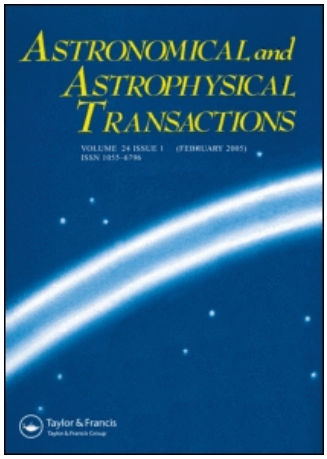

Astronomical & Astrophysical Transactions
The Journal of the Eurasian Astronomical Society
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713453505

Ratan-600 observations of unusual inversion of polarization

N. A. B. Gizani [a]; C. E. Alissandrakis [b]; V. Bogod [c]; V. Garaimov [c]; G. Gelfreikh [d]; V. Zheleznyakov [e]; E. Zlotnik [e]

[a] Centro de Ciências Matemáticas, Universidade da Madeira, Campus Universitário da Penteada, Funchal, Portugal
[b] University of Ioannina, Section of Astrogeophysics, Ioannina, Greece
[c] Special Astrophysical Observatory, Karachaevo-Cherkessia, Russia
[d] Pulkovo Astronomical Observatory, Pulkovo, Russia
[e] Institute of Applied Physics, Nizhnij Novgorod, Russia

Online Publication Date: 01 October 2001
To cite this Article: Gizani, N. A. B., Alissandrakis, C. E., Bogod, V., Garaimov, V., Gelfreikh, G., Zheleznyakov, V. and Zlotnik, E. (2001) 'Ratan-600 observations of unusual inversion of polarization', Astronomical & Astrophysical Transactions, 20:3, 543 - 545
To link to this article: DOI: 10.1080/10556790108213596
URL: http://dx.doi.org/10.1080/10556790108213596

Astronomical and Astrophysical Transactions, 2001,
Vol. 20, pp. 543–545
Reprints available directly from the publisher
Photocopying permitted by license only

RATAN-600 OBSERVATIONS OF UNUSUAL INVERSION OF POLARIZATION

N. A. B. GIZANI,[1,2] C. E. ALISSANDRAKIS,[3] V. BOGOD,[4] V. GARAIMOV,[4] G. GELFREIKH,[5] V. ZHELEZNYAKOV,[6] and E. ZLOTNIK[6]

[1] *Centro de Ciências Matemáticas, Universidade da Madeira, Campus Universitário da Penteada, 9000-390 Funchal, Portugal*
[2] *Present address: Kalymnou 13, 11251 Athens, Greece*
[3] *University of Ioannina, Section of Astrogeophysics, GR-45110 Ioannina, Greece*
[4] *Special Astrophysical Observatory, 357147, Karachaevo-Cherkessia, Russia*
[5] *Pulkovo Astronomical Observatory, 196140, Pulkovo, Russia*
[6] *Institute of Applied Physics, 603600 Nizhnij Novgorod, Russia*

(Received December 10, 2000)

We have made multiwavelength radio intensity and circular polarization observations of sunspot associated bipolar sources using RATAN-600 in the wave band 1.00 to 30 cm. We have found unusual inversion of the circular polarization of the microwave emission in both components of its bipolar structure at 14.5 cm. We explain the observed polarization by linear coupling, using a magnetic field parallel to the solar meridian, i.e. perpendicular to the plane connecting the spots of the group. This field may be a general magnetic field of the Sun, or some large-scale structure in the upper corona.

KEY WORDS Sun, active region, polarization

1 OBSERVATIONS AND POLARIZATION INVERSION

We have observed sunspot associated bipolar active regions with RATAN-600 in consecutive days in May and June 1996 and in May 1997, while the active regions were moving from the center of the disk to the west limb. The resolution of the radio telescope is $15'' \times 12'$ at 2 cm and increases proportionally with the wavelength. The linear and circular polarization were recorded at 39 frequencies in the range of 1.74–30 cm. We detected unusual inversion of the circular polarization: At short wavelengths the polarization is consistent with the extraordinary mode emission, however at 14.5 cm, the sense of polarization of both microwave components drops to zero and then reverses. This inversion is peculiar, because due to linear coupling we expect only the polarization of the side of the bipolar region, which is closer to the limb, to change sign at longer wavelength. Also the reversal should shift to shorter wavelengths as the region moves towards the limb.

Zheleznyakov (1970) explained the *polarization reversal* at a certain frequency in the spectrum of sunspot associated sources and solar microwave bursts, by the effect of linear coupling of electromagnetic modes in a quasi-transverse magnetic field. As a result of the solar rotation, in the magnetic field of a bipolar group – where two components with opposite polarity are connected by force lines – the reversal frequency has to vary daily, due to variations of the magnetic configuration along the line of sight (Gelfreikh *et al.*, 1987). Therefore linear coupling of the electromagnetic modes in the magnetic field cannot explain the observed stability of the reversal frequency. In addition the inversion cannot be due to coupling in a neutral current sheet, because the transformation coefficient in zero B-field is frequency independent (Zheleznyakov, 1996; Zheleznyakov *et al.*, 1996). It also cannot be due to linear coupling in the transverse magnetic field in a current sheet, since the angle in which inversion can take place is extremely small and varies with solar rotation.

The only way to explain the observed inversion by linear coupling is through a magnetic field parallel to the solar meridian. The way the polarization pattern is independent of the solar rotation and the reversal would occur for both components of the group at the same frequency. Such a field could be a manifestation of the very large scale, global solar magnetic field. However observations of the structure of coronal loops in soft X-rays and EUV do not support the existence of such a field. Therefore most likely the reversal can be explained in terms of an emission mechanism: the dominant emission mechanism changes near the wavelength where inversion takes place.

2 CONCLUSIONS

We have observed sunspot associated active regions with RATAN-600. We detected an unusual inversion of the circular polarization of the microwave emission. Linear coupling can explain the observed reversal only if we consider a magnetic field perpendicular to the plane connecting the spots of the group of the opposite magnetic polarity. This way the magnetic field will be parallel to the solar meridian and therefore the polarization will be independent of the solar rotation and inversion can occur for both parts of the group at the same frequency (Lang *et al.*, 1993).

Acknowledgments

NG would like to acknowledge the grant PRAXIS XXI/BPD/18860/98 from the Fundação para a Ciência e a Tecnologia, Portugal for sponsoring her to attend JENAM 2000 in Moscow, where this work was presented.

References

Gelfreikh, G. B., Peterova, N. G., and Ryabov, B. I. (1987) *Solar Phys.* **108**, 89.

Lang, K. R., Willson, R. F., Kile, J. N., Lemen, J., Strong, K. T., Bogod, V. L., Gelfreikh, G. B., Ryabov, B. I., Hafizov, S. R., Abramov, V. E., and Svetkov, S. V. (1993) *Astrophys. J.* **419**, 398.

Zheleznyakov, V. V. (1996) In: Radiation in Astrophysical Plasmas, Kluwer Academic Publishing.

Zheleznyakov, V. V. and Kocharovskii, V. V. (1996) *Astron. Astrophys.* **308**, 68.

Zheleznyakov, V.V. (1970) In: Radio Emission of the Sun and Planets, Pergammon Press, USA.