We present visible and near IR images of the compact H\textsc{ii} region Sh 152. Some of these images reveal the presence of Extended Red Emission (ERE) around 698 nm and emission from Unidentified Infrared Bands (UIRBs) at 3.3 and 6.2 $\mu$m. Other images show the near infrared (7-12 $\mu$m) continuous emission of the nebula. The ERE emission is found to coincide with the ionized region and significantly differ from the UIRBs location. Also some evidence is found in favor of grains as carriers for ERE.

Key words: H\textsc{ii} regions, ERE, UIRBs

1. INTRODUCTION

Extended red emission (ERE) is a continuous emission band observed in the red part (600–800 nm) of the spectrum of various astrophysical objects like reflection nebulae (Schmidt, Cohen & Margon 1980, Witt & Boroson 1990), planetary nebulae (Furton & Witt 1992), H\textsc{ii} regions (Sivan & Perrin 1993, Darbon, Perrin & Sivan 1998), high-latitude galactic cirrus clouds (Szomoru & Guhathakurta 1998), the halo of the galaxy M82 (Perrin, Darbon & Sivan 1995), and also in the diffuse galactic interstellar medium (Gordon, Witt & Friedmann 1998). This emission can be attributed either to Hydrogenated Amorphous Carbon (HAC) grains (Watanabe, Hasegawa & Kurata 1982, Furton & Witt 1993) or silicon grains (Gordon & Furton 1998, Ledoux et al. 1998). A series of emission bands in the 3–16 $\mu$m range, the so-called UIRBs, is also observed in dusty environments and commonly attributed to Polycyclic Aromatic Molecules (PAHs) (Puget & Léger 1988, Allamandola, Tielens & Barker 1989) and/or carbonaceous materials (Papoular et al. 1989). In particular, the existence (or absence) of a spatial correlation between UIRBs and ERE might be useful to put constraints on the nature of the carriers. Compact H\textsc{ii} regions are bright and dusty objects well suited for this kind of study.

This is the reason why we have carried out an observational program for imaging compact H\textsc{ii} regions at visible and infrared wavelengths in order to detect and to map respectively ERE and UIRBs. This paper reports on the results obtained for Sh 152.

2. OBSERVATIONS AND DATA REDUCTION

Infrared images of Sh 152 were obtained with ISOCAM in June 1997, during ISO revolution 563. These include UIRBs images at 3.3 and 6.2 $\mu$m and four continuum images taken with the ISOCAM circular variable filter (CVF) at 6.911, 8.222, 10.52 and 12.00 $\mu$m. These observations and data reduction are described in Zavagno & Ducci 1998. In particular, the 3.3 and 6.2 $\mu$m images presented in this paper were corrected for the adjacent continuum emission. Visible images in the 500–850 nm range were obtained, in October 1997, with a 1024 × 1024 thinned back-illuminated Tektronix CCD camera mounted at the Newton focus of the 120 cm telescope of the Observatoire de Haute Provence. Four interference filters with a FWHM $\approx$ 10 nm centered on 528.2, 612.0, 697.5 and 812.5 nm were used. For each continuum filter, twenty-five 15 min exposure time frames were obtained and co-added, yielding a resulting image of six hours exposure time. Standard data reduction was performed using ESO-MIDAS software. It includes: dark current subtraction, flat fielding, airmass and interstellar extinction corrections, deconvolution by point spread function.
3. RESULTS AND DISCUSSION

The 3.3 µm, 6.2 µm and Hα images of Sh 152 are displayed in Figure 1. It can be seen that the 3.3 and 6.2 µm emission bands have the same spatial distribution over the entire nebula. This suggests their carriers could be the same. Also, it appears from Figure 1 that the infrared emissions arise from regions located outside the ionized regions (traced by Hα emission).

Figure 2 presents the spatial distribution of ERE superimposed on the 6.2 µm band image and the Hα image. ERE is found to coincide with the Hα emission but significantly differs from that of the 6.2 µm emission band. Hydrogen environment and UV radiation are well suited to induce luminescence from HAC grains (Furton & Witt 1993).

Figure 3 presents the spatial distribution of ERE superimposed on a 12 µm continuum image. It can be seen that the 12 µm emission extends over the area where the ERE intensity reaches its maximum. This coincidence is in favor of grains as carriers of the ERE because (i) the 12 µm emission is thought to be the short wavelength part of a strong thermal emission
from cold grains (see, for example, IR spectra of ultra compact galactic H\textsc{ii} regions presented by Roelfsema et al. 1998) and (ii) because such cold grains can exist in Sh 152 at the distance from the exciting star where the observed coincidence occurs. In effect, according to Lamy & Perrin 1997, the temperature of a dust solid particle located at a distance $10^4 \ R_\star = 2.10^2 \ AU = 10^{-3} \ pc$ from an O9.5 V star of radius $R_\star \simeq 2.10^{-2} \ AU$, would be of 200K for a silicate grain or 400K for a carbonaceous grain. The region in Sh 152 where ERE maximum and 12 $\mu$m emission coincide is in fact much farther from the star (about 0.2 pc, assuming a distance of 3.5 kpc for Sh 152 (Heydari-Malayeri & Testor 1981)) than in the calculations so that, although the exciting star of Sh 152 is slightly hotter than an O9.5V star (Hunter & Massey 1990), we can assume that cold grains do exist in the area.

Figure 4 presents the four continuum images of Sh 152 at 6.911, 8.222, 10.52 and 12.00 $\mu$m taken with ISOCAM. In these images, the flux is normalized to the maximum observed in the LW6 filter, centered at 7.7 $\mu$m. At the location of the ERE maximum, the infrared images show flux values increasing with wavelength : this is in agreement with thermal emission from cold grains (note that the 10.52 $\mu$m flux might be contaminated by the [SIV] 10.54 $\mu$m emission line).

4. CONCLUSION

Visible and infrared images of Sh 152 allowed us to compare the spatial distribution of ERE and UIRBs and to deduce basic physical properties. We found that :

- the spatial distribution of the two UIRBs at 3.3 and 6.2 $\mu$m are the same, suggesting similar properties for their carriers
- the UIRBs emission peak is located at the border of the ionized region
- the ERE emission coincides with the ionized region and significantly differs from the UIRBs location.
- the continuum emission observed between 10.5 and 12 $\mu$m is coincident with ERE emission and possibly due to cold grains, which is in favor of grains as carriers of the ERE.

Nevertheless, the exact nature of the ERE carriers will only be constrained using spectroscopic data and comparing the ERE band shape with laboratory experimental data (Darbon et al., in preparation)

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