

**NOM, Prénom :** EL MELLAH, Ileyk

**Date de naissance :** 5 Avril 1989

**Nombre de candidatures antérieures :** 0

**Interruption(s) d'activité(s) :** -

**Établissement et équipe d'accueil demandés :**

Institut de recherche en astrophysique et planétologie de Toulouse

Equipe galaxies, astrophysique des hautes énergies et cosmologie

**Post-doctorats et situation actuelle :**

Mai 2017 - Juin 2020 | Bourse FWO [Pegasus]<sup>2</sup> Marie Skłodowska-Curie | 3 ans | KU Leuven

Octobre 2016 - Mai 2017 | Contrat postdoctoral | 8 mois | KU Leuven



**Thèse :** *Wind accretion onto compact objects*, supervisée par F. Casse & A. Goldwurm à l'APC (Paris 7, équipe High Energy Astrophysics), soutenue le 7 Septembre 2016 (après 3 ans).

**Thèmes des recherches effectuées :** Compact objects (CO): neutron star (NS), black hole (BH) - Roche lobe overflow (RLOF), wind accretion - High mass (HMXB) and low mass X-ray binaries - Stellar and disc outflows, line-driven winds - Ultra-luminous X-ray sources (ULX)

**Méthodologies :** Théorie – Modélisation – Simulations

**Tâches de service effectuées et/ou envisagées :**

ANO2 SVOM - Bertrand Cordier (CEA) - Avec Jean-Luc Atteia et Olivier Godet (IRAP), caractérisation de la réponse instrumentale d'ECLAIRS et développement d'outils d'analyse de la performance de l'instrument pour le segment sol et l'*ECLAIRS Instrument Center* pour produire les fichiers auxiliaires de calibration nécessaires au traitement des données.

**Enseignements effectués :**

2018-19	Computational methods for Astrophysics	40h cours	5 <sup>th</sup> year	KU Leuven
2017-18	Linear Algebra	30h TD	1 <sup>st</sup> year	KU Leuven
2016-17	Computational methods for Astrophysics	60h TD	5 <sup>th</sup> year	KU Leuven
2014-16	Classical Mechanics	128h TD	1 <sup>st</sup> year	Paris 7
2013	Physics for Medical studies	32h TD	1 <sup>st</sup> year	Paris 7
2013	Deterministic systems and signals	32h TP	4 <sup>th</sup> year	Paris 7
2009-10	Teaching assistant	16h cours	high school	Gustave Eiffel

**Résultats principaux :**

2019: I proved that discs could be formed around a CO in a HMXB by capture of the wind, without RLOF, with dramatic consequences on the spinning up/down of the accretor. I also proposed a new mechanism for mass transfer in ULX. 2018: overdense regions form in the wind of hot stars (clumps). I showed that the serendipitous capture of these clumps by an orbiting CO does not account for the time variability of the mass accretion rate we observed in Vela X-1 with Chandra, contrary to previously thought. Additional instabilities in the immediate vicinity of the BH or in the NS magnetosphere are required. 2015-17: characterization of the structure of the bow shock formed as a CO moves through an ambient medium (mass accretion rate, stability, topology of the inner sonic surface), for instance the wind of a stellar companion.

**Programme de recherche :** Mergers between a NS and a BH or another NS can lead to the formation of a an accretion disc around the remnant. 1. Study of the parameters of this disc and of its evolution as it undergoes accretion onto the remnant at high mass accretion rates (above the Eddington limit). 2. Analysis of the neutrino-driven and subsequent line-driven outflow from this disc and its interaction with the surrounding ejecta responsible for the kilonova.

**Compétences acquises et points forts de votre candidature :** Wide expertise in Computational Astrophysics (e.g. MHD approximate Riemann solvers and flux-limited diffusion for radiative transfer). Improvements of MPI-AMRVAC, a finite volume code to numerically solve the equations of MHD, on an adaptive grid whose geometry can be adapted to the needs of a physical problem. I also gained experience in adjacent domains such as visualization, high performance computing, hardware, cluster and data management, profiling and code optimization.

## Publications

**Nombre de publications de rang A publiées et sous presse:** 11

**Nombre de publications de rang A soumises:** 0

**Nombre de communications et/ou de posters présentés à des conférences:** 14

**Autres (participation à des ouvrages, rapports techniques, codes, logiciels, sites web, etc...) :**

2013-18 Developer for the MHD code MPI-AMRVAC  
2017 Radio show *Faconde* on scientific outreach (Radio Campus, Bruxelles)  
2016 PhD manuscript  
2015 Festival of Sciences (Paris 7) and 3D-printing of Roche potentials  
2015 Personal webpage  
2015 Website of the *Rencontres des Jeunes Physiciens 2015*  
2015 Community manager of the *Rencontres des Jeunes Physiciens 2015*  
2015 Wolfram demonstration *Trajectory of a Test Mass in a Roche Potential*

**Liste des 5 publications de rang A, par ordre d'importance, qui illustrent le mieux votre travail et vos compétences (avec liens) :**

[1] El Mellah I., Sander A. A. C., Sundqvist J. O. & Keppens R.  
*Formation of wind-captured discs in Supergiant X-ray binaries : consequences for Vela X-1 and Cygnus X-1* (2019) - A&A

[2] El Mellah I., Sundqvist J. O. & Keppens R.  
*Accretion from a clumpy massive-star wind in Supergiant X-ray binaries* (2017) - MNRAS

[3] El Mellah I., Sundqvist J. O. & Keppens R.  
*Wind Roche lobe overflow in high mass X-ray binaries : a possible mass transfer mechanism for Ultraluminous X-ray sources* (2018) - A&A

[4] El Mellah I. & Casse F.  
*A numerical simulations of axisymmetric hydrodynamical Bondi-Hoyle accretion on to a compact object* (2015) - MNRAS

[5] El Mellah I. & Casse F.  
*A numerical investigation of wind accretion in persistent Supergiant X-ray Binaries I - Structure of the flow at the orbital scale* (2016) - MNRAS