

Portuguese Participation in ESA's Eddington Mission

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Résumé

Eddington est une petite mission scientifique potentielle (F2/F3) qui adresse deux buts scientifiques majeurs: l'un est de produire des données sismiques d'étoiles sur le diagramme H-R; l'autre est de détecter et caractériser les planètes habitables extrasolaires. Le Portugal s'est impliqué dans le projet Eddington, en début 2000, suite à une collaboration de longue date entre le Centre d'Astrophysique de l'Université de Porto (CAUP), le Collège Queen Mary (Londres) et l'Institut danois de Physique et Astronomie (Aarhus), sur la sismologie stellaire.

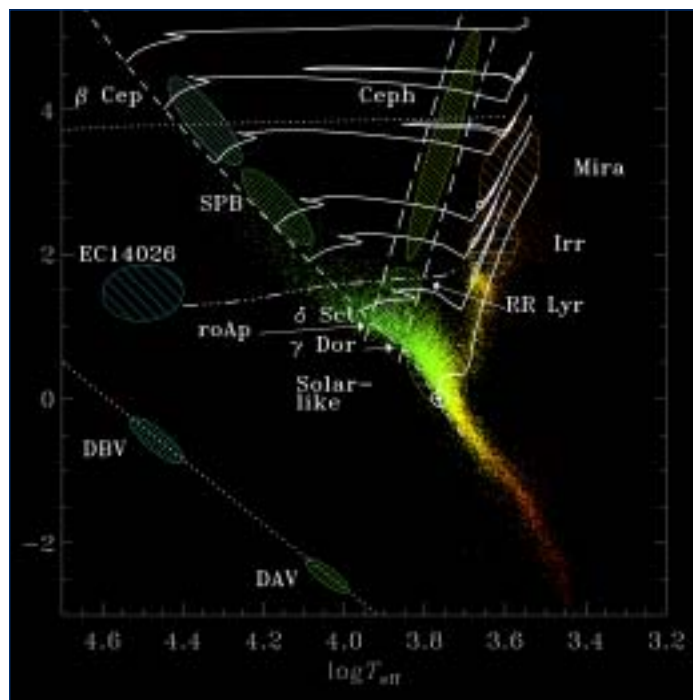
Introduction

Eddington is a proposed ESA scientific flexi-mission (F2/F3 – small size), which addresses two major scientific goals: to produce seismic data on stars across the HR Diagram and to detect and characterize extrasolar habitable planets.

The scientific goal for Eddington in terms of stellar seismology is to produce the data necessary for a detailed understanding of the interior structure of stars and the physical processes that govern their evolution. Seismology is a unique tool, which is able to provide the empirical basis for developing the theory of stellar evolution to the stage where it can be applied with confidence to address some of the major issues in modern astrophysics.

The detailed study of stars across the Hertzsprung-Russell (HR) Diagram through asteroseismology – i.e. the study of the resonant oscillation frequencies of stars of different masses, ages and chemical compositions – is the fundamental component for understanding the evolution of structures of all scales in the Universe (Fig. 1).

Figure 1. The Hertzsprung-Russell (HR) diagram for pulsating stars



The objective of the mission element on habitable planets is the detection of terrestrial planets around other stars, and in particular planets orbiting inside the "habitable zone", and thus in principle able to sustain life. The method consists of searching for photometric dips caused by the transit of a planet in front of its parent star. A large number of planets will be found which will also provide unique data for the study of the formation and evolution of planetary systems around stars with different characteristics.

The Eddington mission proposal (Fig. 2) was submitted in reply to ESA's Announcement of Opportunity (AO), in early 2000, by I.W. Roxburgh (Queen Mary College, London), J. Christensen-Dalsgaard (Aarhus, Denmark) and F. Favata (ESA/ESTEC). This proposal followed on from previous efforts to pursue the possibility of using stellar seismology from space to study and solve some of the fundamental problems in stellar structure and evolution. The mission will complement, and extend, the scientific goals addressed by the smaller exploratory space missions in preparation within national programmes (France, Denmark or Canada).

Portugal became involved in the Eddington proposal, in early 2000, as a result of the long-standing collaboration (over more than 10 years) between the Centre for Astrophysics of the University of Porto (CAUP) with Queen Mary College (London) and the Danish Institute for Physics and Astronomy (Aarhus), on stellar seismology. From this initial contact, the Porto team was incorporated into the proposed plans for the Scientific Data Centre (SDC) for Asteroseismology. Such a collaboration would build on the existing strong scientific cooperation with Aarhus (the institution proposed to host the SDC). It was subsequently possible to secure the confirmation from Portugal (given by ICCTI) of the national interest in the participation of the Portuguese teams in such a mission.

The mission proposal went through a feasibility study and the preparation of the scientific case, culminating in the submission of the Assessment Study Report in July 2000. Later that year the report was evaluated by the ESA Space Science Advisory Committee (SSAC), which recommended Eddington's inclusion in the package of ESA scientific missions for the 2008-2013 time frame. Following that decision, in October 2001 the ESA Science Programme Committee (SPC) unanimously endorsed the SSAC's recommendations, defining Eddington as a "reserve" mission in the ESA schedule for 2008-2013.

The "First Eddington Workshop" took place in Córdoba-Spain in June 2001. Also in 2001 there was an Invitation to Tender (ITT) for the study of the telescope (May) and a Call for Letters of Interest for scientific involvement in the Eddington study activities (June). Two Portuguese teams have integrated the proposal of a consortium to form the "EddiSDC Definition Working Group", aiming at achieving full definition of the Eddington payload and mission by the end of 2002. It will be followed by a final evaluation by ESA in order to decide on the mission's implementation in the proposed time frame.

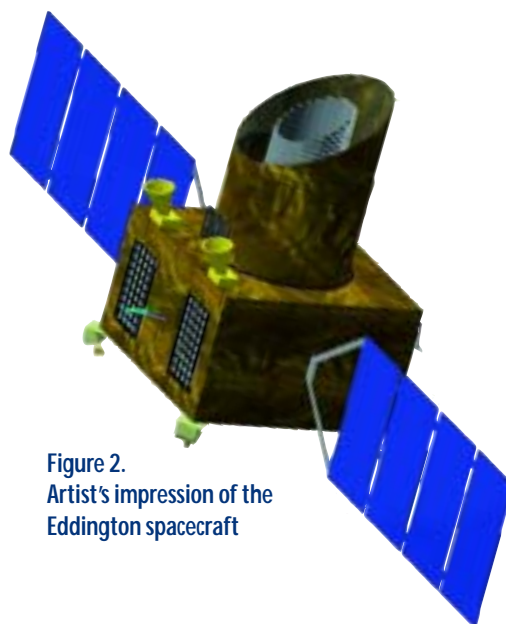


Figure 2.
Artist's impression of the
Eddington spacecraft

Conclusion

The Portuguese involvement in the planning, preparation, definition and support of an ESA mission (and Eddington in particular) has been mainly possible due to the close and extensive collaboration with the teams heading the initiative of proposing a space project in this field. Such an involvement is a challenge and has a strong and positive impact on developing the capacity of the Portuguese research community and institutions to take full advantage of the opportunities (present and future) provided by Portugal's participation in ESA.

To understand the inner workings of ESA and to know what is the most effective way to contribute to the success of the ESA activities, requires a strong scientific capacity on the part of the teams in Portugal and the existence of effective connections with other major groups in Europe. But above all, Portugal must reinforce the experience of the researchers by supporting an active involvement of the community in the preparation of the major missions of the ESA programme. Such participation requires support from funding agencies in Portugal and an open management of the projects by ESA.

At this point CAUP is still working on the stimulating possibility of contributing to the understanding of the inner workings of stars, through asteroseismology, by using a unique and powerful tool provided by a space mission dedicated to stellar seismology. With Eddington, or a similar mission, we will work towards the success of an ESA scientific programme which will contribute to putting the European research community at the forefront of stellar astrophysics.

For further information see:

[Http://astro.esa.int/SA-general/Projects/Eddington/](http://astro.esa.int/SA-general/Projects/Eddington/)
[Http://www.astro.up.pt/](http://www.astro.up.pt/)