S08b Counterrotating Nuclear Gas Disks in Arp 220

K. Sakamoto, N. Z. Scoville (Caltech), M. S. Yun (NRAO), M. Crosas (CfA), R. Genzel, and L. J. Tacconi (MPI)

The ultraluminous infrared galaxy Arp 220 has been observed at $0.5''$ resolution in CO(2-1) and 1.3 mm continuum using the newly expanded Owens Valley Millimeter Array. The molecular gas disk surrounding the double nucleus of the merging system is clearly resolved. Each nucleus has an associated peak of dust continuum and molecular gas. It is found that there are steep velocity gradients ($\Delta V \sim 500$ km s^{-1} within $r = 0.3''$) across each nucleus. The direction of the velocity gradient is different at the two nuclei and not aligned to that of the outer gas disk. We conclude that both of the double nuclei of Arp 220 have their own gas disk ($r \sim 100$ pc), which are counterrotating with each other and embedded in the outer molecular gas disk ($r \sim 1$ kpc) rotating around the dynamical center of the system. The western nuclear disk corresponds to the dust disk seen in HST/NICMOS images by Scoville *et. al.* (1988). The dynamical mass of each nucleus is $M_{\rm dyn} \gtrsim 2 \times 10^9 M_\odot$. The CO and continuum brightness temperatures suggest that the nuclear gas disks are hot (≥ 30 K), dense, and have high area filling factors. The two compact continuum peaks suggest that the large luminosity ($10^{12.1} L_\odot$) of Arp 220 arises from both nuclei within $d \lesssim 100$ pc in the two nuclear gas disks. It is therefore likely that the concentration of molecular gas to the nuclei of the progenitor galaxies that has caused the large far-IR luminosity of Arp 220.