

« Hubble Tuning Fork Diagram » project with Faulkes Telescopes.

- **Faulkes Telescopes**

As written on the Faulkes website : « The Faulkes Telescope Project was established to inspire young students to study and take part in real science. The project is managed by staff at the University of Glamorgan who also run a BSc Honours Degree course in Observational Astronomy that includes time using the Faulkes Telescopes. The Faulkes Telescope Project can provide 1500 hours observing time on two, 2-metre astronomical telescopes, one on the island of Maui in Hawaii (Faulkes Telescope North) and the other at Siding Spring in Australia (Faulkes Telescope South). The telescope time is freely available via the Internet to schools in the UK and provides 'live' astronomical observing direct from the classroom. The telescopes were originally funded by the DFET but are now owned and maintained by Las Cumbres Observatory Global Telescope Network (LCOGT)..... »



Dr Sarah Roberts is the Education Director. Thanks to her, the college astronomy workshop got an account for the use of telescopes. We will correspond with her to publish our results.

See our article: <http://www.faulkes-telescope.com/news/2485>

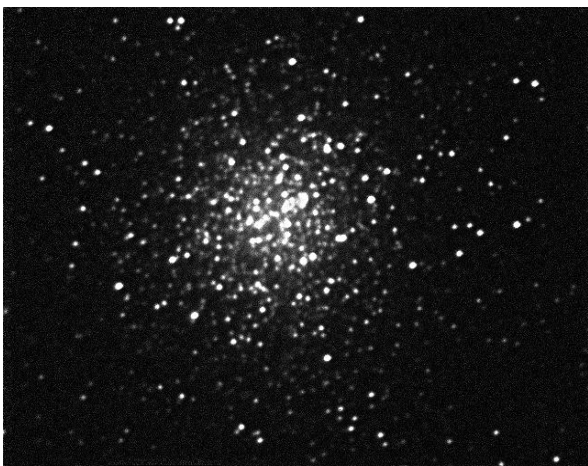
The project was organized by Cardiff University between 2003 and 2010. Since 2010, it has been hosted by the University of Glamorgan. For more information, see the following websites: www.faulkes-telescope.com and www.LCOGT.net

There are many applications and advantages:

The images are of very high quality. The observations are made at midday due to the time difference.

The weather is way more often favorable in Hawaii and Australia. It depends on the seasons

Example: For comparison, see a couple of M13 images, one obtained with the C8 (supplied by Sciences à L'Ecole) at College Astronomy workshop and on other obtained with the FTN (Hawaii)



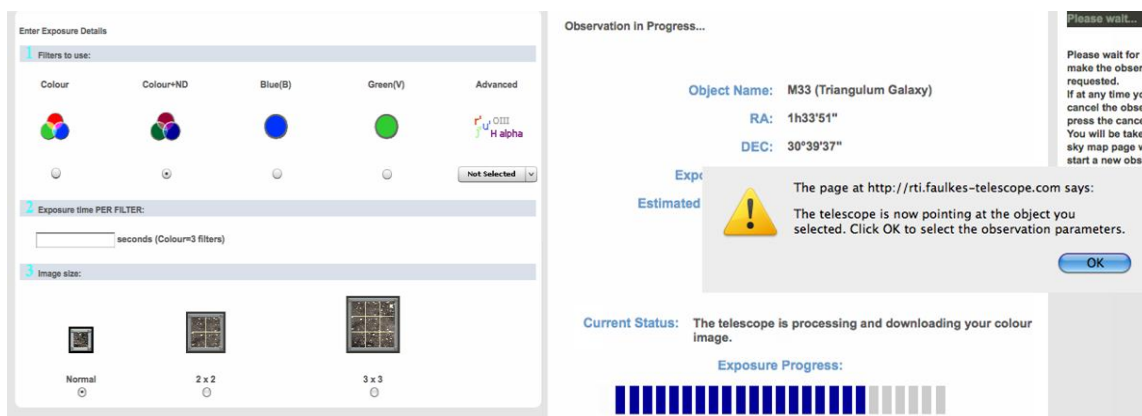
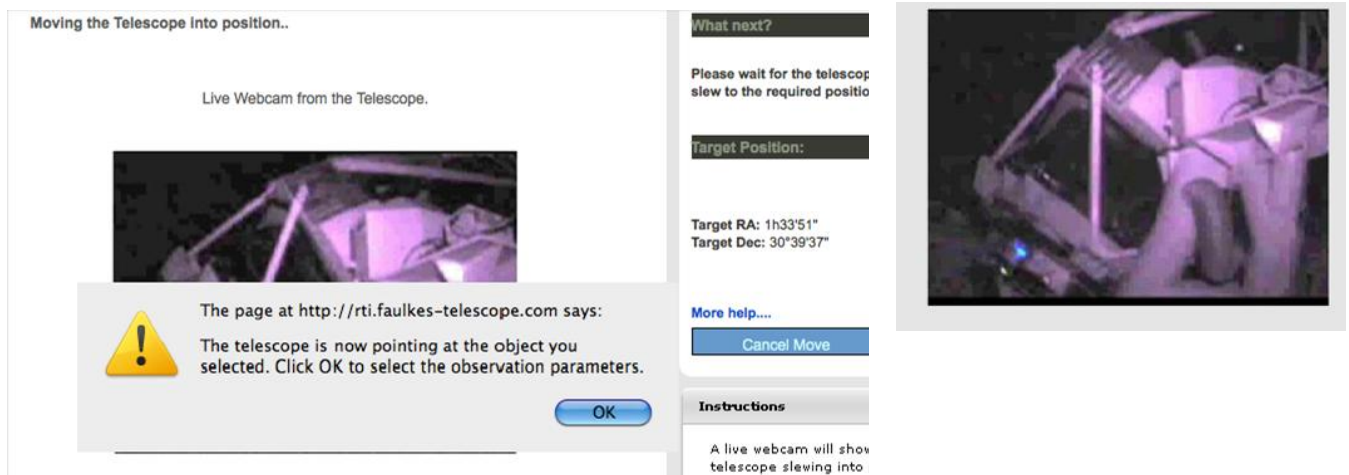
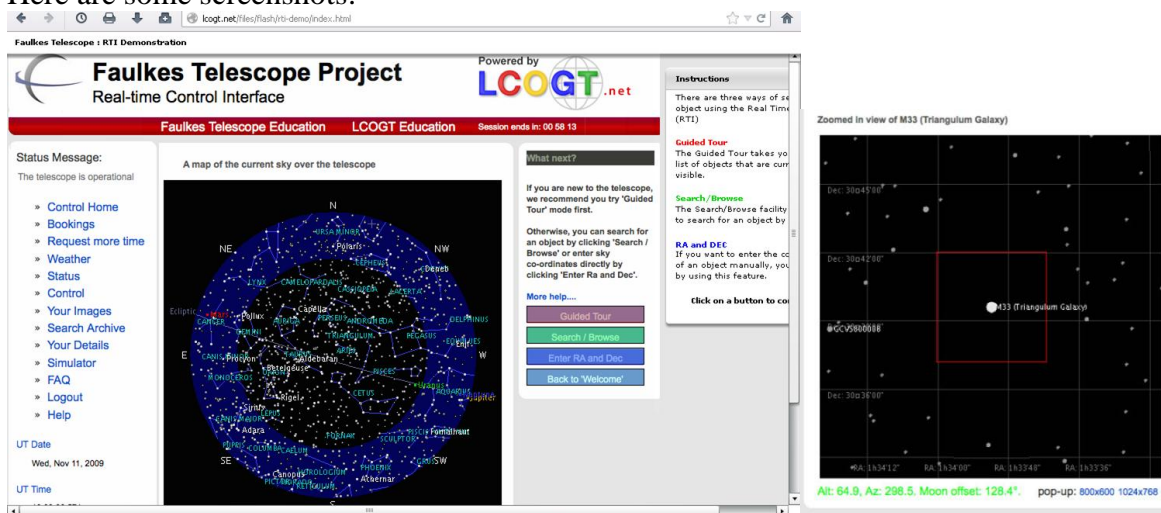
Left C8 + DMK, stack de 12 images 20s each, IRIS processed.

Right 20s on each filter RGB with FTN.



The Faulkes telescopes control interface is very simple. A tutorial and demo mode is available on the site.

Here are some screenshots:



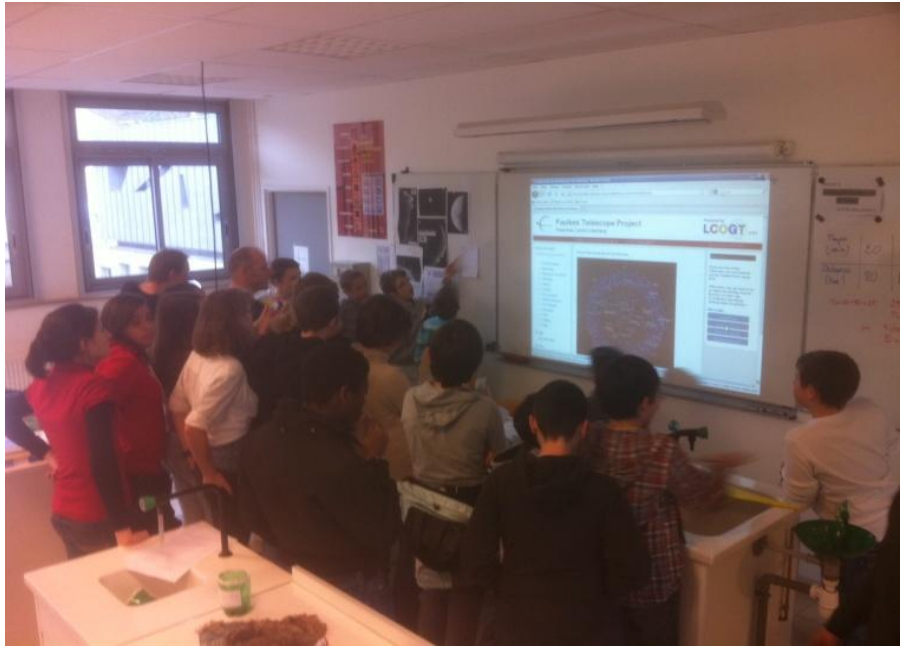
- **EuHou & Nuclio/GTTP**

These European associations of promotion of astronomy in schools with the aim of teacher training (workshops, production of educational materials and software for e-learning) have enabled us to contact the Faulkes telescopes.

It started with a workshop at Pampilhosa da Serra, Portugal which I participated with my colleague Fabien Pradel. This taught us how to pilot small remote radiotelescopes (in Onsala, Sweden.), to start mapping our galaxy. Once again, the interface and the acquisition are quite simple but the interpretation of results is too complex for highschool pupils which are rather attracted by the visual results and therefore the use of Faulkes telescopes.

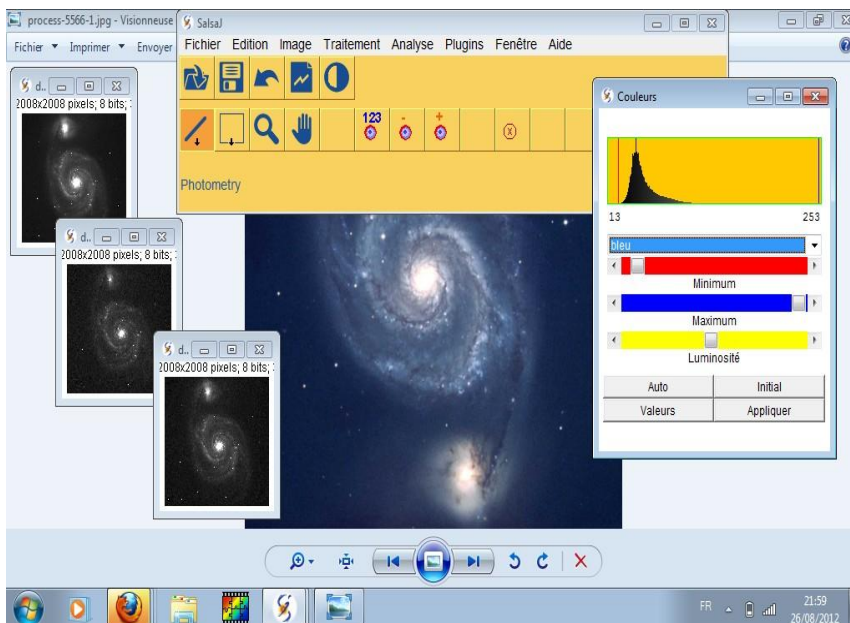
• The Hubble Tuning Fork project

The subject of study is decided. We engage in a bestiary of galaxies with the first classification as was made by Edwin Hubble in his famous tuning fork diagram. We engage in series of image acquisitions with Faulkes telescopes to illustrate the different classes of galaxies. Students start researching and writing a paper on the classification of galaxies. Claire, a pupil in the fifth grade completes the presentation to the group on an interactive whiteboard. (Big success). To search targets for Hawaii and Australia, the students are divided into groups. The tools are simple. (Stellarium and Wikipedia helped a lot) Of course we seek first in the Messier catalog. We must collect the coordinates and magnitudes to assess the necessary exposure times. We check that the objects are clearly visible during the time slots we have booked. (Far from the moon, high enough above the horizon ...) Comparing with the results of other school on the same objects we sometimes adjust our parameters.



Warm in the classroom at noon we are not yet safe from weather hazards: we lose several slots with the Australian telescope because of the rain. The targets will be picked in the archives of LCOGT.

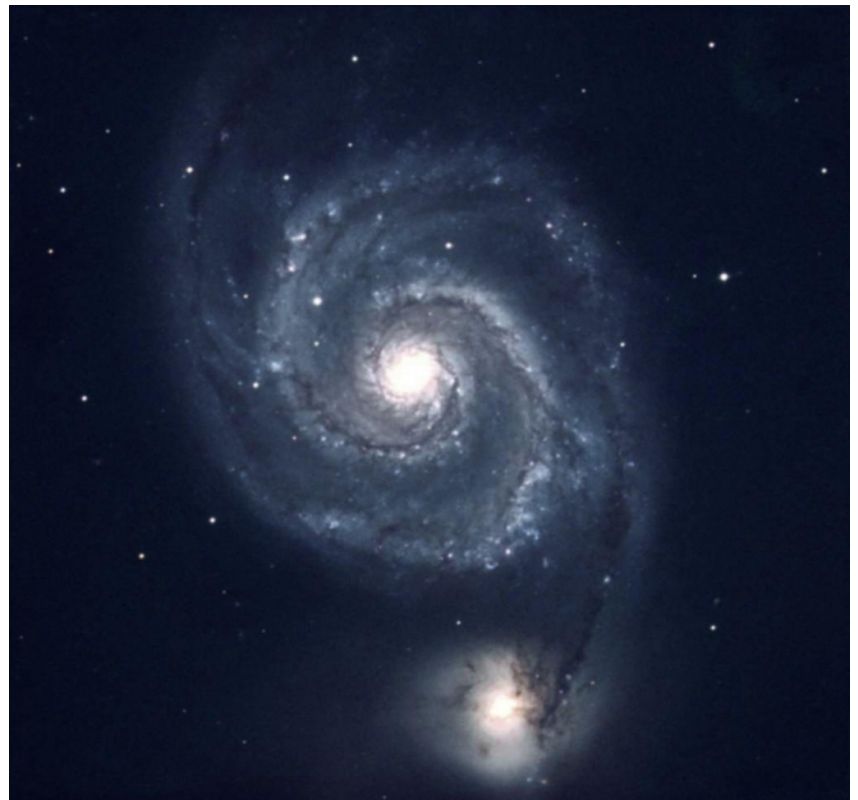
The image acquisition sessions are really great moments full of suspense waiting for the arrival of images on the screen.



The image processing is performed by Quentin 4th using Salsa J, a free Java software for astronomical image processing developed by EuHou. We begin by retrieving Fits images files R, G, B. These files are heavy. (more than 10MB each). We must align colors, edit slightly (cosmetic : RGB balance, contrast, noise reduction by gaussian blur ...). This work is quite accessible to high school students. The software is really designed for.

More complex processing are usually done with the DMK camera. Flat and Dark, for example, are not possible, We assumed that the preprocessing is carried out by the telescope. Therefore, we just make slight unsharp masks, Van Cittert deconvolution (Richardson-Lucy) (IRIS)

M51, 2012/04/13 11:47 UT
 FTN (Hawaiï)
 120s each red green blue
 2008x2008 px.



The English language is used for publication on the websites Faulkes, EuHou, GTTP. It is not really a problem. We seek help from friendly English teachers. The production of a poster is the result of our project. The poster background is offered on the Faulkes website. We add pictures of our targets and complete with archives LCOGT.

The Hubble Tuning Fork Diagram

Diagram *Galaxy Morphological Classification*

Ellipticals
 E0 (M87), E3 (M49), E5 (M59), E7 (M102)

Lenticulars / S0
 NGC5866

Spirals
 Sa (Edge On) (M104), Large dust lane (M63), Sc (M101)

Barred Spirals
 SBa (M95), SBb (M109), SBc (NGC1356)

Irregulars - Peculiar
 M82, M51, M106

All images taken with the Faulkes Telescopes
 College C.Percheret's astronomy workshop 2012
<http://col21-perceret.ac-dijon.fr/col-astro>

• Extensions of our project with Galaxy Zoo

On the advice of Roger Ferlet, Research Director at the Astrophysics Institut of Paris and EUHOU we met at the national *Sciences à l'Ecole* workshop at the Observatory of Haute Provence in April 2012 with my colleague Yann Gardiennet, we extend our project Galaxy Zoo.

"Welcome to Galaxy Zoo, where you can help astronomers explore the Universe. Hubble uses gorgeous imagery of hundreds of thousands of galaxies drawn from NASA's Hubble Space Telescope archive. To understand how these galaxies, and our own, formed we need your help to classify them according to their shapes — a task at which your brain is better than even the most advanced computer. If you're quick, you may even be the first person in history to see each of the galaxies you're asked to classify."

The pupils participate in this project, classifying galaxies according to their shape. Very quickly hooked, they classify more than 2000 galaxies in a week: This is a drop in the ocean but they feel proud to take part in an international project. Just for fun, for science. These volunteers work with images taken by the Sloan Digital Sky Survey program and decide whether the galaxies are elliptical or spiral and report if they have features like having a bulge barred core or have any transformations, whether it's face/edge on, dust lane... The purpose of this survey is to validate the models proposed by galactic scientists.

English interface, once again and Quentin is assigned to present a tutorial for his co-workers and to present the classification algorithm. The opportunity to learn a lot of vocabulary in English.

• ... to be continued.

Students will fully enjoy their vacation but will meet in October to resume workshop with new projects for 2012/2013.

Continuing with the theme of galaxies, we'll try to measure, weigh, or model them... What about, a little later, studying Hubble's Law? the age of the universe?... We won't forget to make a 3D model for the youngest.

But there is the TAROT project. Very interesting, it involves pupils to take part in detecting supernovae ... but that's a different topic.

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Sciences à l'école, F-Hou, Galileo Teacher.

• Webography :

- <http://www.faulkes-telescope.com/news/2485> : Our article sur Faulkes
- <http://lcogt.net/observations/user/5106> : Our pictures
- <http://www.fr.euhou.net/> : EuHou
- <http://col21-perceret.ac-dijon.fr/col-astro> : Our website
- <http://www.galaxyzoo.org> : Galaxy Zoo
- <http://www.site.galileoteachers.org> : Galileo Teachers Training Program