EPSC Abstracts
Vol. 10, EPSC2015-748-6, 2015
European Planetary Science Congress 2015

Sciences pour les Exoplanètes et les Systèmes Planétaires: websites and e-learning

F. Roques (1), C. Balança (1), Y. Bénilan (2), J.M. Griessmeier (3), E. Marcq (4), T. Navarro (5), S. Renner (1), J. Schneider (1), and C. Schott (1)
(1) Paris Observatory, ESEP, France (2) Univ. Paris-Est, ESEP, France, (3) Univ. Orléans, ESEP, France, (4) Univ. Versailles, ESEP, France, (5) LMD, ESEP, France, (francoise.roques@obspm.fr)

Abstract

The websites « *Sciences pour les Exoplanètes et les Systèmes Planétaires* » (SESP) and « *Exoplanètes* » have been created in the context of the LabEx ESEP (*Laboratoire d'excellence Exploration Spatiale des Environnements Planétaires*) [1]. They present planetary and exoplanetary sciences with courses, interactive tools, and a didactic catalogue connected to the Encyclopedia http://exoplanet.eu [2]. These resources are directed towards undergraduate level. They will be used as support for face-to-face courses and self-training. In the future, we will translate some contents into English and create e-learning degree courses.

1. Introduction

The aim of this project is to provide free access to high quality scientific information and multimedia tools for learning planetary and exoplanetary sciences. Both websites *SESP* and *Les exoplanètes* are created under Creative Common 5 license, for undergraduate level (equivalent to L1 to L3 in the European LMD system). They can be used for face-to-face or distant learning scientific degrees, or training coursed aimed at high-school teachers, science guides or journalists.

2. SESP

The website *SESP* presents the current knowledge about planetary systems through the sciences that support this knowledge: maths, physics, chemistry… The chapters are autonomous modules written by researchers and professors specialists in the field. Each of them corresponds to roughly 10 hours of student's work.

They share a common structure: - **Discover**: description of the astrophysical object, with no or few equations. - **Understand**: the sciences necessary for the study of the object. **Test**: self-assessment exercises, to check that the chapters are understood and known. - **Mini-project**: a data analysis project with scientific data about solar system planets or exoplanets.

Figure 1: home page of the site *SESP [3]*

23 authors followed these guidelines to create the modules listed below. The website will open in October 2015 with those 23 modules. 28 modules are expected for October 2016.

1-Histoire et définitions des (exo)planètes – 2-Origine et évolution des systèmes planétaires – 3-Statistique sur les exoplanètes – 4-Structure interne des (exo)planètes – 5-Surfaces planétaires – 6-Structure thermique des atmosphères planétaires – 7-Dynamique atmosphérique – 8-Modèle de circulation globale des atmosphères – 9-Atmosphères : composition – 10-Petits corps – 11-Magnétosphère des planètes – 12-Relations étoile-planètes – 13-Orbites planétaires – 14-Flux et spectre – 15-Polarisation – 16-Mesure de plasmas – 17-Flux UV – 18-Imagerie planétaire – 19-Détection des Exoplanètes : Méthode des vitesses radiales et astrométrie – 20-Transits – 21-Habitabilité des (exo)planètes – 22-Exobiologie – 23-Origine de la vie sur Terre.

Several interactive tools have been created for these modules, in particular in the frame of the mini-projects. One example of crater formation is given in Fig. 2. **Navarro** et al. and **Turbet** et al. will also present two other examples in this session.

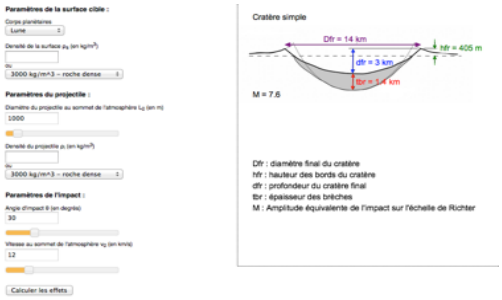

Figure 2: Applet of impact crater simulation (A. Le Gall and C. Schott)

3. « Les exoplanètes »

The website *Les exoplanètes* has been created in the context of the SESP project to replace the obsolete multilingual website *Exoplanètes* [4] created in 2005 but still very much used (3,500 Google hits). The new website is built around a catalogue of exoplanets, which is a simplified mirror site of the research catalogue of the Encyclopedia exoplanet.eu. It is less complete than the research catalogue; however it is up to date with the latest discoverd exoplanets. Whenever possible, the catalogue computes an equilibrium temperature (assuming a zero albedo) and the planet density. In addition to the catalogue, this new website contains visualization tools to work on the data, a histogram and a 4-parameter diagram (Fig. 3). Commented diagrams show how these statistical tools allow exploring the exoplanetary systems' properties and the outstanding issues.

The site contains a table of exoplanet families, an exoplanet counter, 2D and 3D sky maps, and small chapters answering questions about exoplanet definitions, discovery methods, habitability… A 3D simulator shows the structure of all the exoplanetary systems and compares it with the solar system and displays the habitable zone.

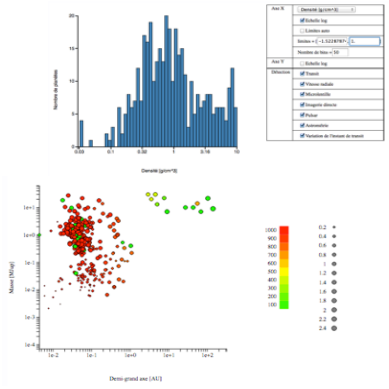

Figure 3: *Top* Histogram of the planet densities. *Bottom* Diagram of the semi-major axis as a function of mass-radius (size) with equilibrium temperature (color). (F. Roques and C. Schott)

4. Future: E-learning projects

After their launch in October 2015, the websites will be used in the L1 to L3 degrees of the partner universities. Further chapters will be added to the SESP website. Projects of distance training are under discussion.

The website *Les Exoplanètes* will be used for remote training including evaluation, taking advantage of the experience of the Paris Observatory. Moreover, we plan to translate the site into English. A collaboration with the Michigan State University could lead to a Summer School based on this website.

Acknowledgements

The SESP project is supported by the LabEx ESEP. The authors are grateful to the University of Versailles Saint-Quentin-en-Yvelines, the University Paris-Est Créteil Val de Marne, the University of Orléans and the Paris Observatory for their participation. We also thank the UNT Unisciel for funding the project.

References

[1] http://www.esep.pro/
[2] http://exoplanet.eu
[3]http://www.esep.pro/Astrophysique-en-ligne-Sciences.html
[4] http://media4.obspm.fr/exoplanetes/.