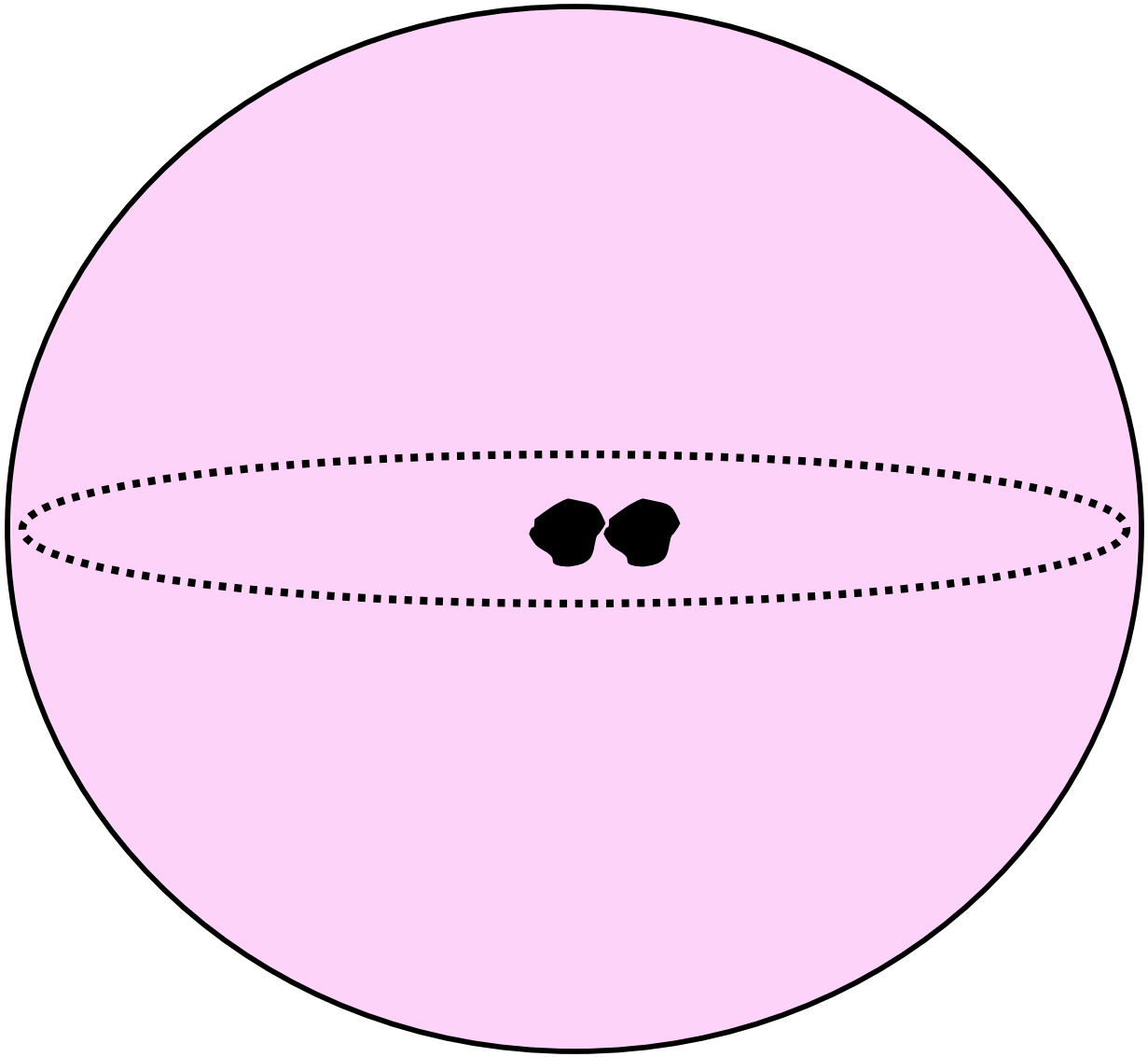
Spectral Monitoring of UXORs with Interference Filters

V. Strelnitski, L. Weiss,
M. Davidson, & G. Walker

Maria Mitchell Association
AAVSO Meeting, 10-17-08

UXORs

- Herbig AeBe stars
- Deep irregular drops of brightness
- Small dust cloudlets [in a disk] ?



RR Tau: Photometry and Spectroscopy

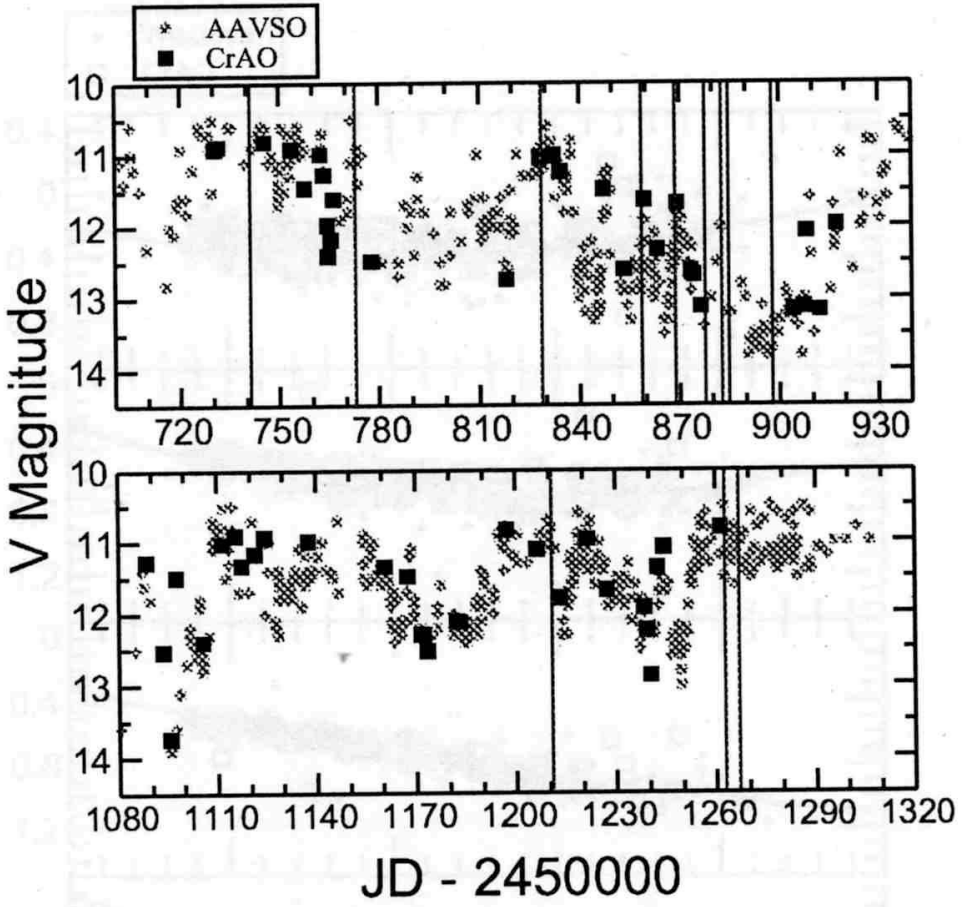


FIG. 1.—Light curve for RR Tau with V-band photometry as a function of Julian date. Stars are AAVSO data, and squares are data from CRAO. Two observing seasons are plotted: approximately 1997 September–1998 April on top, and 1998–1999 on the bottom. The dates of spectral observations are indicated with vertical lines.

RR Tau, Spectra

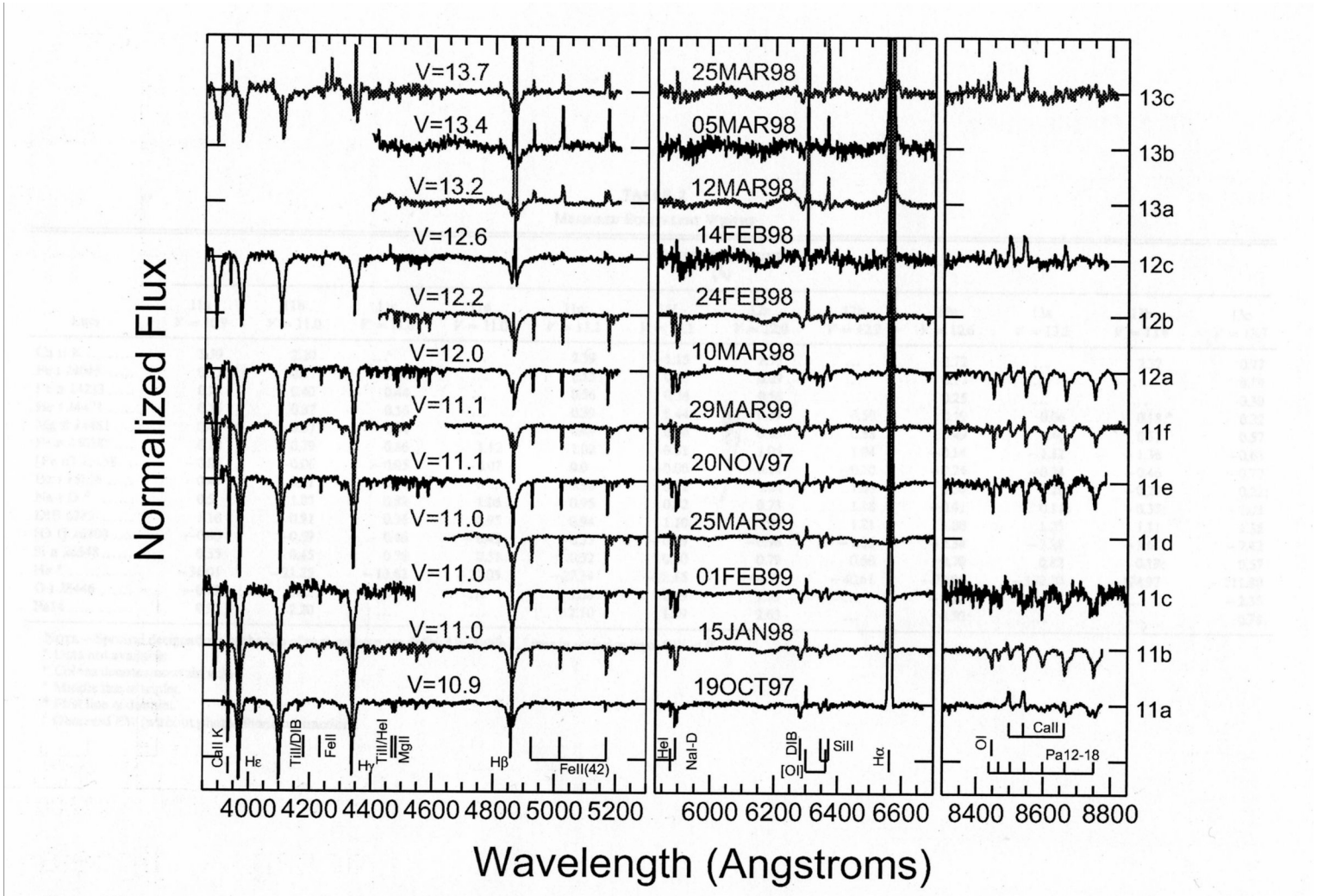


FIG. 4.—DIS spectra of RR Tau vs. wavelength in order of decreasing V magnitude (faintest spectra at the top). All data are normalized and plotted offset from each other by 0.5 (*vertical tick marks*). The dates and corresponding V magnitudes are indicated and prominent spectral features labeled. Along the right-hand side, spectral designations from Table 1 are shown.

Line Flux versus Continuum Brightness

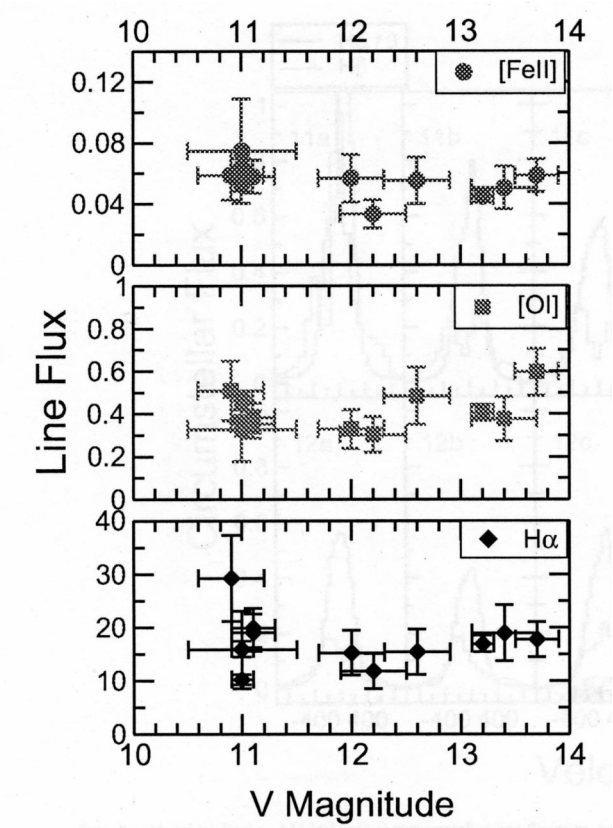
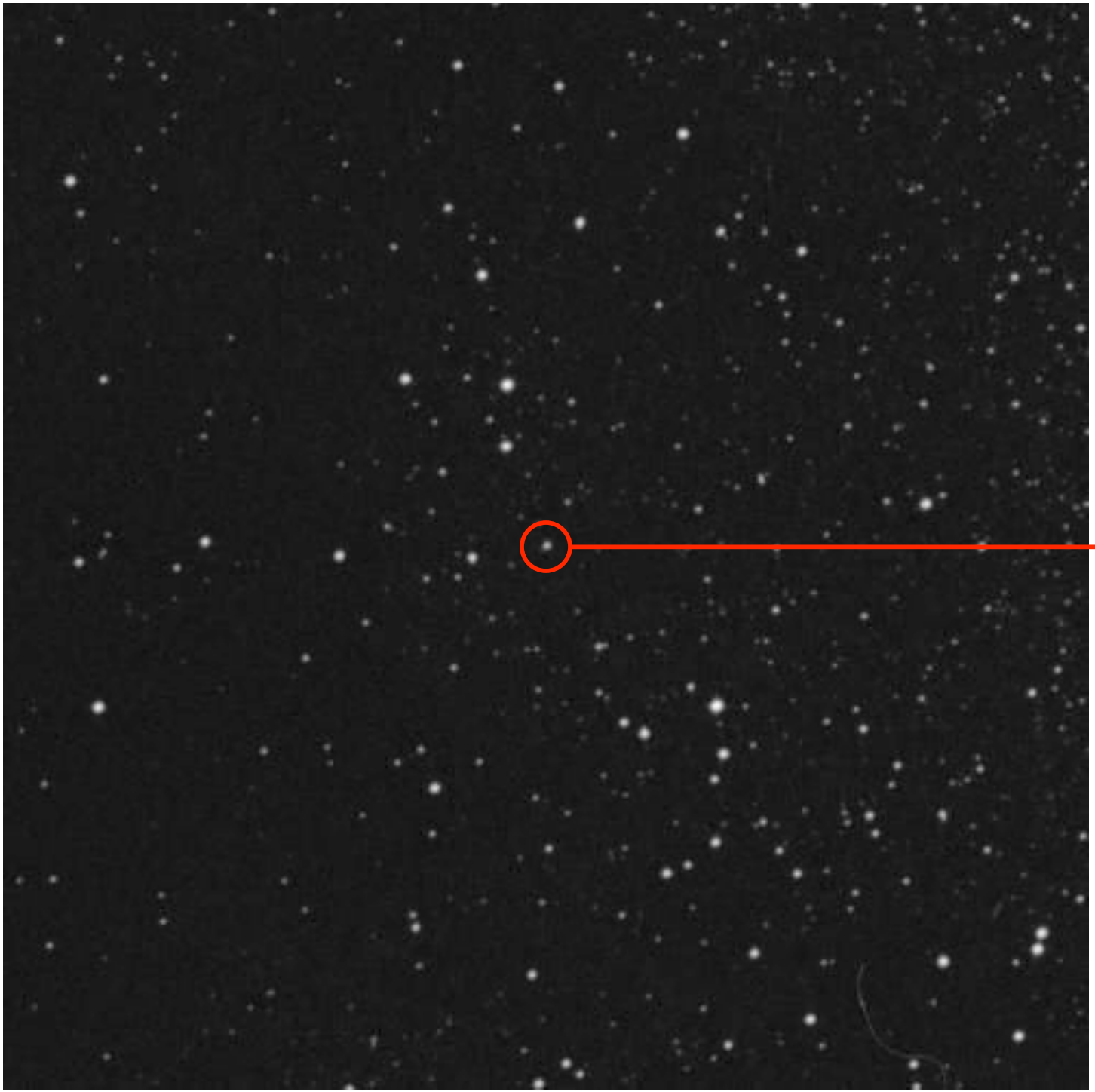
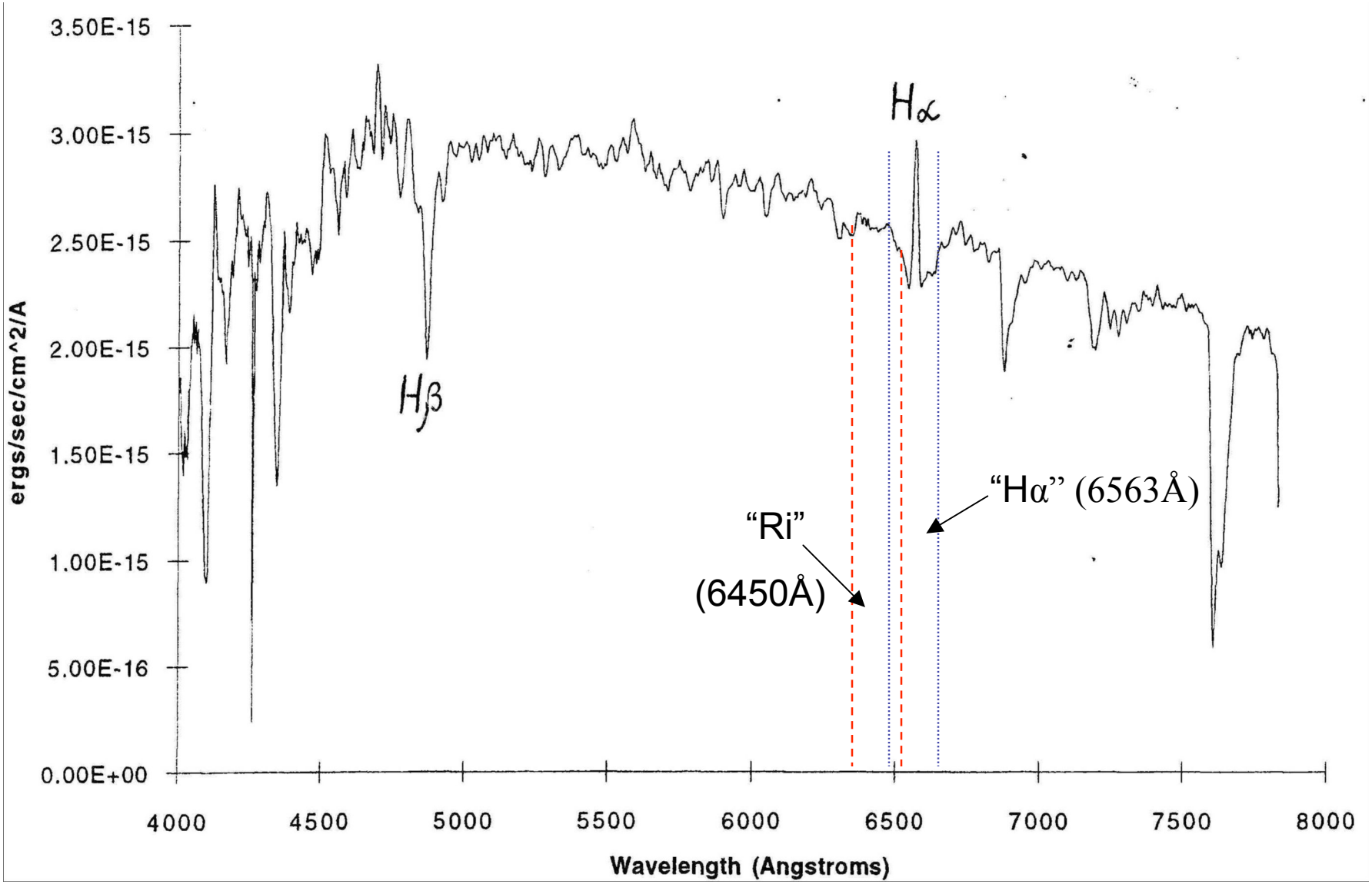


FIG. 8.—Integrated flux of emission lines as a function of V magnitude: [Fe II] (*top*), [O I] (*middle*), and Hα (*bottom*). The flux is in units of 1.6×10^{-13} ergs cm^{-2} s^{-1} (§ 3.3). Errors in line flux are propagated from uncertainty in V magnitude.


V3798 Sgr
R.A.: 18 15 25.73
DEC: -19 39 15.1
(2000.0)

V3798 Sgr


3.50E-15
3.00E-15
2.50E-15
2.00E-15
1.50E-15
1.00E-15
5.00E-16
0.00E+00
ergs/sec/cm^2/A
Hα
Hβ
"Hα" (6563Å)
"Ri"
(6450Å)
4000
4500
5000
5500
6000
6500
7000
7500
8000
Wavelength (Angstroms)

A drop of theory…

Differential Photometry: $S \equiv (adu)_T / (adu)_C$

1. Emission line flux correlates with the observed continuum flux

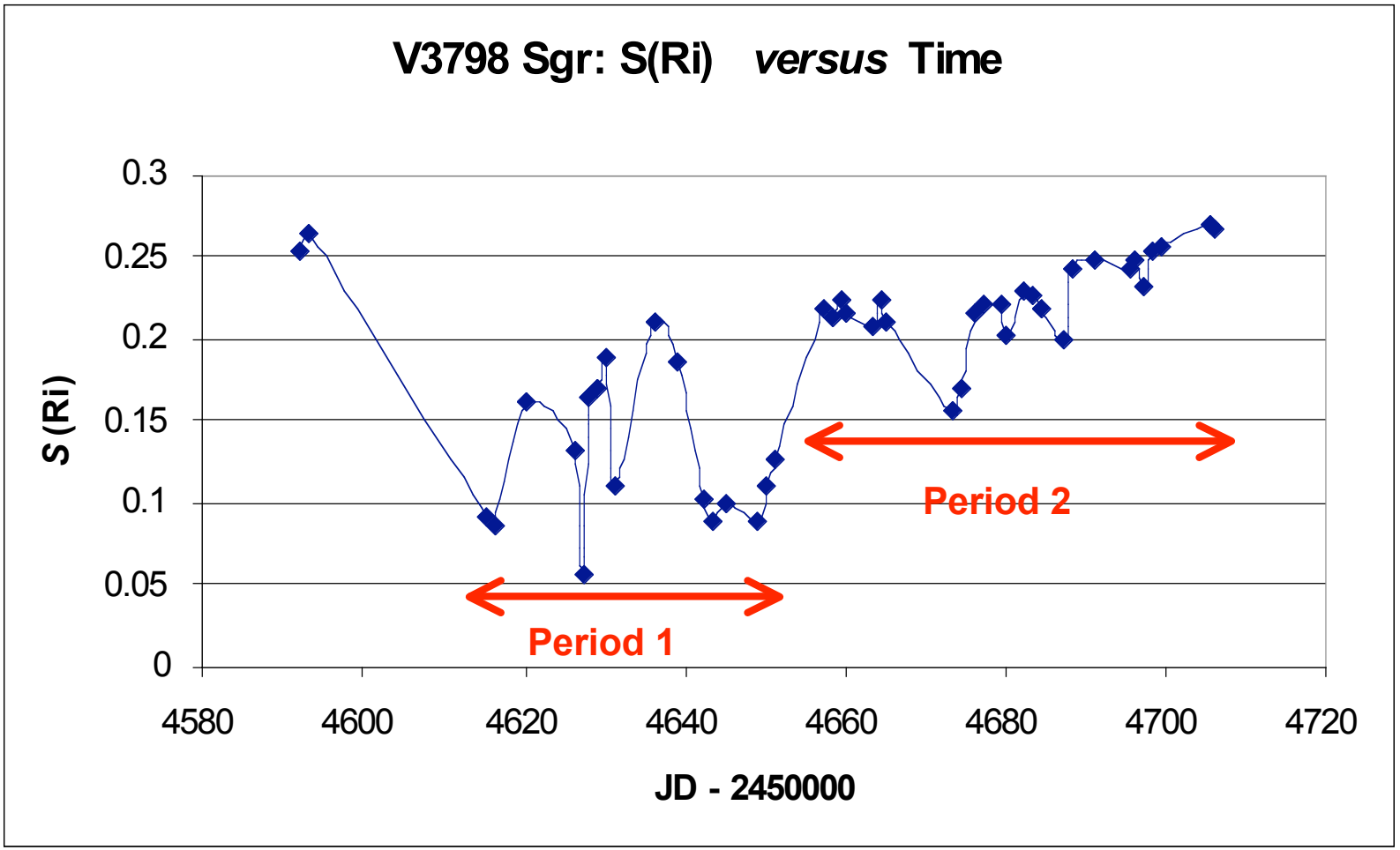
$$S(H_\alpha) = \beta\gamma * \kappa S(Ri) ,$$

$\beta \equiv [f_T(6563) * \Delta\lambda_T(H_\alpha) / f_T(6450) * \Delta\lambda_T(Ri)] * [f_C(6450) * \Delta\lambda_C(Ri)]] / [f_C(6563) * \Delta\lambda_C(H_\alpha)]$
$\gamma \equiv 1 - (W_a - W_e) / \Delta\lambda_T(H_\alpha)$
$\kappa = \exp [\tau(6450) - \tau (6563)] = \exp [0.0158 \Delta m(Ri)].$

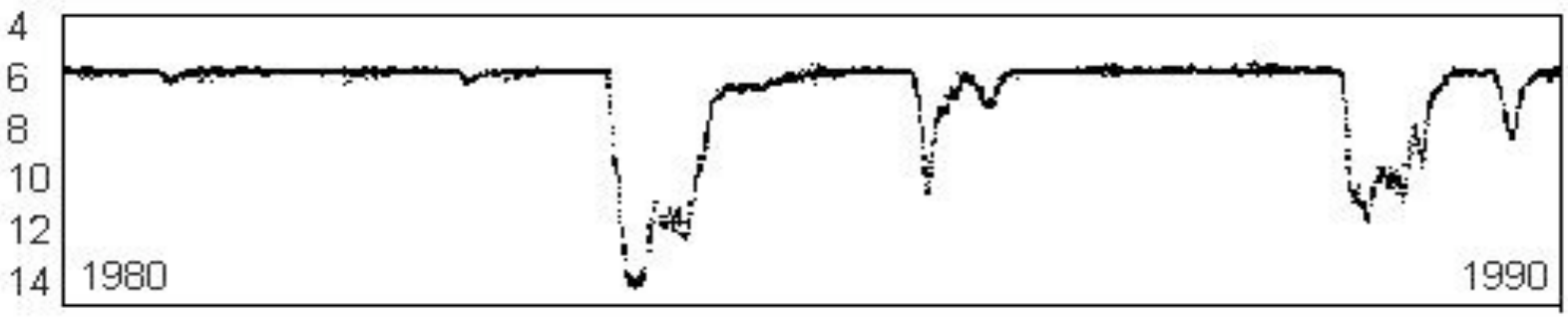
2. Emission line flux does *not* correlate with the dimming due to dust

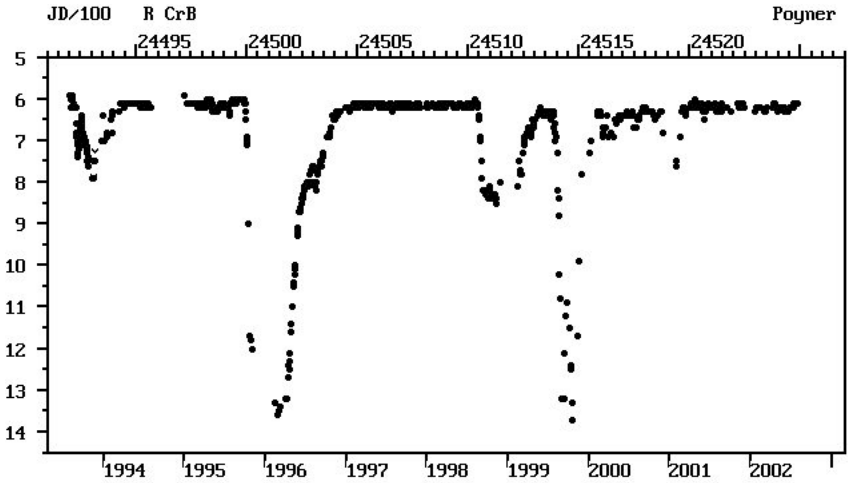
$$S(H_\alpha) = \beta\gamma' * \kappa S(Ri) + E / [f_C(6563)]*\Delta\lambda(H_\alpha)] ,$$

$\gamma' \equiv 1 - W_a / \Delta\lambda_T(H_\alpha)$

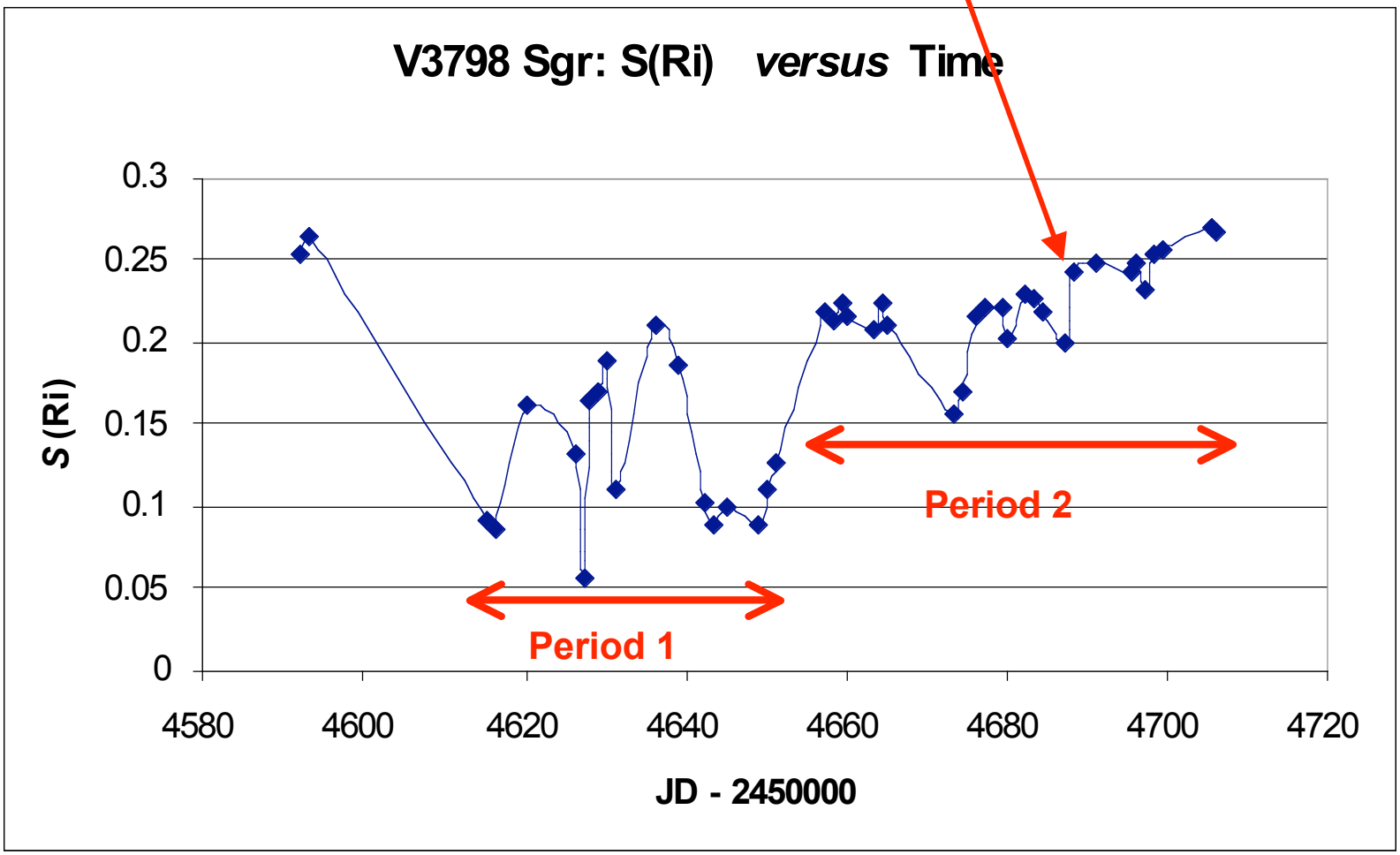

V3798 Sgr: S(Ri) versus Time
S (Ri)
0.3
0.25
0.2
0.15
0.1
0.05
0
4580
4600
4620
4640
4660
4680
4700
4720
JD - 2450000
Period 1
Period 2

R CrB

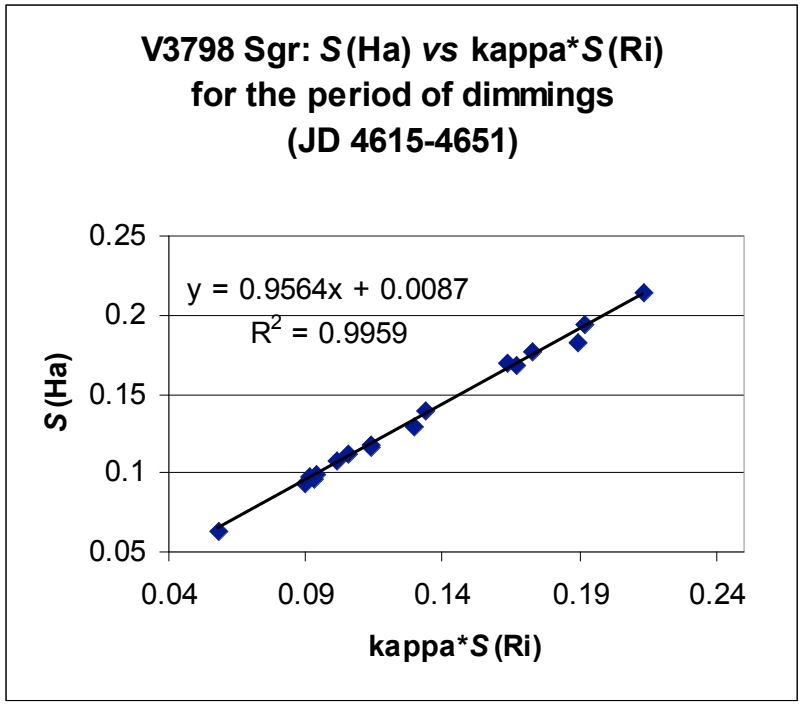

4
6
8
10
12
14
1980
1990

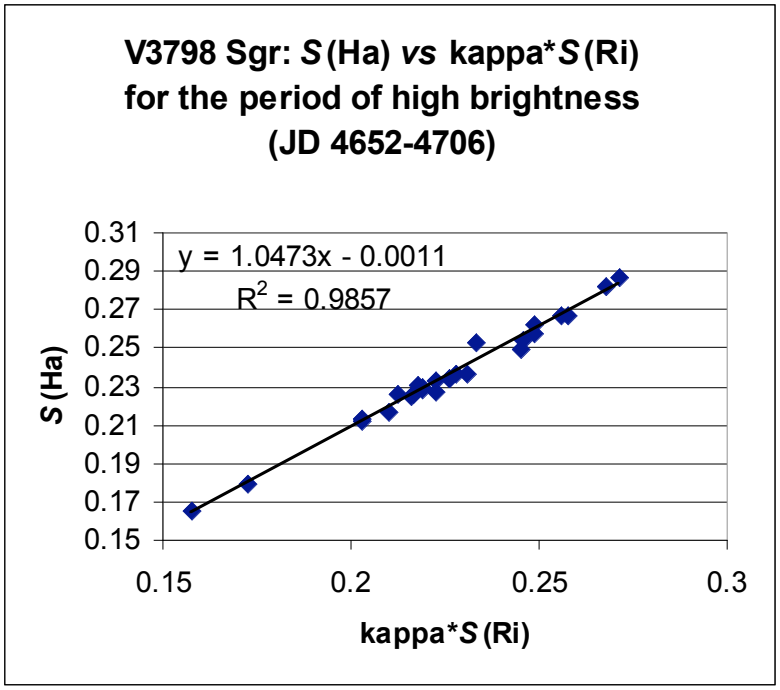

JD/100 R CrB
Poyner
24495
24500
24505
24510
24515
24520
5
6
7
8
9
10
11
12
13
14
1994
1995
1996
1997
1998
1999
2000
2001
2002

Are UXORs *intrinsically* variable?

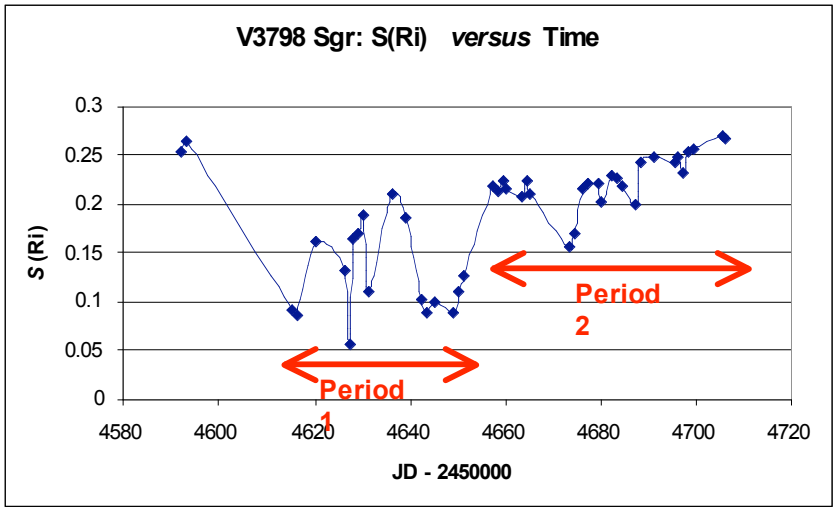


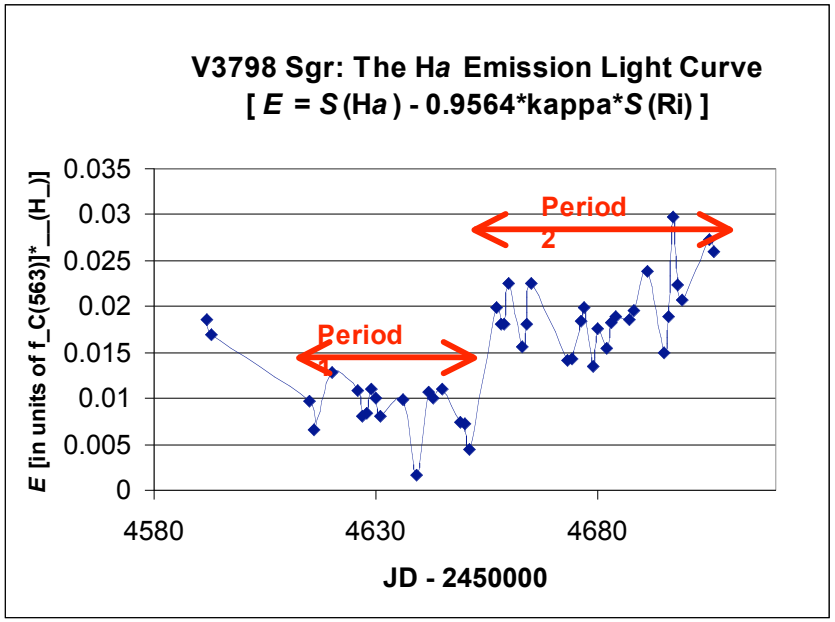
$S(H_\alpha)$ *versus* $\kappa S(\mathrm{Ri})$





V3798 Sgr: Ri and Hα Emission





Conclusions

- Interference filter photometry of UXORs allows for separation of emission line variability from continuum variability
- V3798 Sgr is a new UXOR and it may be *intrinsically* variable
- MMO starts an extensive program of monitoring UXORs with interference filters