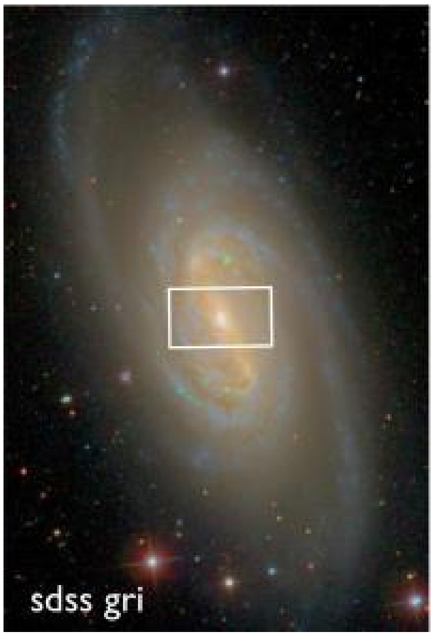
First light for new spectrograph

January 26 2011, By Nancy Atkinson

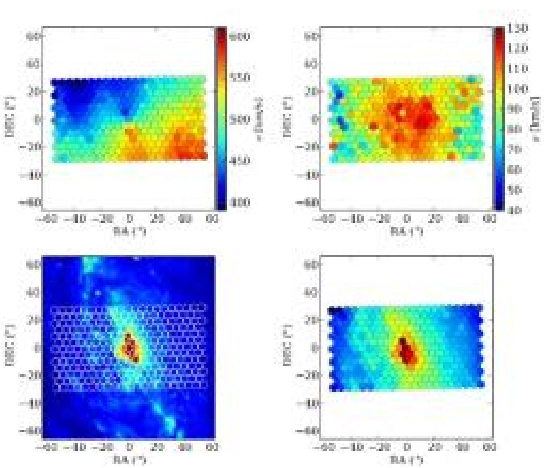


‘First Light’ for VIRUS-W: This image (from the Sloan Digital Sky Survey) shows the galaxy NGC2903 and the field of view of the spectrograph. Credit: SDSS

The new observing instrument VIRUS-W, built by the Max Planck Institute for Extraterrestrial Physics and the University Observatory Munich, saw "first light" on 10th November at the Harlan J. Smith Telescope of the McDonald observatory in Texas. Its first images of a spiral galaxy about 30 million light-years away are an impressive confirmation of the capabilities of the instrument, which can determine the motion of stars in near-by galaxies to a precision of a few kilometers per second.

As an imaging field spectrograph, VIRUS-W can simultaneously produce 267 individual spectra – one for each of its glass fibers. By dispersing the light into its constituent colors, astronomers thus are able to study properties such as the velocity distribution of the stars in a galaxy. For this they use the so called Doppler shift, which means that the light from stars moving towards or away from us is shifted to blue or red wavelengths, respectively. This effect can also be observed on Earth, when a fast vehicle, such as a racing car, is driving past: the sound of the approaching car is higher, while for the departing car it is lower.

VIRUS-W´s unique feature is the combination of a large field of view (about 1x2 arcminutes) with a relatively high spectral resolution. With the large field of view astronomers can study near-by galaxies in just one or few pointings, while the high spectral resolution permits a very accurate determination of the velocity dispersion in these objects. In this way the astronomers obtain the large-scale kinematic structure of near-by spiral galaxies, which gives important insight into their formation history.



These are the first observational data taken by VIRUS-W at the beginning of November. The false colour image in the bottom row, left, shows an enlarged area of the galaxy NGC2903 shown above. Credit: M. Fabricius, MPE

Most galaxies are too distant and the separation between the billions upon billions of stars is too small to resolve it with even the best, cutting-edge instruments. The astronomers therefore cannot study individual stars but only the average motion along a specific line of sight.

The measured velocity distributions are characterized by two parameters: The mean velocity reveals the large-scale motion of the stars along the line of sight. The velocity dispersion measures how much the velocities of the individual stars differ from this mean velocity. If the stars have more or less the same velocity, the dispersion is small, if they have very different velocities, the dispersion is broad. For spiral galaxies, where the stars travel in fairly regular circular orbits, the velocity dispersion is mostly small. In elliptical galaxies, however, the stars have rather disordered orbits and so the dispersion is broad.

With the high spectral resolution of VIRUS-W, the astronomers can investigate relatively small velocity dispersions, down to about 20 km/s. This was impressively confirmed by the first images taken by VIRUS-W of the near-by spiral galaxy NGC2903.

"When we attached VIRUS-W around midnight on the 10th of November to the 2.7m telescope, we were very happy to see that the data delivered by VIRUS-W was of science quality virtually from the first moment on," says Maximilian Fabricius from the Max-Planck-Institute for Extraterrestrial Physics. "As the first galaxy to observe we had selected the strongly barred galaxy NGC2903 at a distance of about 30 million lightyears – right in front of our doorstep. The data we collected reveal a centrally increasing velocity dispersion from about 80 km/s to 120 km/s within the field of view of the instrument. This was a very exciting moment and only possible because of the remarkable teamwork during the commissioning with a lot of support by the observatory staff!"

The observing time at the telescope was made available by the VENGA project, to which VIRUS-W will be contributing from the beginning of 2011 onwards. It will then provide detailed kinematic data to this study.

The main instrument for VENGA is VIRUS-P, a spectrograph operating at the 2,7m Harlan J. Smith-Teleskope of the McDonald observatory since 2007. This instrument is a prototype of the VIRUS spectrographs being developed for the HETDEX project led by the University of Texas in Austin. For a study of the large scale distribution of galaxies, HETDEX will combine about 100 spectrographs at the 9.2m Hobby-Eberly Telescope of the McDonald observatory to form one large instrument. VIRUS-W (where the W stands for a later mission at the Wendelstein telescope of the Munich Observatory) is based on the same basic VIRUS design. Because of its broader spectral coverage and despite its much lower resolution, the prototype VIRUS-P already gives interesting insight into the age and chemical composition of stars and the interstellar medium as well as information about the star formation rate.

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