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# ELONGATED STRUCTURES NEAR STARS: JETS OR PROJECTION EFFECTS?

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RESUMEN

Observaciones recientes en las longitudes de onda correspondientes a las regiones de radio, infrarrojo y visible del espectro han mostrado la existencia de estructuras gaseosas, pequeñas y elongadas, que aparecen emanar de algunas estrellas. Estas estructuras son frecuentemente interpretadas como chorros cuya naturaleza es quizá similar a la de los chorros observados en objetos extragalácticos. En este trabajo proponemos que dichos "chorros" pueden simplemente deberse a la luz emitida por, o reflejada en las paredes de las cavidades que se forman alrededor de las estrellas cuando el viento de las mismas barre el medio gaseoso en sus alrededores. La radiación de las paredes de dichas cavidades, al ser observada desde ciertas posiciones, aparece como estructuras elongadas; un efecto de proyección que ilustramos mediante un modelo sencillo.

Discutimos también algunos casos bien conocidos de objetos, tanto jóvenes como evolucionados (PV Cep, R Mon, R CrA, G34.3 + 0.2, R Aqr, HH57, HL y XZ Tau y NGC 6302) donde este efecto de proyección puede estar operando.

ABSTRACT

Recent observations in radio, infrared and visible wavelengths have revealed the presence of small, elongated gaseous structures that appear to emanate from stars. These structures are frequently interpreted as jets, perhaps similar in nature to those observed in extragalactic objects. We argue that these apparent "jets" could simply be light emitted by or reflected from the walls of the cavities expected to be formed when the winds of these stars drive their surrounding gaseous medium away. When viewed from certain positions the radiation from the walls of these cavities appears to the observer as elongated structures. A simple model is presented to illustrate this projection effect.

We also discuss some well known sources both young and evolved (PV Cep, R Mon, R CrA, G34.3 + 0.2, R Aqr, HH57, HL and XZ Tau and NGC 6302), where this projection effect may be at work.

*Key words:* **STARS-CIRCUMSTELLAR SHELLS – STARS-WINDS**

## I. INTRODUCTION

Gaseous outflows are now known to be a common phenomenon related to stars of recent formation (Rodríguez *et al.* 1982; Bally and Lada 1983; Edwards and Snell 1983; Calvet, Cantó and Rodríguez 1983; Cantó *et al.* 1984, Lada 1985). In a good number of sources the outflow geometry is bipolar, or at least anisotropic, pointing to the presence of a focusing agent. While some authors propose an originally isotropic stellar wind that is later focused by an external structure of circumstellar (Snell, Loren and Plambeck 1980; Rodríguez *et al.* 1986) or interstellar (Cantó *et al.* 1981) dimensions, others have suggested that the wind leaves the star anisotropically (Hartmann and MacGregor 1982; Mundt *et al.* 1984). With the continuous improvement of radio, infrared and optical imaging it has been possible to search for structures of small dimensions that could elucidate the real nature of the focusing mechanism.

Indeed, during the last few years several groups have reported the detection of elongated, faint structures in close association with young stars and Herbig-Haro (HH) objects. These structures have typical projected dimensions of $\sim 0.1 \times 0.001$ pc and are usually evident in deep H$\alpha$ and [S II] images. Their line emission spectrum, similar to that of HH objects, may appear shifted by $\sim 100$ km $s^{-1}$ with respect to the velocity of the star and occasionally may show velocity gradients. Examples of these elongated structures have been found associated with AS353A (Mundt, Stocke and Stockman 1983); HH12 (Strom, Strom and Stocke 1983), L1551 and HH101 (Morgan *et al.* 1984), DG Tau and XZ Tau (Mundt and Fried 1983), HH46-47 (Graham and Elias 1983), Haro 6-5B, HH33-40, HH19 and 1548C27 (Mundt *et al.* 1984), HH57 (Graham and Frogel 1984; Reipurth 1985) and HH34 (Reipurth *et al.* 1986). In these papers, the observed structures have been interpreted as jets collimated in the immediate vicinity of the star. To a lesser extent, elongated structures near evolved stars have occasionally been interpreted as jets. Perhaps the best known case is