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# PROPOSITION DE SUJET DE POST-DOC

## **Intitulé :** Numerical simulations of nanosecond discharges in air.


**Laboratoire d'accueil à l'ONERA :**

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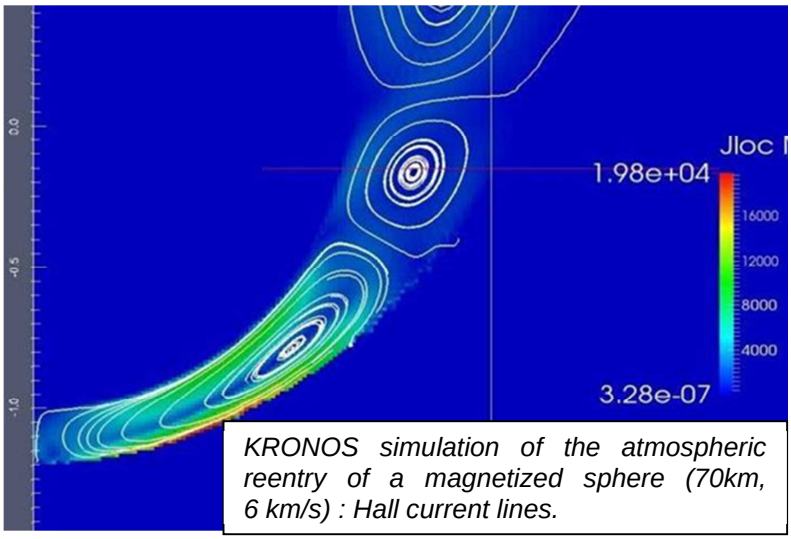
**Subject :** The numerical code KRONOS that couples plasmas with hypersonic flow fields has been developed at ONERA (Palaiseau) during the previous 3 years and is currently being finalized. Under the fluid and quasi-neutral approximations for the plasma, and using the CEDRE CFD platform (hydrodynamic), it is able to simulate atmospheric pressure plasmas from 0D to 3D, with non-equilibrium electron energy distribution or at LTE, with complex plasma chemistry, MHD (including Hall effect), and the interaction with complex flow conditions ranging from subsonic to hypersonic. It is also fully parallel, allowing to compute plasma simulations with high refinement and complex geometries, and runs on the 4000-core computer of ONERA. Given its capabilities, it is a world-level numerical tool.




*KRONOS simulation of the atmospheric reentry of a magnetized sphere (70km, 6 km/s) : Hall current lines.*

The goal of KRONOS is to be able simulate gas discharges for various applications, such as aerodynamic actuators, plasma-assisted combustion, decontamination, arcs and lightning, etc... For most applications, experiments are expensive and often difficult to interpret, and simulations can provide a better understanding of the important physics and parameters to increase the effectiveness of the prototype. The confrontation between experimental results obtained in previous works and simulations have to be used to validate parts of the code.

The purpose of the postdoctoral work proposed is twofold: **to improve the code** in terms of the physics modeled and the interfaces used, and **to use the code to simulate a nanosecond discharge**, for which experimental data is available.

The improvements planned for the code involve the chemistry input and its formalism, and the refinement of several of the physical approximations. For example, a vibrationnally-specific formalism need to be put in place. KRONOS would then be used by the candidate to model a nanosecond pulsed discharge and afterglow in air. This discharge was the subject of experimental work in the past at ONERA, and in particular vibrational and rotational temperature measurements by CARS are available in the afterglow as a function of time. Other tests cases could also be considered for validation of the code.

**PROFIL DU CANDIDAT:** The candidate should have a strong background in low temperature plasma physics. Programming skills are necessary (Fortran, Python ….). Experiences with parallel code would be welcome. The review of the applications will begin in May 2015 and will continue until the position is filled. The duration of the fellowship is 2 years.