A Massive Star Odyssey, from Main Sequence to Supernova
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Radio continuum observations of massive stars in open cluster NGC 6231 and the Sco OB1 association

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Abstract. We present results of the Australia Telescope Compact Array (ATCA) radio continuum observations of massive stars in the Sco OB1 association. Most stars detected in the program show spectral indices lower than value expected from thermal free-free emission.

1. Introduction

The Sco OB1 association, with the very young open cluster NGC 6231 as its nucleus, stands out among OB associations because of its wealth of hot luminous stars. Therefore, at a relatively nearby distance of about 1.8 kpc, this region is ideal for studying the properties of the stellar winds from OB and Wolf-Rayet stars.

Radio observations of Wolf-Rayet and OB-type massive stars provide one of the key ways of studying their dense, ionized supersonic winds. The strong winds from such stars produce extended radio photospheres at mm and cm wavelengths, which result from optically-thick thermal free-free emission. At these wavebands, the thermal emission of continuous, spherically-symmetric winds are expected to have a spectral index of $\alpha \simeq 0.6$ (Wright & Barlow 1975). In addition to the thermal emission, a significant fraction of early type stars show a non-thermal component. The origin of this is likely to be related to shock, either from colliding winds in a binary system (Eichler & Usov 1993), or from chaotic winds of a single star (White 1985).

2. Observation and results

The six telescopes of the ATCA observed the Sco OB1 association at 3, 6, 13 and 21cm radio continuum wavebands (centred at 1384, 2496, 4800, 8640 MHz,

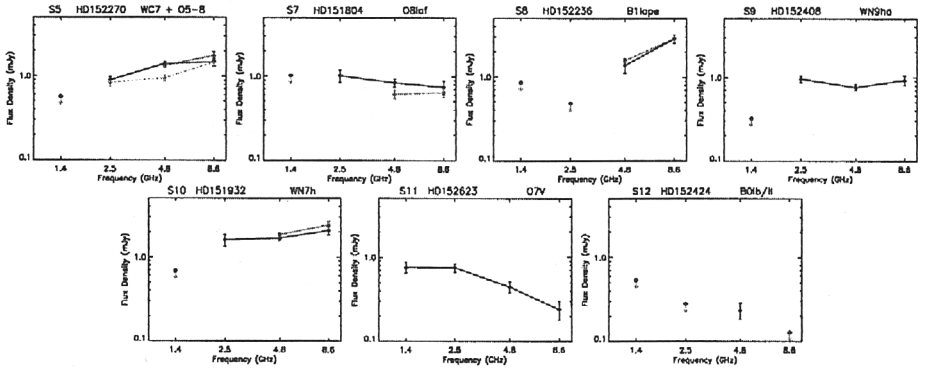

Figure 1. Flux-density of detected WR and OB stars.

Table 1. Radio spectral indices of WR and OB stars.

no.	source	sp. type	α_{3-6cm}	α_{6-13cm}	$\alpha_{13-20cm}$	obs. date
5	HD 152270	WC7 + O5-8	0.41±0.08	–	–	March 2000
			0.07±0.08	0.77±0.06	–	October 2000
			0.65±0.09	0.21±0.08	–	July 2001
7	HD 151804	O8 Iaf	0.06±0.11	–	–	March 2000
			–0.18±0.14	–0.33±0.12	–	October 2000
8	HD 152236	B1 Iape	0.94±0.08	–	–	March 2000
			1.13±0.15	–	–	October 2000
9	HD 152408	WN9ha	0.31±0.10	–0.40±0.07	–	November 2000
10	HD 151932	WN7h	0.41±0.08	–	-	March 2000
			0.31±0.09	–0.09±0.10	–	November 2000
11	HD 152623	O7 V	–0.94±0.20	–0.89±0.12	0.02±0.11	November 2000

respectively), during the period of 2000 March (3 and 6cm only), October and November, and 2001 July. The observations, centred on 12 program stars in the association, were phase-referenced to 1740–517, while the flux density level was calibrated to 1934–638.

The data reduction was carried out using standard reduction procedure in the MIRIAD package. The images were subsequently CLEAN-ed from the effect of strong, extended extragalactic sources present in the field.

Seven out of 12 massive stars of Wolf-Rayet and OB type were detected at one or more wavelengths. Five of the six stars detected at two wavelengths or more show spectral indices that are lower than expected from thermal free-free emission.

References

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