Teaching & outreach statement

El Mellah Ileyk

Like many others, my eagerness to look up has been triggered by the stories and pictures brought back by space missions. From the pillars of Creation to the galactic splendors of Andromeda, from the rings of Saturn to the nebular beauty of V838 Monocerotis, my childhood Universe was full of solemn wonders I spent many nights looking for in the stars. Still today, I can hardly overcome the vertigo I am overwhelmed by at the thought of the infinite diversity of sights beyond the limits of our planet. Unfortunately, the times when we climb the ladder to the canopy of heaven is still way out of reach, but it does not mean that we are condemned to passively stare at the stars in prostration. With my school education came the idea that we were able to grasp what is going on up there, so deep in the infinity of the night, with Mathematics in one hand and Physics in the other : if our material conditions does set a limit on the extent of our sensible world, our understanding can still push the horizon further out and open hatches to unsuspected landscapes. It is with this conscious state of mind that I have always conducted my teaching and outreach assignments, thankful to all the teachers and scientists who cultivate my curiosity and willing to pass on the torch.

Teaching activity

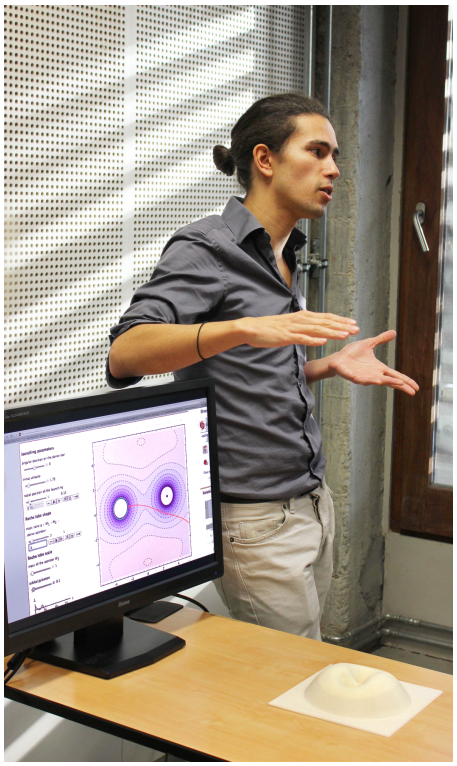
My first teaching experience was at the Ecole Normale Supérieure (ENS), during my first year of studies (last year of bachelor degree), in 2009. I applied to give courses in the high school Gustave Eiffel, under the supervision of Vincent Mayer, a permanent Physics teacher there. It gave me a first glimpse of what it means to prepare a course, a problem set or a lab session. I led activities to illustrate the functioning of telescopes, and gave a course on the components of the atomic nuclei. It is in part this seminal experience which motivated me to prepare for the Agrégation the following year. The Agrégation is a competitive examination to select qualified teachers for *preparatory classes to Grandes Ecoles*, a 2-years curriculum for the most promising undergraduate students. During this year, I reviewed the 4 years of Physics I had been taught (with also minors in Chemistry and Mathematics) so as to be able to teach at any undergraduate level. The diversity of the topics covered (statistical and quantum mechanics, special relativity, electromagnetism, nuclear Physics, wave Physics, organic and analytical Chemistry, signal processing...) brought me a wide cultural background that I put to good use later on in Astrophysics, an intrinsically transverse domain. At the end of this year, I passed the written and oral examinations and ranked second out of 1,500 candidates. Two years later, during my Master degree in Astrophysics, I was hired by the French company *Les Cours Thalès* to give private lessons to a dozen of students in first and second year of University and *preparatory classes to Grandes Ecoles*.

During my PhD, I have been granted teaching responsibilities by the Physics department of Paris 7 University. I monitored exercise sessions of 2 promotions of 40 students each in the first year of Medical studies (32h). From fluid mechanics to matter-light interactions, the students were asked to adopt a qualitative approach and to quickly adapt to practical situations they might be confronted to later on. I took part in the writing of the problem sets and their corrections. I then organized the lab sessions of the 4^{th}-year students in Deterministic systems and signals (32h). The students were asked to carry out data analysis (discrete Fourier analysis, convolutions, power spectral distribution, filtering...) with a Matlab interface. In my second and third years of PhD, I taught a course of classical mechanics to first year students, to the amount of 4 hours a week during the first term of each year (128h). The problem sets emphasized the mathematical skills to acquire (differential, integral and vector calculus) to fruitfully assimilate the following courses later in the year (electro and magnetostatics, thermodynamics...). I also wrote mid-term exams to evaluate the students.

Once at the KU Leuven, I participated in the course Computational Methods for Astrophysical Applications for master degree students (40h during my first year). This topic, closely related to my daily research activity, was the occasion to share in a didactic way the knowledge I had assimilated during my PhD through schools and practice, especially the skills not taught in a Physics major curriculum : the architecture of a MPI-parallelized code, the collaborative code development procedure (eg via Github), the workflow on a cluster (job submission and monitoring), the processing of large data on the run, the benchmarking of an implementation on analytical test-cases, the debugging and profiling of a given setup for HPC facilities (eg with Vampir Trace), the visualization of multi-dimensional results (with Visit, Paraview or Tecplot), how to summarize the results in synoptic layouts. Thanks to the expertise I acquired during my PhD in the field of hot star winds, I also co-monitor a master thesis student with Rony Keppens and Jon Sundqvist on the implementation of line-acceleration and flux-limited diffusion in `MPI-AMRVAC`. Next year, I intend to mentor another master student thesis, with an emphasis on producing synthetic observations from the simulations results.

Outreach activity

To build up bounds within the community of young researchers, the French Society of Physics (SFP) and the main Physics institutions of Paris sponsor a yearly event called the Young Physicists Meeting (RJP). During my second year of PhD, in 2015, I volunteered in the organizing committee as a community manager. My role has been to maximise the media visibility of the event, through its website I designed and maintained and through the social networks. I was also involved in the fund raising (15 k€). To guarantee the permanence of the RJP, I recorded and broadcast the 12 presentations given to the 200 participants, with the help of the technical staff of the Conservatoire National des Arts et Métiers where the event took place. I participated in the selection of the 12 presentations among the 40 abstracts we had received.



Intended for a broader audience, the Science Festival is the occasion to excite the curiosity of high schools pupils and interested citizens, in layman's terms. In October 2015, I gave presentations based on a Mathematica online applet I had developed to explore the trajectories of test masses in a Roche potential. Because I think we always need a material support to rely on, I also made used of the recently acquired 3D printer of the APC laboratory to print Roche potentials for different mass ratios. The coupling between these two interactive supports brought within the reach of the audience the concept of potential in Mechanics.

More recently, I took part in a radio show devoted to the question of the popularization of Sciences. I exposed my viewpoint on the need to challenge the audience's a prioris, in spite of the tempting envy an orator often has to echo the auditors' preconceptions on Science. Confronting people to the limits of their knowledge is a definitely more fruitful outreach strategy than reinforcing them in a peremptory and arrogant mindset. It is also the only way to reenchant the world, always so prone to bring up more questions than answers. Each time we sacrifice a bit of meaning to the sensational, we empower demagogic discourses, pave the way to cynicism and deter the kid who looks for mysteries and beauty, not definitive statements and sophisms. A demanding and enthusiastic sharing of the scientific Aesthetics is required to both preserve the integrity of Science, which drifts each day farther away from the general common culture, and to trigger the vocations we need to overcome the obstacles of tomorrow.