A COORDINATED RADIO AND OPTICAL SURVEY OF M31

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At Leiden we are obtaining coordinated radio, optical and infrared observations of the Andromeda galaxy, M31. Its proximity offers us a unique opportunity to study both the large-scale and small-scale structure of a galaxy which is similar in many respects to the Milky Way. The WSRT has been used to obtain high-resolution (24" x 36") maps of M31 in the HI line and 21- and 49-cm radio-continuum emission. Recently the radio data have been complemented with optical surface photometry in UBVR and Hα, using the Burrell Schmidt telescope at Kitt Peak and the Palomar Schmidt. Results from the HI and IRAS infrared observations are presented elsewhere. Here we present some preliminary results from the radio-continuum and optical surveys.

The figure shows a composite map of the 21-cm radio-continuum emission, made by combining 5 separate Westerbork fields. The emission is concentrated in a ring structure coincident with maxima in the distribution of the HI, HII regions, OB associations, far-infrared, and far-UV radiation. The continuum ring is partly resolved into individual sources at 21 cm; the spectral indices and optical counterparts indicate that both thermal and non-thermal sources are being detected. A separation of thermal and non-thermal emission is being attempted using both the 49- and 21-cm maps and the Hα-emission distribution. Both the thermal and non-thermal emission appear to be strongly correlated with the young stellar population, in agreement with recent results for other spiral galaxies, and with an earlier low-resolution survey by Berkhuijsen.

The UBVR and Hα plates are being scanned at Leiden using the ASTROSCAN reticon densitometer, and will be combined with published and unpublished photoelectric photometry to produce maps of the color distribution of the galaxy with a resolution of 4-8 seconds, and with an accuracy of order $\pm$ $0^{m}.1$. The data will provide direct information on the current and recent star formation, the properties of the interstellar dust, and the spiral structure of the galaxy. When combined with the radio-continuum and line data, we will be able to study the interactions between the interstellar medium and the young stellar population on scales of order 100 pc.

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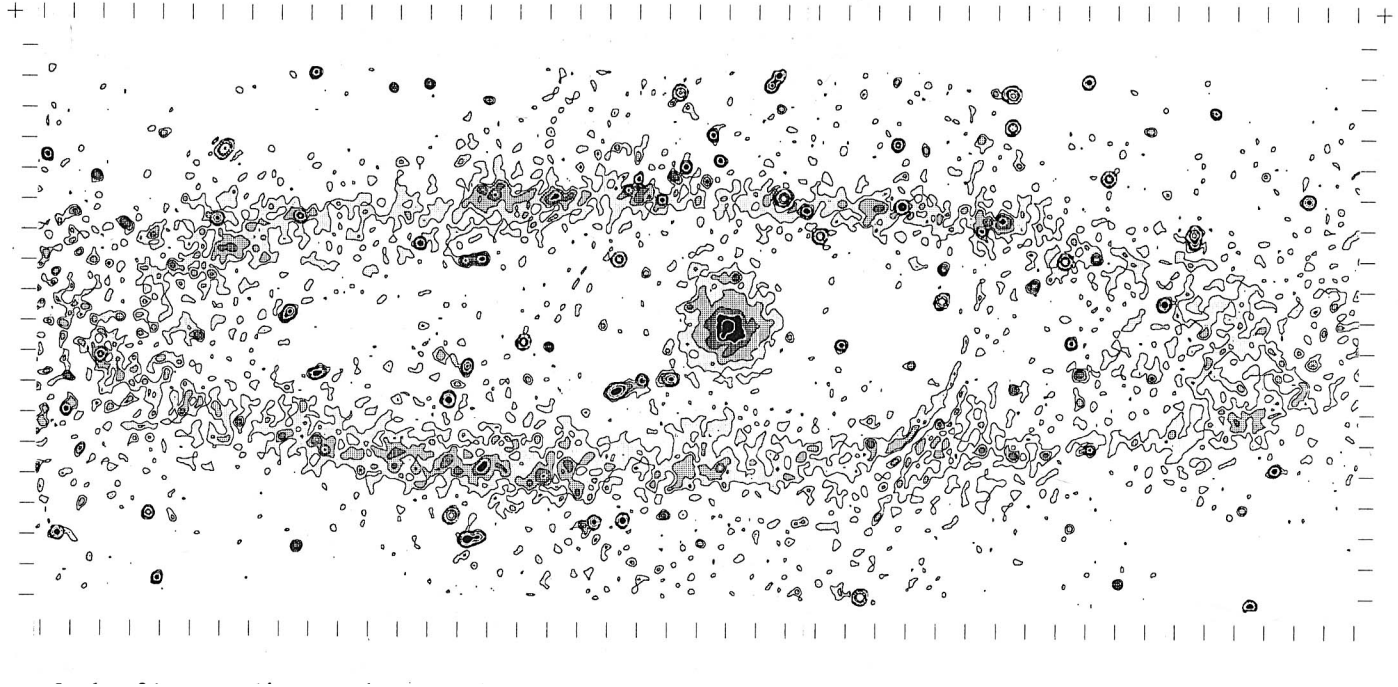

Map of the 21-cm radio-continuum emission of M31 made by combining five separate fields observed with WSRT. Short spacings taken from an unpublished 17.4-cm survey with the Effelsberg telescope are included for the large-scale structures. North East is to the left. The resolution is 35" x 35"; the distance between tick marks is 2!4. Contour levels are at 0.3, 0.6, 1, 1.6, 3.3, 10, 16, 40 K.

Most of the strong sources are far-extragalactic and not related to M31. This includes the double-lobed source close to the nucleus. The weaker sources in or close to the ring of emission generally coincide with HII regions or supernova remnants. The weak ring-like structure to the right of the nucleus is a residual grating ring due to 5C3.107, the only point source subtracted in this map. At the edges the noise increases due to the primary-beam correction.