Soft X-ray Background and Flare Stars

VARIOUS populations[1–3] of *ad hoc* stellar objects have been proposed to explain the soft X-ray background, in particular the component observed from the galactic plane.

In this communication, we point out that flare stars are not unlikely sources for the low latitude component, and might also contribute in an essential way to the high latitude component. Unfortunately, estimates of their soft X-ray emission are uncertain.

According to Bunner *et al.*[4], the source strength in the galactic plane is $S_x \simeq 4 \times 10^{-16}$ eV s^{-1} H^{-1} at 0.26 keV. For a hydrogen density $n_H \simeq 1$ cm^{-3}, and adopting a discrete source interpretation, we obtain

$$S_x = \langle L_x \rangle n = 6.4 \times 10^{-28} \text{ erg s}^{-1} \text{ cm}^{-3}$$

where $\langle L_x \rangle$ is the time averaged soft X-ray luminosity, and n the spatial density of the sources. It is difficult to find reliable estimates of n. Seven flare stars of type dMe are observed within 10 pc and this gives $n \gtrsim 2.3 \times 10^{-58}$ cm^{-3}; consequently, $\langle L_x \rangle \simeq 2.4 \times 10^{30}$ erg s^{-1}. Other estimates[5] give a spatial density as much as twenty times higher (0.3 pc^{-3}), corresponding to $\langle L_x \rangle \simeq 1.2 \times 10^{29}$ erg s^{-1}.

Early computations by Gurzadyan[6] gave a rather high value for soft X-ray emission from M-type flare stars, even for a comparatively low efficiency parameter $\alpha \simeq 10^{-2}$. According to him, the peak luminosity might be $L_{xm} \simeq 10^{32}$ erg s^{-1}, which seems to suggest that the time averaging factor χ (flare duration divided by flare frequency) might range from 10^{-2} to 10^{-3} (for example, a 10 min flare every 16 to 160 h, which compares well with the value $\chi \simeq 1/30$, an early estimate of the radio flare frequency from flare stars[7]).

The soft X-ray luminosity of the whole galaxy might then range from 10^{39} to 10^{40} erg s^{-1}, an estimate which does not conflict with the total optical emission ($L_O \simeq 4 \times 10^{43}$ erg s^{-1}). Some idea of the behaviour of flux with galactic latitude can be obtained by considering that the dM stars belong to a disk population, with density $n = n_0\ e^{-z/\beta}$, where z is the distance from the plane and the scale height $\beta \simeq 350$ pc (ref. 8). The soft X-ray absorption is determined by the neutral hydrogen distribution $n_H(z)$. We have taken $n_H = n_{HO}\ e^{-z/d}$ with various values of n_{HO} and d and typical results are shown in Fig. 1; curve b, which refers to $n_{HO} = 1$ cm^{-3} and $d = 75$ pc, shows a maximum at about 60°.

Experiments are not conclusive about this point: Hayakawa *et al.*[9] observe a ratio of 2.3 between the flux at $b^{II} = 50°$ and $b^{II} = 0°$. According to our model, however, most strong sources in the galactic plane should be very variable, and could disappear entirely between experiments.

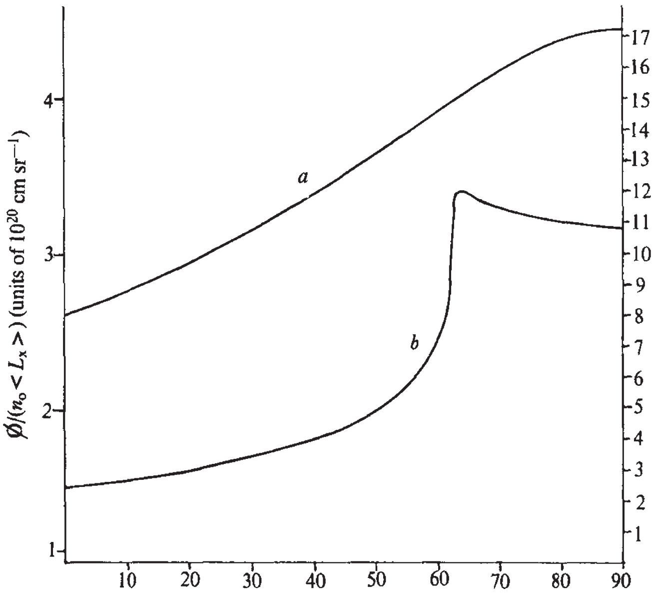

Fig. 1 Normalized soft X-ray flux $\varphi(n_0\langle L_x \rangle)$ against galactic latitude. *a*, Left hand ordinate scale, $n_{HO} = 1$ cm^{-3}, $d = 100$ pc; *b*, right hand ordinate scale, $n_{HO} = 1$ cm^{-3}, $d = 75$ pc.

A strong source was observed by Palmieri *et al.*[10], and was attributed to β Cen (r.a. = 14 h 01 m 7 s; δ = −60° 13′), a strong source of ultraviolet radiation which could be revealed by their detector. It is interesting to note that the flare star Proxima Centauri is very close to that position (r.a. = 14 h 23 m; δ = −62° 15′), and might also be responsible for the effect.

A more extensive analysis taking into account different experiments, the detailed HI distribution, and the expected statistical fluctuations is being undertaken.

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Raman Scattering Cross Sections

RAMAN scattering of light from molecules has long been interesting as a source of information about molecular structure and as a versatile technique for chemical analyses. The advent of the laser, however, has broadened the usefulness of this method for the quantitative measurement of density (ref. 1, for example) and temperature (ref. 2, for example) and there is now considerable activity in both the basic and applied aspects of this field.

Values for Raman scattering cross sections are of fundamental interest because they are related to molecular polarizability derivatives, and so contribute to a basic understanding of molecular properties. Furthermore, as the cross sections

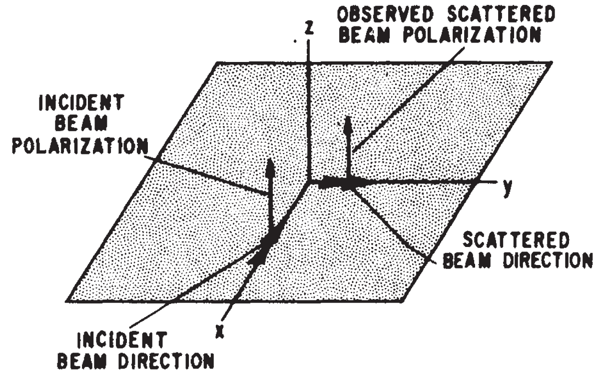

Fig. 1 Schematic of Raman scattering geometry corresponding to the definition of the cross section σ_{zz}. This cross section corresponds to linearly polarized incident radiation and to scattering for which only the light polarized in the same direction as the incident radiation is observed.