Modeling and simulation of air plasmas using particle methods applied to Air-Breathing Electric Propulsion

Pietro Parodi

University supervisor: Prof. Giovanni Lapenta
VKI supervisor: Prof. Thierry Magin

Aeronautics and Aerospace Department
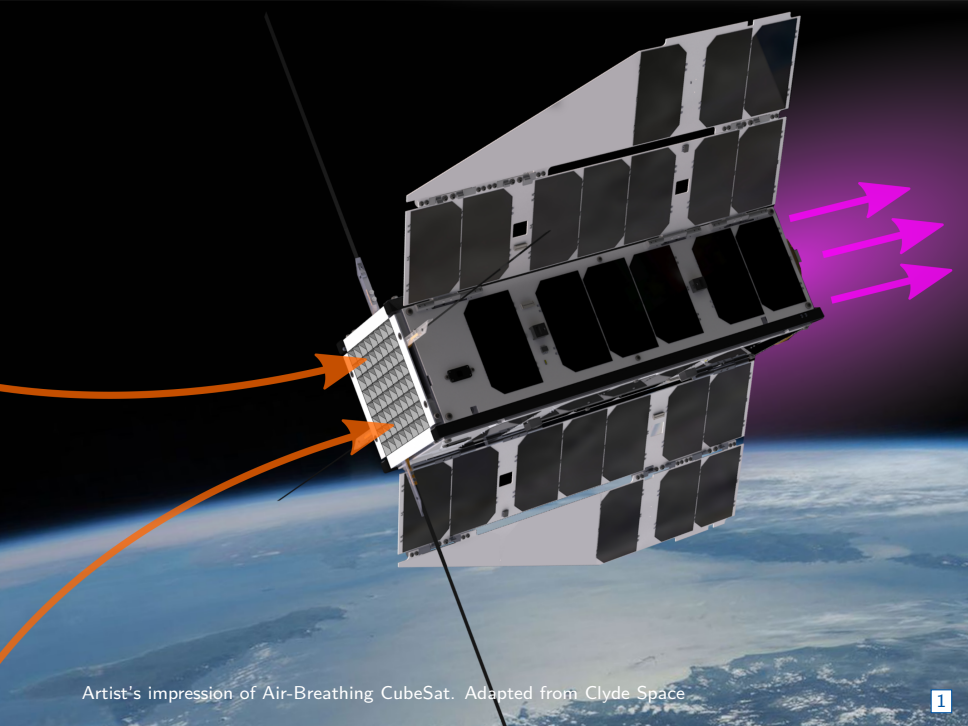von Karman Institute for Fluid Dynamics

Faculty of Science: Mathematics
KU Leuven

28th Spacecraft Plasma Interaction Network in Europe (SPINE) meeting
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Artist's impression of Air-Breathing CubeSat. Adapted from Clyde Space

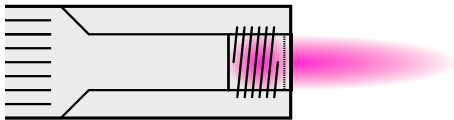# Motivation: ground reproduction of orbital flows

Real scenario – satellite

$\mathcal{S}_\infty = \{N_2, O\}$

$p_\infty \approx 10^{-4}$ Pa

$V_\infty \approx 8$ km/s

$T_\infty \approx 1000$ K

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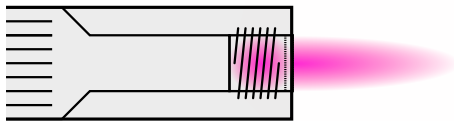
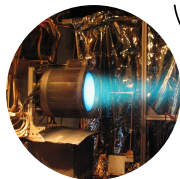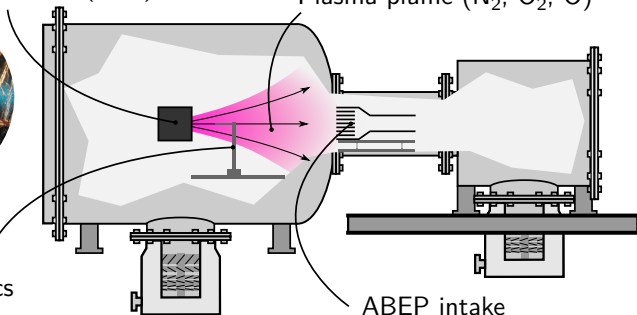**Ground testing facility**

Particle flow generator (PFG)

Plasma plume (N_2, O_2, O)

Diagnostics

ABEP intake

Objectives of the PhD project

PFG   plume   ABEP intake

ionization

dissociation

SEE

emission

$h\nu$

CEX

electron dyn

$\vec{E}$

elastic coll.

sheaths

GSI

n_e n_i
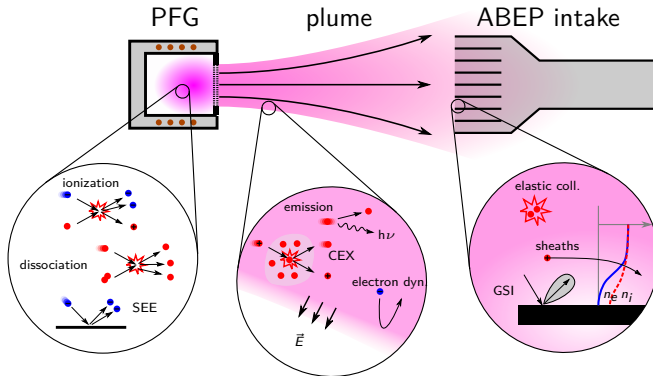
Modeling

Develop models for complex, multi scale phenomena

- Identify driving collisional processes
- Understand effect of GSI
- Study plasma sheath dynamics

Simulation

Advance plasma simulation tools

- Develop PIC-DSMC code
- Take advantage of semi-implicit PIC schemes
- Solve problem of under-resolved sheaths

V,V & UQ

Compare with VKI experiments

- Replicate experimental setup in simulations
- Estimate uncertainty from numerical error and uncertainty of input parameters

Thank you for your attention!