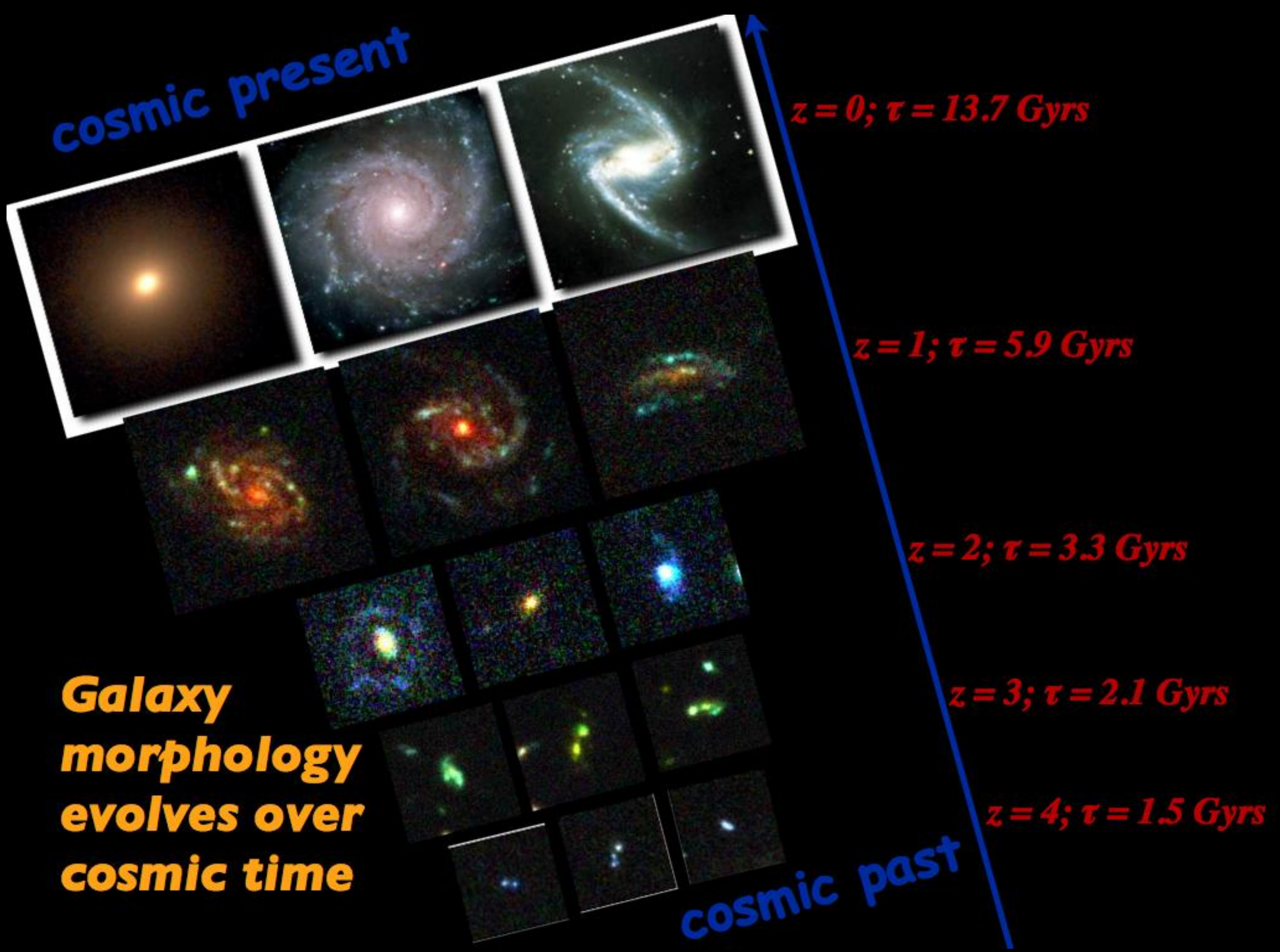
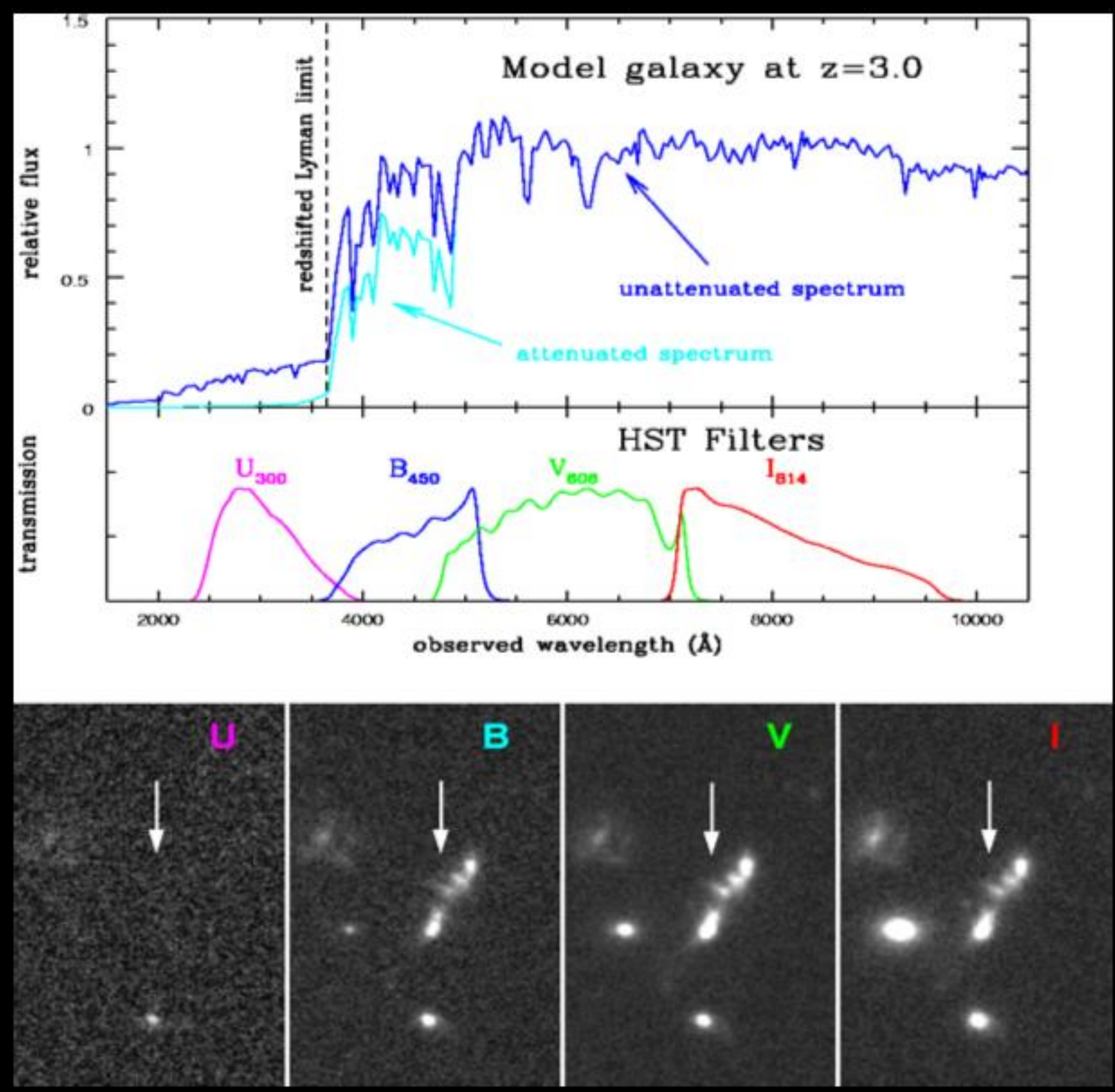
Galaxies: Research @ IUCAA



Most of the luminous galaxies in the present-day Universe have regular Hubble-type morphologies. However, as one steps out in redshift, towards earlier epochs of cosmic time, irregular morphologies become more common. The observed structural change may be attributed to (a) increased merger activity in the past, (b) dominant star formation which overwhelms light from older stars, (c) effect of only observing morphology in rest frame. Also, there is significant size evolution with redshift. Current research in this area focuses on quantifying the evolution of galaxy sizes and structure as a function of cosmic time & to see how this compares with the prediction from theories of galaxy formation and evolution.

Galaxies – Their First Few Billion Years

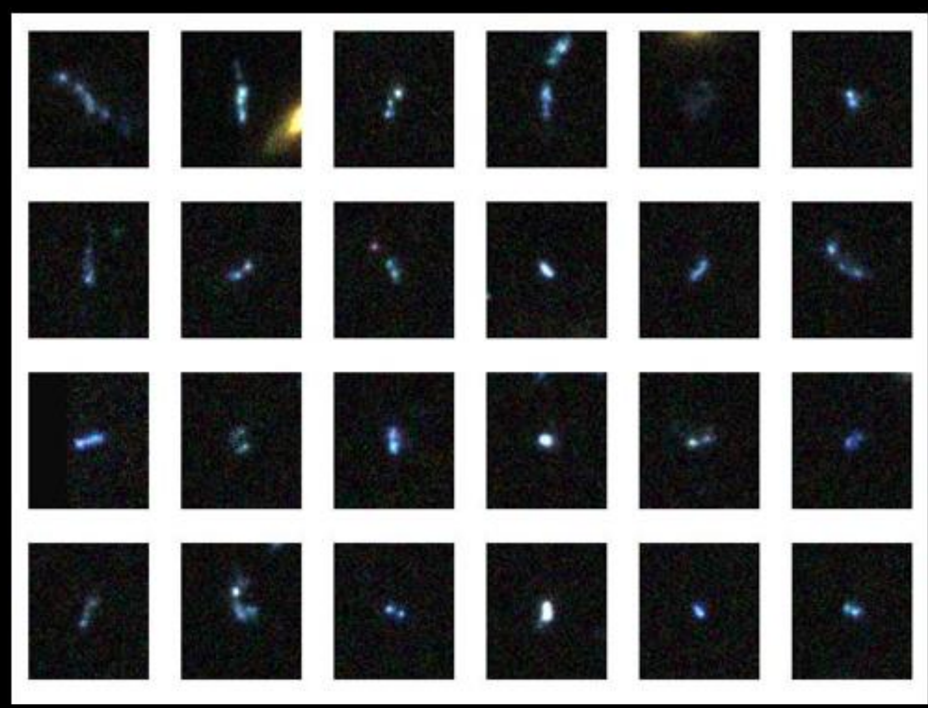


Lyman-break Galaxies:

Flat UV continuum of star-forming galaxies show a strong break at 912 Angstrom due to the absorption of ionizing photons by the intervening neutral hydrogen.

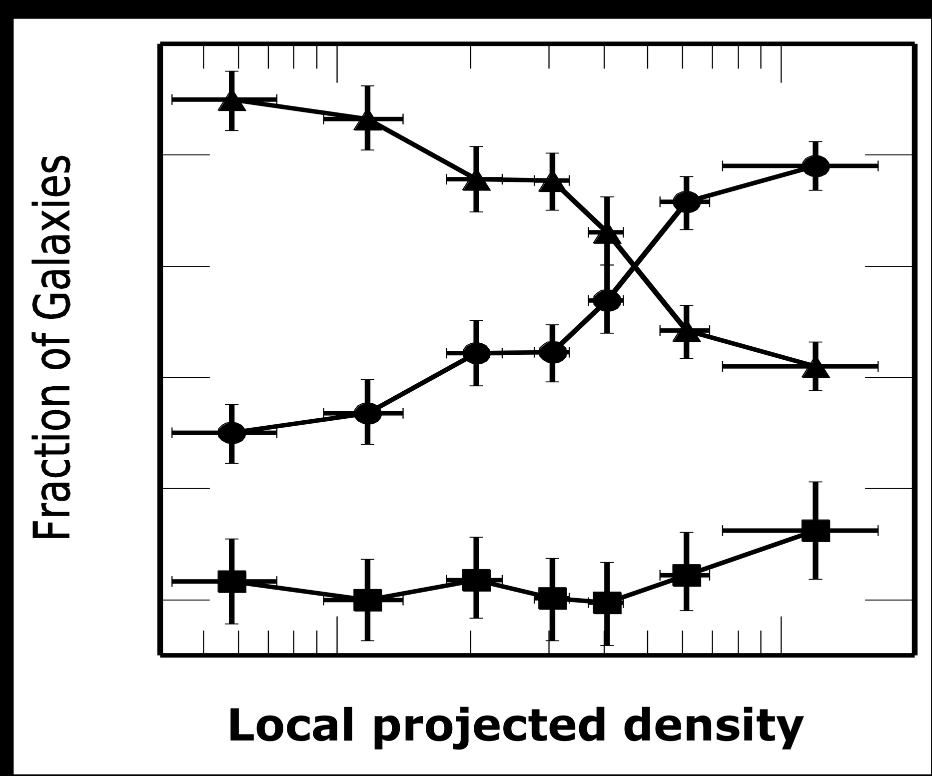
At redshifts z>3, the break feature shifts into the optical & NIR wavelengths. "Lyman-break technique" which uses a color selection to identify this strong feature as a redshift indicator is the most robust & efficient method used to select star forming galaxies out to z>8

Studying The Phases of Galaxy Evolution & Formation



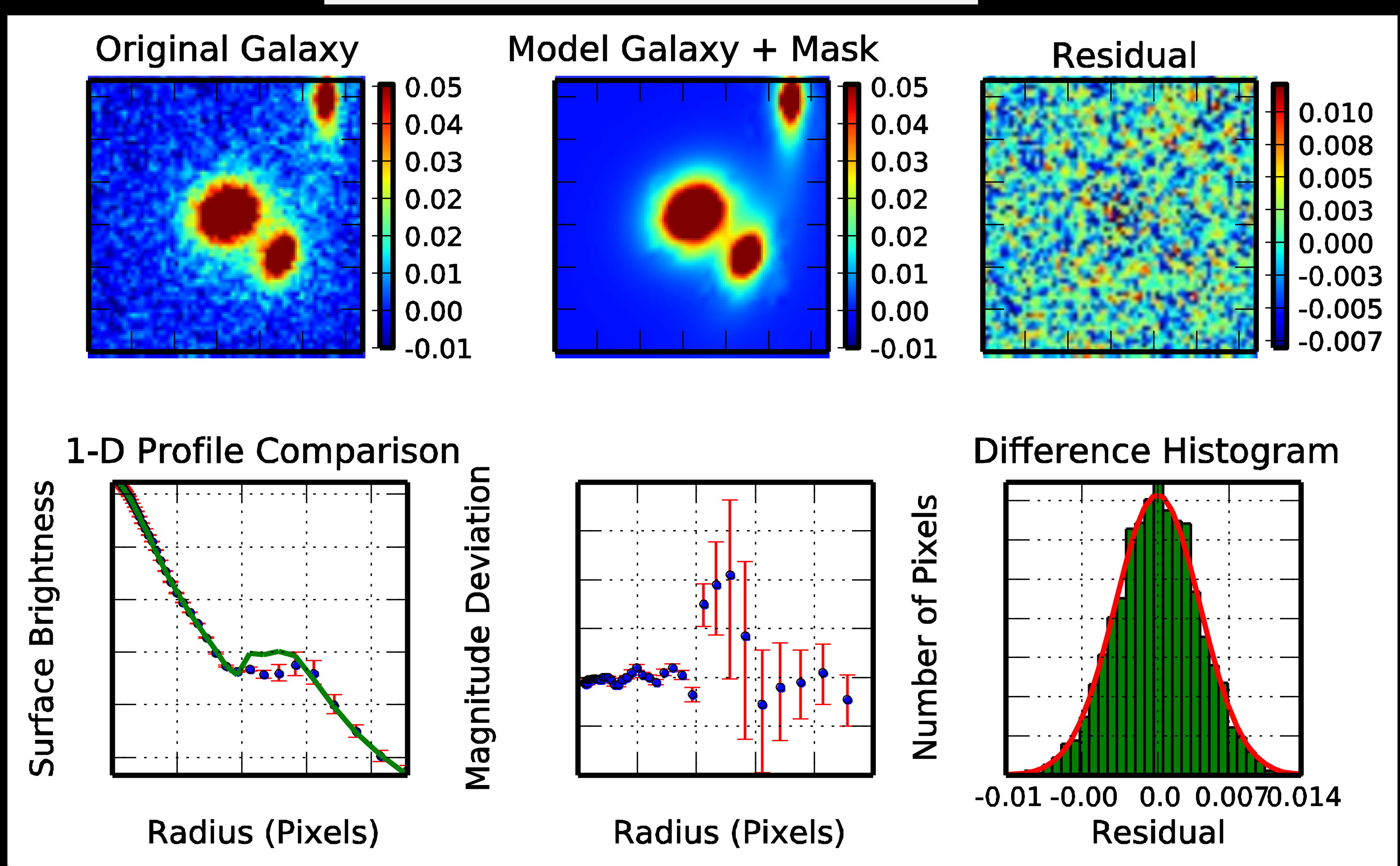
Are these high redshift galaxies undergoing multiple mergers? Or are they rotating disks with on-going active star formation? Do the morphology suggest starbursts occurring in cold accretion flows along filaments?

Researchers at IUCAA are trying to use images & spectra of high z galaxies to understand the basic physical processes involved in the earliest stages galaxy assembly.



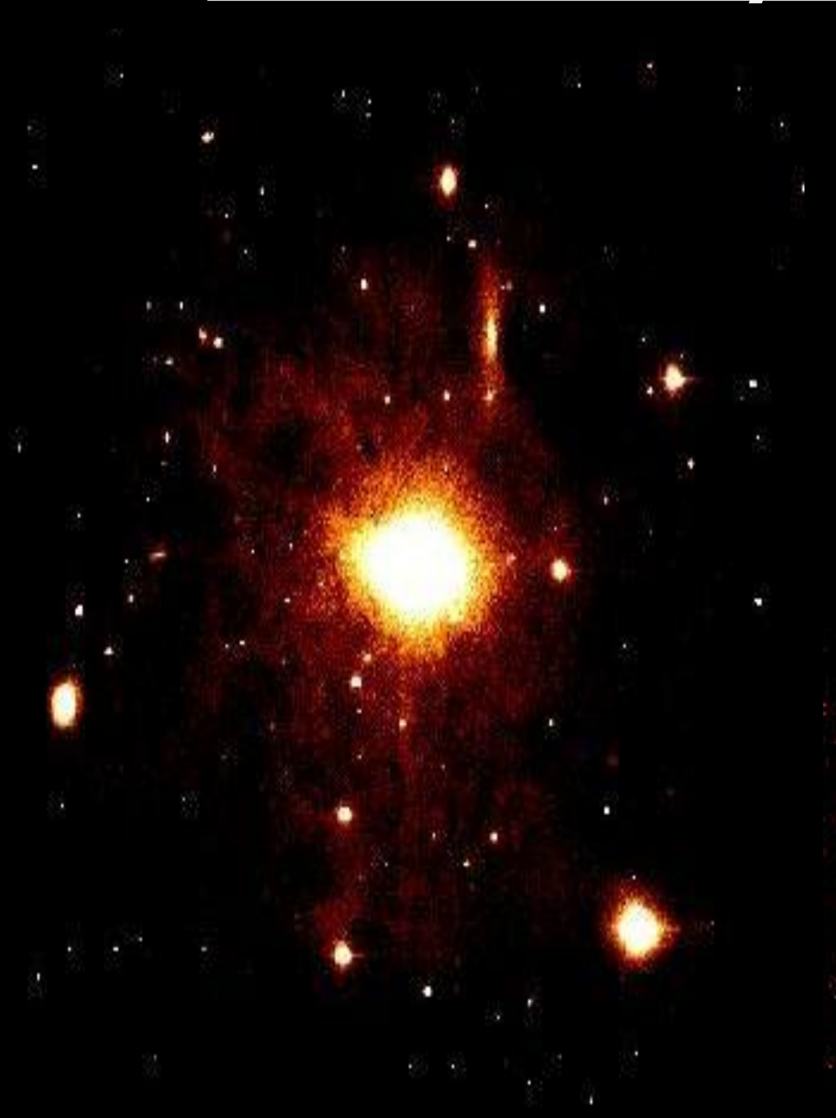
The quantitative morphology-density relation at z ~ 0.31 - 0.83. The figure shows the variation of fraction of galaxies with local projected density. The circles represent the fraction of bulge-dominated galaxies. Intermediate type and disk dominated galaxies are represented by squares and triangles respectively.

Pipeline Software To Automate the Galaxy Parameter Estimation



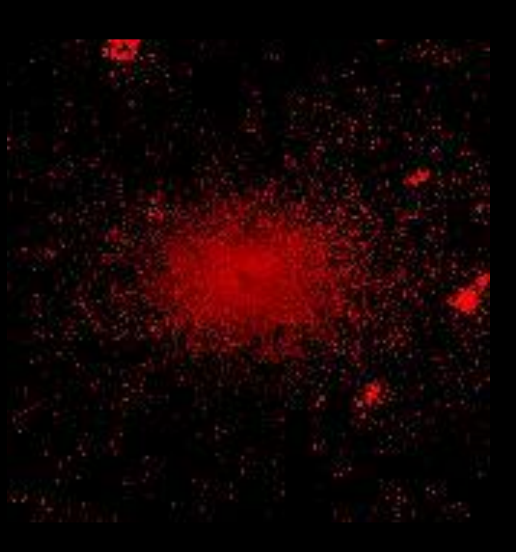
The output from PyMorph. The top left panel shows the image of the galaxy, top middle shows the model image and the top right shows the residual (difference between galaxy and model) image after the fit. Lower left panel shows the one dimensional profile comparison of original (as data points) and model (as a solid line) for the galaxy. The lower middle image is the difference of the 1-D profiles of input and model galaxy. The lower right image is the histogram of the residual image, with the best fit Gaussian shown in red.

Work on Dusty ellipticals done at IUCAA



NGC 7562

This image of the dusty elliptical galaxy NGC 7562 (shown on the left) was taken by IUCAA scientists using the 2 meter Himalayan Chandra telescope located at Hanle , Ladakh. As the name suggests, these galaxies have dust in them which leads to extinction of the starlight that the galaxy otherwise emits.

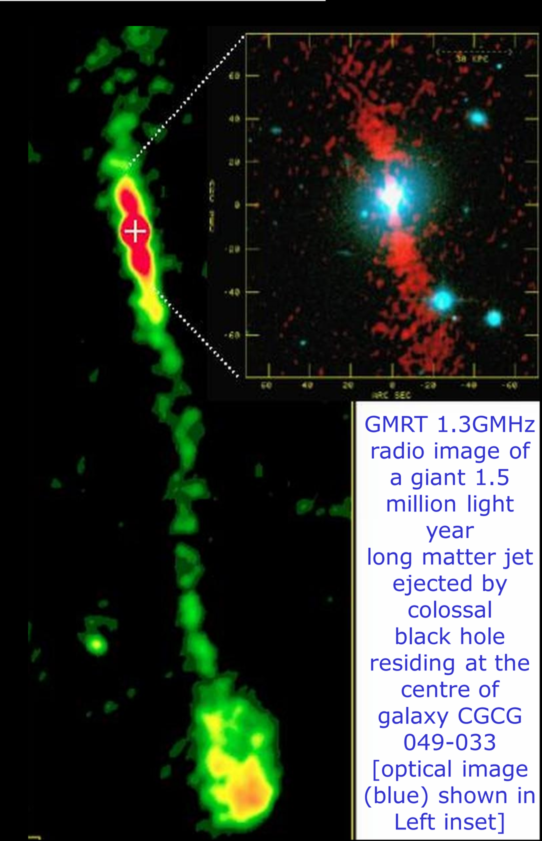


Color map of NGC 7562

This color map is useful for finding dust features in galaxies. It uses the fact that the extinction of light coming from a source is a function of wavelength of the light. Hence if you observe a source in two different wavelengths, you can find out the relative extinction caused by dust and thus estimate the amount of dust present in the galaxy.

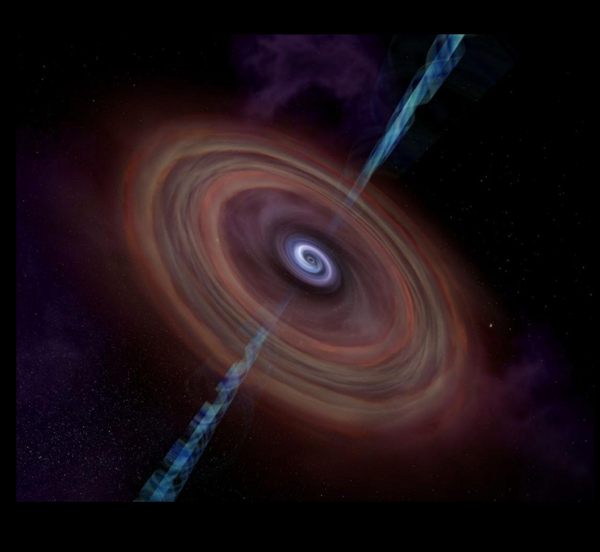
GMRT 1.3 GHz Radio Image of a Giant 1.5 Million Light Year Long Matter Jet Ejected From a Residing Black Hole

IUCAA and TIFR radio astronomers have discovered an intergalactic particle beam stretching for more than a 1.5 million light years, the longest ever seen. This giant beam (jet) which also emits strong radio waves, emerges from the center of a large elliptical galaxy called CGCG049-033, which is about 600 million light years away . The scientists took a closer look using the Giant Meter wave Radio Telescope (GMRT) and the 100-metre Effelsberg radio dish in Germany. Optical spectrum of the galaxy taken with the IUCAA's 2-meter optical telescope at Girawali revealed a colossal 2 billion solar mass black hole at the center of this giant particle jet.



GMRT 1.3GMHz radio image of a giant 1.5 million light year long matter jet ejected by colossal black hole residing at the centre of galaxy CGCG 049-033 [optical image (blue) shown in Left inset]

The new jet's counterpart appears much shorter. That could be because the apparently shorter jet is pointing away from us - so light from its far end might not have had time to reach us yet. The radio waves emitted by the newly discovered jet are strongly polarized, revealing a powerful magnetic field wrapped around the jet and acting as a containing sheath, preventing the high-pressure gas in the jet from dispersing. That could explain why this jet is so long and well collimated.



Jets from Central Supermassive Blackholes