Massive stars: from α to Ω, Rhodes, Greece, 2013

Supernova remnants (SNRs): powerful agents of star formation feedback

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The fact that SNR-induced shocks on molecular clouds strongly affect their conditions is not new. Indeed multi-J CO line imaging has revealed some extreme line ratios in such "hot" shocked regions (Seta et al. 1998; Arikawa et al. 1999; Bolatto et al. 2003), reaching up to those found for entire galaxies.

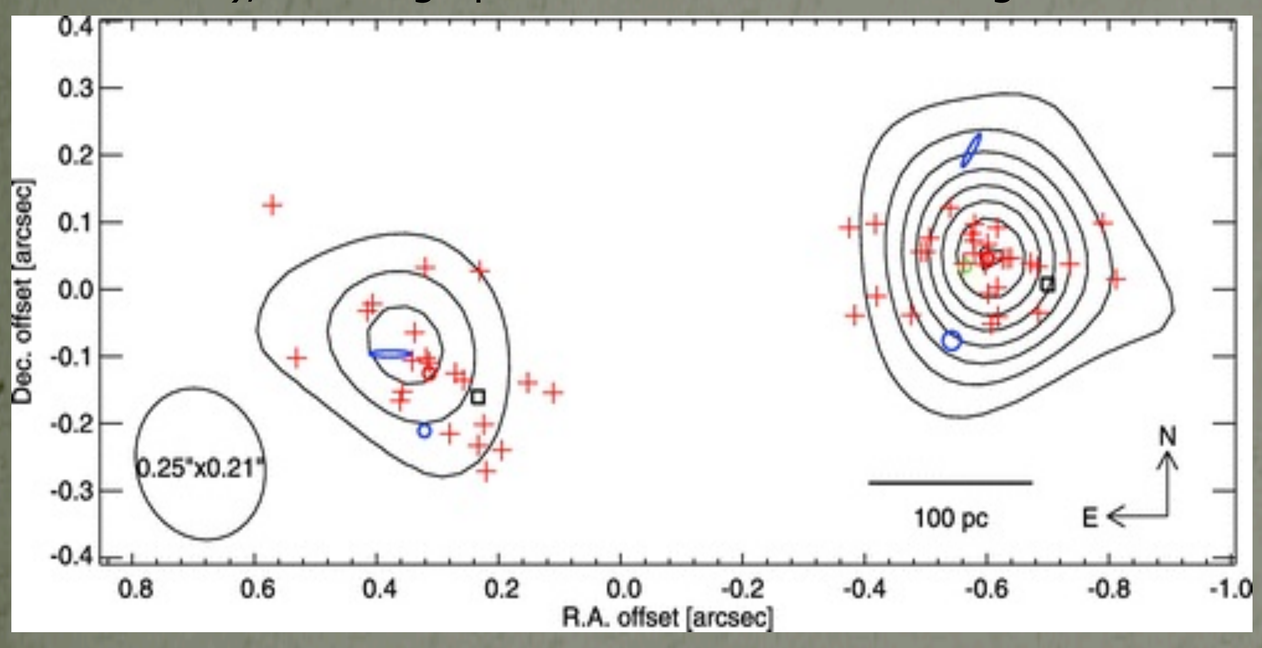

Figure 1: Compact centimeter radio sources and sub-millimeter continuum in the nuclear regions of Arp 220 (Sakamoto et al. 2008). Red plus signs are compact (<1 pc) continuum sources thought to be radio supernovae or young supernova remnants (30-50 yr). The red circle in each nucleus indicates the "center" of the compact sources. The blue circles and ellipsis are OH megamasers. The green circle indicates the peak of diffuse centimeter emission of the west nucleus. This contour map (860 μm continuum data) is shifted so that the west peak coincides with the center of the supernova distribution in the nucleus. The black squares show the positions of the sub-millimeter peaks before the shift.

We have initiated a program (funded under the DeMoGas project*) to investigate the effects of these shocks much more closely, with a focus on the dense gas phase ($n > 10^4$ cm^{-3}) from which the IMF emerges. Given the importance of SNRs in continuously injecting energy in the highly turbulent ISM of ULIRGs (e.g. there are ~50 SNRs in two disks of ~100 pc diameter in Arp 220, see Figure 1), and that Sub-Millimeter Galaxies (SMGs) may be similarly compact starbursts (Swinbank et al. 2010), such a study is indeed timely. We have already acquired optical spectroscopic data from the 2.1-meter SPM telescope in Mexico (see Figure 2) as well as fully-sampled maps of ^{12}CO J=1-0 (Figure 3) and ^{13}CO J=1-0 (Figure 4). This unique set of data along with publicly available 2MASS, Spitzer, and 1.4GHz continuum maps will be used as constraints on our radiative transfer codes in order to deduce the physical conditions of the dense gas in the shock-impacted areas of the molecular clouds.

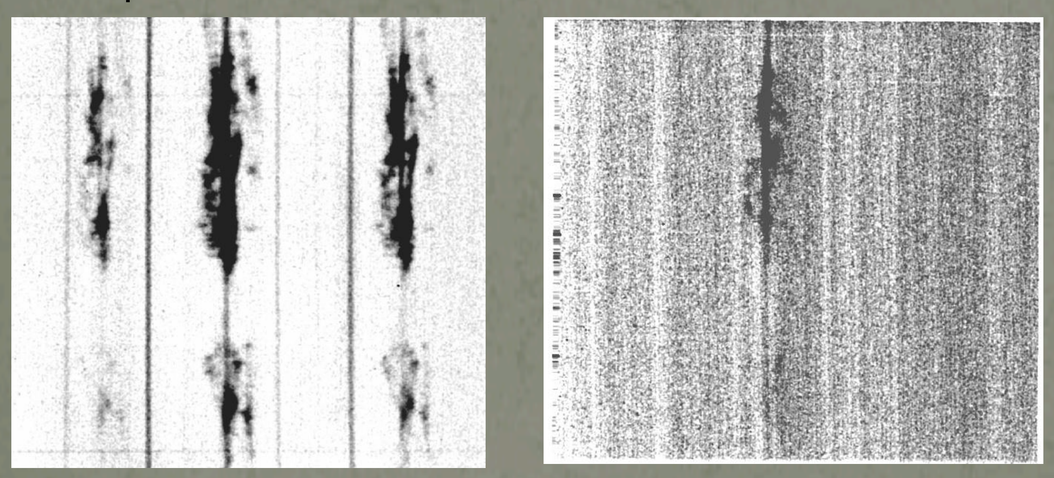

Figure 2: High resolution optical spectra of selected filamentary structures of the Supernova Remnant IC 443.

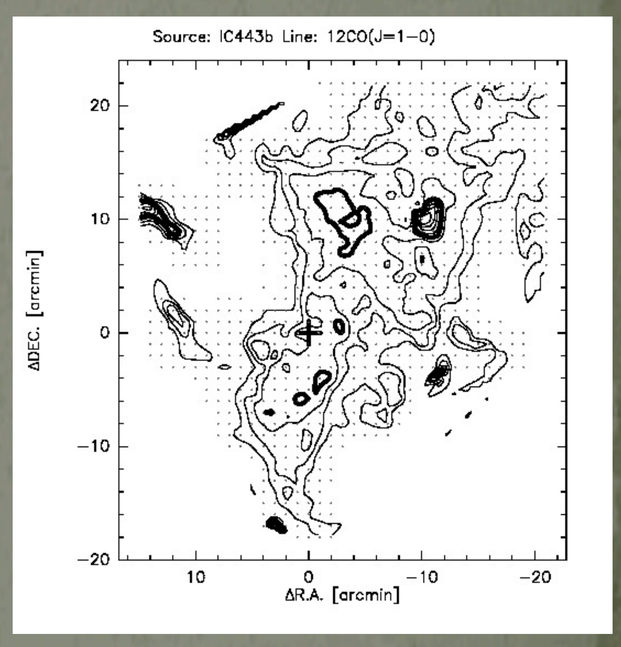

Figure 3: ^{12}CO J=1-0 map of the Supernova Remnant IC 443

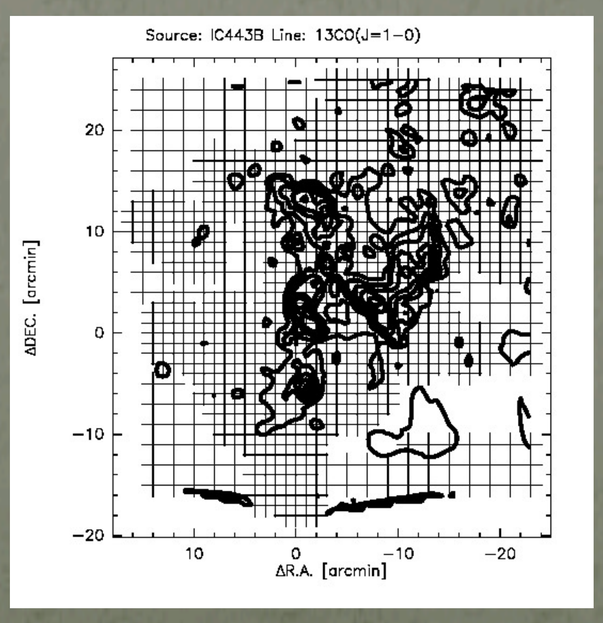

Figure 4: ^{13}CO J=1-0 map of the Supernova Remnant IC 443

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- Arikawa et al. 1999, PASJ, 51, 7
- Bolatto et al. 2003, ApJ, 595, 167
- Sakamoto et al. 2008, ApJ, 684, 957
- Seta et al. 1998, ApJ, 505, 286
- Swinbank et al. 2010, Nature, 464, 733

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