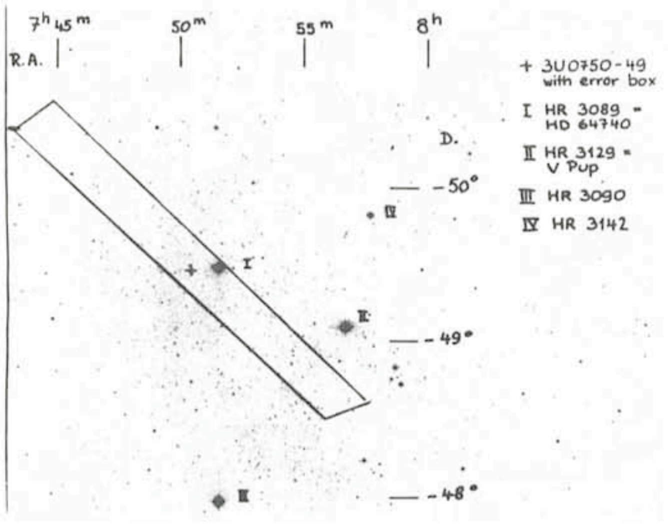

Fig. 3. — *The sky area near the X-ray source 3U 0750-49.*

line. Dots represent the theoretical profile obtained from an adapted model atmosphere. The effective temperature turns out to be exceptionally high (27,000 K), for the class of helium variables. At this temperature, the line of He II λ 4686 Å should appear in absorption with an equivalent width of 50 mÅ. Figure 2 shows a portion of the spectrum from λ 4650 to 4700 Å. No absorption line is readily detectable at λ 4686, although the weak lines of O II, N II and C III can be identified down to 20 mÅ (for identification see the right-hand scale).

Instead, a broad emission feature is indicated, with a central absorption of the anticipated strength. The emission exceeds the (well-defined) continuum by 2 per cent.

A New Class of X-ray Sources?

In X-ray binary systems, He II λ 4686 sometimes appears in emission. HD 64740 indeed is located inside the error box of the weak source 3U 0750-49 (see Fig. 3) as was noted already by Pedersen and Thomsen, whereas the contact binary V Pup, so far suspected to be the candidate, lies 3 arc min outside the error box. Better X-ray positions are needed to confirm the identification. However, if confirmed, it would mean that a new class of X-ray sources has been found. It would also solve the mystery of the helium variables, which would then be binaries containing a compact object, i.e. either white dwarf or neutron star.

The N 119 Complex in the Large Magellanic Cloud

J. Melnick

One of the most striking objects seen in blue photographs of the Large Magellanic Cloud (LMC) is a spiral-shaped H II region situated almost at the very centre of the so-called "bar" of the LMC. This H II region is generally referred to as N 119, since it is the one hundred and nineteenth entry in a catalogue of emission nebulae in the LMC prepared in 1956 by the American astronomer Karl Henize.

Figure 1 shows a negative enlargement of N 119 made from an excellent ultraviolet plate of the central region of the LMC obtained with the ESO Schmidt telescope on La Silla. On this plate, the peculiar structure of N 119 can be very clearly appreciated. It mainly consists of a bright condensation with a bright star cluster at its centre and two prominent, spiral-shaped filaments extending several arc-minutes on either side of the nuclear region. The overall diameter of the "spiral" filaments is about 8 arc-minutes or more than 100 pc, i.e. more than twenty times larger than the Orion nebula; indeed, even the central part of N 119 is already much larger than Orion!

It can also be seen in figure 1 that the area around N 119 appears to be a region of relatively recent and vigorous star formation. Several open clusters may be discerned on the photograph as well as a large number of individual stars which are significantly brighter than the field stars in the LMC bar. In addition, the whole region is covered with faint, diffuse gaseous filaments.

What is the nature of this peculiar object? Are the spiral-shaped filaments only the densest parts of a gigantic spherical shell of gas seen projected against the plane of the sky? If so, is this shell expanding? Or are the filaments really thin wisps of gas in the interstellar space? With these questions in mind, and as part of a more general programme, investigating the internal kinematics of giant emission nebulae in external galaxies, I have obtained accurate velocity profiles at the positions along the "arms" of N 119 as indicated in figure 1.

The Fabry-Pérot Spectrometer

The instrument used for this work was a photoelectric Pressure-Scanned Fabry-Pérot Spectrometer at the 1.5 m telescope of the Cerro-Tololo Interamerican Observatory. The principle of operation of the Fabry-Pérot interferometer is illustrated in figure 2.

It basically consists of two parallel, semi-transparent mirrors. Parallel light entering the cavity formed by the two mirrors undergoes multiple reflections inside the cavity, producing the interference pattern shown in figure 3. When perfectly monochromatic light is fed into the cavity, it is then concentrated by the interferometer in very narrow rings, each corresponding to the same wavelength, but to a different interference order. Assuming that the mirrors are perfectly parallel, the resolution of the interferometer is given by the width of the rings which in turn depends on the number of reflections inside the mirrors and on their separation. With the advent of low-absorption dialectric multilayer coatings, very narrow rings can be produced.

In typical astronomical use the wavelength of the line to be studied is first preselected, usually by means of interference filters. However, the observed light is still not monochromatic and the width of the rings depends also on the intrinsic width of the observed line. Since the "instrumental" width of the rings is very small, very accurate information about the shape of the observed lines can be obtained.

Typically, Fabry-Pérot interferometers are used in two modes: In the first, more classical mode, a Fabry-Pérot is placed in front of a photographic camera, for instance to

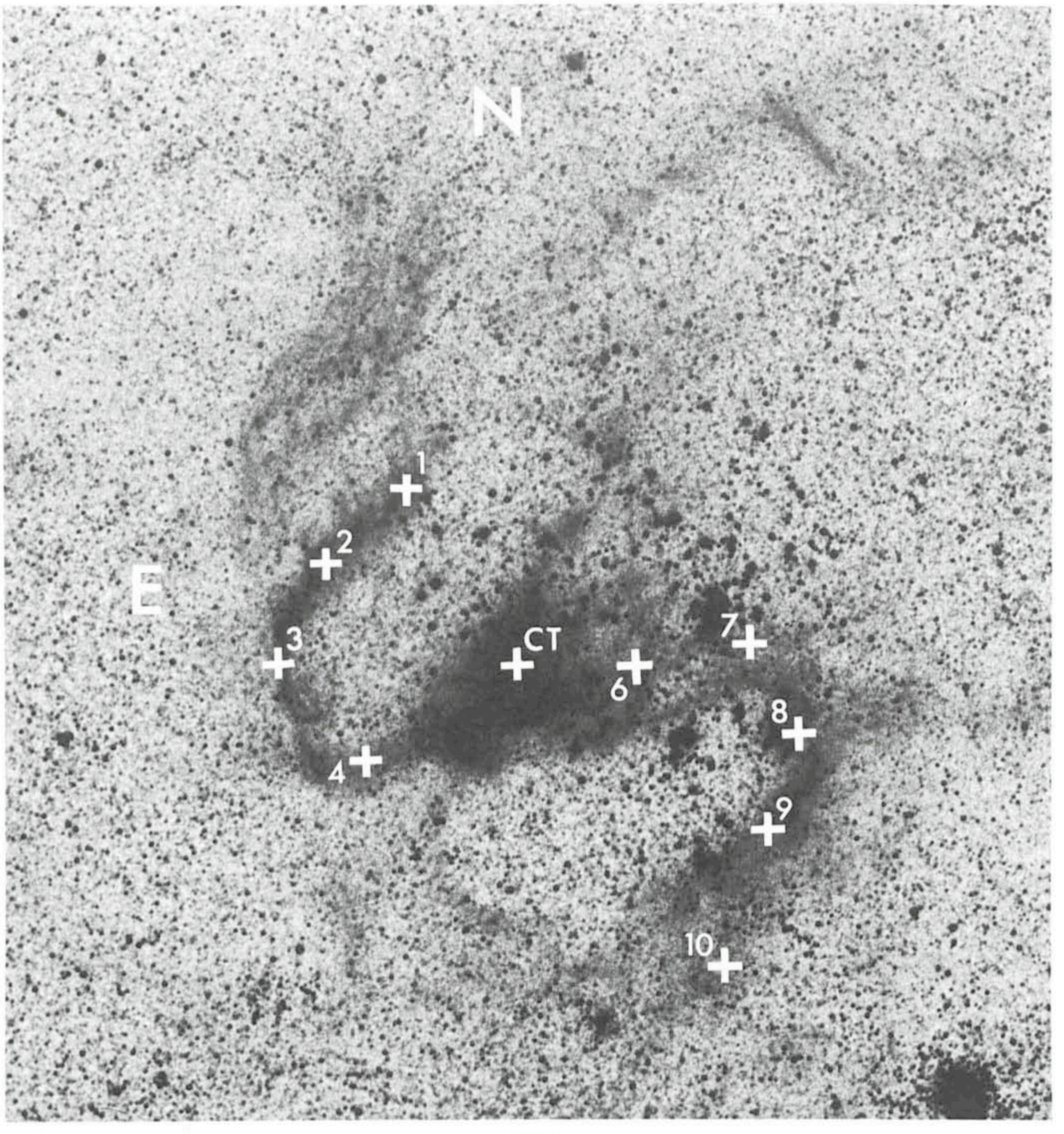

Fig. 1.

investigate the kinematics of emission nebulae (cf. the article by M.F. Duval in *Messenger* No. 8).

In the second mode, the light from the Fabry-Pérot plates is fed into a photomultiplier. The rings are then scanned by changing the length of optical path of the light inside the cavity, either by changing the separation of the plates or by changing the index of refraction of the medium inside the cavity (by increasing the amount of gas between the two mirrors).

But what is the advantage of Fabry-Pérot interferometers over conventional slit-spectrographs? Well, the resolving power of the Tololo interferometer is about 50,000. To achieve a similar resolving power using conventional coudé spectrographs, the entrance slit must be of the order of 0.1 arc-second and with typical seeing conditions of 1 arc-second, only a few per cent of the light would actually be

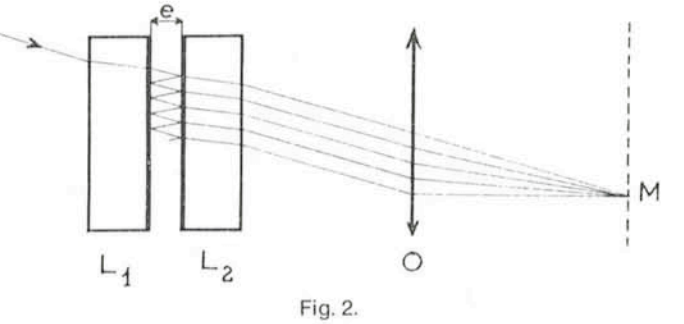

Fig. 2.

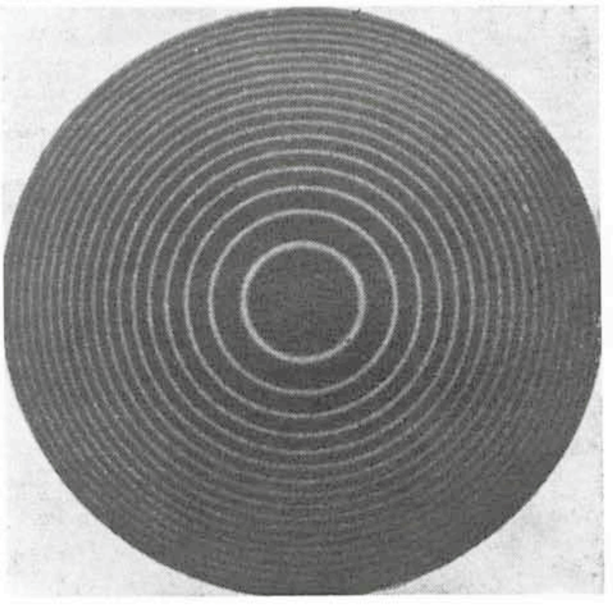

Fig. 3.

used! By contrast, F-P interferometer entrance apertures as big as several minutes of arc can be used without degrading the resolving-power. Thus, they are superior for the investigation of the kinematics of extended objects. It should not be forgotten, however, that when using F-P spectrometers only one line can be looked at at the time!

The interferometer used in the present investigation works in the pressure-mode. The amount of nitrogen gas inside the cavity is continuously increased by a computer-controlled valve while the output of the photomultiplier is read at fixed intervals.

The radial velocity of the gas is obtained to an accuracy of about 1 km/sec by comparing the measured nebular profiles with those of a standard hydrogen lamp on the instrument, by using a computer line-fitting programme.

Observations of N 119

The results for N 119 are shown in figure 4 where the difference in velocity (ΔV) between the individual positions observed and their mean value (a heliocentric velocity of 276 km/sec) has been plotted as a function of distance to the N 119 centre projected along the line joining Positions 1 and 9 in figure 1. It is seen that there is a systematic increase in velocity from the southern end of N 119 to the tip of the norther "arm".

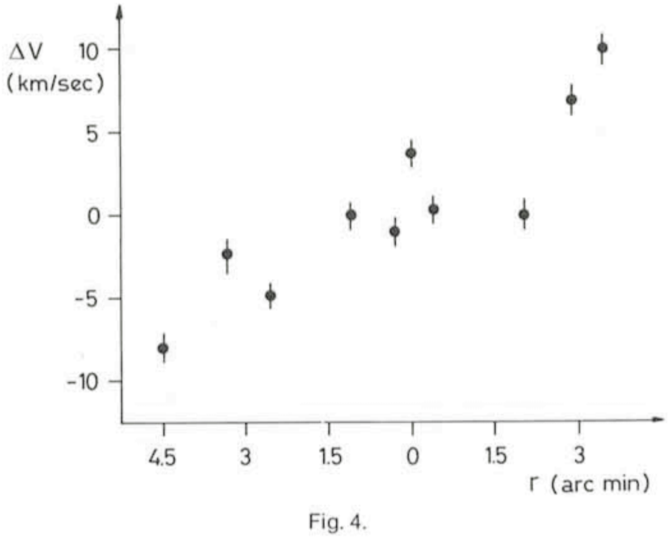

Fig. 4.

Is this the consequence of the general rotation of the LMC? The LMC, as a whole, rotates around an axis roughly perpendicular to the (1 to 9) axis of N 119. Therefore, the motions in N 119 ought to reflect those of its parent galaxy. However, in its central regions, the LMC rotates as a solid body with a velocity gradient (along an axis nearly parallel to that of N 119) of about 20 km/sec/deg. Over the observed length of N 119 (7.5 arc-minutes) one expects a velocity difference of only 3 km/sec, i.e. much less than the observed 18 km/sec! The observed velocity field must, therefore, be intrinsic to N 119.

A possible explanation for this velocity field is that the arms of N 119 are just the densest parts of an expanding shell. If this were the case, however, one would expect to see a double-peaked profile at the centre of N 119 with a separation significantly larger than 18 km/sec, when projection effects are considered. The profiles do not show such a structure, although the resolution of the interferometer is about 9 km/sec. However, the profiles do show a certain asymmetry towards lower velocities. The possibility of expansion cannot, therefore, be entirely discarded.

The Structure of N 119

We notice in figure 1, that N 119 has a structure somewhat resembling two spherical shells joined at the centre of N 119. In fact careful inspection of the photo reveals that N 119 has a "figure 8" shape.

But how was this strange structure formed? There are two plausible mechanisms. The first, and perhaps the most classical, is supernova explosions. Here, a star reaches the end of its life and explodes while ejecting large amounts of material at very high velocities. This material then sweeps out the surrounding interstellar gas and is decelerated by what could be called interstellar "friction", forming gigantic loops. An alternative and very attractive mechanism has often been invoked in recent years. Bright supergiant stars (such as Wolf-Rayet stars) are known to loose large amounts of mass from their atmospheres at velocities reaching thousands of kilometres per second. These so-called "stellar winds" act upon the interstellar medium more or less like a supernova blast, producing what has been called "an interstellar bubble".

Since a stellar wind continuously drives the bubble outwards, while a supernova blast gives it only one huge energetic push, there are certain physical differences between the two mechanisms which in principle might allow us to distinguish between the two possible origins for the observed bubbles. This, however, is not a simple problem and it has been the subject of much research during the past few years, especially in connection with the LMC.

In the case of N 119 it is known that it contains at least one very bright supergiant star, located right at its centre. This star, called S Doradus, has been intensively studied by Bernhard Wolf. S Doradus could be driving a massive wind, but it is not easy to explain how it could produce a structure like that of N 119. On the other hand, radio observations of N 119 do not show that a supernova explosion has recently taken place near the nebula.

Clearly, a detailed study of the velocity field of N 119 would be of much help to understand the nature of this interesting nebula. The photographic Fabry-Pérot interferometer used at La Silla by the French group would be an ideal instrument for this investigation. Together with accurate radial velocity information, this instrument provides the necessary spatial resolution required to properly map the velocity field around N 119.

Visiting Astronomers

April 1—October 1, 1978

Observing time has now been allocated for period 21 (April 1 to October 1, 1978). As usual, the demand for telescope time was much greater than the time actually available.

The following list gives the names of the visiting astronomers, by telescope and in chronological order. The complete list, with dates, equipment and programme titles, is available from ESO/Munich.

3.6 m Telescope

April: Kohoutek, Courtès/Boulesteix, Kunth/Sargent, Lub/van Albada, Feitzinger/Kühn/Reinhardt/Schmidt-Kaler.

May: van den Heuvel/van Paradijs/Henrichs/Zuiderwijk, Chevalier/Ilovaisky, King, J.&A. Surdej/Swings, Geyer/Schuster.

June: Bergvall/Ekman/Lauberts/Westerlund, Ilovaisky, Westerlund, Pettersson.

July: Knoechel, Labeyrie, Swings, de Graauw/Fitton/Beckman/Nieuwenhuyzen/Vermue.

August: Laustsen/Tammann, Schnur/Sherwood, Vogt, Schultz/Kreysa.

Sept.: Boksenberg/Goss/Danziger/Fosbury/Ulrich/Schnur, Bergeron/Dennefeld/Boksenberg, Dennefeld/Materne, Turon/Epchtein, Wamsteker, Muller/Schuster/West.

1.52 m Spectrographic Telescope

April: Kunth/Sargent, Feitzinger/Kühn/Reinhardt/Schmidt-Kaler, Schmidt-Kaler/Maitzen, Rahe, Bertout/Wolf, de Loore.

May: de Loore, Ahlin, Breysacher/Muller/Schuster/West, Schnur/Danks, Ilovaisky/Chevalier, King, Briot/Divan/Zorec, van den Heuvel/Henrichs/Zuiderwijk, Thé.

June: van den Heuvel/Henrichs/Zuiderwijk, Thé, Ahlin, Pakull, Houziaux, Ilovaisky/Chevalier, Ardeberg/Maurice, Lindblad/Lodén, Hultqvist, Houziaux/Danks, Ahlin.

July: Schnur/Danks, de Loore, Swings/Surdej, Tscharnuter/Weiss, M. Jaschek, Ahlin.

August: Spite, Schnur/Mattila, C. Jaschek, Andriesse, Bergvall/Ekman/Lauberts/Westerlund, Breysacher/Muller/Schuster/West.

Sept.: Breysacher/Muller/Schuster/West, Breysacher, Querci, Bouchet, Ahlin, Wamsteker, Breysacher/Azzopardi.

1 m Photometric Telescope

April: Adam, Kohoutek, Shaver/Danks, Bensammar, Wamsteker, de Loore.

May: Chevalier, van den Heuvel/Henrichs/Zuiderwijk, Thé/Wamsteker, Zeuge, Ardeberg/Maurice, Crane.

June: Crane, Westerlund, Pakull, Gahm, Smith, Bernard.

July: Bernard, Knoechel, de Loore, Salinari/Tarenghi, Sherwood/Arnold, Wamsteker, Wamsteker/Schober, Vogt.

August: Vogt, Bruch, Alcaíno, Bouchet, Querci, Vogt, Schnur/Mattila.

Sept.: Schnur/Mattila, Fosbury, Bergvall/Ekman/Lauberts/Westerlund, Blair, Turon/Epchtein, Wamsteker, Wamsteker/Schober, Crane/Materne, van Woerden/Danks.

50 cm Photometric Telescope

April: Rahe, Kohoutek, Lodén.

May: Lodén, Debehogne, Briot/Divan/Zorec.

June: Heck, Pakull.

July: Pakull, Haefner, Swings/Surdej, Bouchet.

August: Bouchet, Schober/Surdej, Schnur/Mattila.

Sept.: Schober/Surdej.

40 cm GPO Astrograph

April: Debehogne, Vogt

May: Gieseking.

June: Ardeberg/Maurice, Gieseking.

July: Gieseking.

August: Gieseking, Vogt.

Sept.: Vogt.

50 cm Danish Telescope

May: Lindblad/Lodén, Thé/Bakker.

June: Lindblad/Lodén.

61 cm Bochum Telescope

April: Semeniuk.

May: Semeniuk, Zeuge.

June: J.&A. Surdej, Terzan.

July: Terzan, Wamsteker/Schober.

August: Walter, Walter/Duerbeck.

Sept.: Walter, Walter/Duerbeck, Wamsteker/Schober.

Comet Bradfield (1978c)

A new, bright southern comet was discovered by the Australian amateur astronomer William A. Bradfield on February 4, 1978. A preliminary orbital calculation shows that it may reach 4th magnitude during March, very low in the eastern sky, just before dawn. It was photographed with the ESO Schmidt telescope (observers: H.-E. Schuster and Oscar Pizarro) on February 8, only 25° above the horizon. The magnitude was about 8. The image of the head of the comet was somewhat trailed during the 20 min exposure, since the exact rate of motion was not yet known at that date. A short, fan-shaped tail is visible to the lower right (southwest). 20 min, 098–04 + RG 630 (red).