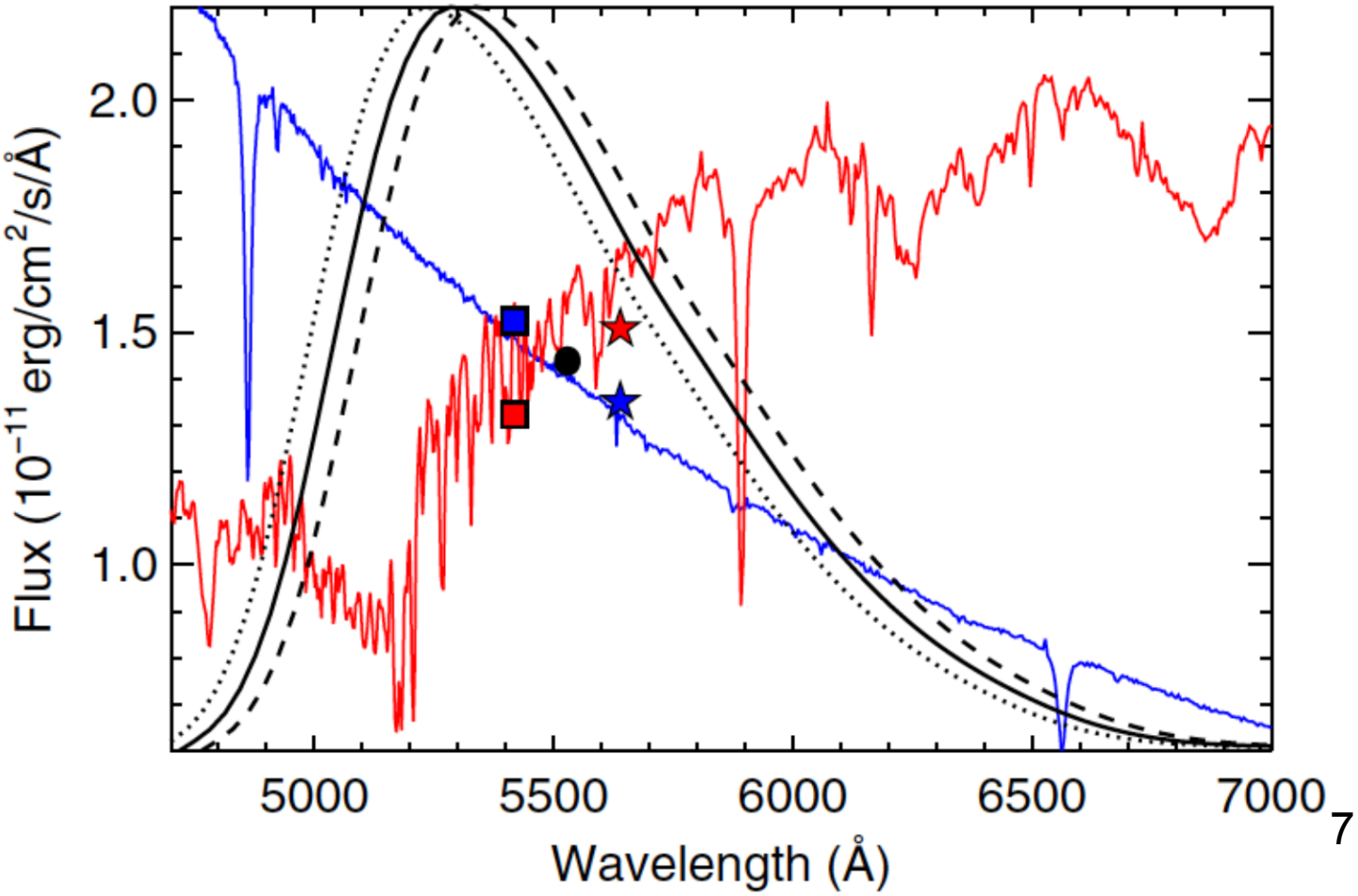
von Braun+2014 − GJ 614



Boyajian+2015

Update 1 − SED fitting

Systematic errors: reverse-engineering filter profiles



Mann & von Braun (2015)

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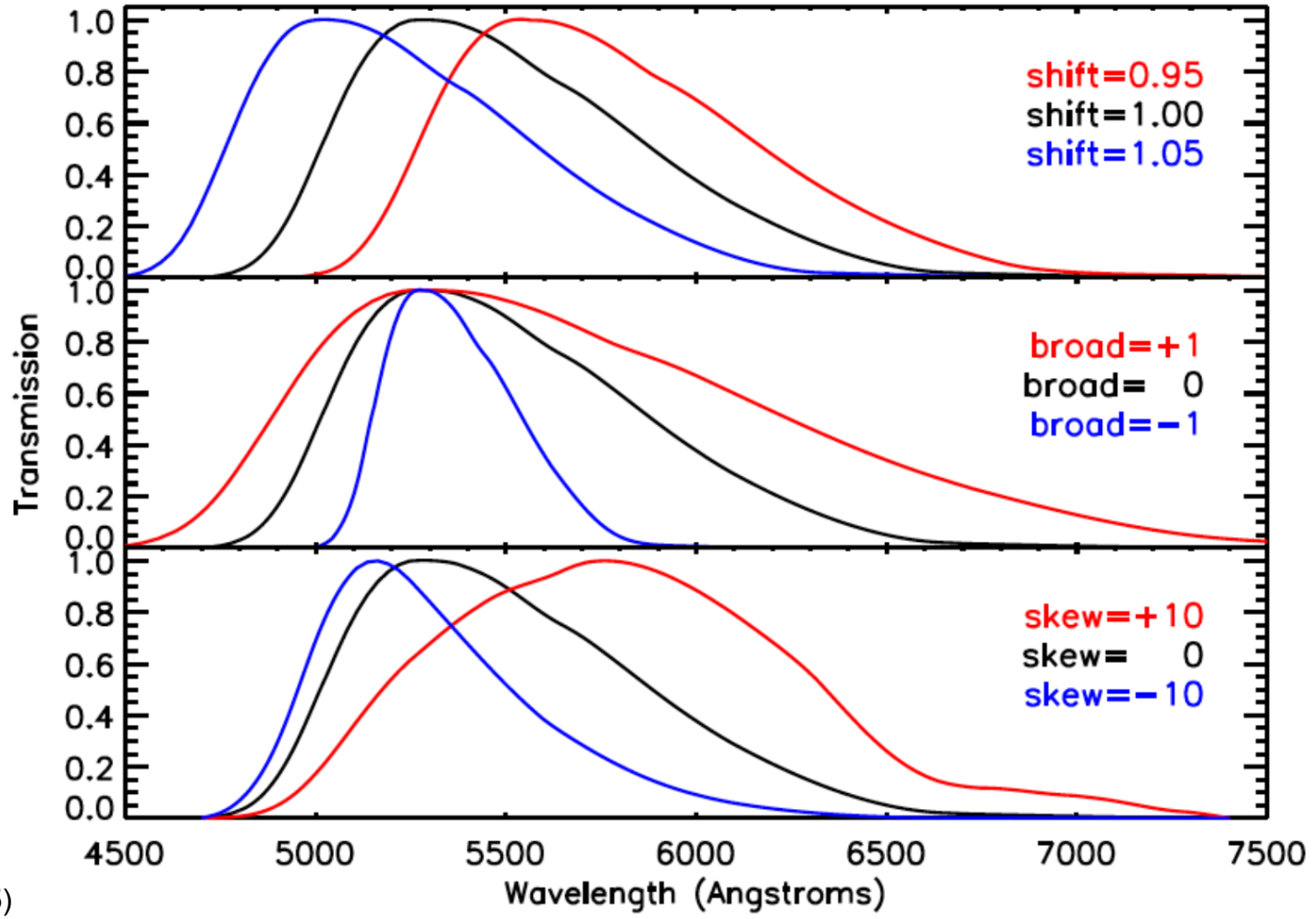

Mann & von Braun (2015)

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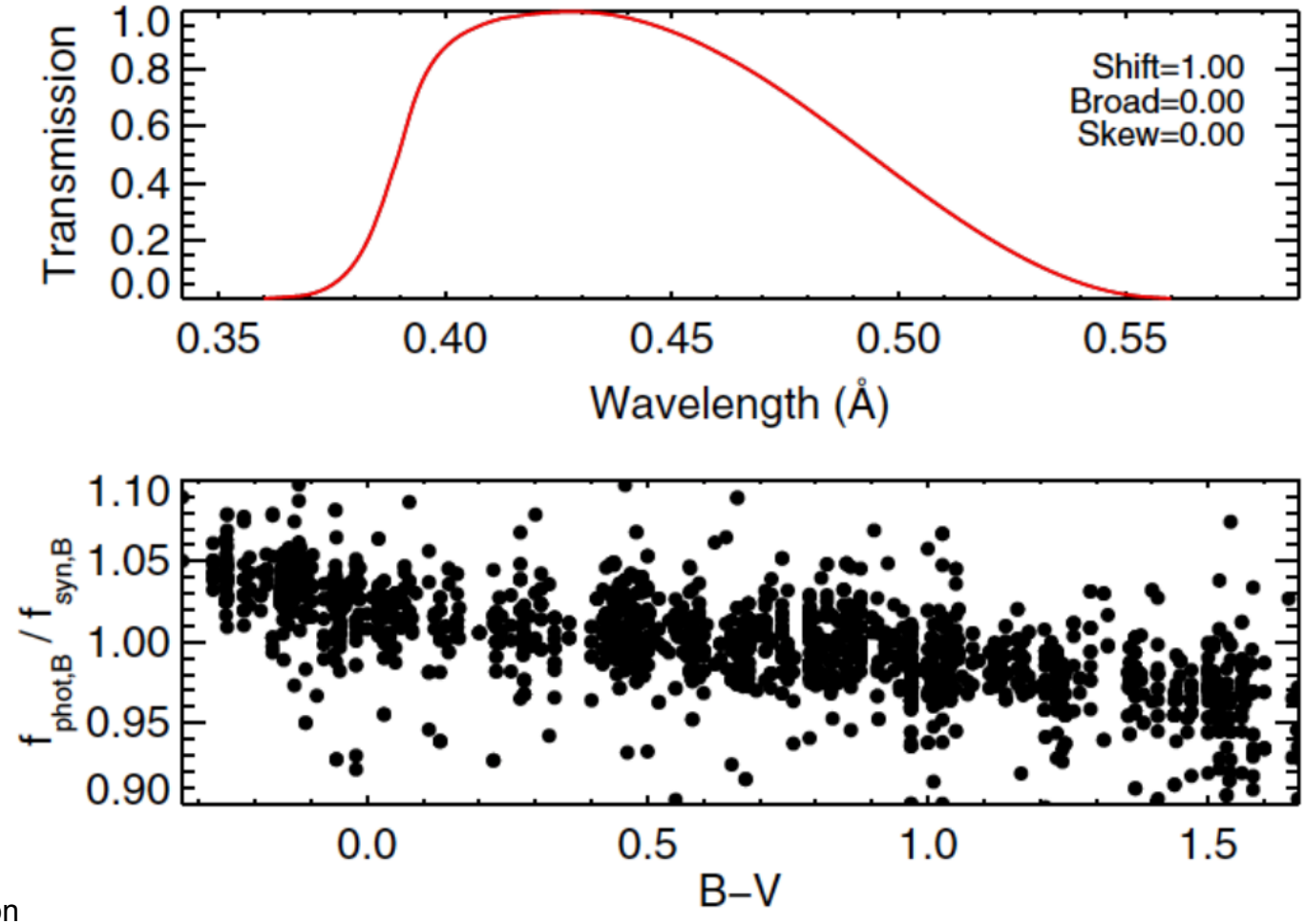

Mann & von Braun (2015)

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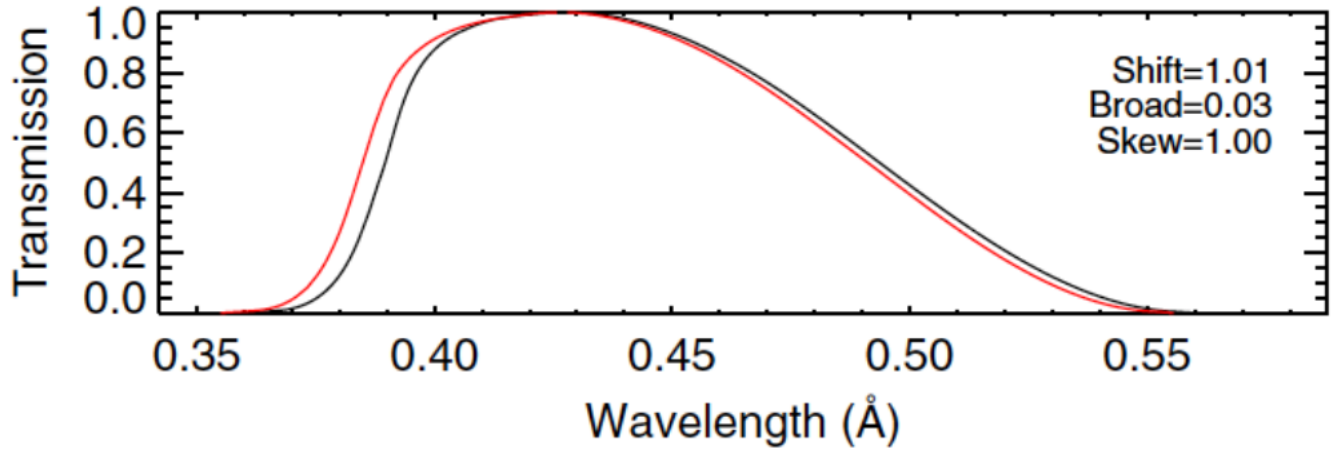
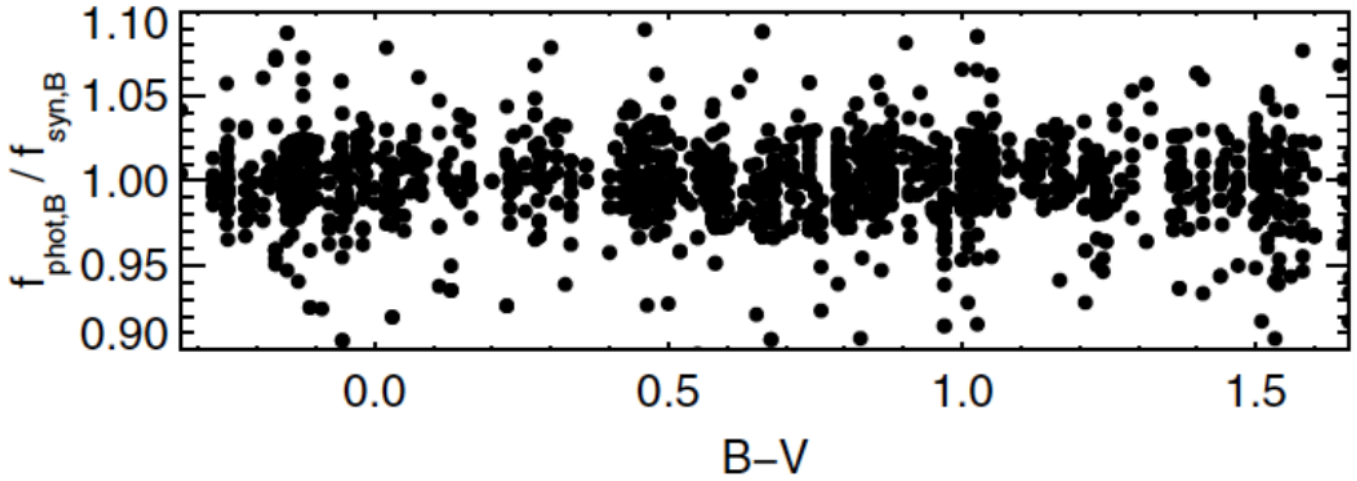
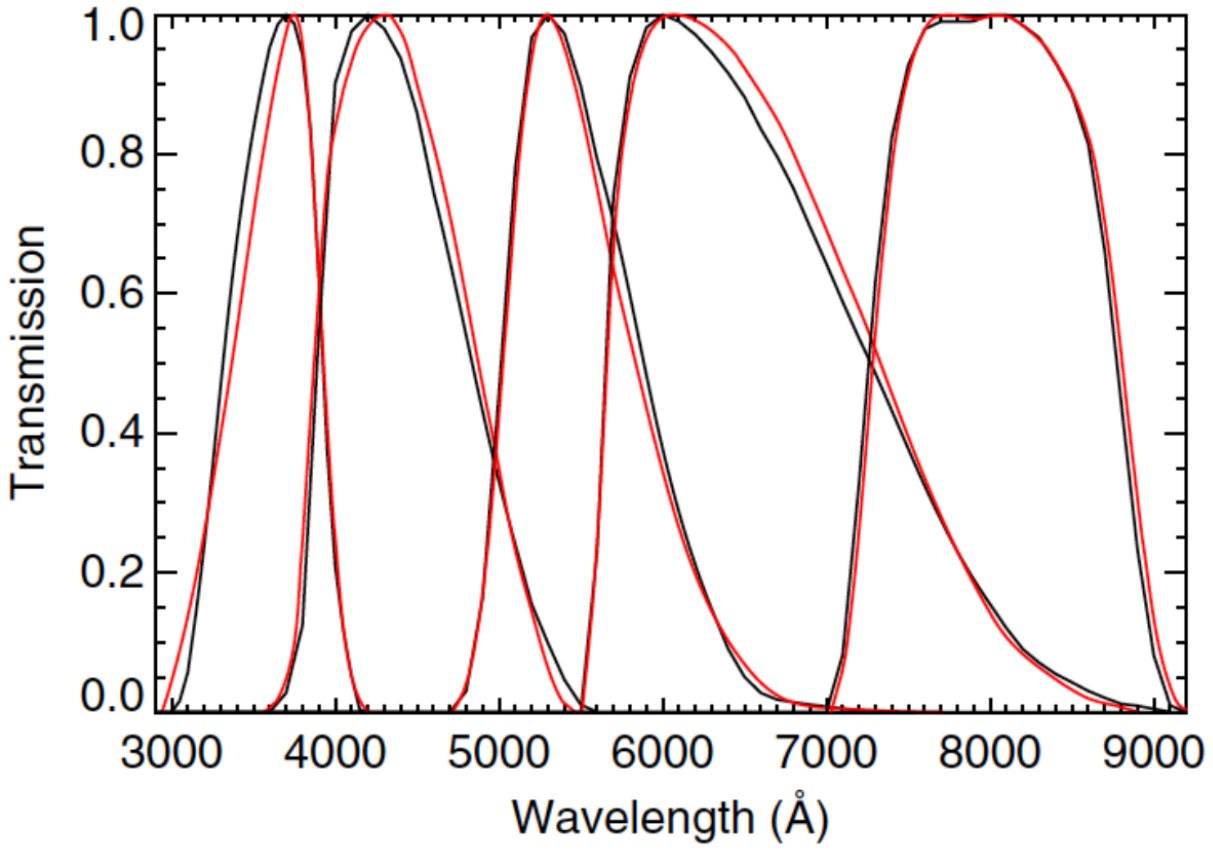




Mann & v
Braun (2

Update 1 − SED fitting

Systematic errors: reverse-engineering filter profiles



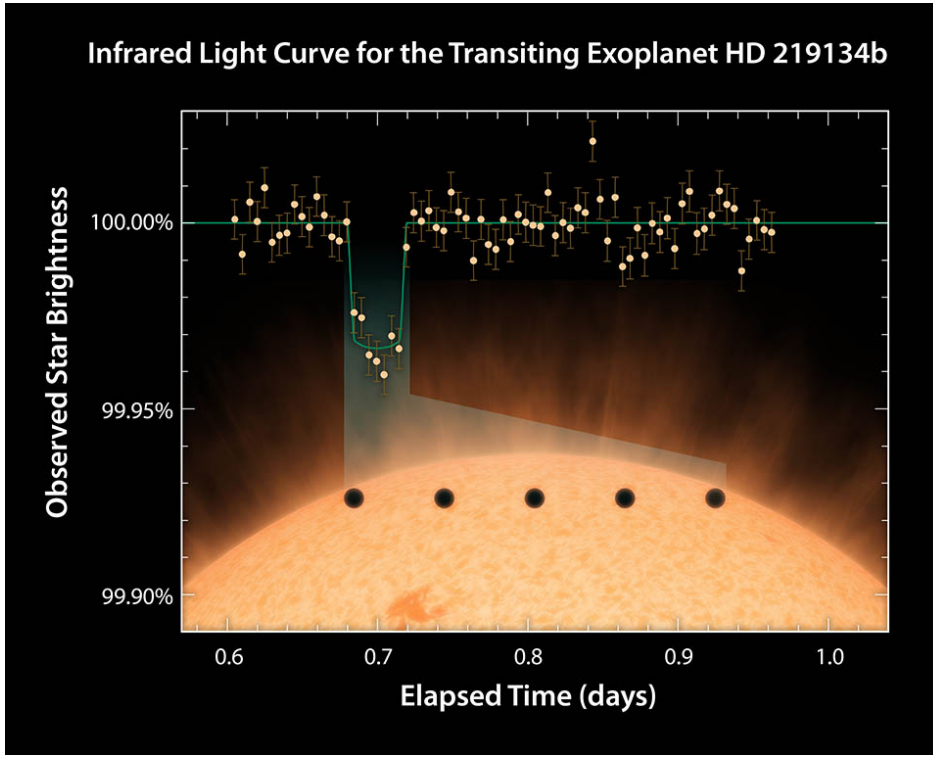
Shown: UBV (Johnson), RI (Cousins). Red: corrected.
Tabulate 39 filter systems, all in electronic table form.

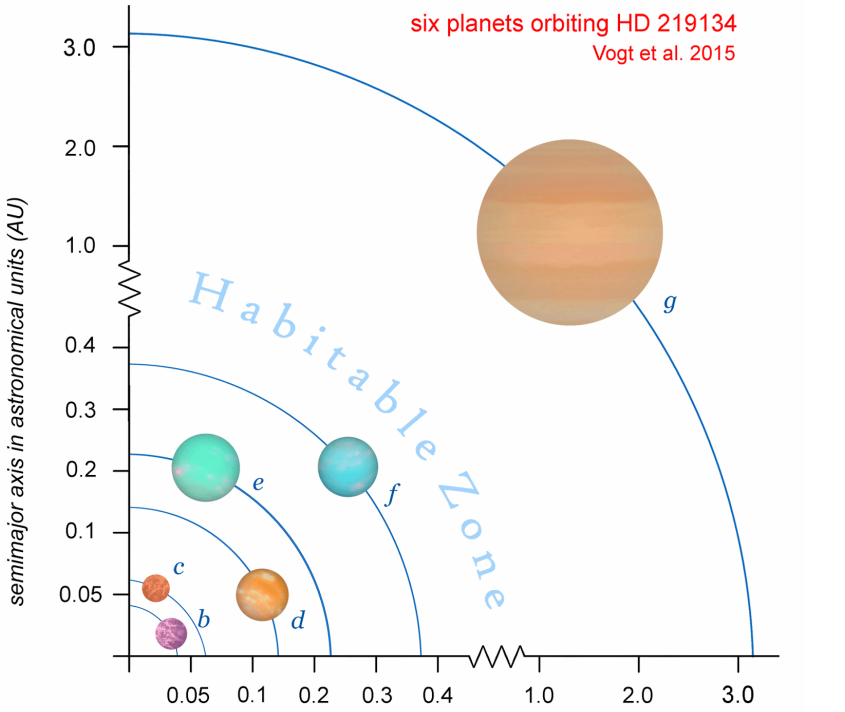
Mann & von Braun (2015)

Update 2 – non EHS become EHS

HD 219134 / GJ 892 (Boyajian+2012, Mann+2013, Huber 2016)

K3V, 6.5 pc, naked eye (Vogt+2015, Motalebi+2015, Johnson+2016)





Spitzer

Back alley astronomy

Update 3 − harmonizing models?

HD 209458 & HD 189733 (Boyajian+2015)

Both are transiting systems and double-lined "binaries" (star & planet).

Full system characterizations using literature data.

HD 209458 (solar type) parameters accurately predicted by models.

HD 189733 (early K) predicted radius 5-10% below measured value.

Myriad literature data products allow thorough testing of models.

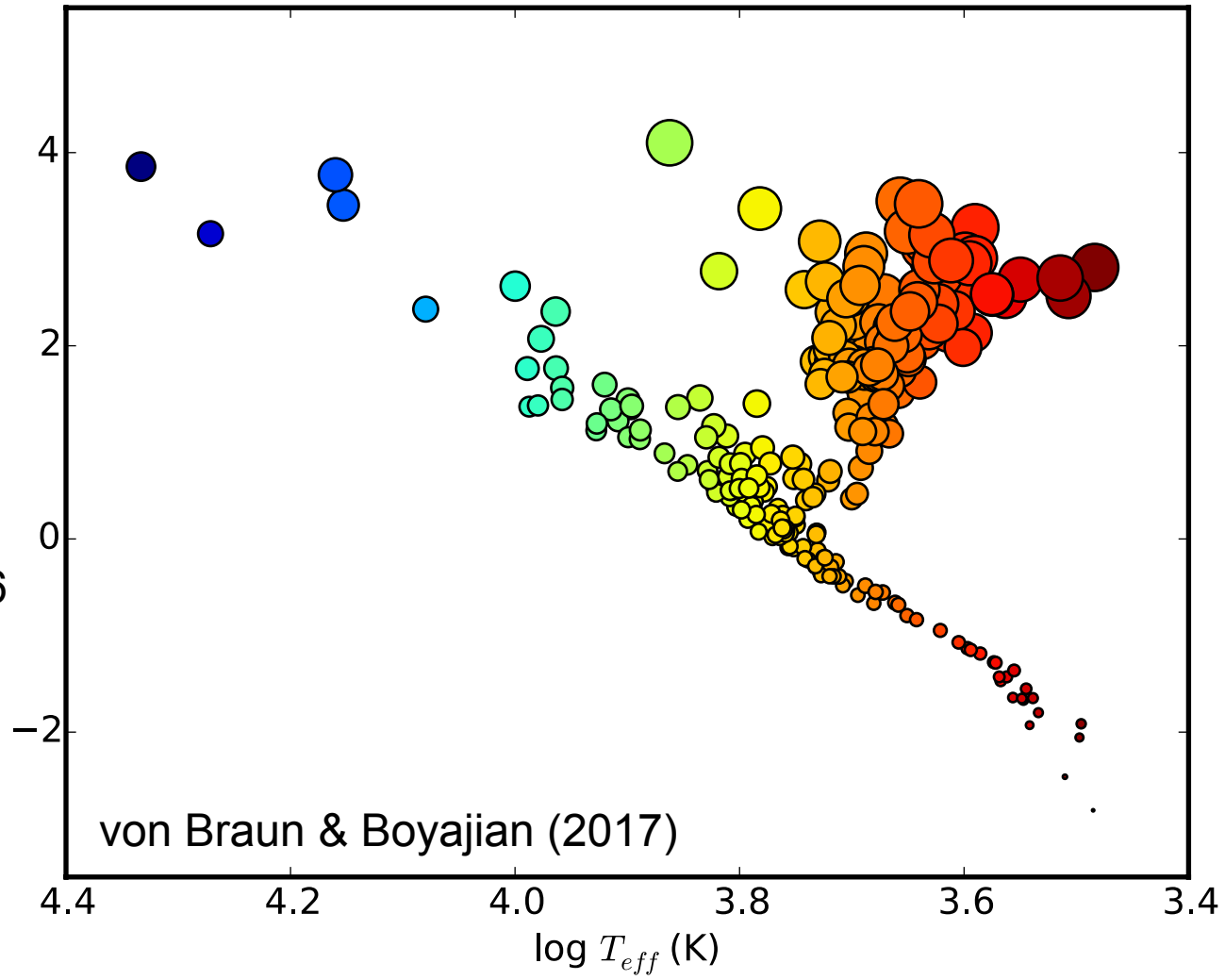
Can harmonize models and measurements for this star with numerical adjustment of α_{MLT}.

Update 4 − Status of Field

Empirical HRD
(~ 290 stars)

size of data point
= log R_{star}

- Status Nov 2016
- δθ < 5%
- d < 150 pc
- R < 100 R_{solar}
- no fast rotators
- no pulsators



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Blue: EHS

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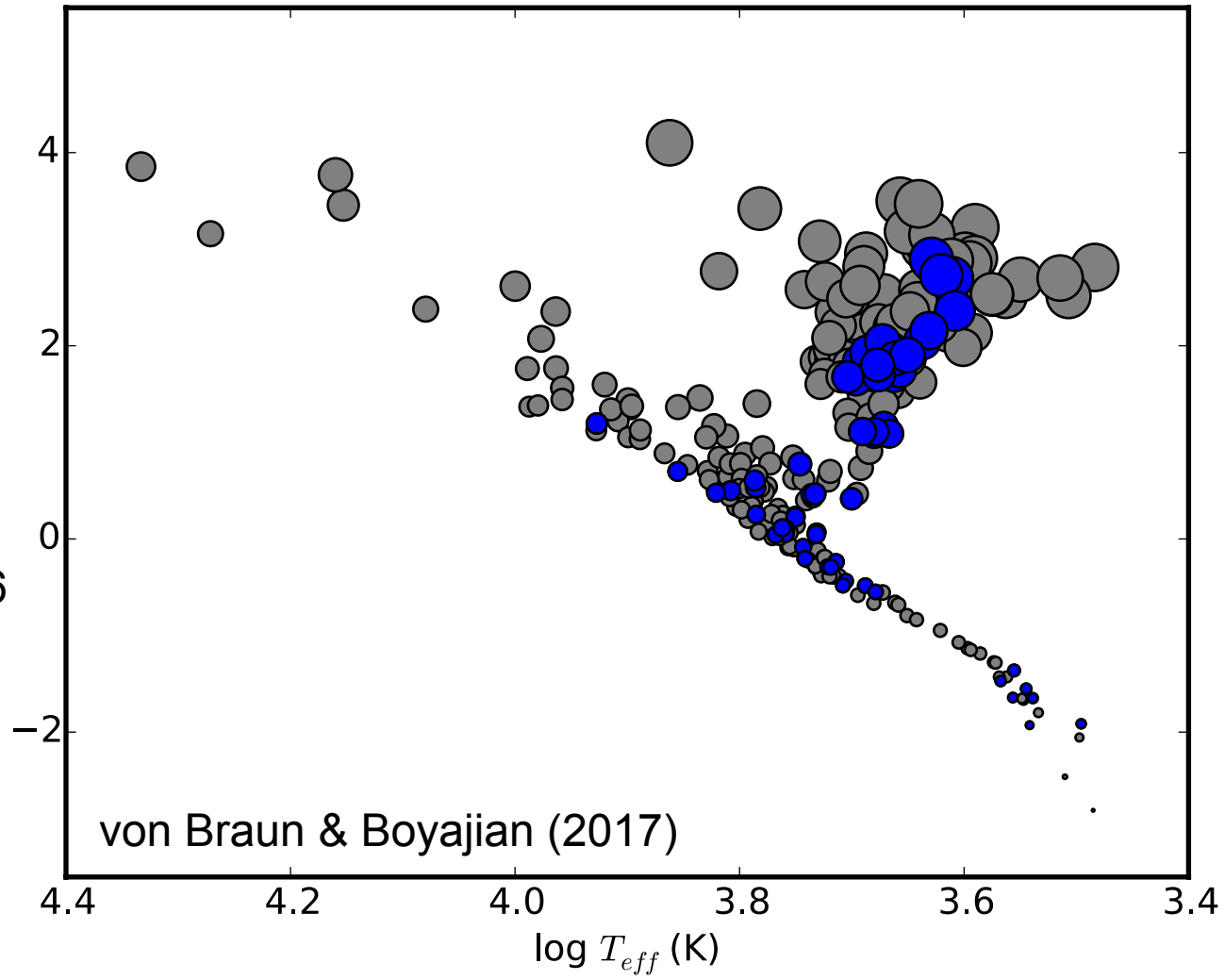

Future Prospects

- Transiting Planet Systems (HD 97658, ...)
- Updated surface-brightness relations, consolidated across lum. classes (Adams+2017)
- Observations complete for 10−20 stars for Classic & PAVO
- Use of Classic plus PAVO