

IMPORTANT QUESTIONS IN THE FIELD OF COLLIDING STELLAR WINDS

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Abstract

Sometimes the most important step toward making scientific progress is figuring out the correct question to ask. Discussion leaders at the X-Ray and Radio Connections Meeting were asked to create a list of important questions in each field which, if we worked on them and met again in five years, we would have made progress on the issues presented at the meeting. Here are the important questions for colliding stellar winds.

Colliding Wind Binaries

Colliding-wind binary systems are great laboratories for studying particle acceleration and the relationship of X-ray and radio production in shocks. The X-rays are due to thermalization of the two winds and thus provide direct diagnostics of the bulk properties of the winds, including speeds and mass loss rates.

Both thermal emission from the winds themselves and non-thermal emission from electrons accelerated to relativistic energies at a shock can be imaged in the radio. The thermal wind emission complements the data from X-rays, and the ability to make milliarcsecond-resolution radio images provides important parameters needed to interpret correctly the X-ray data.

Questions:

- 1) It is clear that non-thermal radio emission can be produced by colliding-wind binaries. Can we produce non-thermal radio emission in the wind of a single mass-losing star by the traditional mechanism of shocks due to inhomogeneity in the winds, when the X-ray data for single stars suggest that any shocks in these winds are weak?
- 2) The importance of the binary-versus-single-star issue arises when we try to interpret observations of distant clusters such as the Galactic center star clusters, where binarity is difficult to determine by other means: if all hot stars showing non-thermal radio emission must be colliding-wind binaries, this has important implications for our understanding of these clusters.
- 3) The number of colliding-wind systems in which we can resolve the radio emission of the two stars is small, and needs to be increased in order to study the effects of viewing angle and of polar dependence of wind parameters. This may require more sensitive VLBI observations, e.g., by including the Green Bank telescope with the VLA and VLBA. Currently planned large-effective-area X-ray missions should also increase the number of systems for which excellent X-ray spectra are available.
- 4) Simulations of the colliding winds need to be improved to handle the more complicated geometries, including realistic simulations of highly elliptical systems, and to try to incorporate acceleration processes self-consistently (first-order acceleration across the shock itself, or second-order acceleration in turbulence in the shock region). What is the role of proton acceleration in the system? Dust formation could also be an important factor in some systems.