1. Introduction

Background on X-rays in O stars

- With the exception of ζ Pup, X-ray lines do not show expected profiles
- Analyses imply that the wind opacity is much smaller than expected. This implies that either
  - $\dot{M}$'s are lower than thought, and/or
  - the winds are porous due to clumping or *large scale* structures.
- Lack of detectable X-ray variability from most O stars favors clumping.

Background on ξ Per

- A normal, single mid-O star, with a high (but not extraordinary) $v \sin i$
- UV wind lines and optical lines influenced by the wind both show a distinctive, well-documented, persistent 2.1d period (deJong et al.)
- Consensus is that the period in the variability results from rotational modulation of large scale wind structures.
- Consequently, this star presents an excellent case to examine for X-ray variability in order to establish a link between X-rays and large scale wind structures.

2. The Data

TBD – should be standard

3. Analysis

The time averaged profiles

- They appear similar to most mid-late O stars.
- Profile analysis implies low optical depth and, hence, porosity.
- Need quantitative comparisons from final numbers

The time series

- Details
  - Background limited
  - Advantages of studying the zeroth order spectrum
  - Characterization of the background
- KS test for variability in the zeroth order spectrum
- Results from a linear regression of the temporal data
  - Why least squares is appropriate for the data
  - 20–30% change over the 2 days of observing run!
  - The probability that the observed trend is real
  - The probability that the observed trend is linear – i.e., monotonic
- Variability of other aspects of the spectrum, e.g., a super-line, the "pseudo-continuum", etc. (TBD – preliminary analysis done, but may not add much. If so, may be best to leave it out.)
- Hα observations obtained with the hope of phasing the observations – (Alex?)

4. Discussion

X-ray profiles

- How they compare to other stars (give numbers – a table?)
- Implications from the implied τ(wind) and fir analysis.
- Bottom line – porosity

X-ray variability

- Did we observe a partial period? See the Hα variability observed by Morel et al. (2004) – its shape is very similar! So cyclic behavior is *plausible.*
- Compare level of variability to other single, normal O stars – all part of a Table?
- ζ Oph is the only other one (true?) – its *ASCA* data also varies for 20% (2001, A&A, 378, L21).

5. Conclusions

- MUST verify whether the variability is periodic. However, the alternative is that the X-ray flux from the star dropped by nearly a third over 2 days as part of some sort of a secular variation – even stranger!
- Profiles indicate much of the X-ray flux we observe may come from deep within the wind, or even the far side of the star.
- IF the variability is cyclic, then the amplitude is *very* large. In fact, if the X-ray variability originates in CIRs, such a large amplitude may indicate that ALL of the X-rays are formed by the CIRs
- Then why don't the X-ray fluxes of all mid-late O stars vary?
  - It may be that the CIRS must be viewed very near to equator-on to observe the variability (see, Dessart's model)
  - This would be consistent with ζ Oph and ξ Per being the two X-ray variable stars.
  - Does this imply that we would expect the optical depths of the X-rays from the winds of ζ Oph and ξ Per's to be somewhat larger than in comparable stars?
  - If the X-rays originate in the CIRs, then why don't the UV observations of variable sources reveal distinctive modulations in the ionization states of the winds.
- Many unanswered questions
- Reiterate that it is essential to verify whether the variability is periodic. If it is, it could signify a fundamental change our view of stellar winds.