Some Ideas for UVIT Programs & Targets

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Improvement of Fundamental Data --- from Eclipsing systems

Extractables:

- Temperatures of hot components
- Photospheric Radii or measurable extents of chromospheric and coronal structures
- Luminosities (& so BCs for analogues)
- UV limb-darkening coefficients, especially for non-solar analogues.

Greater purpose: for placement on CMD/HRD for comparison to theoretical m
of particular masses, ages, & chemical compositions.

Some Eclipsing Binary Targets

- Systems with hot components
  - Algol primaries
  - CVs/ Systems with white dwarf components
- Systems with extensive chromospheres
  - RS CVn-types + “cool Algols” (both comps.)
  - Systems with convective envelope comps.
  - Over-contact systems
- Systems with subdwarf components

["Supernova Binary" by Dirk Terrell, reproduced here with permission]

EB Targets --- Detail

- Bright Algol targets have been looked at in the UV spectroscopically (IUE, FUSE, ROSAT, ...) to observe the properties of the bluer component. However, UV photometry has not been done very much on most of the fainter systems.
- One field system of special interest: the best evolved system studied (optically): AI Phoenicis (Anderson et al. *A&A* **196**, 128, 1988; Hrivnak & Milone, *ApJ* **282**, 748, 1984). Fluxes from the FUV to optical would fill in knowledge of the properties of both components (next pg).
- We have the option of looking at fainter systems, and those in clusters to benefit from the stellar-cluster connection.

AI Phe

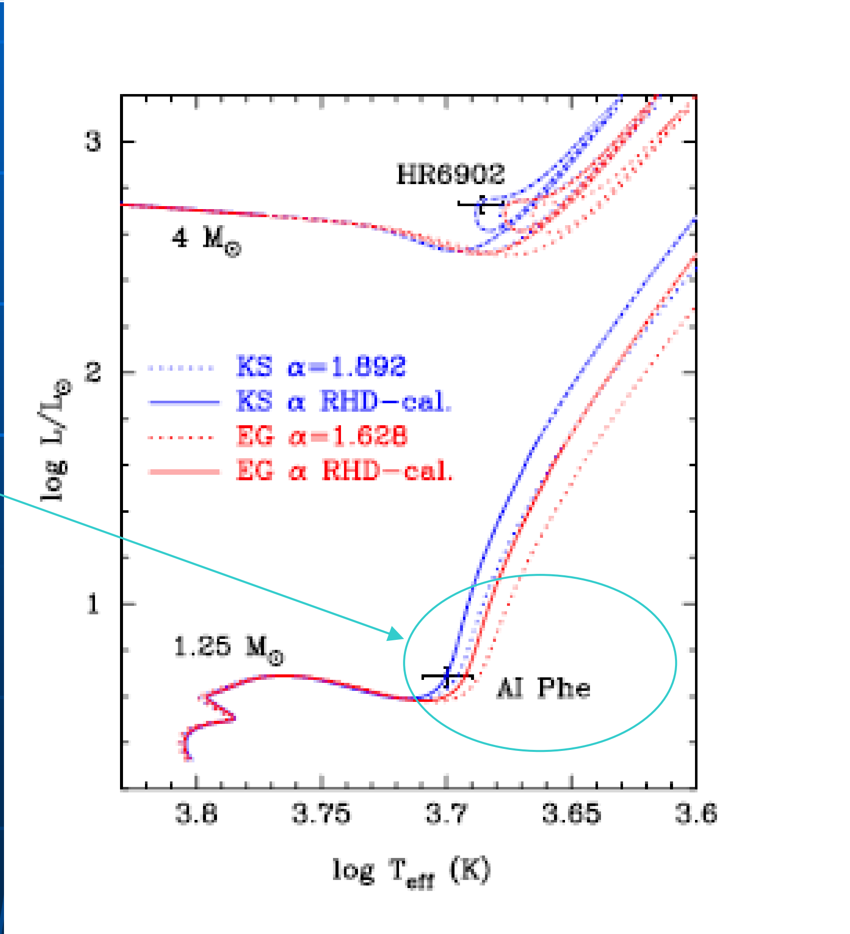
From Weiss & Schattel (2000):

A completely independent method to determine stellar ages is used … to match the positions in the Hertzsprung-Russell-Diagram of both components of known mass with stellar evolution tracks. The classical example for such a successful age determination is AI Phe (Andersen et al. 1988) with determined ages that agree better than 10%.

But for other model tests, more is needed; e.g., from O. Pols (~2000):

Can observed red giant temperatures provide an observational test? The most reliable information comes from giants in eclipsing binaries with accurately known masses and metallicities. Two examples are shown in Fig. 2b: the giant components of AI Phe ($1.236 \pm 0.005\,M_\odot$) and HR 6902 ($3.85 \pm 0.11\,M_\odot$). Observational errors in T_{eff} in both cases are about 100 K, a typical value for a red giant.

The data are compared to 1.25 and $4.0\,M_\odot$ tracks for solar metallicity. In the case of AI Phe the low observed [Fe/H] $= -0.14 \pm 0.10$ will make the tracks bluer, so that the error bar would in fact cover the range of theoretical tracks shown. Ludwig & Salaris (1999) made a very careful study of AI Phe along these lines and also concluded that the data are not good enough for a critical test.



Milone, Stagg, and Kurucz (ApJS **79**, 123, 1992) used IUE data to obtain NUV limb-darkening coefficients, and new model atmospheres to better model stellar parameters.

Properties of Coronae --- cool targets

At bottom end of the MS, we need to improve fundamental data a lot. From Ness et al. (*A&A*, **427**, 667-683, 2004), possible targets to study extensiveness of coronae:

Name	**Sp**	**V**	$\mathbf{T_{eff}}$	$\mathbf{R}_{cor}(R_S)$	$\mathbf{L_x}$(erg/s)*
AT Mic	M4.5	10.3	3175	0.8	$29 \cdot 10^{28}$
EQ Peg	M3.5	10.3	3295	0.4	4.0
EV Lac	M3.5	10.1	3295	0.3	12.
Prox Cen	M5.5e	11.1	3043	0.2	0.2
YZ CMi	M4.5e	11.1	3175	0.3	4.4

* ROSAT data

ROSAT WFC Mixed Source Targets*

(to study dimensions & luminosities)

Name	type	V	N_{60-140} (cts/ks)	$N_{110-200}$
V471 Tau	WD+K2V	9.7	309(16)	1163(30)
RE0720-314	WD+dM	16.1	109(9)	429(21)
RE1016-052	WD+dMe	14.3	486(18)	590(22)
RE1027+323	WD+G	13.2	15(4)	23(7)
GD 123	WD+K	13.2	58(6)	215(13)
IN Com	G5III+M?+sd	8.7	7(3)	54(7)
RE1426+500	WD+dMe	14.0	33(4)	49(5)
RE1629+780	WD+dMe	13.0	1008(15)	1472(18)
RE2013+400	WD+dM	14.6	63(6)	34(5)
RE2024+200	WD+dM	16.4	24(5)	18(5)
RE2300-070	WD+G5	9.8	42(9)	43(9)
HD 223816	WD+F5IV	8.8	80(8)	711(23)

*from Pye et al. (MNRAS 274, 1165, 1995)

Important Additional Targets

In the faint, cool part of the Hertzsprung-Russell Diagram:

- Brown dwarfs
  - Gizis et al. (*ApJ*, **630**, L89, 2006) observed the closest BD: 2MassW J1207334-393254
    - Saw:
      - fluorescent lines in UV: CII,III, IV; H (Lyman alpha); He II; NV; OI; Si I, IV.
      - variable intensity
      - likely due to accretion in **CSM disk** (T ≈10^5 K)
    - HST obs of 2150s to 2900s with STIS; trade off bandwidth & telescope aperture ➔ possibility for emission line monitoring.
  - Stassun et al. (*Nature* **440**, 311, 2006): 2Mass J05352184-0546085, eclipsing SB2 BD system. UV properties unknown.

Some Pulsating Star targets,
for R, T, L data

- NUV, FUV Light curve amplitudes of Hot pulsators (beta Ceph, …)
- NUV Light curve amplitudes of cepheids
  (Sp > ~F I, P >1d)
- RR Lyrae stars (Sp ~A-F III, P ~ ½d)
- Dwarf cepheids (Sp ~ A-G IV/V, P< ½d)
- semi-regular variables

Calibration

- In order to make use of UVIT light curve data, calibrated fluxes will be required.
- Telescope optics, detector, & final filter profiles need to be known, so that Kurucz fluxes and Cohen calibrations can be obtained for specific standard stars.
- These could be drawn from ROSAT standards; we are compiling a list suitable for x-ray and UV. Ground-based support needed for full characterizations.

Simulations

- We at U of C have obtained a new set of flux sources from Kurucz for light curve modeling of both and hot (and cool sources, from the FUV to the intermediate IR). {Final profiles needed to use these.}
- WD versions now permit modeling of some atmospheric features.
- UV observations of EBs with hot components can be modeled realistically with the U of C version of the Wilson & ancillary programs in the Kallrath-Milone WD2007 program package.

The programs to follow the ideas mentioned here are too numerous and detailed for one group to do, so collaborators would be welcome!

Thank you!