On The Source of Optical Variability and Outflow in Z CMa System

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Article:

We discuss our new (Teodorani et al. 1997) and already published photometric and spectroscopic data regarding the binary system Z CMa and conclude that these data, in contrast to wide spread opinion, do not contradict the hypotesis that a FU On type secondary rather than the IR primary is the main source of the observed optical variations and outflow. In the frame of this hypothesis, we explain observed larger polarization in the emission lines than in the continuum as a result of Thomson scattering of line quanta inside the region of their formation.

Z CMa belongs to FU Ori type objects (FUORs) and has an IR companion at projected separation of 0.1". The companion (or Z CMa NW) is dominant in SED at $\lambda > 2\ \mu m$ and has ~ 2 times larger L_{bol} than its optical counterpart Z CMa SE. The system is a sourse of powerful outflow. Whitney et al. (1993) discovered Z CMa emission lines are much more polarized than the continuum and have concluded finally that IR companion is responsible for gas outflow and 1987 yr. outburst. Here we discuss possibility of the opposite view point.

We belive that FUOR Z CMa SE was the reason of 1985 and 1987 outbursts because:

1) they have occured just at the end of a 15 yrs. period of nearly constant Z CMa brightness, and then followed by a decay of brightness. It seems resonable to ascribe all these variations to the same component of the system and we argue that it is Z CMa SE.
2) the amplitude of these outbursts subsequently decreased from U to K spectral bands, what looks strange if the reason of the flash was the rise of the IR companion luminosity.
3) we argue that the flash could not be due to the temporary clearing of Z CMa NW dusty envelope along the line of sight.

We have analised profiles of forbidden lines in the spectra of Z CMa and its jet and have concluded, that the line of site passes within the cone of the outflowing gas. It is why we belive that IR companion surrounded by opaque dust shell can not be the source of the outflow. We have presented arguments that forbidden lines and permitted lines with P Cyg profiles form in different regions of the same outflow.

We have estimated an optical depth of the ionized component of Z CMa stellar wind relative to Thomson scattering and found $\tau_{Th} \geq 0.03$. The lower limit of τ_{Th}, we derived refers to quanta coming from the central source, which reach the observer along the line of sight, such as quanta of Pashen continuum with free-bound optical depth $\tau_{fb}(R)$ not too much larger than unity if at all. But quanta of strong emission lines pass the distance $L \gg R$ inside the region of line formation due to multiple resonance scattering. Thus their optical depth relative to Thomson scattering $T_{Th}^{line} \simeq L\sigma_{Th}N_e$ should be much larger than our lower limit. This is why we believe that Thomson scattering of emission lines quanta inside the densest part of the stellar wind can be responsible for the excess polarization mentioned above. Numerical calculations are necessary in order to estimate the effect quantitatively.

References:

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