February 21st, 2019

To the members of the selection committee,

I am a [Pegasus]^2 Marie Skłodowska-Curie fellow in KU Leuven, at the Center for mathematical Plasma Astrophysics (CmPA), working in Computational Astrophysics with Rony Keppens. I joined the CmPA in October 2016 after defending my PhD on *Wind accretion onto compact objects*, under the supervision of Andrea Goldwurm and Fabien Casse. I apply to the position of *Maître de conférence* at the Institute of Astrophysics of Paris, in the ASTHUP team, for I believe my profile could match the expected requirements and since it would be a valuable support to pursue and develop further my emerging academic career.

After my undergraduate studies at the Ecole Normale Supérieure, I volunteered to join the Kepler satellite data analysis effort under Saul Rappaport's lead at MIT. There, I was introduced to stellar evolution and binary systems and took an active part in the discovery and characterization of the first disintegrating exoplanet in 2012. My involvement also contributed to the identification of 30 new triple star systems and to a detailed analysis of the shortest-period exoplanets, those right in the spotlight of their host star. This seminal long term experience in Research laid the foundations of my scientific program : a better understanding of stellar objects and remnants in interaction with their environment.

As I started my PhD, I turned to numerical tools to complement the analytical skills I had acquired during the previous years and model the turbulent twilight of binary systems, the X-ray binaries. I got familiar with advanced techniques such as solvers for hyperbolic partial differential equations and parallel computing, in the context of the finite volume magneto-hydrodynamics code `MPI-AMRVAC`. With several successful proposals on Tier-1 clusters and the code development I carried out, I could run the widest dynamics simulations of wind accretion onto compact objects.

By the end of my first postdoctoral year in KU Leuven, I was granted a 3-years [Pegasus]^2 Marie Skłodowska-Curie fellowship. I also joined an ISSI sponsored collaboration led by Silvia Martínez-Núñez (IFCA) and Peter Kretschmar (ESAC) to gather observers and theoreticians from the X-ray binaries and massive stars winds communities. It enabled me to design and confront simulations of the accretion process in Supergiant X-ray binaries to the most recent observations of Vela X-1. Thanks to Jon Sundqvist and collaborators' simulations of the internal shocks in the wind of isolated massive stars, we could evaluate the impact of the wind micro-structure on the time variability of the mass accretion rate onto the neutron star.

I am now willing to extend my investigations to the modeling of the ejecta associated to the merger between a neutron star and another neutron star or a black hole, such as the one revealed by the gravitational wave signal and the electromagnetic counterparts of 2017. The expertise available at the IAP in the domain of high energy phenomena around compact objects would be a decisive asset to pursue this goal. May you judge my application admissible, I remain fully available to bring further information you might need.

Sincerely,

Ileyk El Mellah