First atomic hydrogen spectral line images of a nearby galaxy

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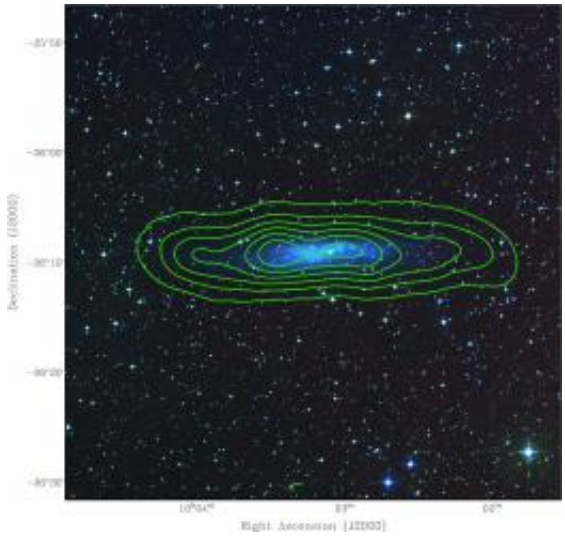


Kat7 Spectral Line - The green contours in this image show the distribution of the atomic hydrogen gas overlaid on an optical image of the same galaxy - showing clearly that the emissions from the hydrogen gas come from a much larger region than that seen by the optical image. (The Digital Sky Survey was produced at the Space Telescope Science Institute under US Government grant NAG W-2166. The images of these surveys are based on photographic data obtained using the Oschin Schmidt Telescope on Palomar Mountain and the UK Schmidt Telescope.)

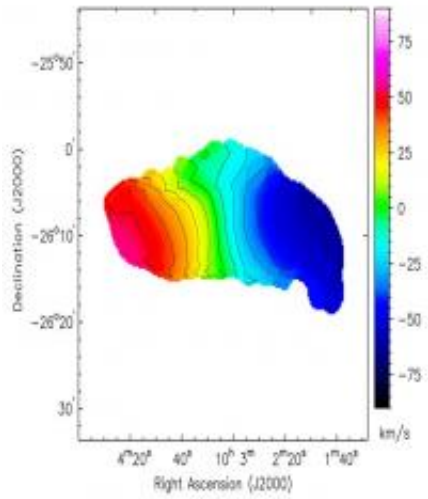
South Africa's KAT-7 telescope, a seven-dish array which is a precursor to the much larger MeerKAT telescope in the Karoo and to the Square Kilometre Array, has reached another major milestone by observing the

radio emission from the neutral hydrogen gas (HI) in a nearby galaxy. Hydrogen gas emits radio emission in a spectral line at a very specific frequency of 1420 MHz.

The astronomers pointed the telescope towards a galaxy called NGC 3109 – a small spiral galaxy, about 4.3 million light-years away from Earth, located in the constellation of Hydra. The observation allowed them to see the HI radio emission of this galaxy, as well as to see how this galaxy is moving. Where the gas is moving towards us, the frequency of the spectral line is Doppler-shifted upwards; where the gas is moving away, the frequency is shifted down. In this way, astronomers can map the way in which all of the gas in the galaxy is moving.

“These exciting results achieved by KAT-7 have given us confidence that we know how to build a cutting-edge radio telescope in Africa to answer some of the fundamental questions in radio astronomy”, says Dr Bernie Fanaroff, director of SKA South Africa. “Our team in the SKA South Africa Project and universities has again shown that they can deliver cutting-edge technology and do excellent science on a very tight schedule.”

“A large proportion of the science planned for the SKA – and MeerKAT – involves mapping of the universe using neutral hydrogen. Because of the ongoing expansion of the universe, distant galaxies are moving away from us. Measuring the frequency of the spectral line from neutral hydrogen in those galaxies allows us to work out how far away they are. By finding billions of distant galaxies, astronomers will be able to map the structure of the universe and how it has changed over time. This cosmic census of the neutral hydrogen in galaxies – far and near – is essential in understanding the deeper physics of the universe, by answering fundamental questions such as the nature of dark matter and dark energy.”



Rotating Galaxy -This image shows that the galaxy is rotating with the blue towards the viewer and the red away. The rotation is not uniform and the structure can be used by astronomers to model the distribution of matter in the galaxy. Current thinking is that most of the matter is actually dark matter, which can't be seen but whose presence can be confirmed by these kinds of observations.

"Observations of the neutral hydrogen content of galaxies also help to form a picture of how galaxies have evolved over cosmic time and show how our own galaxy, the spiral galaxy called the Milky Way, has developed," Fanaroff adds.

The radio waves which KAT-7 picks up from the galaxy were processed in the correlator, the first stage of computing. The correlator currently allows measurement of the gas velocity to an accuracy of 10 km/s. Further upgrades during 2012 will enable astronomers to study this galaxy with a velocity resolution of 1 km/s.

"Such a high velocity resolution will allow us to distinguish between the conventional models which suppose the presence of an important

quantity of dark matter (matter that cannot be seen but that is detected by its gravitational influence) and the Modified Newtonian Dynamics (MOND) models which suppose that no dark matter is present but that it is instead the laws of gravity that change on galaxy scales," explains Prof Claude Carignan, South African SKA Research Chair in Multi-Wavelength Astronomy at the University of Cape Town (UCT).

"We also speculate that an unusual warp in the disk of this galaxy could be caused by a tidal interaction with its dwarf companion galaxy known as Antlia," Carignan adds. "Future KAT-7 observations should reveal more information on this possible interaction."

"It is particularly exciting that we will soon be able to derive new scientific results with a relatively small precursor array," says Bradley Frank, PhD student at UCT and lead researcher for the HI imaging of nearby galaxies with KAT-7.

More information: www.ska.ac.za/

Provided by South African Square Kilometre Array Telescope

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