

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 2 (2B)

Author: Mr. Eric Bertels

ISIS - Innovative Solutions In Space B.V., The Netherlands, E.BERTELS@ISISPACE.NL

Prof. Heino Falcke

Radboud University Nijmegen, The Netherlands, H.Falcke@astro.ru.nl

Mr. Jeroen Rotteveel

ISIS - Innovative Solutions In Space B.V., The Netherlands, J.Rotteveel@isispace.nl

Dr. Marc Klein Wolt

Radboud University Nijmegen, The Netherlands, M.KleinWolt@astro.ru.nl

Dr. Albert-Jan Boonstra

Netherlands Institute for Radio Astronomy (ASTRON), The Netherlands, boonstra@astron.nl

Mr. Zeger de Groot

Innovative Solutions in Space BV, The Netherlands, z.degroot@isispace.nl

Mr. Hans van der Marel

ASTRON Netherlands Institute for Radio Astronomy, Unknown, marel@astron.nl

Mr. Jinsong Ping

CAS, China, jsping@nao.cas.cn

Mrs. Linjie Chen

CAS, China, ljchen@nao.cas.cn

Mr. Mark Ruiter

ASTRON Netherlands Institute for Radio Astronomy, The Netherlands, ruiter@astron.nl

Dr. Mingyuan Wang

National Astronomical Observatories, Chinese Academy of Sciences, China, wangmy@nao.cas.cn

FIRST IN FLIGHT RESULTS OF THE NCLE INSTRUMENT - A LOW FREQUENCY RADIO
RECEIVER EXPLORING THE DARK AGES IN LUNAR ORBIT

Abstract

The Netherlands-China Low-Frequency Explorer (NCLE), is a low-frequency payload that will be part of the Chang'e 4 mission. The instrument consists of three 5-meter long antennas that are mounted on the Queqiao satellite and is sensitive in the 80 kHz - 80 MHz radio frequency range. It is designed to address a multitude of science cases, but predominantly NCLE will open up the low-frequency regime for radio astronomy and will prepare for the detection of ground-breaking emissions from the Dark Ages and the Cosmic Dawn, considered to be the holy grail of cosmology. NCLE is considered a pathfinder mission for a future low-frequency space-based radio interferometer. Low-frequency radio astronomy, below 30 MHz, can only be performed from space due to the cut-off in the Earth's ionosphere and man-made RFI that make sensitive measurement from ground-based facilities impossible. Together with Queqiao, the NCLE instrument is placed in a halo orbit at the Earth-Moon L2 point. At this point NCLE will be outside the Earth's ionosphere and relatively far away from terrestrial interference. As the Earth will always be in sight the instrument can measure and quantify low-frequency radio emissions for the first time in 50 years and with unprecedented quality. This will allow us to explore interference mitigation and calibration techniques needed for exploring radio emission from the early universe and it will allow for improvements

on future instruments operating at this location. Following the delivery in March 2018, less than 2 years after the project started, the instrument was successful launched in the 21st of May 2018 and saw its first return of telemetry January 2019. In this paper, the design of the instrument will be covered, as well as the first in flight results which were obtained. These results indicate NCLE is performing admirably after having spent 8 months in interplanetary space. The NCLE instrument is part of a larger roadmap where this technology will be reused. The NCLE mission will be followed up by further miniaturization.