MULTI-YEAR & POSSIBLY PERIODIC VARIATIONS IN THE UV SPECTRUM OF
56 PEGASI

Robert E. Stencel (NASA-HQ & JILA)
James E. Neff (A.P.A.S., Univ. Colorado), and,
Robert D. McClure (Dominion Astrophys. Obs.)

Abstract

Radical variations in the Mg II emission profile of the late
type supergiant 56 Peg have been observed to occur during the
course of five years of IUE operations. Pronounced and possibly
periodic changes in asymmetry, emission relative velocity and
photospheric radial velocity are reported. Implications for the
study of cool star chromospheres and interacting binaries are
discussed.

Introduction

Timescales in nature do not always conform to human attention
spans, but thanks to the remarkable continuity of the IUE
Observatory, we can report the discovery of significant
ultraviolet spectral variability in the K supergiant star 56
Peg, with a 4 to 5 year characteristic timescale. One
conceivable interpretation of the data is that 56 Peg is a
binary in a dynamic stage of evolution. Alternately, an
infrequent, flare-like event on a single star may have been
observed.

As one of the few bright K type supergiants (Keenan classified
56 Peg as K0 IIp and noted its strong Ba II line), attention
was drawn to it by G. Basri in connection with its unusual Ca II
K line emission profile (cf. Linsky et al. 1979). The K line
more nearly resembles a solar plage than that of a mass losing
red giant. Although systematic observations of the K line have
not been pursued to date, observations by the first author and
others suggest no significant K line profile changes over
several years.

IUE Observations

The initial LWR spectra obtained in June 1979, as part of a Mg
II survey of cool supergiants, showed a doubly reversed, red
asymmetric emission profile typical of mass losing objects. The
initial far UV spectrum revealed an unexpectedly hot continuum,
which was estimated by Schindler et al. (1982) to correspond to
a 32,000K white dwarf. The SWP also showed a variety of strong,
high temperature emission lines similar to those seen in some RS
CVn stars. The soft x-ray flux detected with HEAO-2 IPC was

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ascribed by Schindler et al. to wind accretion on to the surface of the white dwarf.

After a year of attempting to compute a synthetic spectrum for the discrepant Ca II and Mg II profile asymmetries, we returned for a second LWR exposure in late July 1980, and discovered a radical increase in total flux, plus a profile asymmetry opposite the initial observation. Since then, a series of LWR observations showed the total flux has slowly declined and the asymmetry gradually returned to the mass loss sense by early 1984 (Figure 1). A second SWP showed no measurable changes in either line or continuum flux. During the same several years, McClure at DAO began to study Ba II star radial velocity changes using precision photoelectric techniques (cf. Fletcher et al. 1982) and has monitored 56 Peg at our request.

Figure 2 displays the correlations among: (a) the Mg II profile asymmetry (defined by the ratio of k2 peak fluxes); (b) the relative shift between the centroid of the Mg II emission envelope (fit by gaussians) and the k3 central reversal (presumed to be fixed and interstellar); and, (c) the optical, photospheric radial velocity data. The data can be viewed as either reflecting binary motion, or a strong enhancement (flare?) in the Mg II forming region, on a 4 to 5 year timescale. During the Julian Day interval 4400-5100 (modulo 2,440,000), the Mg II emission and the radial velocity both show a redshift trend, suggesting the Mg II is associated with the cool star and not the white dwarf. After JD 5100, the Mg II variation slows and the radial velocities become stochastic. One interpretation of this is that the side of the K star facing the white dwarf is heated, while the opposite side is a relatively normal turbulent cool photosphere and mass losing chromosphere. How the chromospheric Mg II is affected, yet the Ca II is not, remains to be understood.

Further UV and radial velocity observations are planned, and polarimetry is encouraged. Details of this research will be published elsewhere.

References

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Figure 1

Mg II k-56 PEG

RELA TIVE FLUX

WAVELENGTH

11/80
9/80
8/80
6/80
6/79

1/84
5/83
5/82
9/81
9/81
3/81

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