Optimization of a 50 W Helicon Plasma Thruster

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Outline

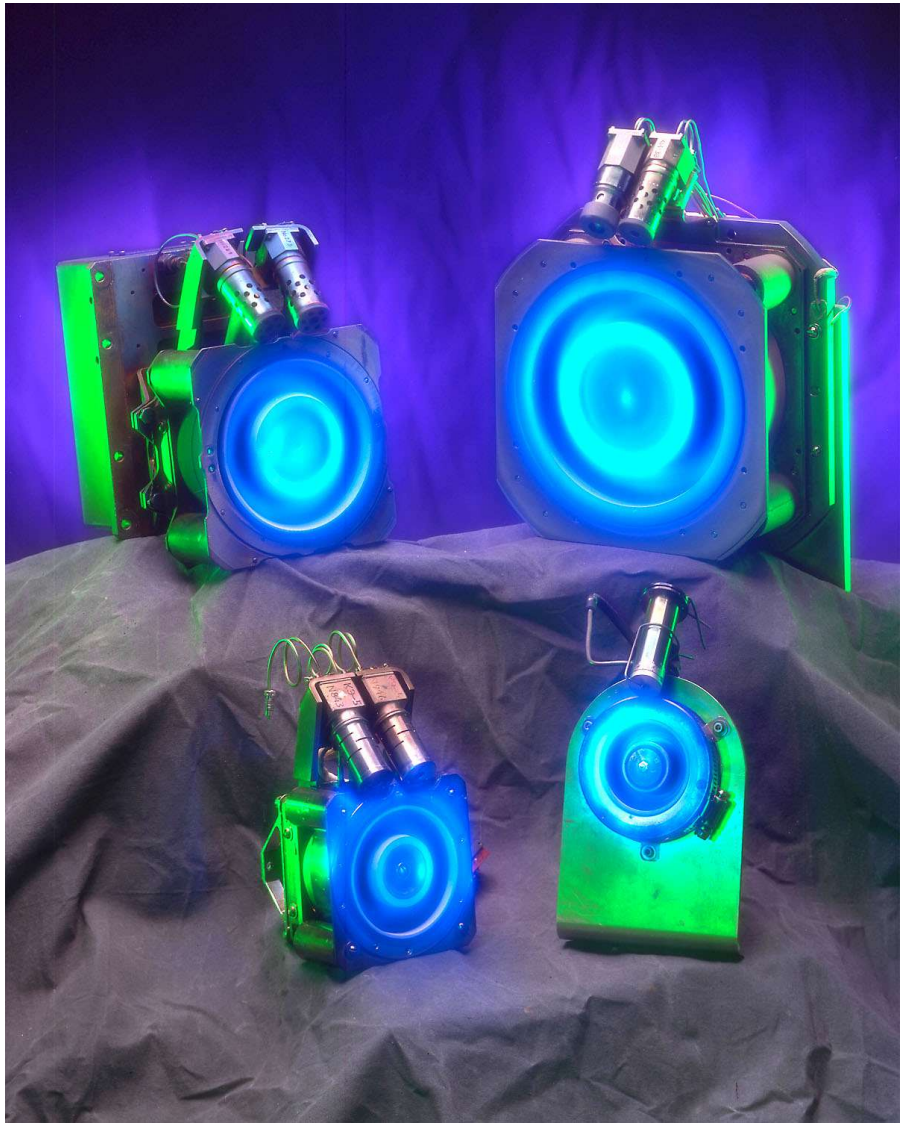
Electric Propulsion

Advantages

- high specific impulse
- high thrust efficiency

State of the Art

- ion thruster
- Hall-effect thruster



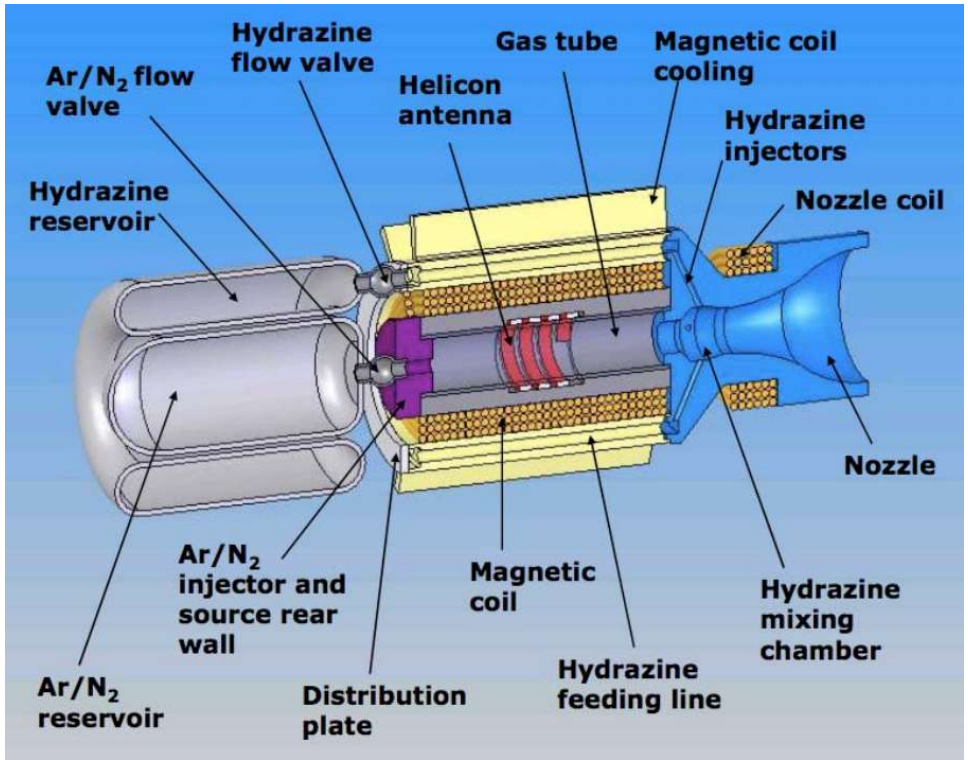
Helicon Plasma Thruster

Main components

- cold gas tank
- plasma source
- magnetic nozzle

Advantages

- long life (no electrodes)
- higher specific thrust



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, is used to simulate the Helicon Plasma Source
2. the fluid model has been be adapted to new specifications (chemical model for Xe)
3. the experimental validation of the code against experiments is ongoing

Numerical-experimental approach

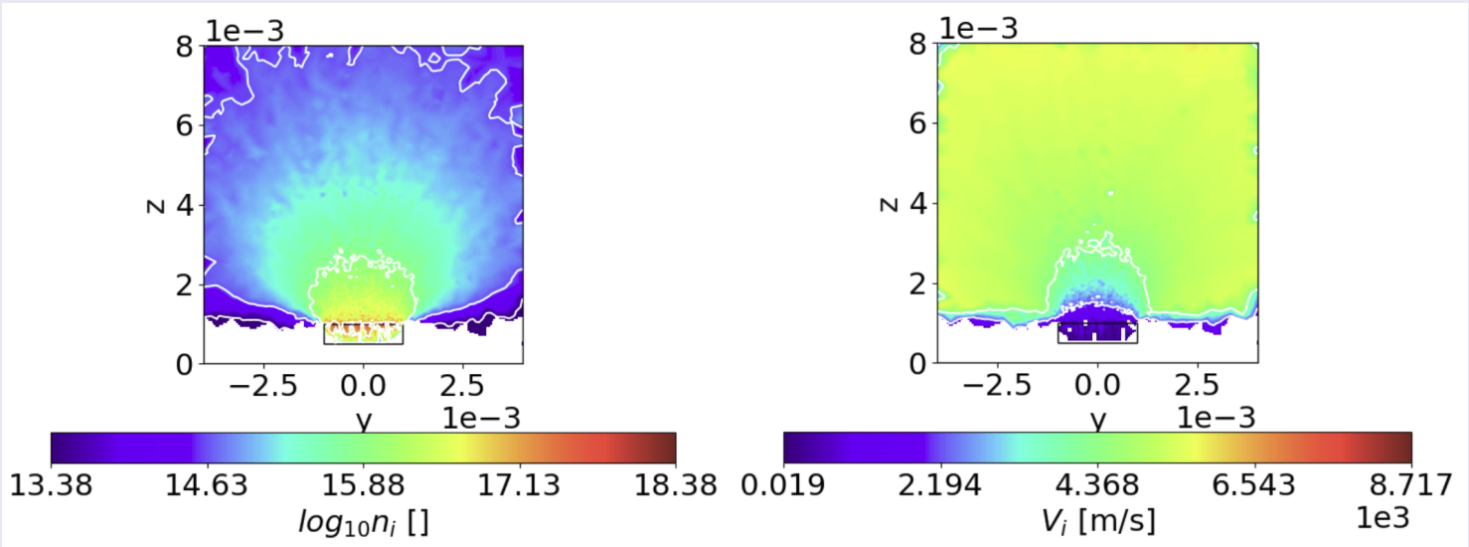
Helicon Plasma Source optimization

4. experimental-numerical optimization of the source is ongoing

Numerical-experimental approach

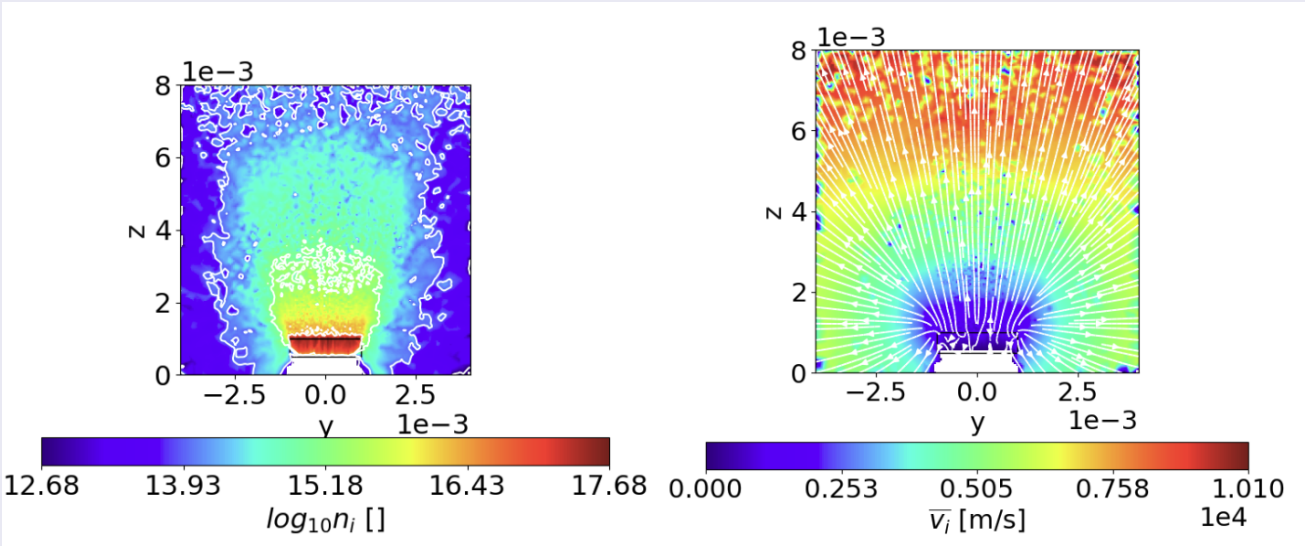
Magnetic nozzle optimization

1. after a literature review, we decide to resort on a three-dimensional Particle In Cell (PIC) simulation strategy
2. the source code of the open-source software Spis has been modified in order to simulate the magnetic nozzle and the plume



Numerical-experimental approach

Magnetic nozzle optimization

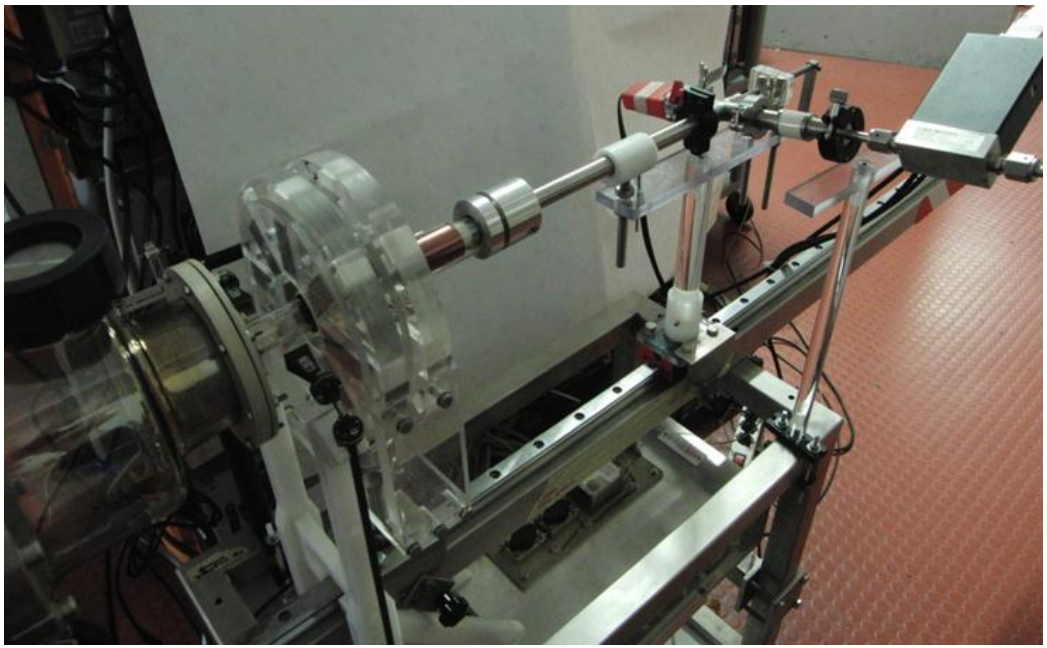


3. the identification of appropriate boundary condition is ongoing
4. the code will be validated against experimental data
5. experimental-numerical optimization of the magnetic nozzle

Experimental Setup

Diagnostic System

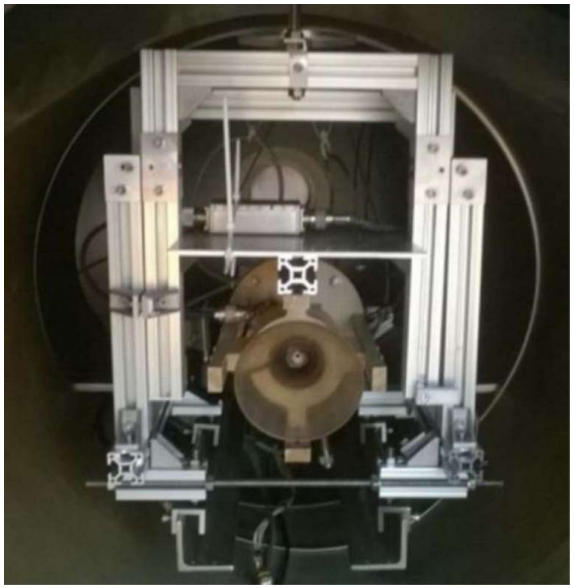
An optical spectrometer, a microwave interferometer and a Langmuir probe to characterize the plasma source



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