

Synthesis Surveys of Southern Supernova Remnants*

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Abstract

A report is presented detailing observations of supernova remnants (SNRs) with the Fleurs and Molonglo synthesis radio telescopes. Fifty-four remnants have been mapped with at least one of these instruments, eleven with both. Approximately half of the maps have been published and a key to these publications is given.

1. Introduction

Southern Hemisphere astronomers are fortunate in being able to see a richly populated part of the Milky Way containing many of the larger-angular-size SNRs (10' to 50' arc diameter). This has been the driving force for a small group from the CSIRO Division of Radiophysics, which for the past nine years has been mapping galactic SNRs with the two synthesis arrays of the University of Sydney—the Fleurs synthesis telescope (FST) and the Molonglo Observatory Synthesis Telescope (MOST).

2. The Instruments

At the commencement of these observations the 1415 MHz FST consisted of sixty-four 5.8-m dishes arranged in a cross with four 13.7-m dishes at the extremities (Christiansen 1973). A near-circular beam of 48" arc was obtained over a 1° field. In recent years two additional 13.7-m dishes were added and the six large dishes correlated with each other and with the small dishes of the east-west arm (only) to give 23" arc resolution (Bunton *et al.* 1985).

The MOST is a cylindrical parabolic reflector tiltable north-south and steered east-west by phasing the array of feeds that illuminate the reflector (Mills 1981). The MOST operates at 843 MHz and is capable of mapping a 70' arc field in a 12-hr synthesis, with a resolution of 43" arc (E-W) by 43" arc cosec declination (N-S).

At Radiophysics we have developed tasks within an astronomical image processing system (AIPS) to process these maps, including adding 843 MHz maps made with the Parkes 64-m telescope to the MOST maps to provide the baselines missing owing to a 43-wavelength gap between the eastern and western halves of the array (Roger *et al.* 1984).

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Table 1. FST and MOST galactic SNR observations

Remnant	Reference*		Remnant	Reference*	
	FST	MOST		FST	MOST
G005.4-01.2 Milne 56		9	G322.5+00.1 Circinus X-1		10
G007.7-03.7 PKS 1814-24		17	G326.3-01.8 MSH 15-56	14	16
G011.2-00.3		†	G327.3+00.5 Kes 27		16
G011.4-00.1		†	G327.6+14.6 SN 1006	7	21
G012.0-00.1		†	G328.4+00.2 MSH 15-57	2	
G015.9+00.2	4		G330.2+01.0	6	6
G027.4+00.0	4		G332.0+00.2		†
G033.7+00.1	3		G332.4-00.4 RCW 103	2	†
G039.2-00.3	4		G332.4+00.1 Kes 32		19
G041.1-00.3	4		G336.7+00.5		16
G260.4-03.4 Puppis A	15	†	G337.0-00.1 CTB 33 (PART)		†
G261.9+05.5 MSH 09-36		18	G337.2-00.7		†
G284.3-01.8 MSH 10-53		†	G337.3+01.0 Kes 40		16
G290.1+00.8 Kes 13 11-61		†	G337.8-00.1 Kes 41		†
G291.0-00.1 MSH 11-62		20	G340.4+00.4	5	
G292.0+01.8 MSH 11-54	12, 16	1	G340.6+00.3	5	
G296.5+10.0 PKS 1209-52		16, 21	G341.9-00.3	5	
G298.5-00.3		†	G342.0-00.2	5	
G298.6+00.1		†	G348.5+00.1 CTB 37A	11	†
G308.7+00.0	3		G348.7+00.3 CTB 37B	11	†
G304.6+00.1	†		G351.3+00.2		8
G309.2-00.7	3		G352.7-00.1	5	
G309.8+00.0	2	†	G355.9-02.5		8
G311.5-00.3	†		G357.7-00.1 MSH 17-39	2	
G315.4-00.3	3	†			
G315.4-02.3 MSH 14-63		16			
G315.9-00.0		11			
G316.3+00.0 MSH 14-57		16			
G320.4-01.2 MSH 15-52	3	13			
G322.3-01.2 Kes 24	2	†			

* References: 1, Braun *et al.* (1986); 2, Caswell *et al.* (1980); 3, Caswell *et al.* (1981); 4, Caswell *et al.* (1982); 5, Caswell *et al.* (1983a); 6, Caswell *et al.* (1983b); 7, Caswell *et al.* (1983c); 8, Caswell *et al.* (1983d); 9, Caswell *et al.* (1987); 10, Haynes *et al.* (1986); 11, Kesteven *et al.* (1987; present issue p. 855); 12, Lockhart *et al.* (1977); 13, Manchester and Durdin (1983); 14, Milne *et al.* (1979); 15, Milne *et al.* (1983); 16, Milne *et al.* (1985); 17, Milne *et al.* (1986); 18, Roger *et al.* (1984); 19, Roger *et al.* (1985); 20, Roger *et al.* (1986); 21, Roger *et al.* (1987).

† Observations not yet published.

3. Observations

The bulk of the maps has now been published in a series of 21 papers. The full list of observations with references to the published material is given in Table 1 and a sample map is shown in Fig. 1. In this figure we show the SNR G296.5+10.0 [PKS 1209-51/52 (Milne 23)]. This map is the result of merging five 70' arc MOST fields and adding the short spacings from Parkes 843 MHz observations. This field is described in detail by Roger *et al.* (1987). For a more complete summary of the FST and MOST observations of galactic SNRs the reader is referred to Milne *et al.* (1985).

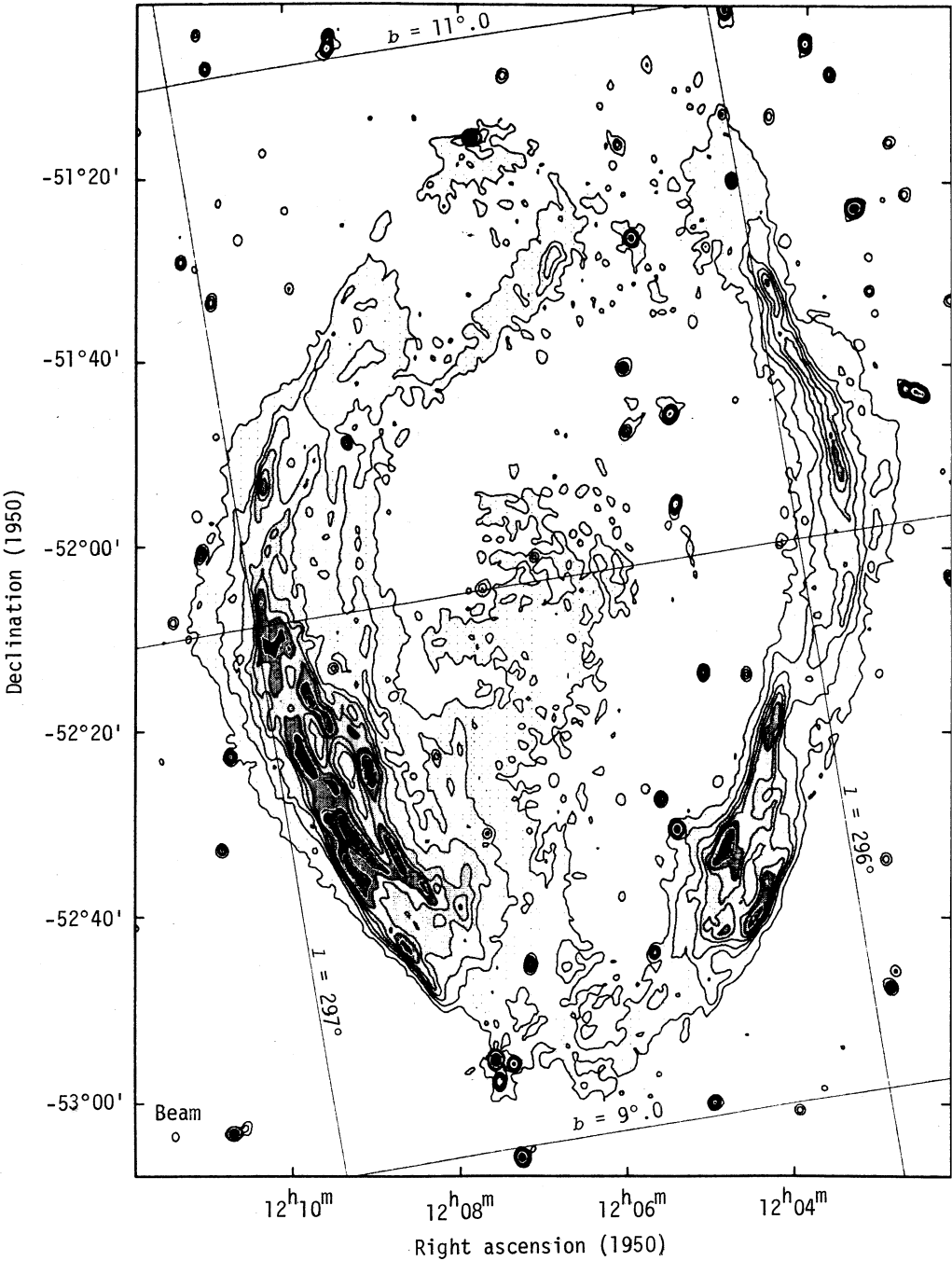


Fig. 1. Supernova remnant G296.5 + 10.0 mapped by merging five overlapping 843 MHz fields and adding the low-order spacings from the Parkes 64-m telescope (Roger *et al.* 1987).

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References

- Braun, R., Goss, W. M., Caswell, J. L., and Roger, R. S. (1986). *Astron. Astrophys.* **162**, 259.
- Bunton, J. D., Jones, I. G., and Brown, D. R. (1985). *Proc. Astron. Soc. Aust.* **6**, 93.
- Caswell, J. L., Haynes, R. F., Milne, D. K., and Wellington, K. J. (1980). *Mon. Not. R. Astron. Soc.* **190**, 881.
- Caswell, J. L., Milne, D. K., and Wellington, K. J. (1981). *Mon. Not. R. Astron. Soc.* **195**, 89.
- Caswell, J. L., Milne, D. K., and Wellington, K. J. (1982). *Mon. Not. R. Astron. Soc.* **200**, 1143.
- Caswell, J. L., Haynes, R. F., Milne, D. K., and Wellington, K. J. (1983*a*). *Mon. Not. R. Astron. Soc.* **203**, 595.
- Caswell, J. L., Haynes, R. F., Milne, D. K., and Wellington, K. J. (1983*b*). *Mon. Not. R. Astron. Soc.* **204**, 915.
- Caswell, J. L., Haynes, R. F., Milne, D. K., and Wellington, K. J. (1983*c*). *Mon. Not. R. Astron. Soc.* **204**, 921.
- Caswell, J. L., Haynes, R. F., Milne, D. K., Wellington, K. J., and Smith, R. M. (1983*d*). *Proc. Astron. Soc. Aust.* **5**, 227.
- Caswell, J. L., Kesteven, M. J., Komesaroff, M. M., Haynes, R. F., Milne, D. K., Stewart, R. T., and Wilson, S. G. (1987). *Mon. Not. R. Astron. Soc.* **225**, 329.
- Christiansen, W. N. (1973). *Proc. Inst. Radio Electron. Eng. Aust.* **34**, 302.
- Haynes, R. F., Komesaroff, M. M., Little, A. G., Jauncey, D. L., Caswell, J. L., Milne, D. K., Kesteven, M. J., Wellington, K. J., and Preston, R. A. (1986). *Nature* **324**, 233.
- Kesteven, M. J., Caswell, J. L., Roger, R. S., Milne, D. K., Haynes, R. F., and Wellington, K. J. (1987). *Aust. J. Phys.* **40**, 855.
- Lockhart, I. A., Goss, W. M., Caswell, J. L., and McAdam, W. B. (1977). *Mon. Not. R. Astron. Soc.* **179**, 147.
- Manchester, R. N., and Durdin, J. (1983). In 'Supernova Remnants and Their X-ray Emission' (Proc. IAU Symp. No. 101) (Eds J. Danziger and P. Gorenstein), p. 421 (Reidel: Dordrecht).
- Mills, B. Y. (1981). *Proc. Astron. Soc. Aust.* **4**, 156.
- Milne, D. K., Goss, W. M., Haynes, R. F., Wellington, K. J., and Skellern, D. J. (1979). *Mon. Not. R. Astron. Soc.* **188**, 437.
- Milne, D. K., Goss, W. M., and Danziger, I. J. (1983). *Mon. Not. R. Astron. Soc.* **204**, 237.
- Milne, D. K., Caswell, J. L., Haynes, R. F., Kesteven, M. J., Wellington, K. J., Roger, R. S., and Bunton, J. D. (1985). *Proc. Astron. Soc. Aust.* **6**, 78.
- Milne, D. K., Roger, R. S., Kesteven, M. J., Haynes, R. F., Wellington, K. J., and Stewart, R. T. (1986). *Mon. Not. R. Astron. Soc.* **223**, 487.
- Roger, R. S., Milne, D. K., Wellington, K. J., Haynes, R. F., and Kesteven, M. J. (1984). *Proc. Astron. Soc. Aust.* **5**, 560.
- Roger, R. S., Milne, D. K., Kesteven, M. J., Haynes, R. F., and Wellington, K. J. (1985). *Nature* **316**, 44.
- Roger, R. S., Milne, D. K., Caswell, J. L., and Little, A. G. (1986). *Mon. Not. R. Astron. Soc.* **219**, 815.
- Roger, R. S., Milne, D. K., Kesteven, M. J., Haynes, R. F., and Wellington, K. J. (1987). Symmetry of the radio emission from two high-latitude supernova remnants G296.5+10.0 and G327.6+14.6 (SN1006). *Astrophys. J.* (in press).