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# LASER LABORATORY EXPERIMENTS, OBSERVATIONS AND NUMERICAL SIMULATIONS OF STRONG EXPLOSIONS.

P.F. Velázquez[1], A.C. Raga[1], H. Sobral[2], E. de la Fuente[3,4], M. Rosado[3], R. Navarro-González[1] and M. Villagrán Muniz[2]

We have employed the *yguazú-a* code to simulate the interaction of two strong explosions, which were generated by means of focusing the beams of two Nd:YAG lasers in air. We also applied this code in order to describe the morphology and H$\alpha$ emission of the supernova remnant 3C400.2. We achieved good agreement between numerical simulation, experiments and astronomical observations.

Recently, laser laboratory experiments have become a new tool in astrophysics because they allow studies of complex phenomena such as shock waves, evolution of supernova remnants (SNR) and jets, and are useful to validating gasdynamic codes, which are usually employed in astrophysical problems.

We present experiments where two explosions interact with each other. These explosions were generated focusing the beams of two Nd:YAG lasers, in air. Two experiments were carried out. In the first experiment, the laser energies were set to 500 and 50 mJ, while in the second one we have considered the same energy (300 mJ). From these experiments, we have obtained shadowgrams at different times. These shadowgrams were compared with density maps obtained from numerical simulations carried out with the *yguazú-a* code (Raga et al. 2000). We also obtained simulated maps of the Laplacian of the density. The agreement between experiments and simulations was good (see Figs. 2, 3 and 5, Velázquez et al. 2001a). In spite that the Mach number of the experiments are lower than the ones of SNRs, the morphology of some interacting SNRs resembles the experimental shadowgrams (e.g. the radio-continuum and [OIII] images of the SNR DEM L316, Murphy-Williams et al. 1997)

The *yguazú-a* code was also employed for studying the SNR 3C400.2. This SNR has a morphology of two apparent shells, partially overlapped in the direction to the NW, as revealed by the radio-continuum study carried out by Dubner et al. (1994).

Different models can be considered in order to explain this double shell structure, such as the interaction between two SNRs or the evolution of a single SN explosion occurring in a stratified medium.

A preliminary H$\alpha$ analysis (de la Fuente & Rosado 2002) and the HI study carried out by Giacani et al. (1998) support the last scenario. Then, in our simulation we consider a single SN explosion taking place in a dense medium and close to an interface with a lower density medium (a density ratio of 4 was used, Giacani et al. 1998). After interacting with this interface, the SNR shock front starts to expand more faster, generating a bubble (the "large shell"). A collimation of the gas can be observed close to the symmetry axis (Fig.5, Velázquez et al. 2001b), injecting momentum and energy from the "small shell" into the "large" one. This is the reason why the "large shell" has a behaviour different from the standard evolution of a SNR (Woltjer 1972).

Comparing the observations (radio-continumm and H$\alpha$ images) with our numerical results, we conclude that the single SN explosion model is adequate for describing the morphology of the SNR 3C400.2 (Figs. 7 and 8, Velázquez et al. 2001b).

[1]Instituto de Ciencias Nucleares, UNAM, Apdo. Postal 70-543, 04510, México D.F.
[2]Centro de Instrumentos, UNAM, Apdo. Postal 70-186, 04510, México D.F.
[3]Instituto de Astronomía, UNAM, Apdo. Postal 70-264, 04510
[4]Facultad de Ciencias, UNAM, México

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