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Optical Search For Supernova Remnants in M81 And M82

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Rationale, Aim And Method

- M82: Huang et al. 1994.

- Optical search for SNRs in M81 and M82:

* Narrow [SII] and H_α filters.

* S[II]/H_α line ratios: for SNRs > 0.4, for HII regions < 0.2.

Equipment

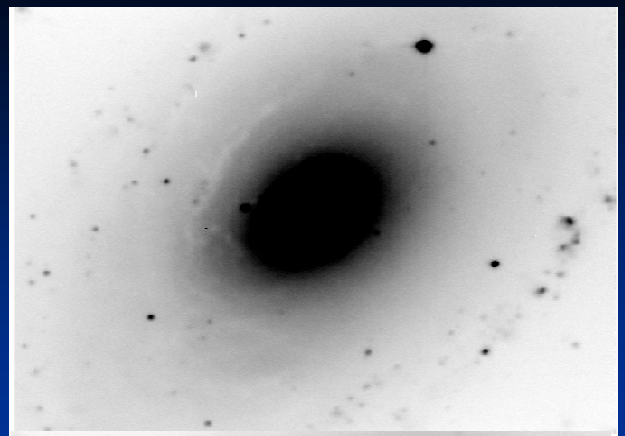
Filter name	λ_0 [Å]	FWHM [Å]	T_{max} [%]
Hα	6572	32	86.7
[SII]	6719	33	83.3
Red continuum	6416	26	58

- 2m RCC at the National Astronomical Observatory, Rozhen, Bulgaria
- Telescope: fl = 16m, fow = 1°×1° with a scale 12.89 ”/mm.
- Camera: VersArray 1300B CCD 1340×1340 px array with a plate scale of 0”.257732/px giving fow 5’45”×5’35”.

Observations

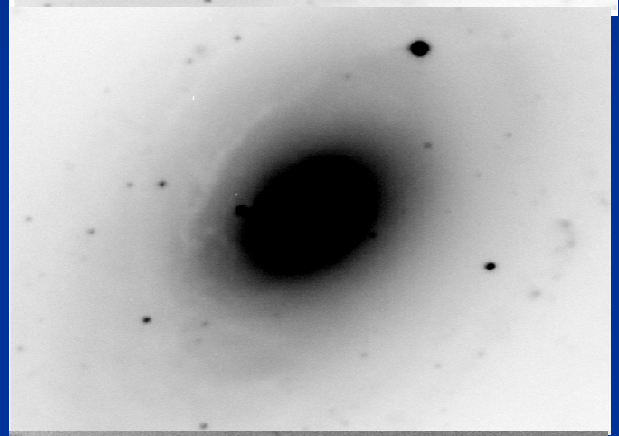
- January 2007.
- We took sets of three images through each filter of the central region of M81, with exposure time ranging from 500-1000 s.
- Typical seeing was ~ 3” (51 pc).
- Bias frame and sky flat-fields were also taken.

Results:

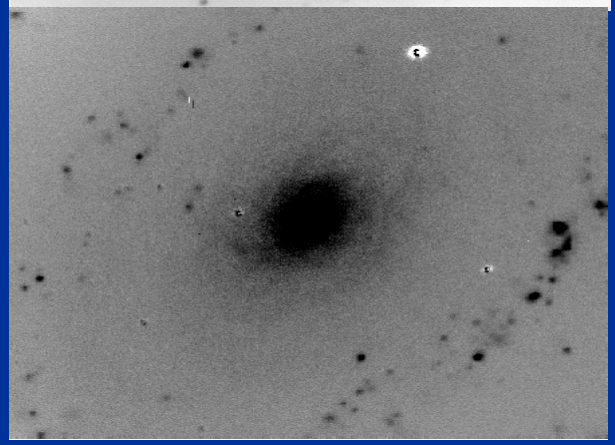


This poster:

H_α



S[II]



H_α continuum-subtracted image

Matonick & Fesen 1997:

Seeing was ~1.5”, 8/41 over 51 pc in W and S region.

Optical Search for Supernova Remnants in M81 and M82

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Overview:

M81 and M82 form a most conspicuous physical pair among the nearby galaxies (Yun et al. 1994). M82 is a starburst galaxy – it's sturburst activity is most likely a result of the encounter with M81. As a consequence of the enhanced star formation there are number of compact radio supernova remnant (SNR) candidates discovered in M82 (Huang et al. 1994) and number of optical candidates in M81 (Matonick & Fesen 1997). Our aim is to perform an optical search in the galaxies M81 and M82 with 2m RCC telescope at Rozhen Observatory, using narrow [S II] and Ha filters to confirm the SNR status of the existing objects and possibly do discover new SNR candidates, especially in the interaction regions of these galaxies. All radio remnants in M82 found so far are small and luminous, and are probably evolving in a very dense surrounding medium (Arbutina et al. 2004, Arbutina & Urošević 2005, Urošević et al. 2005) which makes them a rather special population of objects among SNRs. Finding larger remnants in M82 would be of great importance in understanding the evolution of SNRs and their environment. In the case of M81, we could see what is the provoked effect of M81-M82 encounter on this galaxy.

Observations:

The observation were done in January 2007 with 2 m Ritchey-Chrétien-Coudé telescope at the National Astronomical Observatory, Bulgaria. In the focus of the telescope, the equivalent focal length is 16 m and the field-of-view is one square degree with a scale 12.89 "/mm. The telescope is equipped with VersArray:1300B CCD camera with 1340x1300 px array, with plate scale of 0".257732/px, giving field of view 5'45"x5'35". We used the narrow-band filters for [SII], Hα and red continuum (details in Table 1). We took sets of three images through each filter of the central region of M81, with exposure time ranging from 500-1000s. Typical seeing was approx. 3". Bias frame and sky flat-fields were also taken.

Filter name	λ_0 [Å]	FWHM [Å]	T_{max} [%]
Hα	6572	32	86.7
[SII]	6719	33	83.3
Red continuum	6416	26	58

Table 1:
Characteristics of the narrow band filters

Data Reduction and Analysis:

Standard reduction procedures including bias subtraction, trimming, flat-fielding and image alignment were performed with the help of the IRAF software package. Since the images were taken with different exposures, depending on the filters, we needed to scale all the images. We did this by normalizing the flux of the stars in the field. Continuum subtracted [SII] and Hα images were also constructed.
In this analysis we use the fact that the optical spectra of SNRs have elevated [S II] / Hα emission-line ratios compared to the spectra of normal H II regions (Blair & Long 2004, Matonick & Fesen 1997). This ratio is an accurate mean of differentiating between shock-heated SNRs (ratios >0.40, but often considerably higher) and photoionized nebulae (0.40, but typically <0.2).

Preliminary results:

In Figure 1 we present only the center of the galaxy M81 as due to the bad weather we did not managed to map the whole region that would include both galaxies. We present here the center of the M81 galaxy taken with Hα filter (A) and [SII] filter (B), as well as the Hα continuum-subtracted image, where smaller details can be seen. After performing the above analysis we did not find any SNR candidates, as the seeing was bad, so we only managed to observe H II regions. We plan to perform a new search with the same telescope, as it is larger then one used in the search of Matonick & Fesen (1997).

References:

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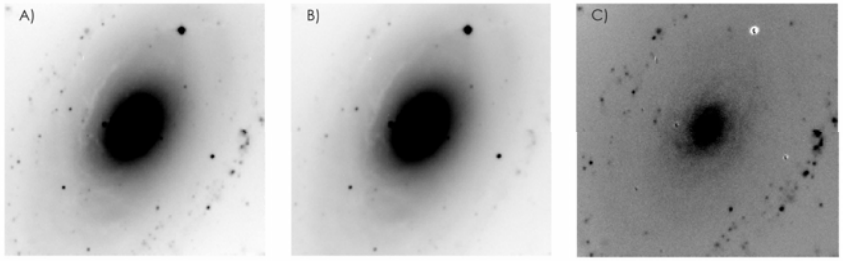
Figure 1:
A) Hα and B) [SII] images of the central region of M81 (fileld of view 5'45"x5'35"), as well as C) Hα continuum-subtracted images.