The Evolution of Molecular Gas and Star Formation from z=0 to 2.5: Results from the PHIBSS Large Programs and a Forward Look to NOEMA^{3D}

Linda Tacconi[1], Reinhard Genzel[1], Francoise Combes[2], Roberto Neri[3], Santiago Garcia-Burillo[4] , and the PHIBSS and NOEMA^{3D} teams

[1] *Max-Planck-Institut für extraterrestrische Physik, Giessenbachstrasse, 85748 Garching, Germany*

[2]*Observatoire de Paris, LERMA,Collège de France, CNRS, PSL University, Sorbonne University, UPMC, Paris, France*

[3] *IRAM, 300 rue de la piscine 38406, St Martin d'Hères, France*

[1] *Observatorio Astronómico Nacional (IGN), Alfonso XII 3, 28014, Madrid, Spain*

In this talk, we present PHIBSS, comprehensive and systematic surveys of star formation and the molecular gas contents of galaxies during the epochs that are associated with the peak (z~1-3), and subsequent winding down (z<1) of star formation in the Universe. PHIBSS targeted ~200 massive (logM*>10.4 $M_{\odot}$) star forming galaxies from z=0.5-2.5 in CO 3-2 or 2-1 lines, with a detection rate of over 80%, and covering well the stellar mass – star formation "main sequence" in the selected mass and redshift ranges. We present results on molecular gas scaling relations on global scales from PHIBSS and the spatially resolved gas properties in a sub-sample of PHIBSS targets. We will also describe the next big step with the newly upgraded NOEMA telescope: NOEMA^{3D}, which will map the molecular gas distributions and kinematics of 50-60 z=0.5-2 galaxies on ~2 kpc scales.