UPPER LIMITS TO THE MAGNETISM OF THE SHELL
AROUND THE BOOTES VOID

J. P. VALLÉE

Radio Astronomy Section, Herzberg Institute of Astrophysics, National Research Council of Canada,
Ottawa, Ontario, Canada

and

Groupe d'Astrophysique à l'Observatoire, Université J. Fourier, Grenoble, France

(Received 14 May, 1990)

Abstract. A substantial decrease of galaxies toward l = 80°, b = +60°, with a mean radial velocity of
15 500 km s⁻¹, has earlier been nicknamed the 'Bootes Void', around which a shell of galaxies is seen.

Some theories predict strongly magnetised shells of thermal gas, whose Faraday Rotation Measure (RM)
should be detectable as an excess over the larger scale background to the left or to the right.

An attempt is made here to detect an excess Faraday RM within the shell at the edge of the Bootes Void.
Only a 2-σ upper limit to the RM, of at most 10 rad m⁻², is obtained. In turn, this limits the shell magnetic
field to less than 0.1 microgauss (ordered component only).

1. Introduction

Observationally, what is detected when observing a distant quasar is the position angle (PA) in the sky at which the polarised radio emission is maximum at a certain wavelength. A plot of PA versus the square of the wavelength is a line whose slope is the rotation measure (RM). The RM (rad m⁻²) is thus directly deduced from observations, and it is

\[ \text{RM} = 0.81B_{11} nL \text{ rad m}^{-2}, \]

where the line-of-sight magnetic field \( B_{11} \) is in microgauss, the thermal electron density is \( n \) (cm⁻³), and \( L \) (pc) is the coherence length of the field along the line-of-sight. The Hubble constant is taken as \( H_0 = 50 \text{ km s}^{-1} \text{ Mpc}^{-1} \) (\( h_{50} = 1 \)) throughout.

The technique of measuring RM over various sky areas has already been applied in the field of interstellar magnetic bubbles (Vallée and Bignell, 1983; Broten et al., 1985). The RM will show a characteristic double-bell shape when one goes across the line-of-sight through the center of the bubble. Typical values of 25 rad m⁻² are readily detected (e.g., the Monogem ring, Vallée et al., 1984) over the background RM found to the left and to the right of the bubble.

To date, an excess RM has been found in three superclusters of galaxies or in galaxy clusters: in Abell 2319 (Vallée et al., 1986, 1987), in Coma (Kronberg, 1987; Kim et al., 1989), and in Virgo (Vallée, 1990). Several voids have been identified by galaxy counts, and one of the largest is the Bootes Void (e.g., Tift et al., 1986, their Figure 9(c)). The Bootes Void is centered near \( l = 80° \) and \( b = +60° \) (RA 50 = 14h48m and Dec 50 = +47°) with a diameter of nearly 23°, and is located off the plane of the Constellation Bootes in the northern sky.
Galaxy in an ideal place for RM testing. The void’s redshift of 0.0517 (Weistrop, 1989) gives a distance of 310 Mpc and its diameter is 120 Mpc for $h_{50} = 1$.

An attempt is made in Section 2 to detect such an excess RM in the shell around the Bootes Void, and the resulting lack of magnetism is discussed in Section 3.

2. The Bootes Void

Figure 1 shows all quasars seen behind and to the side of the Bootes Void as listed in the most recent all-sky RM catalogue of Broten et al. (1988). These objects are located between RA of $13^h30^m$ and $17^h10^m$, and Dec. of $+25^\circ$ and $+75^\circ$. In Figure 1 the center of the Bootes Void is at the center of the concentric rings, and the Bootes shell is shown as a circle with a radius of 11.3°. Other concentric circles are drawn in order to facilitate the statistical study of circular rings in and around the Bootes Void.

![Fig. 1. Map of the sky toward the Bootes Void, showing the observed rotation measure values of objects seen behind the void (first 2 concentric rings) and to the side of it (last 2 concentric rings).](image)

As can be seen in Figure 1, all 23 quasars except one in or near the Bootes Void have a small positive or negative RM value not exceeding 45 rad m$^{-2}$. The exception is the quasar 1409 + 5226 (with a value of 2250 rad m$^{-2}$) which is well known for its steep-