ABSTRACT

Key words: *DSA3, Deep Space Antenna, Multiprocessing, GPU, Radio astronomy*

This thesis contains results that were obtained in the research carried out at the Institute of Technologies in Detection and Astroparticles (ITeDA) using the third Deep Space Antenna (Deep Space Antenna 3 or DSA 3) of the European Space Agency (ESA). Research made during the period between 2012 and 2017, under the direction of PhD Beatriz García and co-direction of PhD Manuel Platino.

This thesis required observational data that were formally requested from ESA. At the beginning of 2016 and during 2017, through observations we acquire the necessary data for the development of the work proposal.

In the framework of the development of the doctoral thesis, the achievements correspond to the analysis of observational data from the DSA 3 ground station installed in Mendoza, corresponding to the 8.4 GHz X-band emission of 3 astronomical sources previously selected because they are “calibrators”.

This data analysis is related to the software developed; tool that is the core of this thesis, and that should be applied to the different available configurations of the antenna, in order to transform raw data into scientific interest data. It should be mentioned that both, the DSA 3 as its similar antennas, there are two other antennas, one in Spain and one in Australia, do not have been used as single dish radio telescopes.

Difficulties that arose during this work development correspond to the high learning curve of the use of DSA 3, the description of its characteristics, as well as what parameters that should be activated or deactivated, what mode of acquisition, and what data structure should be used.

Likewise, a critical difficulty presented was the need for the development of an interpreter of raw data of the antenna; an intensive work, thought already solved at the time of writing and presenting the original work plan. In order to achieve the final objective set at first (the study of RRATs), it was necessary to begin the thesis work in a development of much lower level, and leave the study of specific objects for future works.

The proposed work plan had some modifications because the antenna does not have L-Band reception equipment as expected, it can work only in X and Ka band. It is necessary the development of Processing Software (interpreter or translator format) to be able to carry out astronomical studies, such as signal dispersion, original proposal work plan.

Despite having slightly modifications to approach the problem, which does not imply a change in the use of proposed technologies, we must recognize that the task developed during the investigation period has represented a mutual learning, for the managers and operators of the DSA 3 and for me.

In summary, this thesis explores the use of DSA 3 as an instrument to make observations from astronomical sources in radiofrequency. The work details DSA 3 ground station characteristics. We evaluate the use of existing equipment in the ground station to acquire the radio signal from an astronomical source, as well as the need for additional equipment and what would be its characteristics. The thesis describes the observational method necessary to use the DSA 3 as a radio telescope of single plate, and the development of the necessary software to adapt, process, and convert data obtained by DSA 3 to a useful product for scientific community. The use of commercial solution parts and platforms helped reduce the cost and the need for custom hardware design.

Achievements regarding the understanding of the data, reduction and management for scientific purposes, allow us to think that having obtained flow data from the observed sources that

correspond to the data published in the literature, we are in a position to offer this antenna for radio astronomical use.

It is important to note that Argentina can also carry out scientific work with the monitoring antenna for spacecraft, produced by China and installed in Neuquén, which has the same technical and acquisition characteristics as DSA 3; therefore, this development can be adapted and applied beyond the initial objective set.

This work is the first step for the use of telecommunications antennas installed in Argentina for radio astronomical purposes.

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