Titre : Analysis of atmospheric ionic wind propulsion inside a high-velocity adverse stream

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Context The goal of this project is to demonstrate the efficiency of ionic wind propulsion upon high velocity adverse stream. Several paper have recently renewed the interest for ionic wind propulsion. In 2013 [5] have shown that the thrust to power ratio was relevant for aircraft propulsion, later on confirmed by [4] showing propulsion caracteristics compatible with Solar Inpulse 2 flight [7]. Recently Barrett team at MIT sucessfullly flew a 2.4kg, 5m wing span drone [13, 9]. Even if this exploit showcase the ability of this propulsion, much remains to do to demonstrate its real applicability. One key discouraging point about ionic propulsion has been its poor efficiency [12, 11], but some theoretical predictions indicate it should increase at high speed [10]. A vast litterature exist on the use of ionic wind for boundary layer control over the last twenty years, e.g. [3]. Some studies have shown the influence of stream velocities, up to 25m/s [6] and at 60 m/s velocity [8]. Nevertheless at high speed, the injection of charges has been poorly studied. Chapman [2] has shown the influence of high velocity on the Intensity-Voltage curve of a tip-plate configuration for velocity as large as 394 m/s at 0.18 atm and 110 m/s zt 1.93 atm, and found a strong influence of the imposed flow with a modified Townsend law. In a turning wire configuration with 50m/s velocity a rising efficiency has been found [1] up to 7.5% as expected from theoretical prediction. A much larger efficiency of ionic wind is expected from basic theoretical arguments, but has never been experimentally reported.

Objectives The goal of this post-doc is to experimentally measure this propulsive efficiency at high speed inside a subsonic wind tunnel, and to demonstrate experimentally an improved efficiency. For this purpose a highly sensitive thrust force apparatus needs to be calibrated and adapted to the subsonic vein.

Pre-requisite skills :
- Aerodynamic education
- Experienced in experimental fluid mechanics
- Data processing
- Autonomous, communication skills.

Key words : Aerodynamics, ionic wind, electronic post-processing, PIV

Administratif issues :
- One-year contract, starting during October 2019-January2020 period
- An extra 12 months is possible from CNES funding support
- Net salary 2500 euros/month (including social security taxes)
- The post-doc will be located @ IMFT, Toulouse, www.imft.fr

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