Dark Matter and MOOCs

Paolo Salucci¹, Claudia Antolini¹

SISSA/ISAS, via Beirut 2-4, 34013 Trieste, Italy

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ABSTRACT

**Aims.** To teach the topic of Dark Matter in Galaxies to undergraduate and PhD students is not easy, one reason being that the scientific community has not converged yet to a generally shared knowledge.

**Methods.** We argue that the teaching of this topic and its subsequent scientific progress may benefit by Massive Online and Open Courses.

**Results.** The reader of this paper can express his/her opinion on this by means of a confidence vote

**Conclusions.** Will MOOC and Astrophysics meet?

**Key words.** Dark Matter halos, MOOC

1. Introduction

Dark Matter is a main protagonist in our understanding of the Universe. As an example, let us recall the recent observations from the Planck Mission in which the existence and the position of the acoustic peaks in the temperature spectrum leaves little opinion other than the existence of dark particles filling the entire cosmos and driving the formation of its structures. It is well known that this and other independent observations point to a 25% of the density of mass energy of the Universe residing in a still unknown massive (particle) form.

On galactic scales, the evidence for the phenomenon we wish to explain in terms of Dark Matter is outstanding. The inner kinematics of galactic structures so as the properties of their lensing of distant sources (e.g. [Rubin et al. 1980; Bosma et al. 1981]) reveals the presence of something that the great majority of astrophysicists considers a dark “mass component”. Furthermore, there is also a general acceptance that the luminous component made of gas and stars is playing an important role in determining the present day properties of galaxies including their dark component. This is pretty about all on the shared knowledge.

In fact, the scientific community has no unique answers from universally shared truths about the distribution of dark and luminous matter in galaxies of different mass and Hubble type and how it compares with predictions from fundamental theories of elementary particles and galaxy formation. Furthermore, in investigating this issue even the connections themselves among phenomenology, simulations and theory are under debate. Let us stress that in the past 30 years a quite small number of groups and individuals has worked on this issue. The number is insufficient for the knowledge transfer especially if we consider that this topic has become indispensable to every single astrophysicist and elementary particle physicist. Furthermore, even experts sometime cannot agree also on fundamental points of the topic. Today, to teach DM in Galaxies to 1000 classes/year and to 10000 individuals/year is not a very easy task.

A Massive Open Online Course (MOOC) is an online free course aiming at large scale interactive participation and open access via the web. MOOCs provide interactive user forums that help build a community for the students, professors, researchers.

Although there has been access to free online courses on the Internet for years, recently the quality and quantity of courses has changed. Nowadays, the access to free courses has allowed students to obtain an high level of education. According to the New York Times “in the past few months several ten thousands motivated students around the world who lack access to elite universities have been embracing them as a path towards sophisticated skills...” The Top 10 Sites for Free Education With Elite Universities include now the University of Stanford and Berkeley, MIT, Harvard and so on.

The question is: what about a MOOC course on Dark Matter in Galaxies? Of course, this must be thought as the first step of a fruitful collaboration between the worlds of innovative teaching and that of Astrophysics. This proposal comes out by the fact that in our opinion, in addition to the advantages discussed above, a MOOC on Dark Matter in Galaxies will allow 1) a more general uniformity and better quality of the content taught to students everywhere 2) the formation of a world community that includes scientists active in this field and, e.g., students in countries where Astrophysics is not developed. 3) an impulse for the scientific community to search for a shared knowledge.

What does the reader think about it? Discussion about MOOCs in many countries has not yet started, personally a month ago we never heard of them. We started to grasp the potential of MOOCs for Cosmology as we heard of the MOOC Production Fellowships contest, hosted by Stifterverband fur die Deutsche Wissenschaft and iversity. The ten winning projects will receive funds and technical help to implement their MOOC concepts. In our particular case, to win one of the ten assigned fellowship is to speed up innovative teaching of astrophysics into (a possible) future because we believe that, today, in this field, without appropriate financial support, the will to produce such courses is near to zero.

The SISSA project “Dark Matter in Galaxies” envisages 25 one-hour lectures of highly fruitfully interaction between students and lecturer. Original data and codes will be made available for the learning pipeline. A global forum will be set up for ideas exchange, discussion, feedback and insights from experts in the field. This project has been presented by one of us at
Fig. 1.

Euclid Consortium Leiden Meeting in the "Education and Public Outreach" splinter session, receiving a good interest.

Readers that want to see details of this project and even vote for it, please follow the link

https://moocfellowship.org/submissions/dark-matter-in-galaxies-the-last-mystery

We thank of course, those the vote for it (the interest of the general public is very important in order to win the fellowship and this project is the only one presented in the wide field of astrophysics).

Of course small or even negative interest for what was discussed here, means no vote! Such a feedback would be useful to set the present point of view of the scientific community.

References

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