OPTICAL SEARCH FOR SUPERNOVA REMNANTS IN TWO-SPIRAL GALAXIES

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ABSTRACT

We present the results of an optical search for Supernova Remnants (SNRs) in the spiral galaxies NGC6946 and NGC628. The SNR identification technique consisted of constructing continuum-subtracted H_α and [SII] $\lambda\lambda$ 6716,6731 images and then using [SII] / H_α ratios obtained from the image. 32 emission nebulae have been detected as SNR candidates in NGC6946. 22 of them were previously identified by Matonick et al (1997). We found five SNR candidates in the spiral galaxy NGC628. We will compare and contrast the new SNR candidates and our optical data with the existing Chandra and XMM observation of the two galaxies of interest and VLA radio observation of NGC6946. Interference-filter CCD images of two spiral galaxies were taken in 2004 September with the f/7.7 1.5 m Russian-Turkish Telescope at Turkish National Observatory.

Key words: SNR;Optical Observation.

1. INTRODUCTION

Supernova remnants are important probes of the interstellar medium. Although the sample of Galactic remnants is large it is plagued by interstellar extinction and uncertain distances. These problems are much less in extragalactic samples.A number of spiral galaxies have had SNRs cataloged for them but the overall remains small (DOdorico, Dopita & Benvetui 1980, Magnier et al.1995). SNR surveys have been carried out at optical , radio and X-ray wavelengths (Pannuti at al. 2002,Blair & Long 2004).

2. SNR IDENTIFICATION TECHNIQUE

In this work, we use [SII] / H_α ratio to carry out or search for SNRs in NGC6946 and NGC628 (Mathewson & Clarke (1973a)). Basic reduction of our images was accomplished using MIDAS.The twelve exposures for H_α and [SII] and three continuum exposures of each field were combined to obtain a deeper field image and increase S/N for faintest objects. Preliminary SNR candidates were found by blinking between continuum-subtracted [SII] and H_α images. If objects were almost as bright, in [SII] as in H_α they were considered as possible SNR candidates. 32 SNR candidates for NGC6946, (22 of them were identified previously by Matonick et al.1997, hereafter MF97), and 5 SNR candidates for NGC628 were identified. (Fig1 and Fig2). These are the objects that had count rate ratio in the final analysis in excess of the [SII]/$H_\alpha > 0.45$. The list of new SNR candidates in NGC6946 and NGC628 are given in Table 1 and Table 2 respectively.

Table 1. NGC 6946 New Supernova Remnant Candidates

SNR NO	RA (J2000)	DEC (J2000)	[[SII]]/H
TUG 1	20:34:47.4	60:08:20.8	0.57
TUG 2	20:34:45.1	60:11:52.1	0.58
TUG 3	20:35:12.9	60:09:09.5	0.86
TUG 4	20:34:54.5	60:09:08.6	0.62
TUG 5	20:35:02.3	60:10:58.1	0.56
TUG 6	20:34:51.6	60:10:30.4	0.67
TUG 7	20:35:13.0	60:08:58.7	0.95
TUG 8	20:34:24.2	60:07:22.3	0.83
TUG 9	20:34:52.9	60:05:30.4	0.60
TUG 10	20:34:46.9	60:07:29.7	0.67

3. COMPARISON OF MULTIWAVELENGHT OBSERVATIONS

NGC6946 was observed by the ACIS instrument on board Chandra X - Ray Observatory (Holt et al., 2003). The authors detect 72 point sources with luminosities

Table 2. NGC 628 Supernova Remnant Candidates

SNR NO	RA (J2000)	DEC (J2000)	[[SII]]/H
1	1:36:39.8	15:49:07.3	0.88
2	1:36:39.3	15:45:49.6	0.92
3	1:36:47.0	15:45:13.2	0.92
4	1:36:45.5	15:43:06.2	0.73
5	1:36:49.1	15:43:34.2	0.95

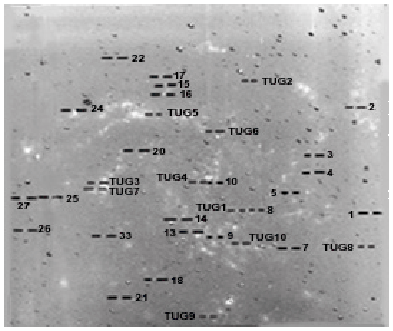

Figure 1. [SII]-continuum image of NGC6946 with SNRs

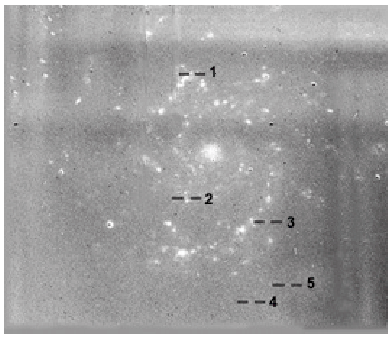

Figure 2. [SII]-continuum image of NGC628 with SNRs

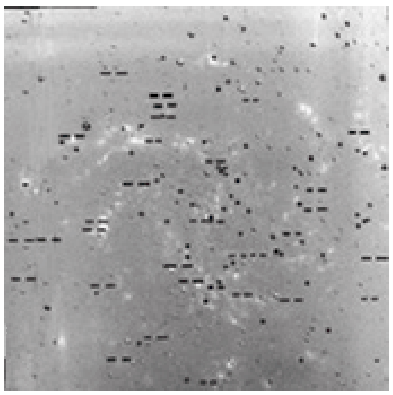

Figure 3. H_α image of NGC6946 with Chandra X-ray point sources. Dashed lines indicate SNR candidates and filled circles indicate X-ray sources

greater than 7 x 10^{36} (d5.9 Mpc)^2 ergs^{-1}. We have taken these 72 X - ray sources and projected onto continuum subtracted H_α image of NGC6946. It is shown in Figure3. We have not found any positional coincidence with the X-ray point sources within 2" errors radius of our SNR candidates except for the one previously identified by MF97. NGC6946 was also observed with the Very Large Array (Lacey et al., 1997). The authors detect 118 radio sources. 37 of the candidate sources have been identified as possible SNR or background object. Except one previously identified by MF97 any positional coincidence have not been recovered within 5" error radius between optically identified SNRs and radio sources defined as possible SNRs. NGC628 was observed by XMM - Newton in January 2003. Soria et al. (2004) detect 77 point sources with luminosities 2 x 10^{37} ergs^{-1}. There is no match with five optically identified possible SNR candidates in NGC628. Six historical supernovae have been detected in NGC6946. Only five of these were in the field of our NGC6946 image. We were able to identify optical counterpart for only one (SN1917A) of the five historical supernovae that have occurred in NGC6946. SN 1917A has positional coincidence with one of our SNR (TUG10) candidates. NGC628 was observed by XMM - Newton (Soria et al., 2004). There is no match with five optically identified possible SNR candidates in NGC628.

4. CONCLUSION

We have performed an optical search for SNRs in two spiral galaxies. The technique consist of imaging the galaxies using narrow H_α and [SII] filters and find emission nebulae with [SII]/ $H_\alpha > 0.45$ to identify SNRs. We have detected 10 new SNR candidates in NGC 6946 and 5 other new ones in NGC628. We also have scheduled observations at TUG to obtain spectra of some of the reference stars in the fields in order to calibrate the flux ratio of the H_α and [SII] emission lines; the work is in progress.

REFERENCES

Blair, W. P. & Long,K. S.2004, 155,101 - 121

D'Odorico, et al., 1980, A&AS 40, 67D

Holt,S.S., et al., 2003, ApJ, 588, 762

Lacey, C, Duric, N., & Gross, W.M, 1997, ApJS, 109,417

Magnier, E., et al., 1995, A&AS, 114, 215 - 245

Mathewson, D. S. & Clarke,J.N., 1973,ApJ, 180, 725

Matonick D.M., et al., 1997, ApJS, 113, 333

Pannuti,T.G., et al., 2000,ApJ, 565,966

Soria,R. et al., 2004, A&A 413,107