

13<sup>th</sup> December, 2015

Dear Professors,

I am applying to the postdoctoral position in Black hole accretion at the Max Planck Institute for Extraterrestrial Physics in Garching. I am currently a 3<sup>rd</sup> 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 GRMHD 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 on to compact bodies with more holistic simulations then ever before.

I am applying to this postdoctoral position in Garching for I believe my commitment to numerical simulations of wind accretion on to compact objects provided me with skills which make me well qualified to meet the needs of the available fellowship. The case of SgrA\*, the main target for the contemporary missions the MPE is taking part in, is likely to be representative of this turbulent sub-Eddington accretion regime, albeit on a different scale. Working with Jason Dexter and his collaborators at UC Berkeley would be a decisive occasion for me to tackle the question of the observational properties of such a flow in a relativistic framework, following the pioneering work initiated in the 90's by people like Eric Agol, Heino Falcke & Fulvio Melia - the latter of whom I had the pleasure to meet as he was visiting the APC laboratory in my first year of PhD.

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,

Ilyk EL MELLAH

