Visual Light and Infrared Observations as Complementary Sources of Data on Intergalactic Dust

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Abstract

The significance of investigations of intergalactic dust in absorption, as well as of complementary observations in emission, is discussed. Infrared observations, particularly interesting for the Okroy Cloud, are cited. A program for further investigations is suggested.

1 General remarks

As is well known, intergalactic dust (IGD) is difficult to study observationally. If we leave out purely theoretical publications as well as all observational contributions which proved to contain substantial observational errors or misinterpretations of the results, and sometimes even reflect systematic side-effects instead of physical reality, then there remain about 40 papers giving observational evidence of the existence of IGD (Rudnicki 1986) — within 70 years of research, initiated by the "prehistorical" paper of Lundmark and Lindblad (1917). Those 40 papers deal mostly with the search for intergalactic continuous extinction. The effects found are very small indeed. An advantage of optical investigations of absorption attributed to IGD is that there are methods which can distinguish between interstellar (within our own Galaxy) and intergalactic extinction. This applies to Hoffmeister's (1962) method of searching for the effect, and also Kwast's (1974) Θ-method, particularly in its modified form (Zabierowski 1985), which is convenient for numerical use.

On the other hand, if IGD absorbs light, it must also emit radiation. A major difficulty is the absence of methods in the infrared domain which distinguish between IGD and radiation originating within our Galaxy. The unknown temperature of IGD clouds makes the problem even more complicated. As of today, no methods like those of Hoffmeister or Kwast have been conceived for infrared observations.

2 Preliminary results

The search for IGD, based on its emission effects, is thus rather a matter of the future, when relevant methods will have been developed. Therefore, for the time being, we have attempted to use the infrared IRAS data just as additional evidence for the existence of IGD clouds, well established otherwise. Since IGD radiation is obviously cooler than 300 K while at least some parts of it should have a temperature higher than 3 K, we assumed, to start with, a value of 30 K and looked for corresponding emission in the IRAS 100 μm survey. So far we have found a distinct maximum in infrared emission in the Okroy Cloud (Murawski 1983), centered exactly on the cloud centre as established in the original report of Okroy (1965). This maximum can

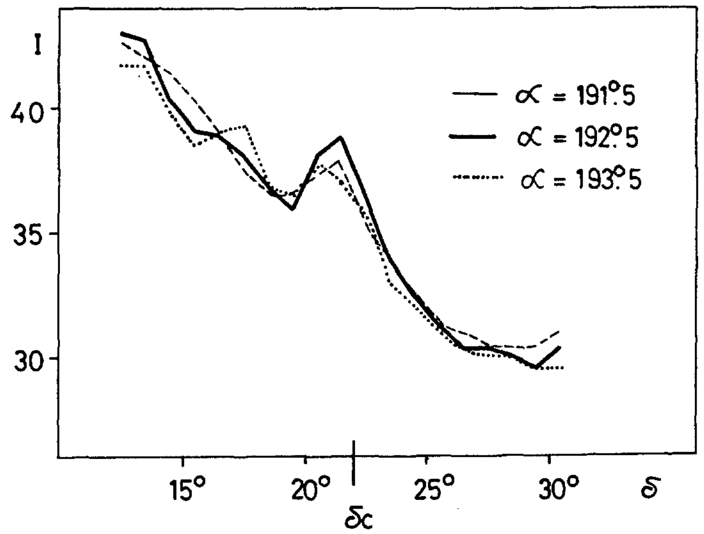

Fig. 1. Profiles of 100 μm radiation (IRAS data) in the Okroy Cloud at fixed right ascensions. δ_c denotes the cloud centre as given in Okroy's original paper. The units here as well as in the next figures are IRAS units: 7.5×10^{-15}W cm^{-2}sr$^{-1}\mu$m^{-1}.

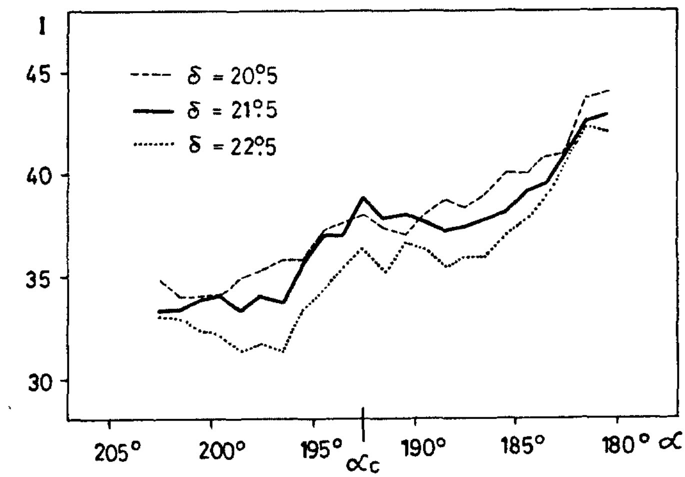

Fig. 2. As in Fig. 1, but for profiles at fixed declinations. α_c denotes the cloud centre.

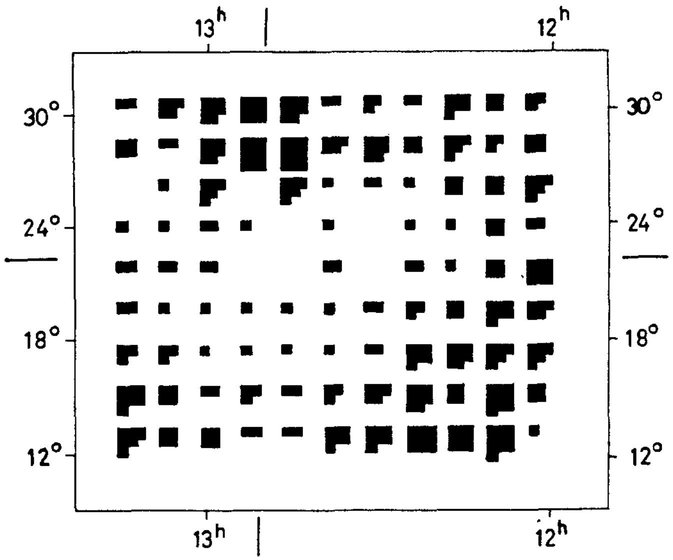

Fig. 3. Galaxy density map with proportional blackening (including all galaxies from the Zwicky Catalogue), a fragment of Okroy's original map. The centre of the cloud is indicated by lines on the margins.

be seen in the declination profiles (right ascension fixed) at three neighbouring right ascensions (*Fig. 1*); but only in one right ascension profile (declination fixed) (*Fig. 2*). This leads to the conclusion that the cloud is elongated in right ascension, which is in agreement with Okroy's original drawing (*Fig. 3*). Of interest may also be a sudden emission drop from one side of the Coma cluster, accompanied by a similarly sharp increase of galaxy density towards the centre of the Coma Cluster. The conclusion, that some outer parts of the Coma Cluster might extend further into the direction of lower declination but is concealed from sight by the overlapping cloud, is a tempting one.

A similar check for the Rudnicki-Baranowska Cloud (Kwast 1974) has not yielded any such distinct effects (*Figs. 4* and *5*).

A noticeable infrared radiation maximum has been found in the neighbourhood of the Okroy Cloud (*Figs. 6* and *7*). Whether this can be attributed to an IGD cloud, or perhaps linked to the peripheral parts of the Okroy Cloud itself, is a matter for further investigations.

3 A tentative program for further investigations

From the results obtained so far one can take the following hints for further investigations:

(1) to plot all regions of the sky with a deficit of galaxies if it is manifest in all magnitudes;

(2) to investigate those regions using Kwast's Θ-method and look for Hoffmeister's effects to distinguish the actual IGD clouds from clouds within our Galaxy as well as from voids between clusters;

(3) to look for infrared and radio emission in all regions where the existence of distinct IGD clouds has been confirmed by (2);

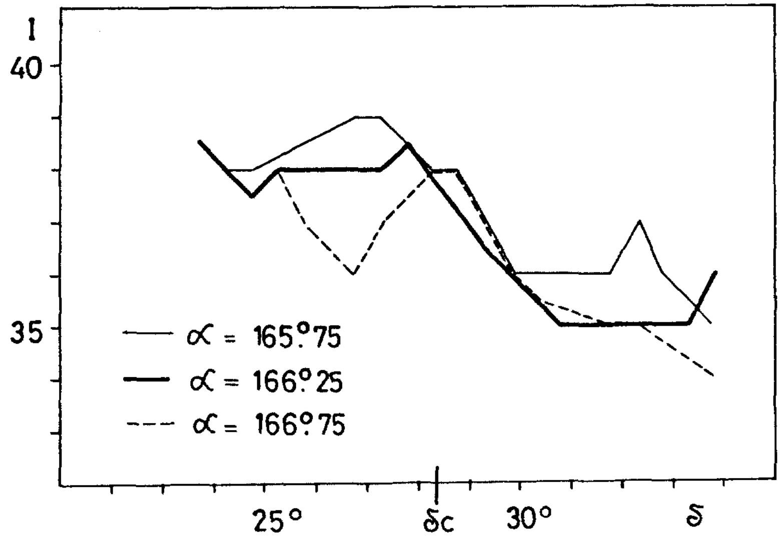

Fig. 4. Profiles of 100 μm radiation at fixed right ascensions, as in Fig. 1, for the Rudnicki-Baranowska Cloud. In the central section, a part of the profile is omitted due to the absence of data. The centre of the cloud as seen in absorption is denoted with δ_c.

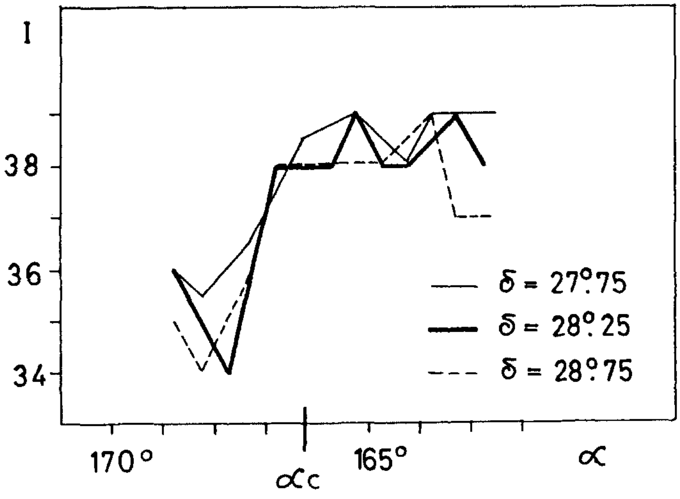

Fig. 5. As in Fig. 4, but for profiles at fixed declinations. The centre of the Rudnicki-Baranowska Cloud is denoted with α_c.

(4) to determine the infrared and radio emission spectra for all these clouds (they are probably different for different clouds);

(5) to determine the physical and chemical properties of IGD, and their possible relation to the uniformly distributed dust and gas in intergalactic space;

(6) to conceive methods of discovering IGD clouds directly by spectral analysis of their radiation;

(7) to determine the contribution of IGD radiation to the cosmic background radiation, and herewith to falsify or verify the hypothesis of Rana (1979, 1980a, 1980b) that the 3 K relic radiation is just of IGD origin.

The programme we outlined here, even the points (1) to (4) only, is very laborious indeed due to the extensive observational evidence needed, as well as to the broad range

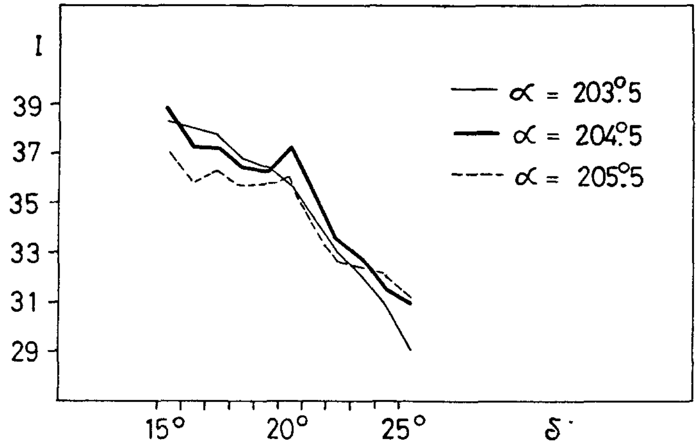

Fig. 6. A maximum of 100 μm radiation (IRAS data) near the Okroy Cloud; profiles at fixed right ascensions.

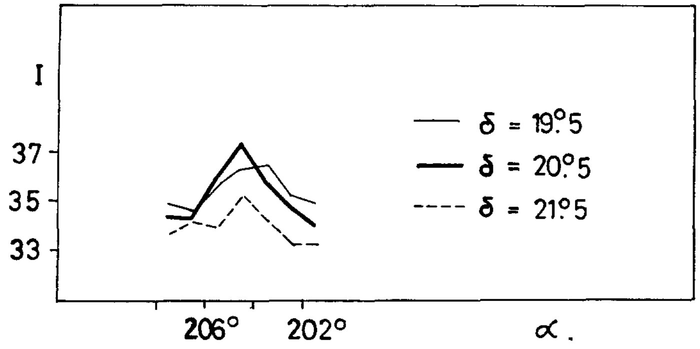

Fig. 7. As in Fig. 6, but for profiles at fixed declinations.

of methods to be applied. It can be successfully realized only through collaboration of a number of astronomical institutions.

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