

# Educational Projects at ESO

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## Abstract:

ESO's public outreach activities comprise communication and media activities, educational projects and targeted events, addressing well-defined audiences. In 2004, one major activity stands out both in terms of visibility and in covering all of the above areas: the Venus Transit 2004 Public Science Discovery Programme. This very successful programme comprised the development of an extensive set of teaching materials for schools, a web-based information and reporting system, observational activities on the day of the transit as well as a video contest and a final event in Paris in November.

## 1 Introduction

In order to understand the latest reports on new and exciting discoveries, put them into context and then, hopefully, continue to support research, it is essential that the public has some basic scientific knowledge. It is therefore quite alarming to discover for example that only about a third of US adults are aware and accept the idea that “the universe began with a huge explosion” (NSB, 2000; quoted by Miller, 2004). As worrying is the fact that the same study reveals that only half of US adults know that the Earth rotates around the Sun once in a year. And the situation does not look better in Europe since a comparative study with Britain in 1988 found this ratio to be only one third (Miller, 2004). At a time when science is becoming more and more ubiquitous in our modern society, more and more affecting our daily lives, such reports cannot but raise a lot of concern. This appears even more critical in the framework of the *Lisbon strategy* devised by the leaders of the European Union in order to make Europe a knowledge-based society by 2010. This goal can only be achieved if the new generations become more and more scientifically literate and if science can attract many students, who will become the much needed scientists of tomorrow.

At the same time, however, that there is a well-documented and widespread public interest in science there is a clear disinterest in science learning! The ROSE survey has, for example, shown that to the question “*I would like to have as much science as possible in school*”, the answer, in European countries (but also in Japan), was clearly not very encouraging (Schreiner & Sjoeborg, 2004). This is complemented by a worrisome decline in science teachers. Between 1993 and 1998, the number of new science teachers in the UK fell from 553 to 181 per year. And this is just one example.

## 2 An ensemble of activities

There is thus no doubt that a dedicated effort to improve science education in Europe's primary and secondary schools is crucially important. The subject of Astronomy and Astrophysics plays an increasingly important role therein. Indeed, this particular field of basic science is very attractive to young people and its interdisciplinary dimension makes it an ideal tool to address many topics in schools. ESO, the European Organisation for Astronomical Research in the Southern Hemisphere, has since many years undertaken, often in association with other European organisations, to address these issues. ESO has for example played a most fundamental role in the setting-up of the European Association for Astronomy Education (EAAE), a network of teachers, and has since more than a decade successfully participated to the calls of the European Commission for the Science Weeks. Initial programmes were often collaborations with the EAAE, as well as with CERN and ESA, while in the last years, most educational programmes, except for the more astronomically oriented Venus Transit 2004, were performed in the framework of EIROforum, a partnership of seven of Europe's major intergovernmental research organisations (CERN, EFDA, EMBL, ESA, ESO, ESRF, and ILL), that was created in 2002. One of these programmes is the very successful "*Physics on Stage*" concept that is directed towards science teachers and pupils in Europe's secondary schools. The project seeks to improve the quality of teaching and to find new ways of stimulating pupils to take an interest in science. It aims to facilitate the exchange of good practice and innovative ideas among Europe's science teachers and to provide a forum for a broad debate among educators, administrators and policy-makers about the key problems in science education. The "Physics on Stage" programmes have now been extended to encompass all sciences and are organised through the EIROforum partnership in the "*Science on Stage*" festivals, the first one being organised at CERN in November 2005, the next one in Grenoble in Spring 2007.

The "Physics on Stage" and "Science on Stage" are by far not the only educational projects done by ESO. Many projects were done in collaboration with the EAAE - thereby ensuring that the programmes are most suited to teachers - and are presented further in this volume (see F. Wagner's contribution). To make things more formal, in 2001 it was decided to set up an Educational Office within ESO. One of its first task was to conduct a survey of the specific needs for astronomy education in Europe's high-schools (Bacher, 2002). Another was to publish, in collaboration with ESA, four comprehensive astronomy exercises that allow high-schools students to gain exciting hands-on experience in astronomy by making realistic calculations based on data obtained by the Very Large Telescope and the Hubble Space Telescope. Two more exercises - on measuring the acceleration of the Universe based on supernovae data and on Trans-Neptunian Objects - are in preparation. ESO also recently embarked upon another ambitious teaching project, in connection with the intercontinental ALMA observatory. The new project, the "ALMA Interdisciplinary Teaching Project", aims at developing and producing ALMA-related educational material at the secondary level. A brainstorming meeting with teachers and scientists took place to specify the format and the content. A list of 30 key topics was established, with teachers volunteering to work on most of them. It is planned to have a useful version of the Educational toolkit ready by the end of the summer of 2006.

## 3 The VT-2004 Science Discovery Programme

The Venus Transit 2004 (VT-2004) programme is another successful programme established through a major organisational effort by ESO, in collaboration with the EAAE, the Institut de Mécanique Céleste et de Calcul des Ephémérides (IMCCE) and the Observatoire de Paris in

France, as well as the Astronomical Institute of the Academy of Sciences of the Czech Republic. It profited from substantial support of the European Commission within the framework of the European Science and Technology Week. The main idea of this highly innovative, educational programme was to take advantage of this extraordinary and rare celestial event to expose the wide public – in a well-considered, interactive and exciting way – to a number of fundamental issues at the crucial interface between society and basic science.

The programme established wide international networks of individuals, including school teachers and their students, amateur astronomers and interested laypeople, as well as educational institutions like astronomical observatories, planetaria, science centres, etc. It went to great lengths to encourage real-time measurements from which one of the most fundamental astronomical parameters could be determined, the distance from the Earth to the Sun. In order to promote the Venus transit and provide information about the opportunities for participation in the various countries and geographical regions, VT-2004 “National Nodes” were established in many places and as such constituted the main contact points for the media in the corresponding countries and regions. VT-2004 moreover promoted web-encounters and international collaboration throughout Europe as well as in Africa and Asia, stimulating visual and photographic observations of this rare celestial event, with related debates via the Internet. During the preparatory phase, highly useful meetings were held between the organisers and school teachers (Luxembourg, January 2004), media representatives (Germany, March 2004), and amateur astronomers (Czech Republic, May 2004), respectively, which greatly contributed to the shaping of the various activities so that they optimally responded to the expectations and needs of different communities.

On the day of the transit itself, the best images available, via dedicated links to the foremost observatories and from numerous websites set up by observers in many different countries, were selected and displayed at the ‘VT-2004 Central Display’ page with live comments by a team of professional astronomers in the ‘VT-2004 Control Room’ at the ESO headquarters in Garching. Judging from the number of registered hits, there is no doubt that the VT-2004 web site may be qualified as resoundingly successful. During the 8-hour interval around the transit period, there were no less than 55 million hits on the VT-2004 website and 1.75 terabytes of data were delivered. This would have brought most servers to their knees, but thanks to foresight and good preparation, the VT-2004 website with its hundreds of *Akamai* mirrors did not suffer the fate of several other sites – including some by major organisations – which collapsed under the load, as was reported in the news. In fact, at the moment of the transit, the VT-2004 website received almost exactly as many hits as the official website of the Athens Olympic Games and it was one of the 6000 most visited websites worldwide.

As a unique aspect of the VT-2004 programme, and never before attempted on this scale, the ‘VT-2004 Observing Campaign’ was launched with the goal of a real-time measurement of the Astronomical Unit. This sub-programme was carefully organized to re-enact the historical determination of the AU by means of accurate timings of the four moments of contact between Venus’ black circle and the border of the solar disc. The preparations paid off and this complex project generally went very well. A large number of groups of observers registered in the months and days before the transit; by the stipulated deadline on July 10, 2004, no less than 4509 contact timings had been received from 1549 registered observing teams. While most of these were located in Europe where the observing conditions were particularly good, there were also data from teams on all other continents except Antarctica. Following extensive analysis of this large material by staff members of the Institut de Mécanique Céleste et de Calcul des Ephémérides, the final result of the VT-2004 Observing Campaign to determine the distance from the Earth to the Sun was published in late 2004: 1 Astronomical Unit = 149 608 708 ±

11 835 km, i.e., only 10 838 km larger than the ‘true’ value!

In addition to the many activities around the Venus Transit itself, the organisers also aimed at evaluating in gross terms the sociological impact of such a very rare astronomical event and the way it was perceived in different countries. This programme indeed provided a rare field test for the execution of large-scale public activities relating to a particular, scientific event with strong operational constraints (including the requirement to act in real-time as the scientific event progresses). The organisers were therefore keen to gather valuable experience for possible future continent-wide activities involving the same mechanisms and carried out under similar conditions. A thorough post-event evaluation was therefore incorporated as an important element of the VT-2004 programme. Thus, on November 5-7, 2004, a follow-up conference took place at the French Ministry of Research in Paris, entitled the ‘*Venus Transit Experience*’. It brought together more than 150 persons closely connected to the VT-2004 programme in various functions, as organisers, specialists, educators, students, observers, participants, etc. The major goal was to sum up the vast experience gained through this exceptional public science discovery programme and to evaluate its many components and overall public impact. On the second day of the conference, detailed reports about the circumstances and impact of the Venus transit were given by experts operating in different surroundings, e.g. in primary and secondary schools, at the media and among amateur astronomers. National Committees from about 25 countries, either orally or by posters, documented comprehensively the individual approaches taken in different regions and cultural environments and reported many useful ‘lessons learned’ within the unique VT-2004 pilot project. These presentations clearly demonstrated the eminent success of the entire effort but also served to identify some technical and organisational shortcomings – as was to be expected in a complex and ambitious pilot project like this. However, the overall impression was thoroughly positive and much experience has been gained that will become extremely useful for any future projects of this kind. Most of the presentations given at this conference are now available on the web at: [www.vt-2004.org/FinalEvent/](http://www.vt-2004.org/FinalEvent/).

While the Venus transit is now over, the VT-2004 programme is still very much alive on the Web. From the outset of the project, and given its all-European dimension, it was decided that the Internet would be the main vector of interaction, with a central website at <http://www.vt-2004.org>. Altogether, there are about 20,000 web pages and over 2.6 GB – not counting the numerous comprehensive National Nodes web sites in many languages – which offer insights into the many interesting facets of this celestial phenomenon and which will remain a rich source of information and stimulation for years to come. Faithful to its high goals, the trailblazing VT-2004 programme successfully developed into a true encounter between Science and Society and will most certainly serve as a most effective and useful guide for future projects, thereby helping addressing the issues raised at the beginning of this article.

## References

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