NASA to support IU astronomer's quest to develop largest-ever star formation database

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(PhysOrg.com) -- Samir Salim has a lot of space to fit into a new NASA-funded database; about 11 million galaxies of it would be a ballpark estimate based on the number of galaxies for which distances can be estimated to about 3.5 billion light years, what astronomers still refer to as the relatively "local" universe. But the Indiana University astronomer and research scientist believes the vast archives produced by NASA space telescopes and ground-based observatories hold the right information to create the largest resource ever for the study of how star formation proceeds in galaxies.

By integrating the measurements of the electromagnetic radiation of galaxies from four projects -- the two space missions Galaxy Evolution Explorer (GALEX) and Wide-Field Infrared Survey Explorer (WISE), and two ground-based projects, the Sloan Digital Sky Survey (SDSS) and the Two Micron All-Sky Survey (2MASS) -- an international team led by Salim hopes to use novel galaxy modeling techniques to produce a single database of the physical properties of millions of galaxies.

That database will involve constructing spectral energy distributions (SEDs) for 11 million galaxies, a resource that will use wide-field, multi-wavelength observations at a scale that does not currently exist. The SED of a galaxy is the quantification of the electromagnetic radiation it distributes over the full range of frequency and wavelength, from ultraviolet to far infrared, and analysis of that multi-wavelength radiation is a primary means of learning about star formation and evolution.

The team may have selfish reasons for developing such a huge database: They want to focus on so-called transitional galaxies that have subdued star formation activity and that may be transforming from what are known as spiral galaxies to more bland-looking elliptical galaxies. They argue that the study of star formation regulation requires large galaxy samples in order to identify and analyze trends for robust statistical significance.

"And in order to reveal the physical processes behind star formation regulation, these large samples require reliable, well-calibrated sets of fundamental galaxy physical properties like star formation rates, stellar mass, dust content, stellar age and stellar metallicity," Salim said. "For this purpose we proposed building a database of galaxies in the local universe combing the data from GALEX, 2MASS, WISE and SDSS, based on which we will derive these physical properties using the techniques of modeling galaxy evolution. Both the SEDs and the physical parameters will be included in the database that will be made publicly available."

Each of the four studies provides a unique type of data to the creation of the SEDs. The GALEX photometry, for example, used a telescope that swept the sky for ultraviolet light sources, or frequencies higher than those humans identify as the color violet. It provided the necessary sensitivity to low levels of star formation that will be needed to separate transitional galaxies from true "red and dead" passive galaxies.

Salim, who joined IU's Astronomy Department in September 2009, is no stranger to GALEX and its primary science mission of studying galaxy evolution. After earning his Ph.D. from Ohio State University in 2002, he went on to work as a GALEX postdoctoral researcher at University of California, Los Angeles, until 2006. Before coming to IU, he was at the National Optical Astronomy Observatory (NOAO) in Tucson as a research associate, where he compared and contrasted star-forming

properties of galaxies derived from GALEX with mid-infrared emissions recorded by the Spitzer Space Telescope.

Work on the database will begin next year and is expected to run into 2015, with NASA expected to provide about $330,000 for the work. Recent results from Salim's continuing work employing multi-wavelength observations to study star formation have included the discovery of observational evidence for active galactic nuclei feedback in transitional galaxies; establishing of the robust SED fitting technique to derive galaxy's star formation rates and stellar masses; identification of intermediate-age populations as the significant source of mid-infrared dust heating; and the discovery of early-type galaxies with extended star forming regions.

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