USER REQUIREMENT STATEMENT FOR MAURITIUS DEUTERIUM TELESCOPE

VERSION D

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1 SCOPE

1.1 Identification

This is a User Requirements Statement

1.2 Purpose

The purpose of this document is for the user to put down all the scientific requirements along with some fundamental technical ones.

1.3 Introduction

As we develop the User Requirement, we will update this review document for each version of the URS (User Requirement Statement). In this way we will develop a traceable document trail until the Requirements Baseline is reached.

User Requirement Statement

The user is proposing to build a radio telescope that is capable of searching for the 327 MHz hyperfine line of Deuterium with more sensitivity than previous experiments. The proposed instrument is to look for Deuterium in areas where the line has already been successfully detected. A dual linear polarisation telescope is envisaged which should observe the line whilst driving the detection uncertainty (obtained by other experiments) down. One such experiment is the study of D1 line in the galactic anti-centre[1]. The line has a temperature of 780μK and an

[1] Galactic Anticentre is found in the Auriga constellation. Rogers et al. uses a galactic longitude and latitude between 171°, 0° and 183°, 0° to get the best result. This corresponds to a right ascension and declination of 5^h 22^m 20.06^s, +36° 29' 37.00" and 5^h 45^m 37.2^s, 28° 56' 10"

SNR of 10 will require a telescope sensitivity of 78μK. It is estimated that an integration time of 10^4s per observation for a period lasting roughly 320 hours is required to have a credible detection. This means that the primary beam of the antenna must be between 40° to 45°. The clouds of gas can be observed from galactic longitude of 165° to 195°. 2 or more galactic longitudes can be chosen within this range and these can become a target. A station beam in the range of 8° to 10° will be needed and the source has to be tracked throughout the primary beam. The instrument should then be able to move to other targets that have not be fully observed or has the potential to give a better galactic abundance of Deuterium than the targets already investigated. These are mainly the Galactic Centre and the Large Magellanic Cloud[2] with a particular focus on the latter. The LMC has a size of 9° which means the same set up as the anti-center observation can be used here. The antenna system will need to be tiltable in the North-South projection since the galactic anti-centre and the LMC are in different declination zones. The former will appear towards the Northern cardinal point while the latter in the Southern. Furthermore the system needs to cater for radio frequency interferences. The proposed site is comprised of an observatory facility which harbours numerous EM generating apparatus. These need to be subdued or removed completely. Recent RFI tests do not show any potential threats in the band of interest. However RFI environment can change with time, hence the need for the telescope to be the least responsive on the horizontal plane meaning having sidelobes as low as possible. The stations should also have the capabilities of observing calibrators during each observation run(or as far as possible if calibrators are unavailable). Each station is projected to cost $2400 which includes the station electronics[3] but excludes receiver costs. These are yet to be determined. The instrument will need to operate for a period of 2 to 5 years which means some operational costs will need to be determined. These will be mainly power, human resource and maintenance. This has to be discussed at the MRT and University's upper hierarchical level. We can only provide the costs that will be incurred after the telescope is built.

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[2] The LMC has a right ascension of $+05^h\ 23^m\ 34.5^s$ and declination of -69° 45′ 22″

[3] Station electronics comprise of the amplifier/balun circuit, combiners, coaxial and fiber cables, filters and rfof links. See https://goo.gl/qbgm1p