

HIGH SENSITIVITY, HIGH FREQUENCY AND HIGH TIME RESOLUTION  
DECIMETRIC SPECTROSCOPE

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RESUMEN. Se ha desarrollado el primer espectroscopio decimétrico latinoamericano 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 millimeter, (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 occasionally 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 efficiency of the antenna. Hence it is desirable to have a separate 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 steering 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 approximately  $1.2^\circ$  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 photographic film, and will be operational soon. In second phase burst data over limited frequency range will be digitized 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 continuously moving 70 mm film. Over limited time period, we have plans to use existing Acoustic Optical Spectrometer with frequency resolution of 150 KHz.

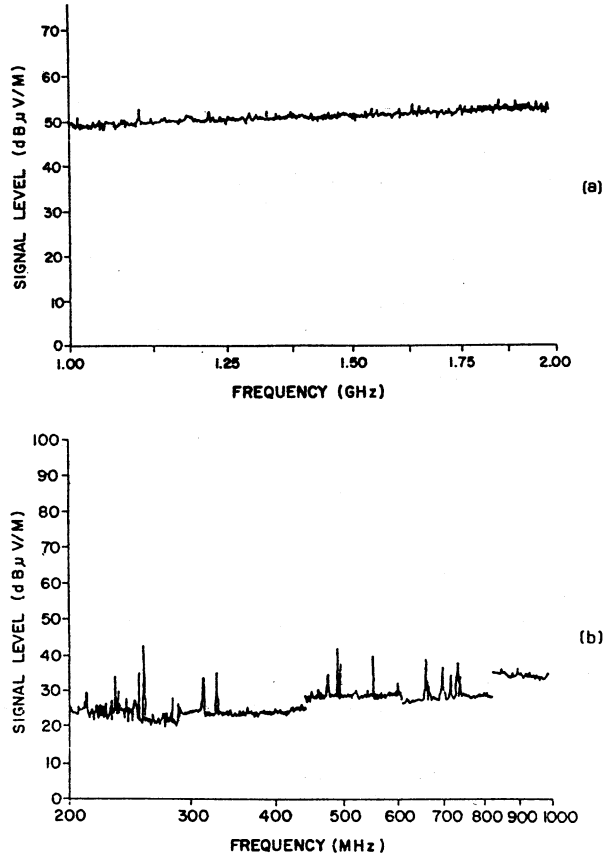


Fig. 2.(a,b) Local interference in the range of: (a) (2000-1000) MHz and (b) (1000-200) MHz.

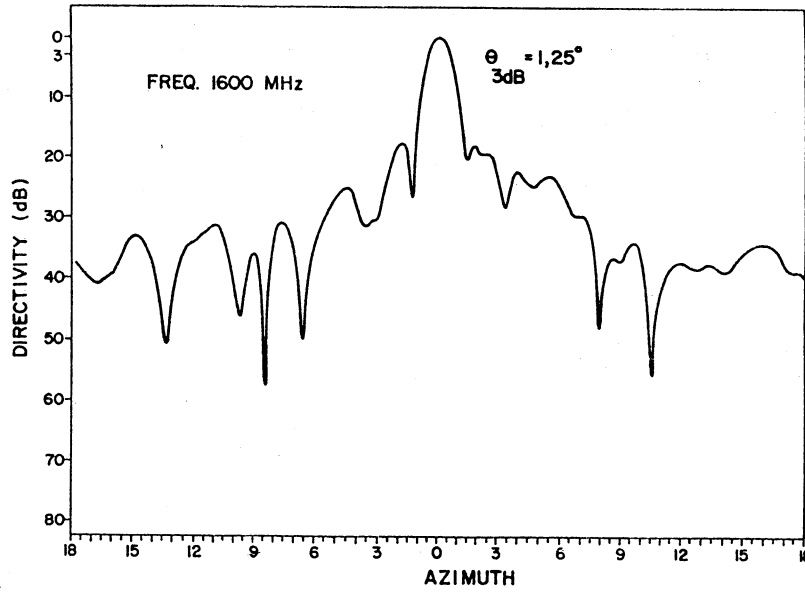
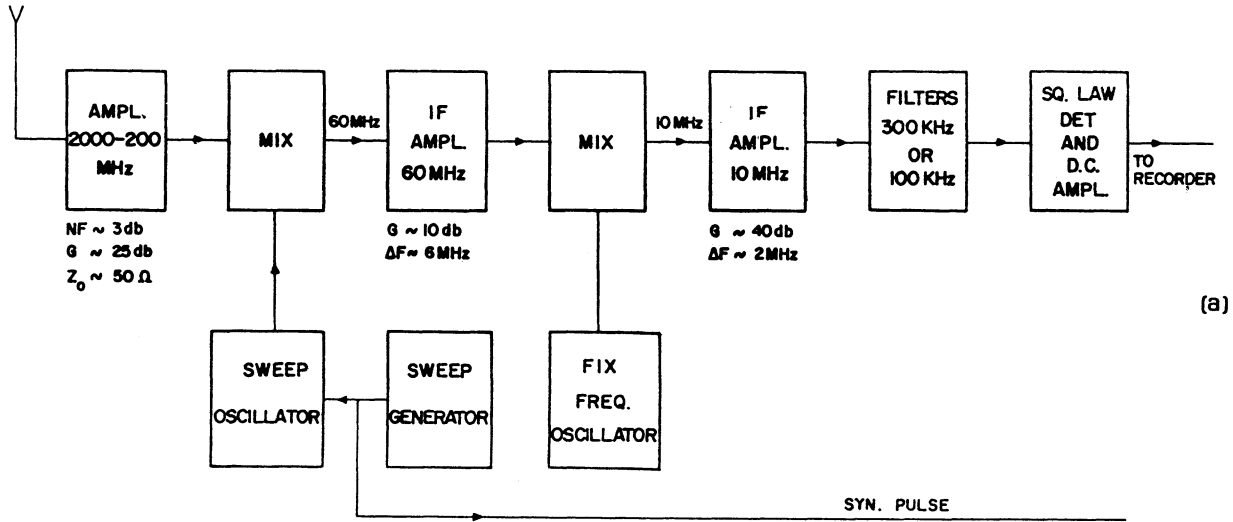


Fig. 3. Beamwidth of the antenna at 1.6 GHz showing side lobes.

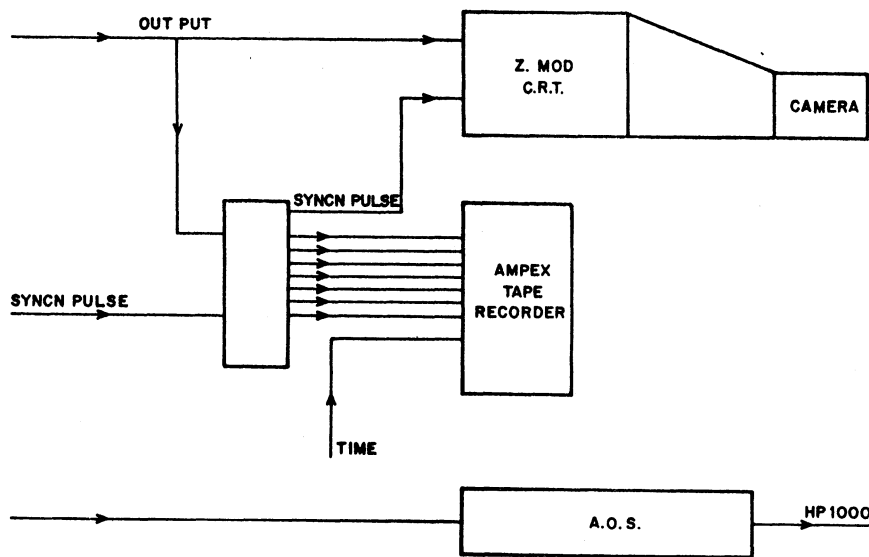
Slow Mode Configuration: Broad band (2000-200 MHz) amplifiers with noise figure of 3 db will be used. Received frequencies will be first down converted and amplified by sweep frequency oscillator in order to avoid local interference and the whole band will be swept 10 times per second. Finally this signal will be down converted to 10 MHz and will be passed through desired filter having bandwidth of 300 or 100 KHz and will be suitably detected. Detected output will be passed on to synchronized z-mode oscilloscope, in synchronization with sweep frequency receiver. Displayed C.R.T. output will be photographed with continuously moving 70 mm film, Fig.(4 a,b).

DECIMETRIC SPECTROSCOPE "2000-200 MHz"



(a)

RECORDING SYSTEMS



(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 observations was well discussed in three recent workshops devoted to decimetric solar bursts observations in relation to solar flares, conducted by CESRA-Committee of European Solar Radio Astronomers (Benz, 1986; Trotter and Pick, 1987; Magun and Benz, 1989). Pursuing their recommendations decimetric bursts exhibiting fine structures in time and frequency will be observed with the above discussed spectroscopy 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 et al, 1984). The signatures of these will be recorded in spectroscopy 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 inhomogeneities (Johnson, 1988). It should be noted that there are very scanty scintillation observations on southern hemisphere at low latitude.

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