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Title

An Optical Study of Stellar and Interstellar Environments of Seven Luminous and Ultraluminous X-Ray Sources

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Abstract

We have studied the stellar and interstellar environments of two luminous X-ray sources and five ultraluminous X-ray sources (ULXs) in order to gain insight into their nature. Archival *Hubble Space Telescope* images were used to identify the optical counterparts of the ULXs Ho IX X-1 and NGC 1313 X-2, and to make photometric measurements of the local stellar populations of these and the luminous source IC 10 X-1. We obtained high-dispersion spectroscopic observations of the nebulae around these seven sources to search for He II $\lambda 4686$ emission and to estimate the expansion velocities and kinetic energies of these nebulae. Our observations did not detect nebular He II emission from any source, with the exception of LMC X-1; this is either because we missed the He III regions or because the nebulae are too diffuse to produce He II surface brightnesses that lie within our detection limit. We compare the observed ionization and kinematics of the supershells around the ULXs Ho IX X-1 and NGC 1313 X-2 with the energy feedback expected from the underlying stellar population to assess whether additional energy contributions from the ULXs are needed. In both cases, we find insufficient UV fluxes or mechanical energies from the stellar population; thus these ULXs may be partially responsible for the ionization and energetics of their supershells. All seven sources that we studied are in young

stellar environments, and six of them have optical counterparts with masses $7 M$; thus, these sources are most likely high-mass X-ray binaries.

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