IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Advances in Space-based Network and Communication Technologies (7)

Author: Dr. Mirko Magarotto
Università degli Studi di Padova, Italy

Dr. Giorgia Franchin
Università degli Studi di Padova, Italy
Dr. Elena Colusso
Università degli Studi di Padova, Italy
Dr. Paola De Carlo
T4i, Italy
Ms. Fabiana Milza
T4i, Italy
Dr. Elena Toson
T4i, Italy
Prof. Daniele Pavarin
T4i, Italy
Prof. Alessandro Martucci
Università degli Studi di Padova, Italy
Prof. Paolo Colombo
Università degli Studi di Padova, Italy
Dr. Luca Schenato
University of Padova, Italy
Prof. Antonio Capobianco
University of Padova, Italy

PROJECT LANDAU: BOOSTING PLASMA ANTENNAS IN SPACE

Abstract

Gaseous plasma antennas (GPA) utilize ionized gas, namely plasma, to communicate electromagnetic signals. GPAs offer unique capabilities: the plasma can be de-energized when the antenna is not in use, rendering it "electrically" invisible. Moreover, the antenna's performance, including its radiation pattern and operating frequency, can be electrically controlled by adjusting the plasma's properties. This technology is pivotal for various space applications, offering antennas that can communicate across different frequencies and direct signals without altering the satellite's attitude. Thus, GPAs are a compelling alternative yielding substantial savings in both volume and mass. Consequently, GPAs are very appealing for the SmallSat market, estimated to reach approximately 50 billion over the next decade. However, the widespread adoption of plasma antennas faces a significant obstacle: producing plasma efficiently and compactly. Recent advancements have shown promise, notably the adoption of Cold Cathode Fluorescence Lamps (CCFLs) for plasma discharges. Nonetheless, currently available commercial sources are not tailored for telecommunications, lacking optimization in both geometry and performance.

The LANDAU project, funded by the Italian Space Agency (ASI), aims to address these limitations by developing a GPA built upon optimized plasma sources. Meticulous material selection and the application of advanced manufacturing techniques will be pivotal in meeting diverse specifications. Surface coatings will enable the adjustment of material properties to enhance source performance, such as achieving a

density of approximately 10^{19} m^{-3}. Additionally, additive manufacturing will facilitate the creation of customized geometries not available in the market. The plasma sources will be integrated into a prototype GPA for space applications, advancing to Technology Readiness Level 5/6.

This work will showcase the progress made under the LANDAU project. It will cover enhancements made to the plasma discharges and share the results of preliminary tests. Additionally, a detailed explanation of the design of the demonstrator, namely a plasma-based reflective surface, will be provided.