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Professor, Department of Physics & Astronomy

Education
A.B. mcl, Astronomy, Radcliffe College, Harvard University
Ph.D., Astronomy, The University of California, Berkeley

Positions
Professor, Department of Physics and Astronomy, UCLA
Visiting Scientist, Joint ALMA Office, Santiago, Chile (2011)
Caroline Herschel Visiting Fellow, STScI (2007)
Visiting Associate, Caltech (2004)
Harvard-Smithsonian Center for Astrophysics Fellow (1984-1986)

Memberships:
Sigma Xi Society
Phi Beta Kappa
American Association for the Advancement of Science (Fellow)
American Astronomical Society
International Astronomical Union
Union Radio-Scientifique Internationale

Research Interests

Early in its history, the Milky Way formed many massive and luminous star clusters, many of which have survived to this day in the form of globular clusters. Currently the disk of our Milky Way does not seem to be able to form such massive clusters. However, young clusters that appear to be as massive as globular clusters do appear to be forming in the present universe, and are visible in nearby galaxies. Young, forming super star clusters are examples of extreme star formation taking place in luminous and ultraluminous infrared galaxies and starburst galaxies, and this is the area of my research.

My targets are the very youngest star-forming regions. Like the youngest Galactic star-forming regions, these are typically still "embedded" in their natal dusty gas clouds. While this allows us to study their pristine natal environments, before the stars have had a chance to disperse the gas, it also means that they are hidden from optical view. To see them, one observes in the infrared, millimeter/submillimeter and radio portions of the spectrum. In many cases the star clusters themselves are completely hidden within dusty cocoons of gas, invisible even in the near and mid-infrared. They are indirectly detectable at longer wavelengths, through the HII regions that are excited by these young clusters and their surrounding gas clouds. The nearby molecular clouds from which they formed can be detected in millimeter and submillimeter-wave emission from lines of molecules such as CO.

My approach has been to use radio continuum imaging to detect free-free emission from HII regions, using the VLA. Radio continuum emission is emitted by hot nebulae surrounding the most massive young stars, stars less than a few million years old. The great advantage of radio emission is that it is

unaffected by the dust extinction, which can be extremely high, up to thousands of magnitudes, in the youngest star-forming regions.

Star formation in the Milky Way is slow and inefficient; at any given time only a percent or less of a giant molecular cloud is collapsing to form stars. The existence of globular clusters implies that this efficiency was much greater in the past, since efficiencies of closer to 50% are required to form such clusters. What conditions favor efficient star formation? I am presently using data from the Submillimeter Array (SMA), and in the future, the Atacama Large Millimeter-Submillimeter Array (ALMA), to study the efficiency of star formation in the youngest super star clusters. The high resolution of array telescopes allows the imaging of molecular clouds on the scales of individual giant molecular clouds, or better. ALMA will image down to the scales of star clusters themselves, resolving regions only a few light years across.

The new instrument, ALMA, is just coming online and is still being commissioned. This instrument will transform our knowledge of dust and gas around extragalactic star-forming regions. It will be ten times more sensitive than current millimeter arrays, and it works in the submillimeter too. I have served on many of the committees leading to the design of this telescope, starting when it was the U.S.-only project, the Millimeter Array. I spent three months in 2011 in Chile helping out with commissioning, reducing science verification data.