THE MAGELLANIC STREAM AS A PROBE OF THE GALACTIC HALO

R. J. Cohen, R. D. Davies and I. F. Mirabel*
University of Manchester, Nuffield Radio Astronomy Laboratories, Jodrell Bank, Macclesfield, Cheshire SK11 9DL England

Recent observations of the Magellanic Stream can be used to set limits on a possible hot halo surrounding the Galaxy. The observations are described in detail elsewhere (Mirabel, Cohen & Davies, submitted to Mon.Not.R.astr.Soc.). Briefly, the neutral hydrogen in the northern end of the Magellanic Stream is concentrated in narrow filaments which contain small elongated clouds of typical size $0.^{\circ}4 \times 0.^{\circ}6$. These clouds have a large velocity halfpower width (25 km s^{-1}) and are gravitationally unstable, unless there is a massive low luminosity stellar component. If we consider only the observed gas the expansion age of a typical cloud is 6×10^5 D years, where D is the distance in kpc from the Sun, and this falls at least a factor of ten short of the age of the Stream predicted by current models. This strongly suggests that some containment mechanism is operating.

We have considered the possibility that containment is provided by a hot gas. A gas pressure of $nT \sim 2 \times 10^4\ D^{-1}$ K cm^{-3} is required, where n is the halo density and T the temperature. For the halo to support itself against the gravitational field of the Galaxy a temperature of $\sim 10^6$K is necessary, so for a distance D = 50 kpc a halo density of $n \sim 4 \times 10^{-4}$ cm^{-3} would be required to contain the clouds. If the Magellanic Stream were moving through such a halo at a relative velocity of ~ 100 km s^{-1} then ram pressure effects should lead to momentum transfer, and hence produce differential motion between the dense and the faint parts of the Stream. However no such differential motion has been observed in any of the regions surveyed, suggesting a very low drag on the Stream. Our observations set a limit of a few percent on the efficiency of momentum transfer in the case of the halo just mentioned ($T \sim 10^6$K, $n \sim 4 \times 10^{-4}$ cm^{-3}). Alternatively the containment could come from a very hot intergalactic medium ($T \sim 10^8$K, $n \sim 4 \times 10^{-6}$ cm^{-3}), but in this case a small magnetic field would also be necessary to prevent this very hot gas from entering the clouds and evaporating them.

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