Cold jets and dense cores in galaxies with extremely compact nuclei

Spectacular starburst and AGN (Active Galactic Nucleus – accreting supermassive black hole) activity occurs when interactions and mergers of gas-rich galaxies funnel massive amounts of molecular gas and dust into the remnant centers of luminous and ultraluminous infrared galaxies (LIRGs/ULIRGs). In these compact regions molecular gas rotating in the cores obscures and feeds the activity. There is now mounting evidence of powerful molecular outflows in LIRGs/ULIRGs. Molecular gas may be evicted at rates exceeding the star formation rate of the galaxy by factors > 5. This negative feedback impacts very strongly on the evolution of the nuclear activity and will regulate star formation and the growth of supermassive black holes.

An emerging subclass of the LIRGs host Compact Obscured Nuclei (CONs) where Lbol > 109 Lsun emerge from inside d <100 pc, dusty (Av > 100 mag) cores. The nuclear activity is caught in a short- lived phase of its development since feedback from the luminous nuclei should quickly clear the obscuring material. I will present very recent ALMA (Atacama Large Millimeter Array) observations of CONs such as the LIRG IC860. Observations at unprecedented resolution (30 milli arcseconds) reveal the presence of an extremely dense and obscured nucleus – opaque even at millimeter wavelengths which requires H2 column densities N(H2) >5x1025 cm-2 . Determining the nature of the buried activity is achallenge - even using hard X-rays.

Winds, jets and outflows from CONs should eventually clear out the material feeding the activity. With ALMA we have discovered a ”dark jet” of molecular gas – very faint at radio wavelengths – that is evicting gas from the nucleus of the early type galaxy NGC1377. I will present new results on the dense dusty jet of NGC1377 at 5 pc (50 milliarseconds) resolution revealing the origin and structure of this mysterious jet.

Dusty outflows are important because they are probably closely related to the emergence of type-2 quasars from their dust shrouds. We expect that dense, dusty outflows are common at high redshifts and are an important mechanism for regulating the rapid growth of supermassive black holes.