The Devil Star: Analyzing Data from the Massive Magnetic Star HD66665

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Purpose

The magnetic massive star named tau Sco (Fig. 1) was unique with its unusually complex magnetic field until two other stars were discovered with similar light spectra, HD63425 and HD66665 (aka the "Devil star"). Dr. Petit *et al.* determined many properties of these clones, including the presence of a magnetic field. It has yet to be determined if the fields are as complex, however, and I am analyzing spectro-polarimetric data to answer this question. The purpose of studying these magnetic fields is to discover if they are causing the stellar wind anomalies observed in UV and X-rays coming from tau Sco.

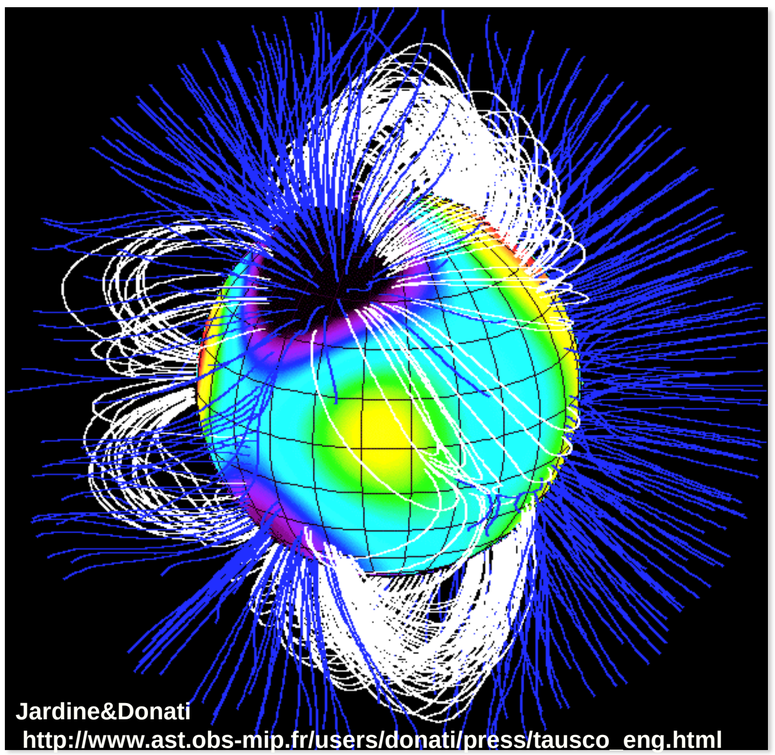

Fig. 1 – Model of the massive magnetic star, tau Sco, with its unusually complex magnetic field lines. Does HD66665 have a similar field?

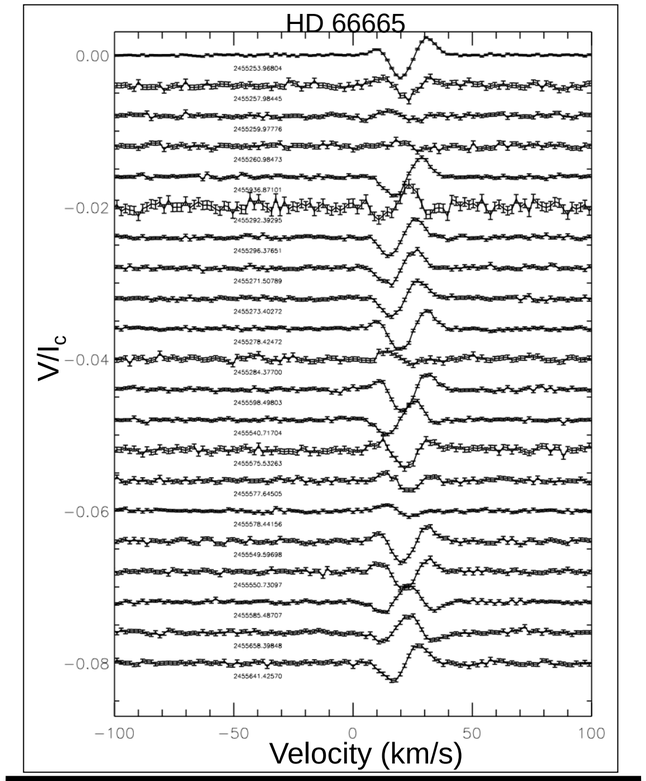

Fig. 2 – Polarization data of HD66665

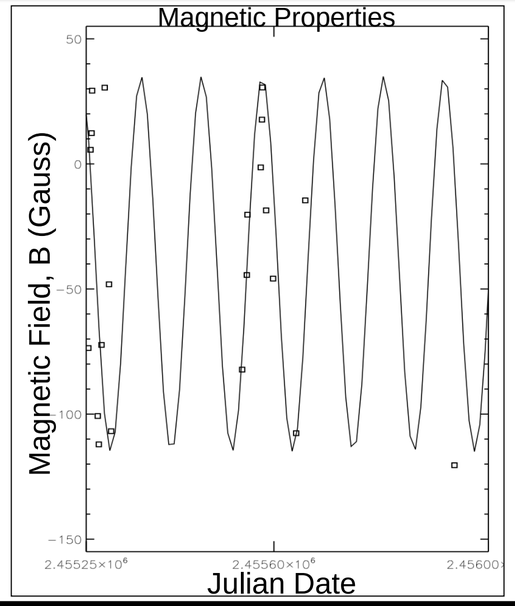

Fig. 3 – The calculated magnetic field values with the theoretical curve they should follow if the magnetic field is not complex

Methods

- **Analyze data observed from HD66665 with the program Interactive Data Language (IDL)**
- **Write an algorithm in IDL to extract flux and polarization data from multiple observations**
- **Use polarization data to calculate the magnetic field, B**

$$B_{||} = -2.14 \times 10^{11} \frac{\int vV(v)\mathrm{d}v}{g_{\mathrm{eff}}\lambda_0 c \int (1 - I(v))\mathrm{d}v},$$

- **Compare the calculated values with the sine curve expected from a normal massive magnetic star**

Results

The flux and polarization data for the corresponding Julian dates were plotted against velocity shift (polarization shown in Fig. 2). These deviations from zero only appear in the presence of a magnetic field. In Fig. 3, the squares indicate the calculated magnetic field values from the observed data. The solid sine curve is the expected result for a normal magnetic massive star. The fact the points do not match very well indicates HD66665 has at least a slightly complex magnetic field.

Future Research

- **Use a more quantitative approach for fitting the sine curve to obtain more accurate error estimates**
- **Repeat for the other clone, HD63425**