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HIGH SENSITIVITY, HIGH FREQUENCY AND HIGH TIME RESOLUTION DECIMETRIC SPECTROSCOPE

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RESUMEN. Se ha desarrollado el primer espectroscopio decimétrico latino americano operando en una banda de 100 MHz con alta resolución de frecuencia (100 KHz) y tiempo (10 ms), alrededor de cualquier centro de frecuencia en el intervalo de 2000-200 MHz. El propósito de esta nota es describir investigaciones solares y no solares que se planean, programa de investigación y la situación actual de desarrollo de este espectroscopio.

ABSTRACT. First Latin American Decimetric Spectroscope operating over a band of 100 MHz with high resolution in frequency (100 KHz) and time (10 ms), around any center frequency in the range of 2000-200 MHz is being developed. The purpose of this note is to describe planned solar, and non-solar, research programmes and present status of development of this spectroscope.

Key words: INSTRUMENTS — SPECTROSCOPY

I. INTRODUCTION

The radio astronomy group of INPE has already initiated milimeter, (23-18) GHz, wavelength sweep frequency observations using 13.7 m parabolic radome enclosed Itapetinga Antenna (Sawant and Cecatto,1989). Solar and non-solar observations at low frequency (1.6 GHz) also have been carried out ocassionally by using Itapetinga antenna (Sawant et al, 1987, Sawant et al, 1989 and Lattari, 1989). However, radome absorption starts affecting below 2.0 GHz and thus reduces the effective effeciency of the antenna. Hence it is desirable to have a seperate antenna below 2.0 GHz. In view of this, a 9-meter polar mounted parabolic antenna operating in the frequency range 2000-200 MHz with suitable stearing system for tracking the sun has been satisfactorily developed with the help of antenna manufacturing Company Harald Ltda. of Curitiba, Brazil, and is in the process of installation at field site of INPE in São Jose dos Campos (Fig. 1). Fig.2(a,b) shows survey of local interference. There is not much of interference above 400 MHz. Far field pattern of the antenna of 1.6 GHz is shown in Fig.3 and it can be noted that the beam width (HPBW) is approximadely 1.2^{o} and first side lobes are of about 20 db down. Averaged measured gain in horizontal and vertical polarization at 1.6 GHz is 41 db. Cross-talk between two polarizations at 1.6 GHz is 33 db down. Above mentioned parameters indicate good performance of the antenna. Development of solar spectroscope is planned in two phases: first phase involves conventional analogue recording on fotografic film, and will be operational soon. In second phase burst data over limited frequency range will be digitaized and taperecorded. Details of these are at present being worked out whereas details of the first phase involving slow and fast modes are described below.

Fast Mode Operation: The band of 100 MHz around 1.6 GHz will be observed and swept with high frequency (100 KHz) and high time resolution (10 msec). Output of receiver will be displayed in synchronization with receiver output, on 10 cm C.R.T. screen and will be photographed with continiously moving 70 mm film. Over limited time period, we have plans to use existing Acoustic Optical Spectrometer with frequency resolution of 150 KHz.

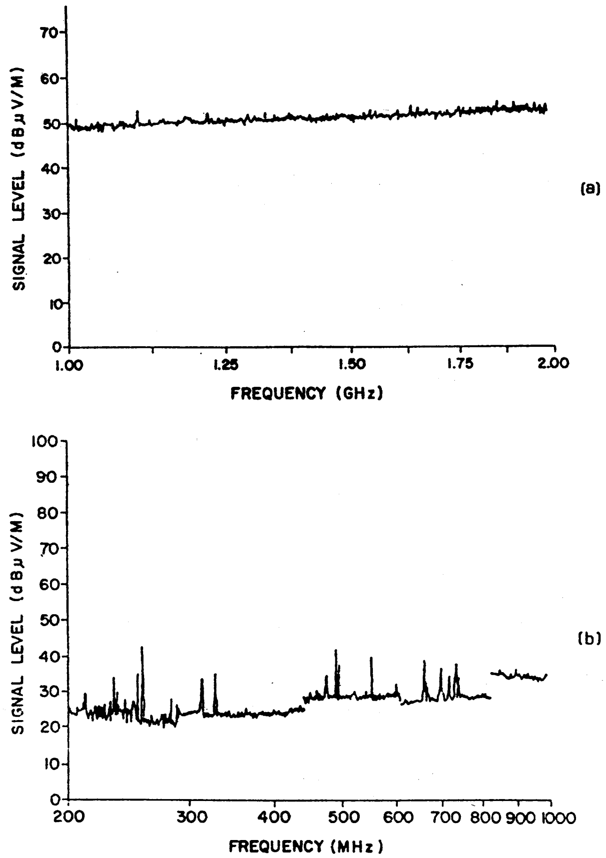

Fig. 2.(a,b) Local interference in the range of: (a) (2000-1000) MHz and (b) (1000-200) MHz.

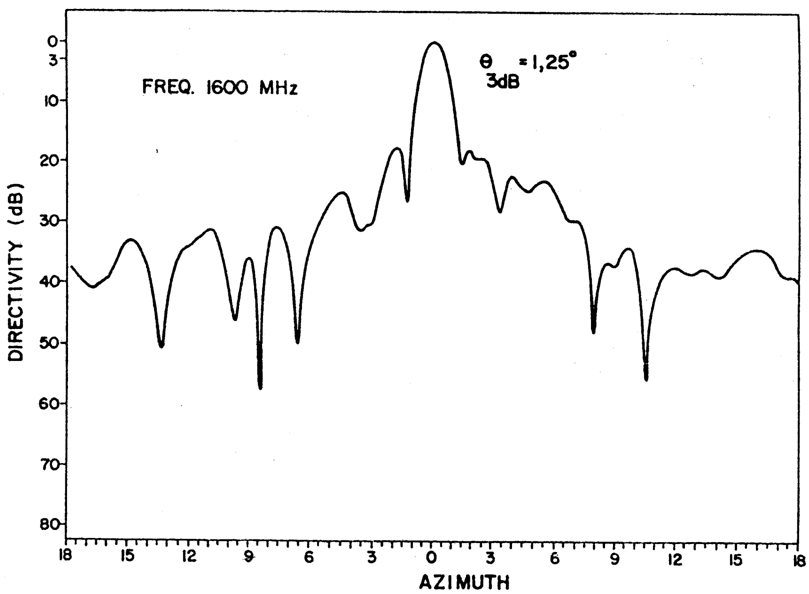

Fig. 3. Beamwidth of the antenna at 1.6 GHz showing side lobes.

Slow Mode Configuration: Broad band (2000-200 MHz) amplifiers with noise figure of } db will be used. Received frequencies will be first down converted and amplified by sweep :requency oscillator in order to avoid local interference and the whole band will be swept 10 :imes per second. Finally this signal will be down converted to 10 MHz and will be passed :hrough desired filter having bandwidth of 300 or 100 KHz and will be suitably detected.)etected output will be passed on to synchronized z-mode oscilloscope, in sychronization whith ;weep frequency receiver. Displayed C.R.T. output will be photographed with continiously ıoving 70 mm film, Fig.(4 a,b).

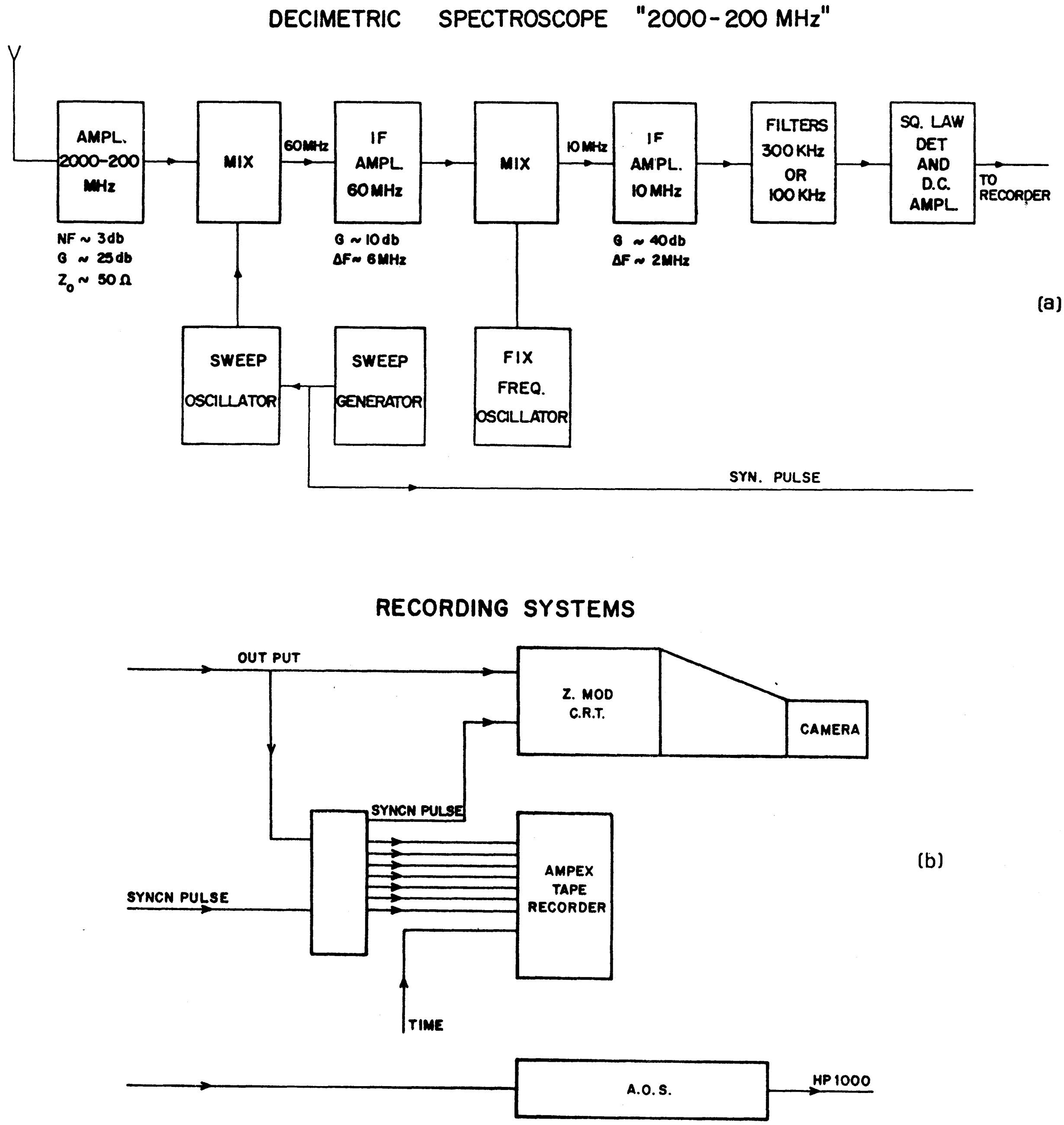

Fig. 4(a,b). Bloch diagram of: receiving (2000-200) MHz system (a), and recording system (b)

II. RESEARCH PROGRAMMES

Solar Observations: The importance of decimetric solar obsevations was well discussed in three recent workshops devoted to decimetric solar bursts observations in relation to solar flares, conducted by CESRA-Committe of European Solar Radio Astronomers (Benz, 1986; Trottet and Pick, 1987; Magun and Benz, 1989). Persuing their recommendations decimetric bursts exhibiting fine structures in time and frequency will be observed with the above discussed spectroscope with the intention of better understanding of primary energy release in a flare and beam plasma interaction.

Study of Travelling Interplanetary Phenomena (STIP): The scientific objective of the "STIP" is to study the phenomena of propagation through the interplanetary medium, of energetic particles and shocks, and search for understanding of these phenomena during both quiet and active periods of solar cycle(Shea at al, 1984). The signatures of these will be recorded in spectroscope in the form of specific radiations.

Weak Multifrequency Ionospheric Scintillations: Ionospheric radio wave scintillation studies of 1.53 GHz have been carried out at INPE by the ionospheric group utilizing a 4-meter diameter antenna. Simultaneous scintillation measurements utilizing that antenna system and the system proposed here, which will be equipped with broad band feed, will allow to observe scintillations at various frequencies simultaneously. This will enable us to investigate time evolution of ionospheric inhomogenities(Johnson,1988). It should be noted that there are very scanty scintillation observations on southern hemisphere at low latitude.

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REFERENCES

Benz, A.: Proc. of Workshop on "Radio Continua During Solar Flare", Sol. Phys. **104** , 1986.
Johnson, A.L.: Short-term magnetic field alignment variations of equatorial ionospheric irregularities", Radio Sci.(USA) vol. 23, nº 3, p.331, 1988.
Lattari, C.J.B.: "Low level (1,63 GHz) burst activity". M.S. Thesis, INPE-1989.
Magun,A. and Benz,A.: Special issue in "Short Duration Radio Emission during Solar Flares", to appear in Solar Phys.1990.
Sawant, H.S. and Cecatto, J.R.: "Fine Structure in the mm-wavelength spectra of the active region", in this issue.
Sawant, H.S., Costa, J.E.R., Trevisan, R.H., Lattari, C.J.B. Kaufmann,P.: "Low level (1.63 GHz) solar burst activity". Solar Phys., **111**, 189, 1987.
Sawant, H.S., Lattari, C.J.B., Benz, A.O. and Dennis, B.R.: "Hard X-rays and associated type III-RS slope decimetric burts". submited to Sol. Phys.,1989.
Shea,M.A., Smart, D.F.,and Mc Kenna-Lawlor,S.M.P.: Proc. of STIP Sym. Held at Maynooth, Ireland, 4-6 Au, 1982.
Trottet, G. and Pick, M.: Special issue on "Radio Continua during Solar Flares", Sol. Phys. vol. 111, 1987.

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