Title:
"Probing the Physical Conditions of Massive Cluster Formation With ALMA"

Authors:
Kelsey Johnson (UVa, USA), Adam Leroy (NRAO, USA), Remy Indebetouw (UVa/NRAO, USA), Crystal Brogan (NRAO, USA), Aaron Evans (UVa/NRAO, USA), John Hibbard (NRAO, USA), Brad Whitmore (STScI, USA), Kartik Sheth (NRAO, USA)

Submitting Author Email:
Kej7a@virginia.edu

Observationally constraining the physical conditions that give rise to massive star clusters has been a long-standing challenge. Now with the ALMA Observatory coming on-line, we can finally begin to probe the birth environments of massive clusters. Our team's ALMA observations of the Antennae Galaxies reveal the molecular clouds in this prototypical starburst in unprecedented detail. We confirm and characterize a proto-super star cluster as a compact CO(3-2) cloud with an exceptionally large line-width. This CO has no associated Pa_beta or thermal radio emission, indicating that star formation has not yet begun -- this allows us to assess the physical conditions *before* the onset of star formation. The observed CO(3-2) intensity and size of the cloud imply a mass of at least 10^7 M_sun and a surface density on 50 pc size scales of nearly 1 g/cm^2. Along with the CO(3-2) linewidth, the observed properties indicate that this cloud appears to be subject to remarkable external pressure (potentially as high as P/k ~ 10^8 K cm^-3). A comparison with ALMA CO(2-1) science verification observations and non-LTE analysis yields an excitation temperature of ~25K; an equilibrium state would require significant internal nonthermal pressure. I will give an overview of the ALMA observations, discuss the properties of this extraordinary source, and put these results in the context of what we know about the formation of massive star clusters.