COSMIC RAYS FROM REGIONS OF STAR FORMATION
II. The OB associations

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Supersonic stellar winds have recently been proposed as active agents of cosmic-ray acceleration (Cassé and Paul, 1980). We try to insert this potential acceleration mechanism in its general astrophysical context. Among galactic objects, OB associations have the narrowest latitude distribution, resembling to that of gamma-ray sources. Here we focus on the bulk rate of kinetic energy deposition in molecular clouds through stellar winds of individual stars pertaining to OB associations. Assuming that a minute fraction of this mechanical energy can be transferred to suprathermal particles (Montmerle et al., 1980), we examine whether OB associations are detectable high-energy gamma-ray sources, owing to the interaction of accelerated particles with the dense molecular cloud still present close to young and massive stars. The 3 factors that govern the gamma-ray "visibility" of a given OB association are i) the rate of kinetic energy deposition $\dot{E} = \Sigma\, 1/2\, \dot{M}_i V_i^2$, where the summation is done on all mass-losing stars ; $\dot{M}_i$ is the mass-loss rate for the star i and V_i is the terminal velocity of its stellar wind;(ii) the distance of the OB association;(iii) the angular extent of the association.

We have examined the relative detectability of the 72 OB associations listed by Humphreys (1978), supplemented by newly discovered associations. Wolf-Rayet stars in OB associations (Van der Hucht et al., 1980) have been included. Since the wind parameters are only measured in a limited number of cases, we used empirical laws derived from recently published bolometric corrections, mass-loss rates and terminal velocities (Montmerle et al., this conference). Table 1 presents the expected gamma-ray surface brightness for the 10 brightest OB associations, normalized to that of the Carina complex (excluding ηCar and ηCar-like objects, and the contribution of SNRs when existing). It can be seen that Wolf-Rayet stars bring a dominant contribution to the mechanical energy injected.

The expected gamma-ray flux from only a few associations (e.g. Cyg OB2, Sco OB1) is comparable to that of the Carina complex possibly associated with the COS-B source at $\ell = 288.5°$, $b = -0.5°$ (Montmerle et al., 1980). Most of the remaining OB associations must be undetectable as individual gamma-ray sources by the COS-B satellite, but they must contribute significantly to the diffuse galactic background. The large scale correlation between galactic gamma

G. Setti, G. Spada, and A. W. Wolfendale (eds.), Origin of Cosmic Rays, 323–324.

radiation and Lyman continuum photons (Pinkau, 1979) is naturally explained here, as well as the dominance of the spiral structure on the galactic gamma-ray emission (Caraveo and Paul, 1979).

Table 1

Rank	Association	number of WN7, WN8 stars (a)	number of other WR stars (b)	number of stars	gamma-ray surface brightness
1	Cyg OB2	0/1	0/2	3	0.45/1.71
2	Cr 121	0	0/1	0	0/1.34 (c)
3	Sco OB1	1	1	3	1.13
4	Carina	3	0	1	1.00
5	H.M. (d)	2	0	2	0.76
6	Cyg OB1	0	4/5	3	< 0.74
7	Sct OB2	0	1	2	< 0.39
8	Sct OB3	0	0	0	< 0.14
9	Cyg OB9	0	0	0	< 0.14
10	Cyg OB3	0	1	1	< 0.13

(a) $\dot{M} = 10^{-4} M_\odot \ yr^{-1}$
(b) $\dot{M} = 3\ 10^{-5} M_\odot \ yr^{-1}$
(c) WR star probably foreground (Moffat and Seggewiss, 1979)
(d) Havlen and Moffat (1977)

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