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IR Mergers/QSOs with Galactic Winds

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Abstract. We report, as a part of a long-term study of IR mergers and IR QSOs, detailed spectroscopic evidences for outflow (OF) features in nearby IR mergers/QSOs (with low and extreme velocity OF, LVOF and EVOF, respectively). We found EVOF in IRAS 01003-2238, 11119+3257, 13218+0552, 14394+5332, 15130-1958 and 15462-0450. The low velocity OF components were detected mainly in objects with starburst processes. Meanwhile the EVOF were found mainly in objects with obscured IR QSOs plus strong starbursts.

HST images of IR+BAL+Fe II QSOs show in practically all of these objects "arc or shell" features probably associated to galactic winds (GW) and/or merger processes. We present also new results of a study of the morphology, kinematics and ionized structure of IR mergers/QSOs with GW. This new study is based mainly in INTEGRAL two-dimensional (2D) fibre spectroscopy (obtained at La Palma 4.2 m telescope).

1. Introduction and The Program

The understanding of extreme star formation and galactic wind processes – especially in galaxy formation – is one of the main goals of modern astrophysics (Taniguchi et al. 2001, 2000). Motivated by this, our group began an international program of intensive investigations of nearby star-forming IR mergers/QSOs (see Lipari et al. 2003a,b, 2000).

IR mergers and IR QSOs are an excellent laboratory at low redshift for the study of GWs and extreme star formation processes (Lipari et al 2003a,b). We have started a 2D study of the morphology, kinematics and ionization structure of IR mergers and IR QSOs with galactic winds (Lípari et al. 2003a,b, 2000). In addition, we are working on a study of star formation and GW at high redshift ($z > 3$; e.g. Taniguchi et al. 2001, 2000; Macchetto et al. 1993). However, the first step of this program is to understand star formation and galactic winds in nearby IR galaxies, where we can obtain more detailed and unambiguous information.

2. Results

We presented in this work mainly a summary of our main results obtained from optical spectroscopy (obtained at La Palma, ESO, KPNO, MKO, CASLEO, and BALEGRE) and high resolution HST-WFPC2 broad band images, of selected IR mergers/QSOs. These results can be summarized as follows:

1. Detailed kinematical and/or morphological evidence for OF and WR features were detected, in the nearby IR mergers NGC 4038/39, IRAS 23128-5919 (with low velocity OF), and in the IR QSOs IRAS 01003-2238 and IRAS 13218+0552 (with extreme velocity OF).

2. Kinematical evidence for EVOF (from a study of a complete sample of ULIRGs and QSOs, "The IRAS 1 Jy MKO-KPNO Survey") in IRAS 11119+3257, 14394+5332, 15130-1958 and 15462−0450 was found. We also probably detected OF in IRAS 05024-1941, 13305-1739, 13451+1232 and 23389+0300.

3. We found that the LVOF components were detected mainly in objects with starburst processes, i.e., OF associated to galactic winds generated in multiple type II SN explosions and massive stars. Meanwhile the EVOF were detected mainly in objects with strong starburst plus obscured IR QSOs.

4. HST images of IR+BAL+Fe II QSOs show in practically all of these objects "arc or shell" features probably associated to galactic-winds (i.e., to multiple type II SN explosions, or to starburst+AGN) and/or merger processes.

   Recently we have obtained high resolution (2Å) 2D spectroscopy for Arp 220, Mrk 231, NGC 2623, and others (with the William Herschel 4.2 m telescope, at La Palma; Lipari et al. 2003b). We are studying if these giant galactic shocks associated with the compression of the ISM by the galactic wind/EVOF could generate new star formation episodes. The presence of "giant arcs, shells or rings" in IR QSOs was already argued in order to explain the BAL system in the QSO IRAS 07598+6508 (Lipari 1994).

The properties found in IR mergers/QSOs with GW mainly point to the importance of the possible link between IR mergers with starburst+GW to IR QSOs with composite nature+GW, and elliptical galaxies (Lípari et al. 2003a,b).

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