Optimization of a 50 W Helicon Plasma Thruster

Simone Di Fede

Centro di Ateneo di Studi e Attivita' Spaziali Giuseppe Colombo
CISAS
University of Padova

Outline

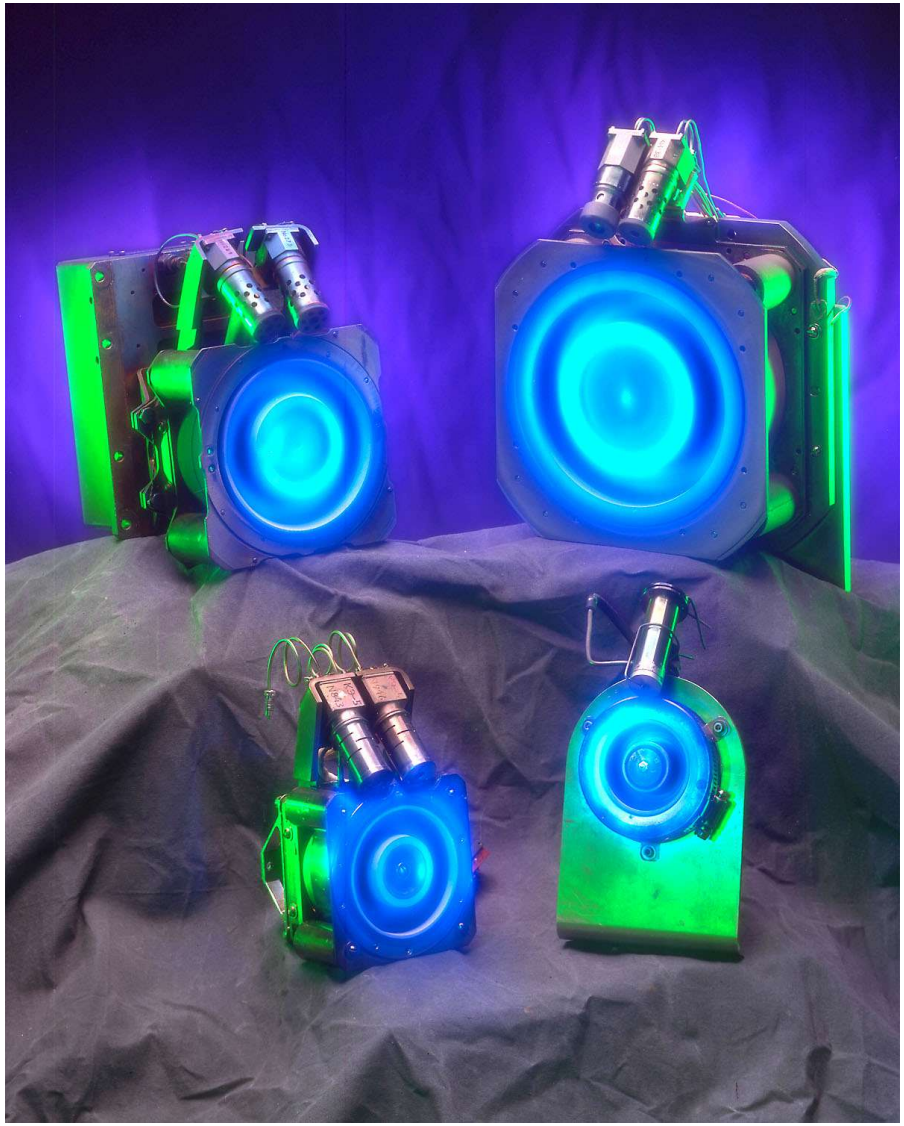
Electric Propulsion

Advantages

- high specific impulse
- high thrust efficiency

State of the Art

- ion thruster
- Hall-effect thruster



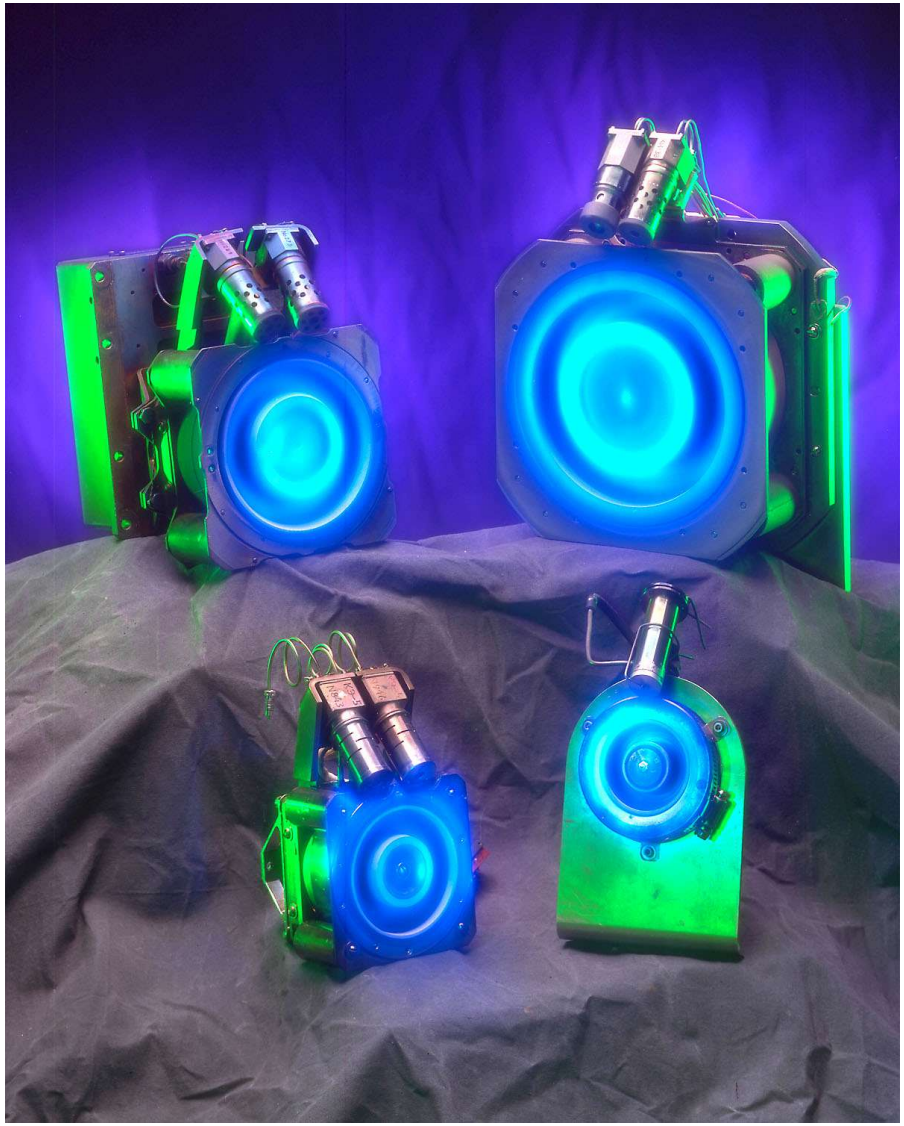
Electric Propulsion

Advantages

- high specific impulse
- high thrust efficiency

State of the Art

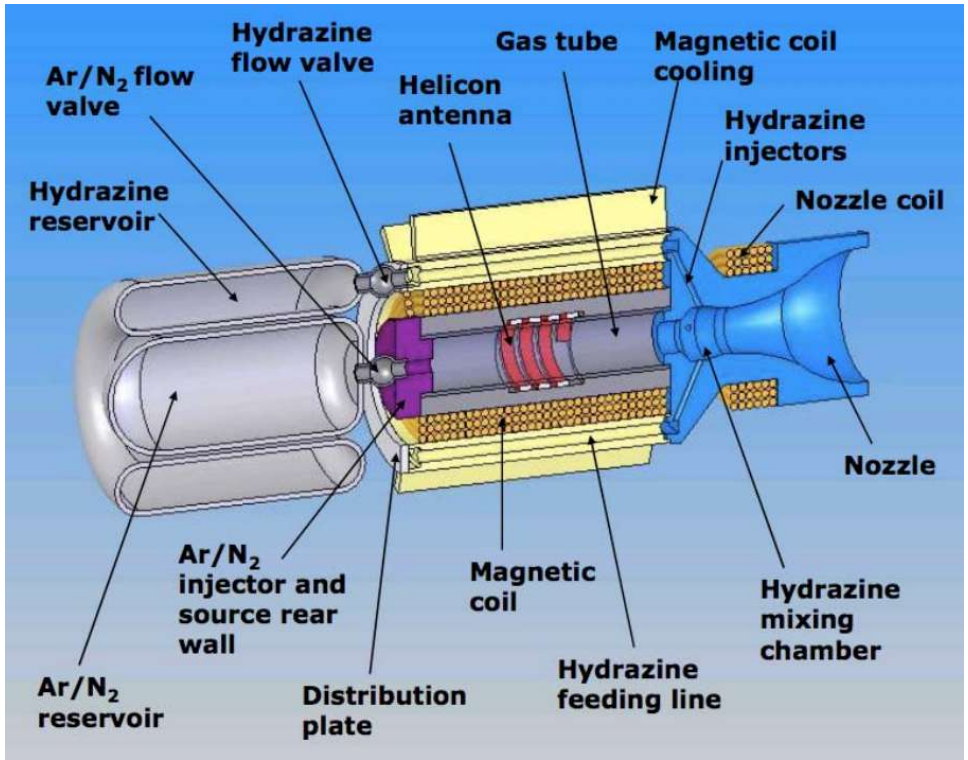
- ion thruster
- Hall-effect thruster



Helicon Plasma Thruster

Main components

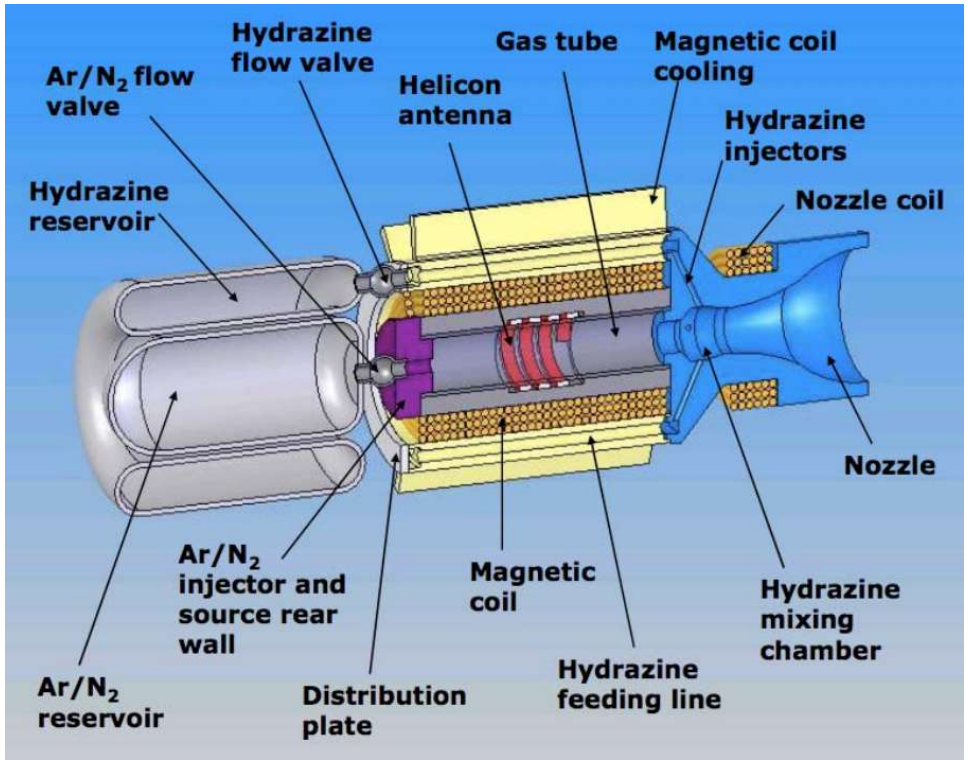
- cold gas tank
- plasma source
- magnetic nozzle



Helicon Plasma Thruster

Advantages

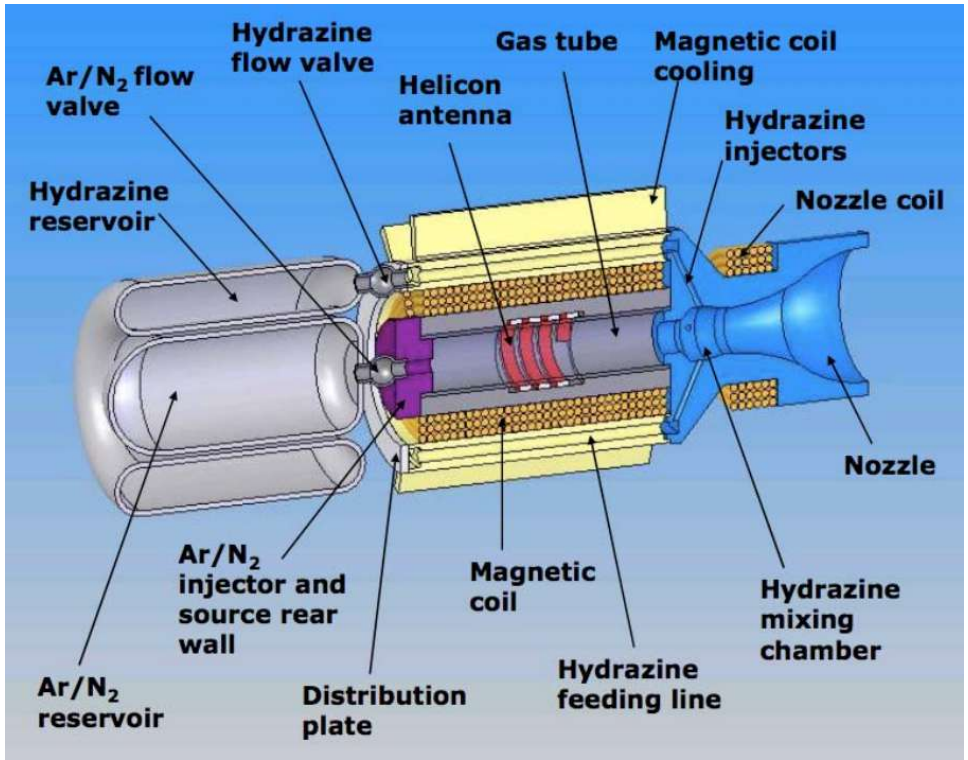
- long life (no electrodes)
- higher specific thrust



Helicon Plasma Thruster

International projects

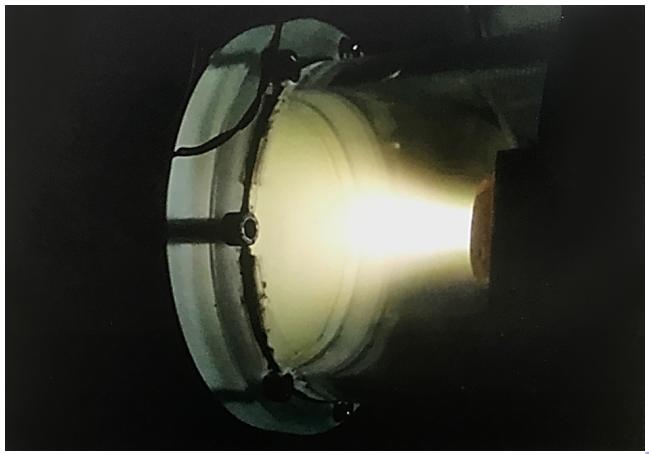
- research started with HPH.com ($Pw < 100$ W)
- followed by REGULUS, specifically designed for CubeSat



Helicon Plasma Thruster Optimization

Numerical-experimental approach

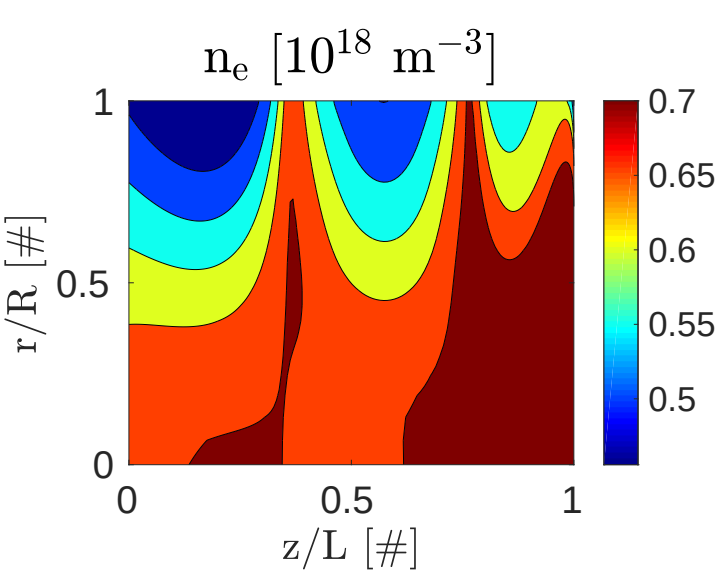
- numerical approach: different numerical strategies to study the different components of the thruster
- experimental approach: experimental setups to evaluate the propulsive performances and plasma properties

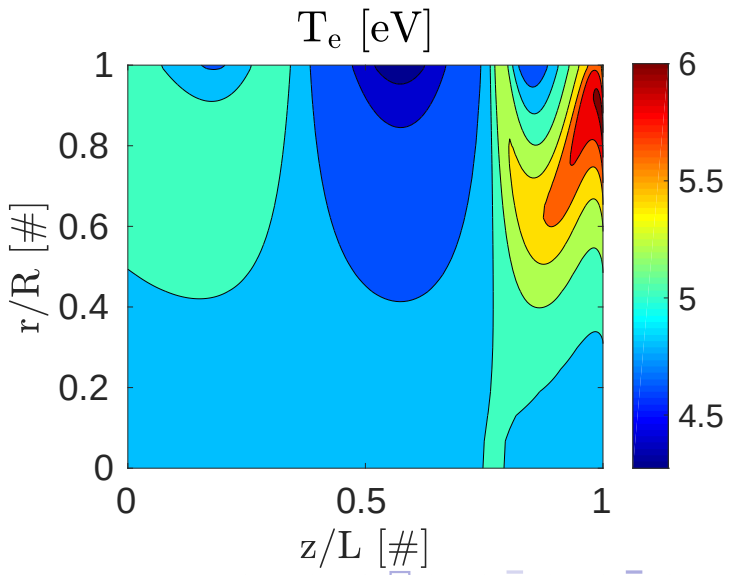


Numerical-experimental approach

Helicon Plasma Source optimization

1. 3D-VIRTUS, a code based on a fluid strategy, will be used to simulate the Helicon Plasma Source
2. the fluid code will be adapted to new specifications and experimentally validated
3. experimental-numerical optimization of the source

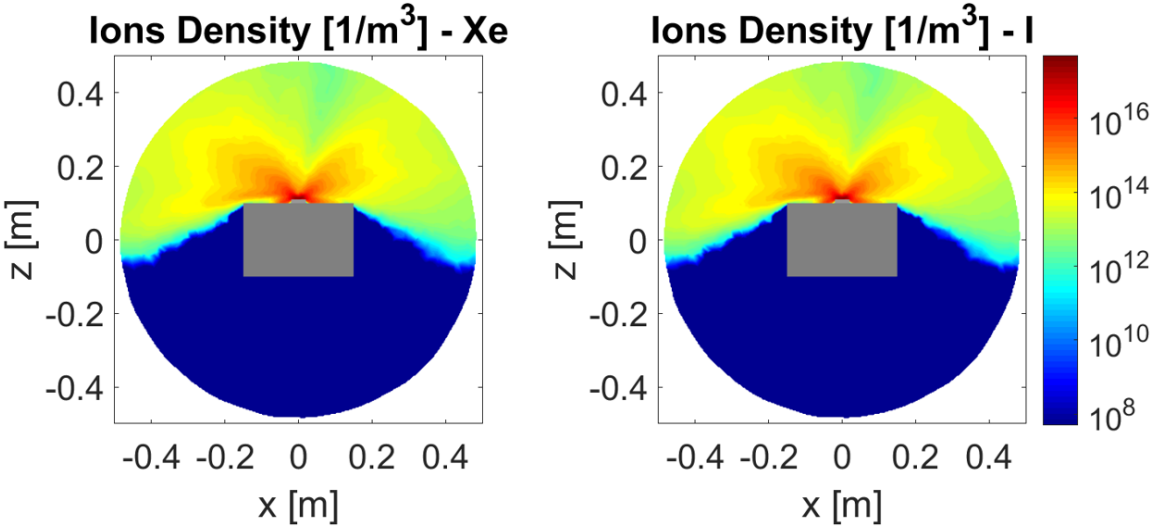




Numerical-experimental approach

Magnetic nozzle optimization

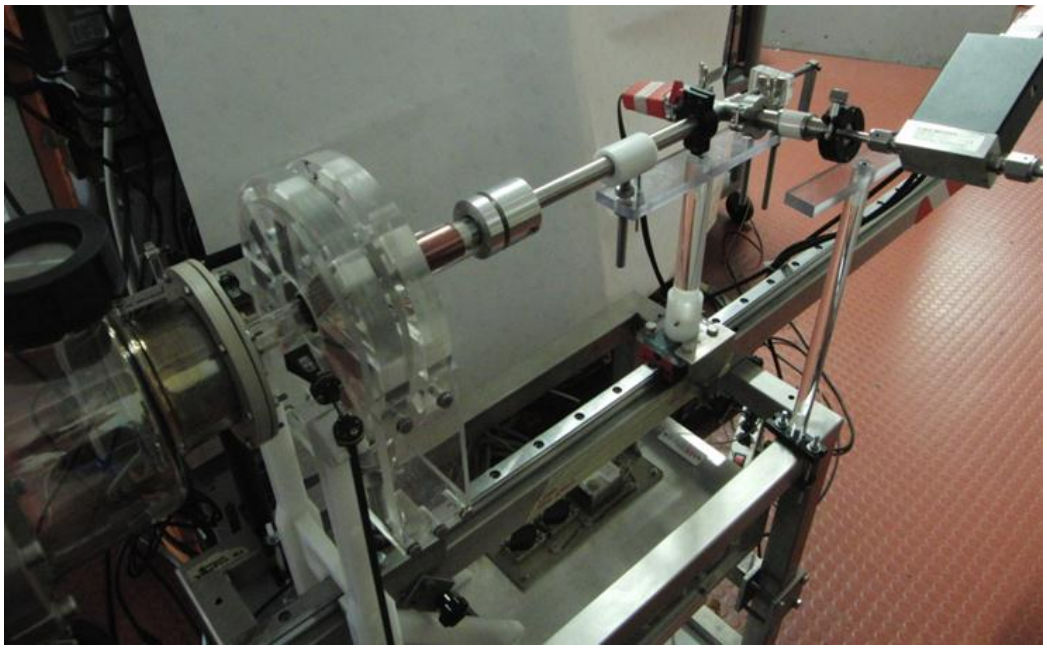
1. a literature review will identify the numerical strategy and the code more adapted to simulate the magnetic nozzle and the plume
2. the code will be validated against experimental data
3. experimental-numerical optimization of the magnetic nozzle



Experimental Setup

Diagnostic System

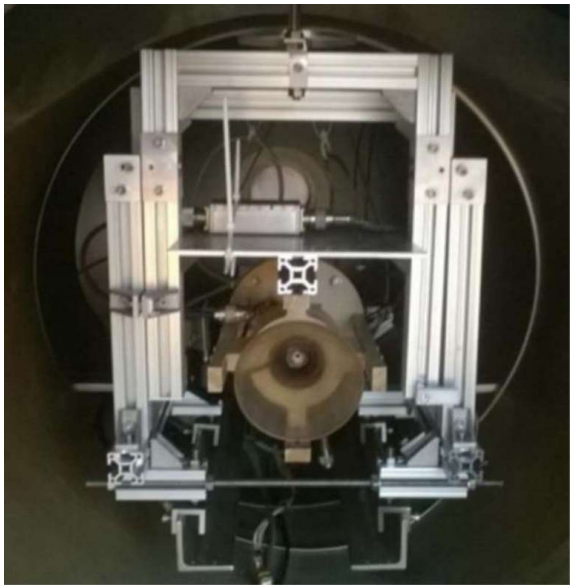
An optical spectrometer, a microwave interferometer and a Langmuir probe to characterize the plasma source



Experimental Setup

Diagnostic System

1. a Faraday probe and a Retarding Potential Analyzer for plume characterization
2. a counter balanced pendulum to characterize the thrust



Main Expected Results

Results

1. 50 W HPT optimization, characterization and testing by means of a combined numerical-experimental approach
2. physical investigation and identification of the driving parameters for the plasma source and magnetic nozzle design
3. detailed numerical simulations of the two main components of a HPT
4. technology exploitation