13th December, 2015

Dear Professors,

I am applying to the postdoctoral research assistant position in observational and theoretical Astrophysics at the Institute of Astronomy. I am currently a 3rd year graduate student at the AstroParticule & Cosmology laboratory in the University of Paris 7 Diderot. Since fall 2013, I have been conducting my PhD research in Computational Astrophysics under the supervision of Fabien Casse and Andrea Goldwurm and I am expected to defend in September 2016.

After my studies at the ENS, I volunteered to join Saul Rappaport at MIT in 2011-12. There, I contributed to his efforts to make the most of the Kepler satellite data for exoplanets and stellar binaries investigations. This inspiring insight into binary systems drove me into the study of one of their turbulent twilight, the X-ray binaries. Fabien Casse then convinced me of the relevance of the numerical tool to complement the analytical skills I had acquired during the previous years. Indeed, the diversity of behaviours of those systems suggests an unavoidable need to pay attention to non-linear evolutions whose full analytical derivation remains beyond our current abilities. Existing semi-analytical scenarios have remarkably succeeded in accounting for specific observational features in X-ray binaries. Yet, our difficulties to devise a unique or even unified frame of thought demonstrate the price to pay for reducing a complex system to a small enough number of parameters to handle it. This is where high performance MHD simulations can be game changers. The new hardware technologies (e.g. GPU and InfiniBand) and optimized algorithmic schemes (e.g. AMR and flux-limited diffusion) both provided us with an incredible computing power. It is a determining moment to seize this quantitative opportunity to qualitatively supersede the previous semi-analytical models of accretion in X-ray binaries with more holistic simulations then ever before.

I am applying to this postdoctoral position in Cambridge for I believe my experience and commitment to computational and theoretical Astrophysics make me well qualified to meet the needs of this available fellowship. I want to capitalize on the numerical expertise I have acquired and develop new numerical setups able to tackle multi-scale and multi-Physics problems. I think I can fit in an enthusiastic and stimulating environment such as the IoA.

I have passed the French Agrégation in Physics where I ranked second and was granted teaching responsibilities at the Paris 7 Diderot University for the last three years. I also actively took part in the organization of the *Rencontre des Jeunes Physiciens* (Meeting of the Young Physicists) and in the promotion of Physics in festivals. I do intend to pursue my outreach and organizing activities and would gladly teach and monitor junior fellows.

I look forward to hearing from you.

Sincerely,

Ileyk El Mellah