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MODELS OF EXPANDING PHOTODISSOCIATION REGIONS

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A star embedded in a molecular cloud will produce an H II region surrounded by a region of photodissociated atomic gas. We constructed spherical models of the photodissociation (or photon-dominated) region by calculating the balance of photodissociation and formation of H_2. The calculation of the photodissociation rate of H_2 includes the Lyman and Werner transitions from the 256 bound levels of the ground state. Collisions with H and H_2, and quadrupole radiative transitions are included in the calculation of the ground state levels. The UV radiation from the central star is attenuated by dust absorption and self-shielding by H_2.

GGD 14 is an active star forming region with a compact cometary-shaped H II region (∼0.1 pc) excited by a B0.5 ZAMS star. Gómez et al. (2010) observed the warm 21-cm emission surrounding the H II region with the VLA C configuration on Dec. 23,1998. Upon subtraction of the continuum, an absorption dip appears between 0 and 11 km s^{-1}. The $V_{\rm LSR}$ of the ambient molecular gas was assumed to be 11 km s^{-1}

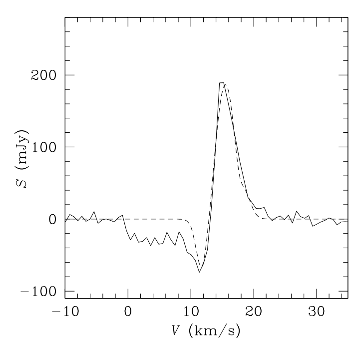

Fig. 1. T(H I) = 250 K, $n(r) = 1.75 \times 10^5 (r_0/r)^2$ cm^{-3}, T(H II) = 6300 K, $EM = 5.4 \times 10^6$ pc cm^{-6}, $V = 0.9$ km s^{-1}.

Our models reproduce the observed inverted P-Cygni profile by dividing a spherical photodissociation region in shells, and calculating the 21-cm line along several lines of sight. The integrated flux over the plane of the sky (S_ν) is independent of the instrument response profile. Lines of sight along the H region will produce red shifted emission while lines of sight that intersect the ionized gas will produce blue shifted absorption. Gussie et al. (1995) have observed similar profiles of the 21-cm line in the neutral envelopes of planetary nebulae, and reproduced them with a purely kinematical model.

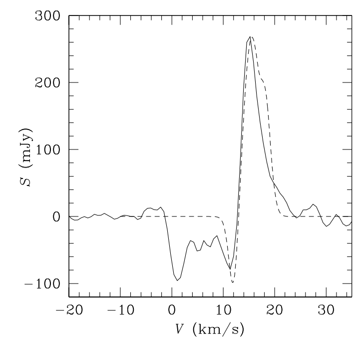

Fig. 2. T(H I) = 350 K, $n(r) = 3.55 \times 10^4 (r_0/r)$ cm^{-3}. Other parameters unchanged. Notice the self-absorption in emission, mimicking a second emission peak.

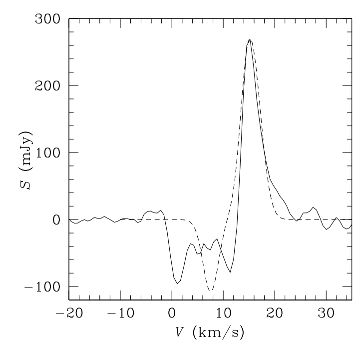

Fig. 3. T(H I) = 650 K, $V = 2.5$ km s^{-1}. Other parameters unchanged. "Best fit?"

The Figures 1, 2 and 3 compare the 21-cm observed profile (continuous line) with predictions (dashed line) from models with different temperatures, and density profiles of the atomic H gas, different temperatures and emission measures for the H II region, and expansion velocities of the atomic gas, V.

REFERENCES

Gómez, Y., et al. 2010, AJ, 140, 113
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