# Black holes, galaxies young and old visible in massive mapping of the night sky

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Color images documenting the past 10 billion years of galactic evolution were distributed online this week as part of the first public release of data from a massive project to map a distant region of the universe that combines the efforts of nearly 100 researchers from around the world, including the University of Pittsburgh.

Researchers in the All-wavelength Extended Groth Strip International Survey, or AEGIS, observed the same small region of sky using all available wavelengths of the electromagnetic spectrum--from X-rays to ultraviolet, visible, infrared, and radio waves. The survey focused on the Extended Groth Strip, an area the width of four full moons near the "handle" of the Big Dipper constellation. Four color images from four different satellite telescopes, as well as numerous data catalogs tabulating the properties of and distances to tens of thousands of galaxies, are now available on both the AEGIS Web site and Google Sky, a downloadable program that allows home computer users to explore these distant galaxies up close and in sharp detail.

Pitt physics and astronomy professor Jeffrey Newman is a key member of the AEGIS project's core team, the Deep Extragalactic Evolutionary Probe, or DEEP2 team. That team measured optical spectra-detailed breakdowns of the amount of light of a given color we see--for 50,000 galaxies, including 14,000 galaxies in the Extended Groth Strip. These spectra tie together all of the AEGIS datasets by allowing the team to determine each galaxy's distance from Earth. Once the distance is known, astronomers know how far back in time light left a galaxy and,

thus, its age. The most distant galaxies in the survey-up to 9 billion light years away-appear as they were only a few billion years after the Big Bang.

Newman then worked directly with Google's Pittsburgh office to convert data from AEGIS into color images for Google Sky and share the information with the general public. Google Sky users can view and explore the Groth Strip in ultraviolet, visible, infrared, or X-ray light--or combine perspectives. "Each wavelength provides unique information about the characteristics of distant galaxies," Newman said.

Newman also worked on the team that created the most detailed of the four color images being released: A visible-light mosaic of 63 separate snapshots from the Hubble Space Telescope. It is the largest unbroken color mosaic ever made with Hubble images and provides images of approximately 50,000 faraway galaxies, including infant and adolescent galaxies just taking on their mature forms.

AEGIS' second image shows the same galaxies through the ultraviolet eyes of NASA's Galaxy Evolution Explorer (GALEX). Young stars produce ultraviolet light in abundance; GALEX brightness therefore provides a measure of the rate at which each galaxy is forming stars. Galaxies that contain relatively few young stars or are obscured by dust or intergalactic gas will appear redder in the GALEX image.

The brightness of galaxies in the third image, taken with the Infrared Array Camera on NASA's Spitzer Space Telescope, is closely related to the total amount of stars they have formed. The colors of a galaxy as seen through infrared eyes reveal information on both its contents (stars and dust) and its distance from us.

The fourth image, produced with data from NASA's Chandra X-ray Observatory, reveals the highly energetic X-ray radiation produced when

gas spirals into a supermassive black hole, like those believed to lie at the center of almost every galaxy. Many of the X-ray-emitting objects lie buried within otherwise normal-looking galaxies. In the X-ray images, the bluest objects are the ones most obscured by gas within their host galaxies.

AEGIS Web site: aegis.ucolick.org/

Source: University of Pittsburgh