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ON THE FUTURE DYNAMICAL EVOLUTION OF THE ORION TRAPEZIUM

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RESUMEN

Basándonos en datos observacionales recientes sobre las velocidades transversales y radiales de las estrellas más brillantes del Trapecio de Orion estudiamos la evolución dinámica de ensambles de sistemas múltiples como el Trapecio. Para ello, llevamos a cabo integraciones numéricas de N cuerpos con las posiciones y velocidades observadas, e incluyendo perturbaciones a ellas compatibles con los errores de observación. Discutimos las propiedades de los sistemas evolucionados y de las binarias resultantes.

ABSTRACT

Based on recent observational data on transverse and radial velocities of the bright Orion Trapezium stars we study the dynamical evolution of ensembles of multiple systems mimicking the Trapezium. To this end we conduct numerical N-body integrations using the observed planar positions and velocities, the radial velocities, and random z-positions for all components. We include perturbations in these quantities compatible with the observational errors. We briefly discuss the properties of the evolved systems and of the resulting binaries.

Key Words: binaries: general — stars: early-type — stars: formation — stars: kinematics and dynamics

The Orion Trapezium has been extensively studied. Nonetheless, many questions about this system remain unanswered. In particular, its dynamical state is unclear. To cast light on this problem, we use newly determined transverse velocities (Olivares et al. 2013) and radial velocities from the literature, to study the dynamical evolution of ensembles of systems mimicking the Orion Trapezium in the plane of the sky. To this end, we perform numerical N-body integrations using three different values for the mass of Component C, the most massive and for which the most discrepant values are cited in the literature (see Allen et al. 2016 and references therin).

Our results show that, using 45 $M_\odot$ for the mass of Component C, the lifetimes of the systems are extremely short. After about 10,000 years, only 5 percent of the systems survive as trapezia resembling the original configuration. After about a million years, we find that 81% of the systems completely dissolve, leaving only a binary. Using larger values for the mass of Component C, namely 65 and 70 $M_\odot$ we obtain still short, but more plausible lifetimes for the systems, about 30,000 years. These lifetimes are similar to the value we found for θ^1OriB, the minicluster (Allen et al. 2015). We also find that Star E always escapes right at the beginning of the integrations. Reversing the integrations in time, we find that Star E is re-captured in about 25% of the cases, within about 2000 years. It is thus possible that the escaping spectroscopic binary θ^1OriE (Costero et al. 2008) was bound to the system in recent times, and that it acquired its escape velocity as a result of dynamical interactions.

The end result of the numerical integrations is usually a binary, sometimes a hierarchical triple. We study the distribution of semiaxes and eccentricities of the resulting binaries, and find that the semiaxis distribution has a maximum around 2000 AU. Thus, the dissolution of trapezium systems may be partly responsible for populating the field with wide massive binaries. The eccentricity distribution is approximately thermal. The dynamical evolution of systems resembling the Orion Trapezium does not produce runaway stars. Indeed, most of he escapers have velocities close to the escape velocity.

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