of a nozzle flow. These three scenarios turned out to be not applicable to HH 1 and 2.

Two other scenarios were proposed for producing HH bow shocks: the "interstellar bullet" model of Norman & Silk (1979, who do not explicitly mention HH 1 and 2) and the "jet" model of Dopita, Schwartz, & Evans (1982b, suggested for HH 46/47). Interestingly, these two scenarios were favored (over the "shocked cloudlet" and "nozzle" models) by the high HH 1/2 proper motions discovered by Herbig & Jones (1981).

Predictions of emission line ratios from stationary, plane-parallel shocks were compared with observations of HH 1/2 by Dopita (1978) and Raymond (1979). The production of the optical continuum in plane-parallel shock waves was discussed by Dopita, Binette, & Schwartz (1982a) and predictions of the radio continuum were made by Curiel, Cantó, & Rodríguez 1987). The H_2 emission of HH 1 was modeled by Wolfire & Königl (1991).

The first "3/2-D" bow shock models (constructed with 1D shocks distributed over a given bow shock shape) were applied to HH 1 and 2 by Hartmann & Raymond (1984). Predictions of line profiles, PV diagrams, line ratios and the spatially resolved line emission from such models were applied to HH 1 and 2 by Choe & Böhm (1985), Raga & Böhm (1985), Hartigan et al. (1987), Raymond, Hartmann, & Hartigan (1988), Noriega-Crespo, Böhm, & Raga (1989, 1990), Indebetouw & Noriega-Crespo (1995), Moro-Martín et al. (1996), Henney (1996, non-axisymmetric bow shocks) and Raga et al. (1997, proper motions in 3/2-D bow shocks).

Axisymmetric, time-dependent bow shock simulations were presented by Raga & Böhm (1987) and Raga et al. (1988), who modeled the proper motions and line profiles of HH 1. A two-plane shock model for the working surface of a jet was described by Hartigan (1989), and axisymmetric simulations of the head of a jet (with predictions of intensity maps for comparisons with HH 1) were presented by Raga (1988), and Blondin, Königl, & Fryxell (1989), Blondin, Fryxell, & Königl (1990). 3D jet head simulations were presented by de Gouveia Dal Pino & Benz (1993) and Stone & Norman (1994, for HH 2). Predictions of the H_2 emission of HH 1 from a jet head simulation were made by Raga et al. (1995), and of the X-ray emission of HH 2 by Raga, Noriega-Crespo, & Velázquez (2002). A precessing jet model was suggested for HH 1 and 2 by Lightfoot & Glencross (1986, most likely incorrect, but being the first suggestion of the importance of precession in HH jets).

Models for scattering of the HH 1 emission in the surrounding, dusty environment were described by Noriega-Crespo et al. (1991) and Henney, Raga, & Axon (1994) and for HH 2 by Riera et al. (2005). The photochemistry of environmental clumps irradiated by HH 1/2 was modeled by Raga & Williams (2000) and Viti et al. (2003).

8. SPECIAL TOPICS

8.1. *Proper motions*

One of the main discoveries made in observations of HH 1 and 2 was the large proper motions of HH objects. Herbig & Jones (1981) measured large proper motions (mostly in the 100–300 km s^{-1} range) for the HH 1 and 2 condensations. These proper motions appear to indicate that the two objects were ejected from a common source, and eliminated stationary flow models for HH 1 and 2 (Cantó & Rodríguez 1980), as well as the "shocked cloudlet" model (Schwartz 1978). Gyul'budagyan (1984) noted that these proper motions indicated a divergence beyond what could be expected from ballistic trajectories from the outflow source (at that time assumed to be the C-S star, though the same argument applies for the VLA 1 source).

This divergence phenomenon was successfully explained in terms of bow shock models. Raga & Böhm (1987) and later Raga et al. (1997) showed numerically and analytically that knots at the head of a bow shock have purely forward motions, and knots associated with the far bow shock wings have mostly lateral motions, therefore producing an "expansion pattern" similar to the one observed in HH 1 and 2.

The proper motions of the HH 1/2 system were later measured in radio continuum maps (Rodríguez et al. 1990, 2000) and in IR H_2 images (Noriega-Crespo et al. 1997). Also, the proper motions of the optical knots were progressively improved and extended (to more knots) by Eislöffel et al. (1994) and by Bally et al. (2002, using HST images).

One should note that HST images allow measurements of proper motions with epochs spaced at intervals of only a few years. Therefore, further HST images of the HH 1/2 system (only two epochs were used by Bally et al. 2002) would provide the possibility of seeing the time-evolution of the proper motions of the line emitting knots. If such a time-evolution were detected, it would again be the first time that HH 1 and 2 show interesting properties possibly shared by HH objects in general.

8.2. *Dispersion of HH emission on dust*

Strom, Strom, & Kinman (1974) measured basically zero polarization in HH 1 and 2. Interestingly,