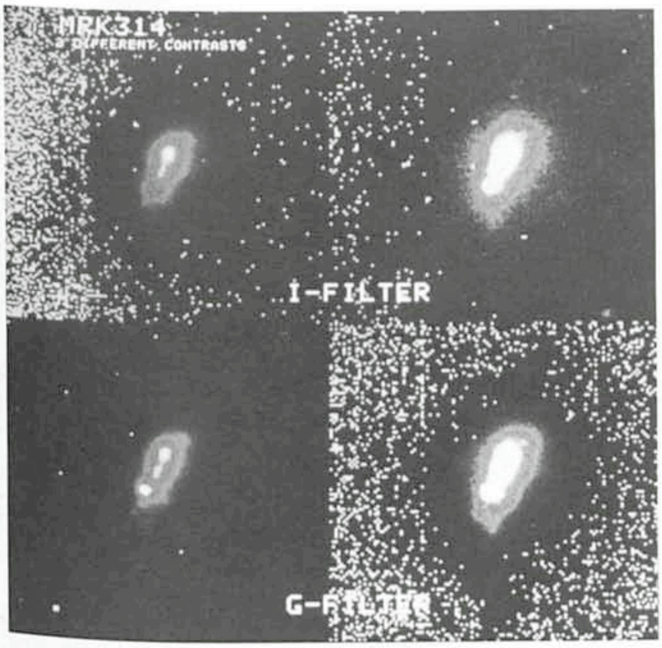

Fig. 3: *The two upper (respectively lower) pictures have been obtained from one exposure of the central part of the galaxy Mrk 314 (July 1982; 15-min exposure) in the i (respectively g) colour band, seen with 2 different contrasts. There is a bridge of matter between 2 main condensations, the southern one is very blue. Mrk 314 is likely to be an interactive case. The inner parts of 2 curved extensions are slightly visible at the upper and lower parts of the g exposures.*

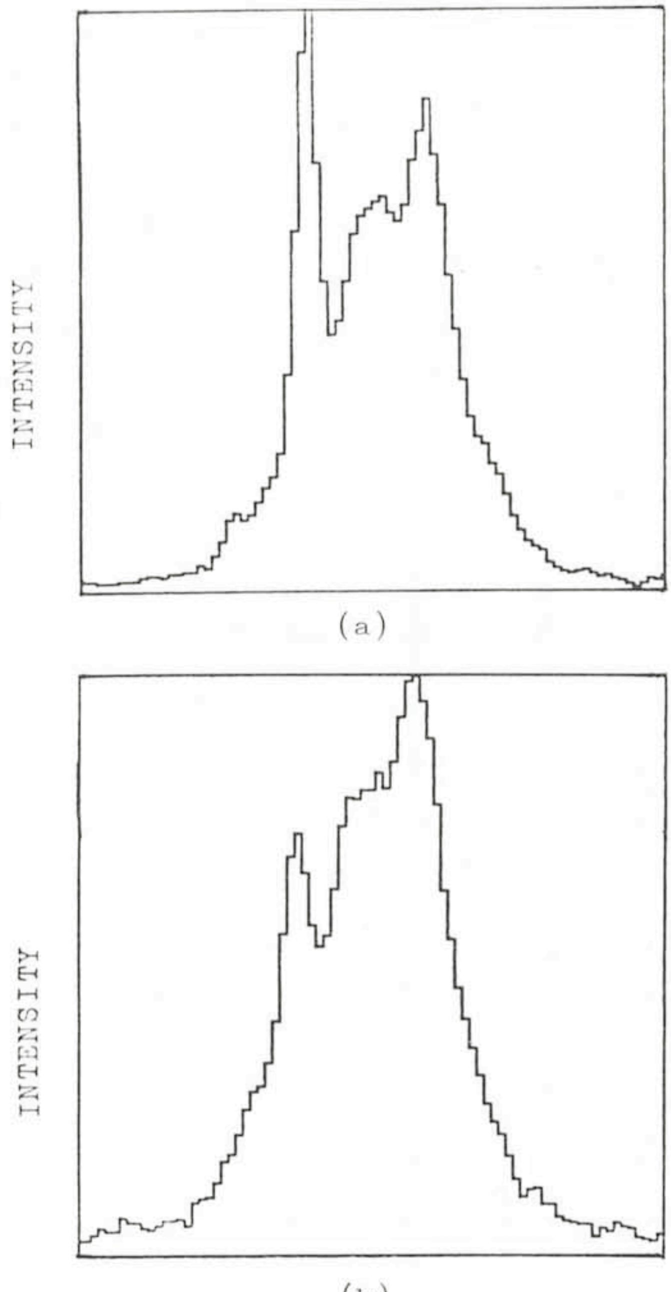

Fig. 4: *Intensity profiles along the line of the central condensations of Mrk 314. (a) for the g colour band (bluer); (b) for the i colour band (redder).*

From a qualitative point of view, the main superiority of a CCD image of one galaxy as compared to what is seen on a Schmidt plate concerns the resolution of the brightest central regions of the galaxy. The sensitivity of the CCD permits a statistical approach while its dynamical range allows a simultaneous investigation of the faint extensions themselves and of the parent galaxies. It is therefore possible to roughly classify all the objects of the sample into different groups by using (i) morphological criteria on the extensions and on the parent galaxies and their nuclei, (ii) photometric properties as the jet-to-galaxy or jet-to-nucleus luminosity ratio in different colours. Among the objects of the sample, 10 % appeared, on the CCD images, to be possibly a superposition of classical astronomical objects, as faint stars or edge-on galaxies. The majority of the objects, however, remain very peculiar. 20 % are likely interactive cases with tidal extensions. 20 % show, besides their jet-like features, multiple nuclear condensations, illustrated by the photographs 2 and 3 and the Fig. 1. No jet strikingly similar to the case of M87 seems to have been found, but further information as spectroscopic and radio data on the jet features are necessary to draw more precise conclusions.

Thanks should go to Massimo Tarenghi for initiating this work and to Preben Grosbøl and Andrezj Kruszewski who helped me to use the ESO data reduction system. I am also grateful to the image processing group and photographers of ESO-Munich, as well as to the staff members of La Silla.

New Optical and X-ray Observations Yield Progress in Understanding of an Old Nova

H. Drechsel, J. Rahe, W. Wargau, Remeis Observatory Bamberg, Astronomical Institute University Erlangen-Fürth

Nova Aquilae 1918 was the brightest new star that was discovered since Tycho's and Kepler's supernovae in 1572 and 1604, which reached a peak brightness of -4^m and -3^m, respectively. On June 10, 1918, Nova V603 Aquilae went through a sharp maximum of visual brightness $-1\overset{m}{.}1$, followed by a subsequent steep decrease, making it an outstanding

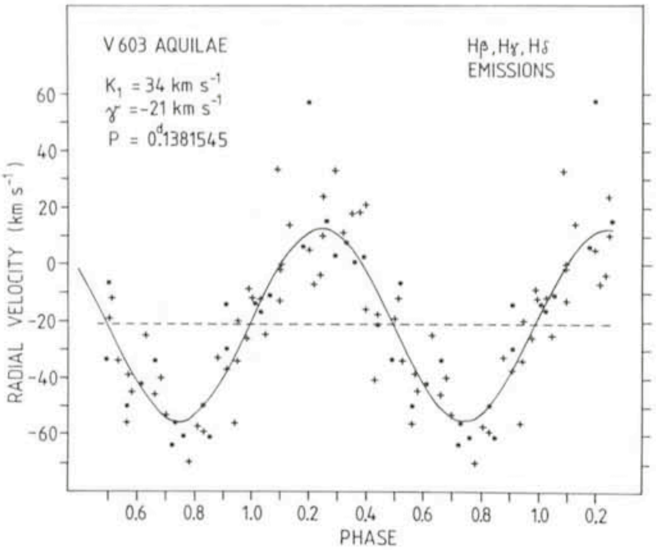

Fig. 1: *Radial velocity curve of the primary component of V603 Aql. The crosses represent our measurements of the Hβ and Hγ emission lines, while the dots give earlier measurements of Hγ and Hδ by Kraft for comparison. The data have also been used for an exact determination of the period.*

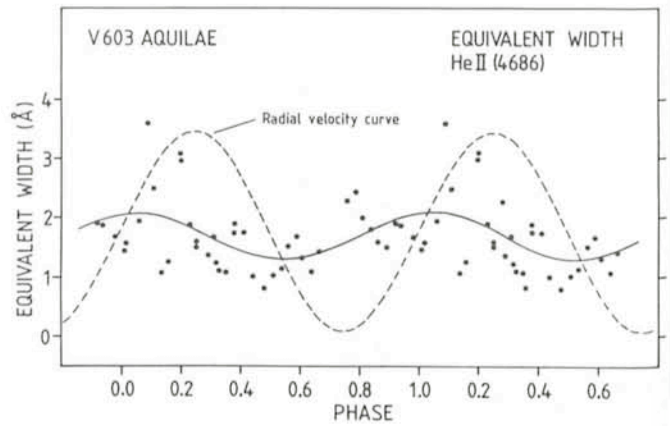

Fig. 2: *Equivalent width of the He II (4686) emission line in the spectra of V603 Aql as a function of orbital phase. The solid line gives the best fit to the data, and suggests mean light intensity changes of about 30 %, which are correlated with the orbital period; superimposed are larger short-term fluctuations. The dashed line is the radial velocity curve of the primary component and illustrates the phase relation of the emission line flux variations.*

example of a classical fast nova. Consequently, it has been the subject of many investigations.

In 1964, Kraft was the first who showed it to be a close binary system with an orbital period of 0.138 days. First evidence for periodic visible light variations correlated with the orbital phase came from photometric observations obtained by the authors during more than two contiguous cycles with the FES instrument aboard the IUE satellite, while UV spectroscopy was carried out simultaneously. At that time, the system was quiet, and at a relatively low mean brightness of about $11^{m}.9$. Subsequent photoelectric measurements and high speed photometry did not reveal any evidence for regular eclipses, because strong non-coherent flickering and photometric disturbances were present at those epochs, when the system was at the higher mean light level of about $11^{m}.4$.

Optical Spectroscopy

Optical spectroscopic observations were obtained with the ESO 3.6 m and 1.5 m telescopes in 1980 and 1981. A total of 65 IDS spectra cover several orbital cycles continuously.

These measurements, together with 23 spectra taken by Kraft during two consecutive nights in 1962, were used to determine the spectroscopic period more precisely. If period changes can be neglected, the power spectrum analysis yields an accurate value for the orbital period of 0.1381545 days, in agreement with the early determination of Kraft. Fig. 1 shows the radial velocity curve of V603 Aql. The crosses represent our data of 1980 and 1981; they are mean values of the Hβ and Hγ emission lines, which are attributed to the more luminous primary component consisting of a white dwarf surrounded by an accretion disk. The dots give Kraft's data of 1962, corresponding to the mean values of the Hγ and Hδ emissions. The relatively small amplitude of the order of 35 km s^{-1} confirms the previously assumed small inclination of about 15°–20°, which makes it difficult to explain the periodic dips in the continuum light curve as regular eclipses.

The optical spectra reveal pronounced time variations of the profiles and intensities of prominent emission lines. As an example, the equivalent width of the He II line at 4686 Å is depicted in Fig. 2 as a function of orbital phase. The amplitude of the mean curve (solid line) corresponds to 30 % changes, while many larger short-term fluctuations are superimposed. The dashed line is the primary radial velocity curve and illustrates the relationship of the line intensity variations with the orbital phase. It is apparent that the maximum intensity of the emission line flux is observed during the phase of conjunction. At that time, the observer on Earth most directly views those surface areas of the late main sequence star which are differentially heated by the radiation of hot regions in the accretion disk or by the central white dwarf. If only a few per cent of the X-ray flux emitted by the primary component is intercepted by the secondary star and partly reprocessed into optical radiation, the variable line-of-sight aspect of the heated surface layers would give rise to the observed modulation of

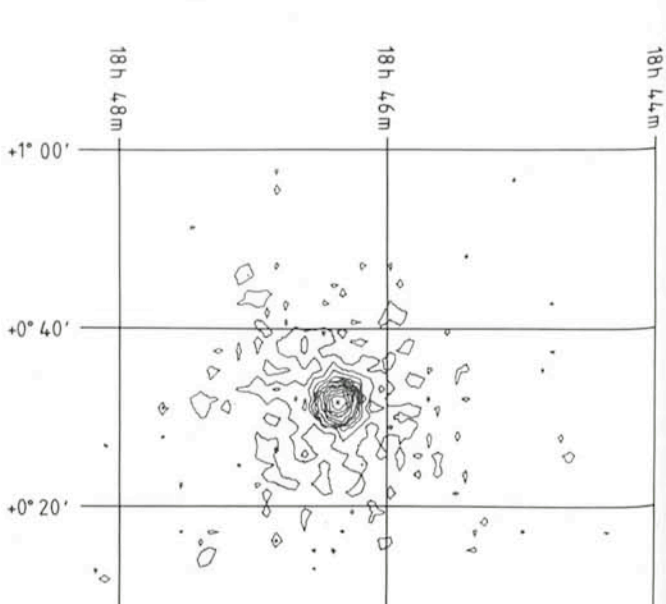

Fig. 3: *The field of V603 Aql as seen by the Image Proportional Counter (IPC) onboard the Einstein satellite. The lines are contours of constant X-ray surface brightness. The old nova shows as a point source, with no obvious emission from an extended shell.*

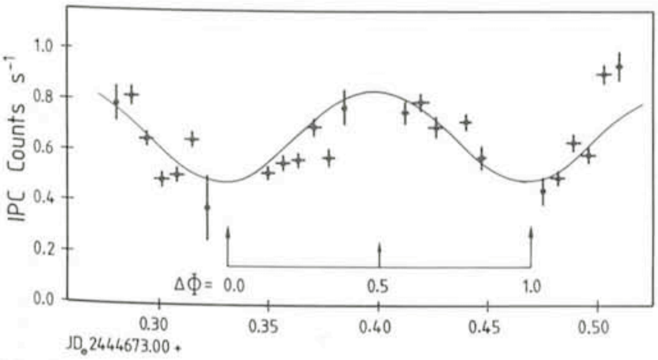

Fig. 4: *The X-ray lightcurve of V603 Aql, measured in the 0.15–4.5 keV range. The dots represent count rates which have been binned in 10-minute intervals. The abscissa is scaled in Julian days, and relative phase units $\Delta\Phi$ are indicated, which have been computed with the optical spectroscopic period. Orbital phase-dependent flux variations are obvious.*

the optical continuum and emission line flux with the orbital period.

X-ray Satellite Observations

More insight into these problems was expected from phase-dependent X-ray measurements which were carried out in 1981 with the Einstein satellite.

Nova Aquilae 1918 was found to be one of the brightest X-ray emitters among cataclysmic variables, with a luminosity of up to 3×10^{33} erg s^{-1} in the 0.2–20 keV energy band. Fig. 3 shows a contour map with lines of constant X-ray surface brightness for a one square degree field centered on the old nova. V603 Aql shows as a point source, which means that the observed X-rays are emitted somewhere within the close binary system, and not from an extended shell. The X-ray position coincides with the astrometric position of the optical counterpart.

The source was monitored over a time interval of about 20,000 seconds, corresponding to approximately 1.7 orbital cycles. X-ray lightcurves were measured in the Image Proportional Counter (0.15–4.5 keV) and Monitor Proportional Counter (2–6 keV) ranges. Fig. 4 displays the X-ray flux variations in the 0.15–4.5 keV energy band. The smooth solid line illustrates the best representation of the data. Obviously, the general trend of the flux variations follows the orbital revolution. The count rates have been binned in 10-minute intervals.

Integration in shorter time steps of 100 second length shows the presence of rapid X-ray flickering with an amplitude of about $0^{m}.8$. These variations exceed the optical fluctuations by a factor of 2 to 3, but occur on a comparable time scale of a few hundred seconds. This suggests that the optical and X-ray flickering are an outcome of the same mechanism for the generation of the radiation, and that the optical emission may at least partly emerge from reprocessing of the X-rays.

The X-ray source is almost certainly connected with the transfer of matter which is lost by the Roche lobe filling secondary star and accreted by the white dwarf, either directly along magnetic field lines, or from the inner edge of the accretion disk. The observed high X-ray temperature (20–30 keV) and luminosity (3×10^{33} erg s^{-1}) can be explained by applying models for the emission of a hot transition region between the disk and the surface of the star. Such a hot region can persist due to the more or less continuous release of the kinetic energy and momentum of matter rotating in the disk. An accretion rate of only a few 10^{-10} solar masses per year is sufficient to produce the observed X-ray flux with the radiating power of the Sun.

Optical and X-ray data show that the orbital inclination of the binary is small. Why is the X-ray flux then modulated with the orbital period, if we can rule out a partial eclipse of the X-ray source by the secondary star or by material contained in the accretion disk? The variation must be due to the source geometry or to a variable mass accretion rate correlated with the binary orbit. It still remains open, whether the white dwarf is corotating, and a weak magnetic field channels material to particular surface areas, or wheter the orbit is eccentric, leading to variable mass accretion.

We need more observations before a definite model can be developed for this system, which might serve as a representative example for a whole class of by now extensively discussed objects. Especially phase-dependent observations carried out simultaneously in the optical, X-ray, and possibly other spectral ranges would be most useful.

The Optical Jet of R Aquarii

H. Sol, Observatoire de Paris-Meudon

R Aquarii is a stellar system containing a long-period (386 days) Mira variable of spectral type M7e. The presence of an irregularly variable blue continuum and possibly of a several years modulation in the lightcurve suggests that the Mira has a companion, namely a white dwarf with an accretion disk. The most spectacular feature of this symbiotic system is a brigth circumstellar nebula (photographs of which are shown in *Sky and Telescope*, **64**, 141, 1982 by Kaler). This nebula is very likely due to a nova outburst undergone by R Aquarii centuries ago and described in Japanese astronomical records of AD 930 (Kafatos, Michalitsianos, *Nature*, **298**, 540, 1982).

For several years R Aquarii has been known to eject some material as it presents P Cygni type profiles. Besides, an optical protuberance appeared sometime between 1970 and 1977. Photographic plates of 1980 show that it extends to 10 arcsec from the star with two brightness peaks at about 6 and 8 arcsec and that there is a gap between the inner end of the jet and the star (Sopka et al. *Ap. J. Lett*, **258**, L35, 1982). This jet probably corresponds to a collimated ejection of matter from the stellar system. If the observed expansion is due to a real transfer of matter, the jet velocity appears to be ≥ 300 km/s, which is a rather large value. It is therefore possible that we observe in fact the speed of displacement of a zone of gas ionization, the gas itself moving outwards more slowly. Sopka and his collaborators detected this jet in radio wavelengths also.

The Mira variable has been kind enough to be almost at its minimum during my observing run of last November in La Silla. Thus I obtained CCD exposures of different exposure time (30 sec, 1, 2, 5, 10, 20 min) of its system in the B and V Johnson colour bands, in order to study the inner part of the jet, close to the star. Fig. 1 shows a 2-min exposure. The 10 arcsec nodule extended towards a position angle ~ 30° and already seen in