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THE UNIVERSITY OF SAO PAULO 2.4 METER MILLIMETRIC ANTENNA

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RESUMO. São apresentadas as características principais do radiotelescópio de 2.4 m do IAG-USP, destinado a observações de linhas moleculares do meio interestelar. O radiotelescópio é equipado com um receptor nao refrigerado para a região de frequências de 100-115 GHz, e de um banco de 50 filtros com 300 KHz de resolução para análise espectral.

ABSTRACT: We present the main characteristics of the radiotelescope of 2.4 m of IAG-USP, designed for observations of molecular lines of the interstellar medium. The radiotelescope is equipped with a room temperature receiver for the frequencies range 100-115 GHz and with a bank of 50 filters with 300 KHz resolution for spectral analysis.

Key words: INSTRUMENTS — RADIO TELESCOPES

I. INTRODUCTION

The construction of a 2.4 m millimetric radio telescope, mainly designed for interstellar molecular spectroscopy, has recently been completed at the Instituto Astronomico e Geofisico (IAG), University of Sao Paulo. The antenna is installed in the ground of the IAG in the city of Sao Paulo, at -23 degrees latitude and at about 800 m altitude. With the exception of the front-end receiver, the whole system was designed and built in Brazil.

II. MECHANICAL CONSTRUCTION

The antenna is a Cassegrain system, with an equatorial mounting. A sketch of it is presented in figure 1; the main characteristics are listed in Table 1.

The main dish was constructed at low cost in an original way by fixing together 3 thin (3 mm) low precision aluminium dishes manufactured for microwave communications. The internal surface of the resulting thicker dish was covered with aluminium tiles glued with epoxy, and a reinforced backstructure was fixed on the external surface. Finally, a thin layer was removed by machining the dish on a lathe, so as to reach a surface accuracy better than 0.1 mm r.m.s.

The pedestal of the telescope was designed in collaboration with the Instituto de Pesquisas Tecnológicas (IPT, Sao Paulo).

III. TRACKING SYSTEM

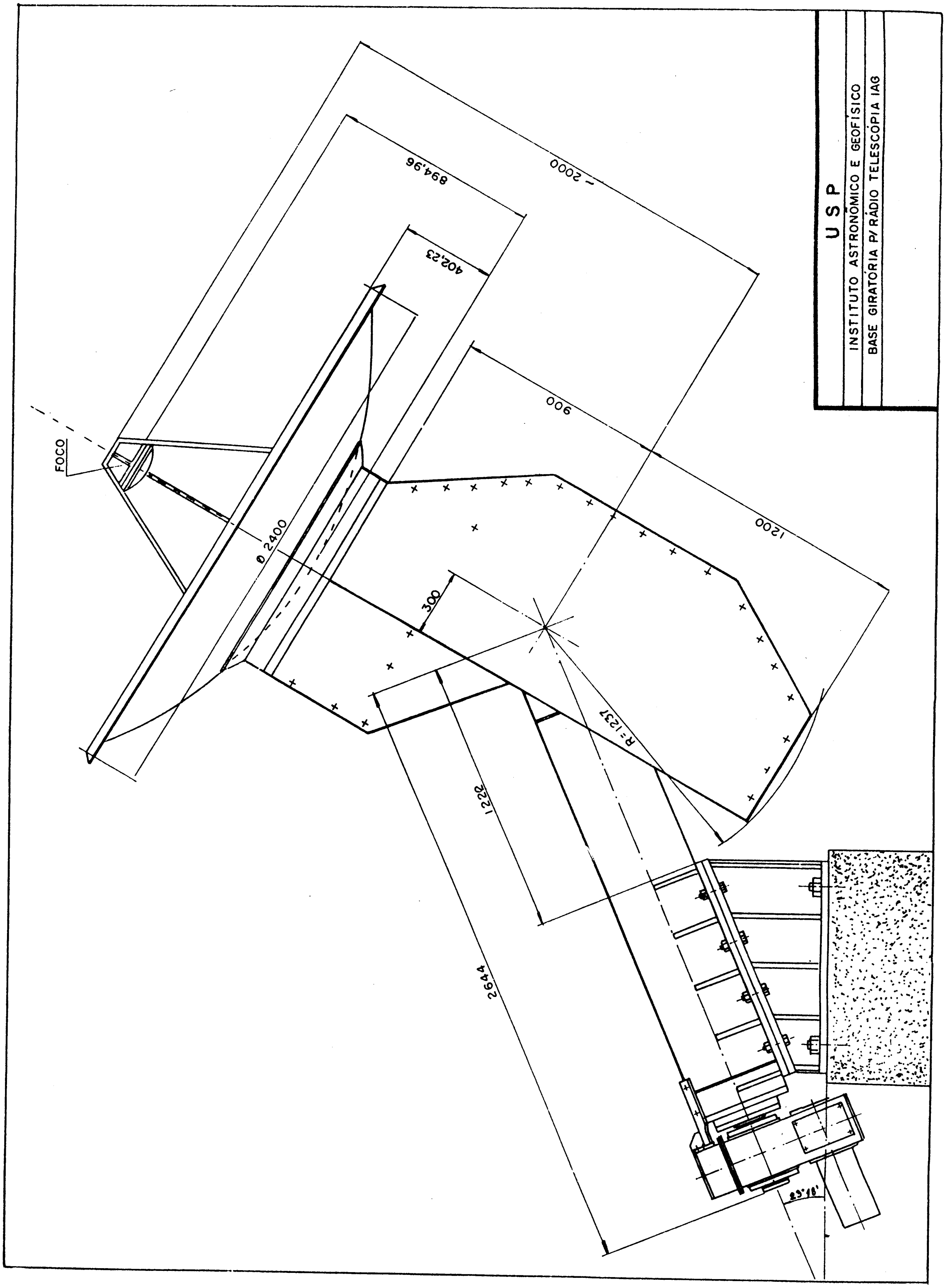
The rotation of each axis is driven by a stepping motor coupled through a gear system, with a reduction factor of 1296. Consequently one 1.80° step of a motor produces a 5 arcsecond displacement of the beam.

"Inductosyn" type encoders, manufactured for measurement of linear displacements, are installed on 50 cm diameter wheels fixed on each axis. The reading of the encoders is converted to angular units by the Apple-like microcomputer which controls the tracking. The resulting accuracy of angular measurements is 8 arc seconds.

The electronics of the tracking system includes the two encoders, the drivers of the stepping motors, and a sideral clock, all interfaced with the control microcomputer.

IV. RECEIVER AND BACK-END

The presently available front-end receiver is a room temperature Shottky-barrier mixer tunable in the frequency range 100-115 GHz, purchased from Radiometer Physics (FRG). The system temperature is about 1000 K. The Local Oscillator is a Gunn oscillator working around 55 GHz, used with a frequency doubler. The LO is phase-locked to a signal originated from a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frequency synthetizer, to allow for fine tuning for line observations.

A chopper wheel system can be used for both Dicke-switching observations and for noise temperature calibrations. Frequency-switching observations are also possible.

A filter bank consisting of 50 channels, 300 kHz resolution, is available for spectral analysis. In order to increase the frequency coverage, an acousto-optic spectrometer has been developped. The AOS makes use of a PbMo4 Bragg cell, and a CCD array; its resolution is about 100 kHz and its frequency coverage about 100 MHz. The AOS is not yet operational; it is described in more detail elseqhere in this volume. The data acquisition system for the filter bank is controlled by an Apple-like microcomputer similar to the one used for tracking. An IBM-AT like microcomputer is being purchased for data acquisition from the AOS.

V. CONCLUSION

Many subsystems of the radiotelescope have been built at low cost, making use of original solutions, of donations and of student manpower. The instrument will soon produce competitive results such as CO maps of molecular clouds, being one of the few instruments working above 100 GHz in the Southern Hemisphere. It is our plan to work on several improvement like a cooled receiver, automation of the production of maps, etc. The experience obtained will be usefull for larger projects, like the planned joint millimetric project between Argentina and Brasil.

This project received grants from the research agencies FAPESP, CNPq and FINEP. The dish was machined gratuitously by the industry Termomecanica.

TABLE 1 - Main characteristics of the Radiotelescope

Primary reflector	
Shape	parabolic
Diameter	2.45 m
Focal distance	0.9 m
Construction technique	aluminium dish machined on a lathe. (see text)
Surface accuracy	better than 100 microns
Aperture efficiency	about 50% at 110 GHz.
Beam-width	5 arc minutes at 115 GHz
Weight	300 kg including sub-reflector.
Secondary reflector	
Shape	hyperbolic
Diameter	22 cm
Construction technique	machined aluminium
Focusing	manually adjustable axial, shift and tilt
Gear mechanism reduction	factor 1296
Encoders	Linear "Inductosyn" type installed on a wheel
Tracking accuracy	10 arc second
Receiver	
Mixer	room temperature Shottky diode
System temperature	1000 K
Filter bank	50 channels, 300 kHz resol.

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