

# PFE/Master internship 2022

## Modeling impinging jet resonances for reusable launchers

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<b>Location</b>	ISAE-ENSMA, Institut Pprime (CNRS, UPR 3346)
<b>Duration</b>	5-6 mois
<b>Starting date</b>	June 2022 or before
<b>Profile of candidate</b>	Master 2/Engineer
<b>Requirements</b>	Fluid Mechanics, gas dynamics, signal processing
<b>Allowance</b>	~600€/month
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<b>Pour candidater/To apply :</b>	Send CV and motivation letter before April, 30th 2022

### Subject of the internship

The space industry is facing strong competition which requires the rapid development of disruptive technologies allowing both increased competitiveness and minimal impact on the environment. Reusing the building blocks of the launcher is a solution that seems relevant, and bringing boosters back to earth is an option that has already proven to be convincing.

During the landing phase, the flow configuration: the propellant jet coming from the nozzle impacting the landing surface (figure 1), presents a high risk of instabilities that should be avoided, if we want to ensure an optimal design of the mechanical structure. To this end, the proposed project aims to perform acoustic and aerodynamic measurements of an impacting supersonic jet in order to build a reference database allowing the future improvement of predictive resonance models [2].

This will be achieved by 1) mapping the occurrence of the strongest instabilities and the associated resonances, using high speed sound pressure measurement, and 2) carrying out a campaign of velocity measurements using PIV, on well-defined cases, to obtain velocity fields for the construction of base fields which will be used, *a posteriori* for theoretical studies of flow stability.

The candidate will be integrated into the 2AT team, FTC department of the PPRIME institute and the experiments will take place in the SUCRÉ wind tunnel of the Prométéé platform. The candidate will have to master fluid mechanics and gas dynamics, skills in data analysis and signal processing will be an asset.

### Sujet du stage

L'industrie spatiale est confrontée à une forte compétition qui impose le développement rapide de technologies disruptives permettant à la fois un regain de compétitivité et un impact minimum sur l'environnement. La réutilisation des éléments constitutifs du lanceur est une solution qui semble pertinente et le retour à terre des boosters est une option qui s'est déjà montrée convaincante.

Pendant la phase d'atterrissage, la configuration de l'écoulement : le jet propulsif issu de la tuyère impactant la surface d'atterrissage (figure 1), présente un fort risque d'instabilités qu'il convient de maîtriser si l'on veut assurer une conception optimale de la structure mécanique. Dans ce but, le projet proposé a pour objectif de réaliser des

