

A public summer school on astronomy in Denmark: experience from the course in 2002, 2003 and 2004

H. Kjeldsen

Department of Physics and Astronomy, University of Aarhus, Ny Munkegade, Building 520, DK-8000 Aarhus C, Denmark

Received: 5 October 2004 – Revised: 18 February 2005 – Accepted: 22 February 2005 – Published: 16 June 2005

Abstract. During the summers of 2002, 2003 and 2004 a one-week public course on Astronomy took place at Silkeborg Folk High School in central Jutland, Denmark. The aim of the course was to offer a possibility for students to meet research scientists and discuss central scientific questions and their answers. Researchers from the Department of Physics and Astronomy at Aarhus University in Denmark took an active part in running this summer school and the course could also be seen as a part of the Department's general public outreach activities. The main aim of those activities is to: (1) show why research is important, (2) give students and children the possibility to meet people that do research, and (3) present authentic role models.

1 Introduction

It is a special Danish tradition to offer courses at the so-called "Folkehøjskoler" or Folk High Schools for the general public. Folkehøjskoler is a type of school for adults, designed to open people's minds and broaden their views. There are 87 such schools spread across Denmark.

The important background for the curriculum at any of the 87 schools is not the amount of education that a given student will have when he or she arrives at the school, but more the desire for the students to broaden their minds during their stay at the School.

The idea of this special type of education came from the Danish writer and philosopher, Nikolai Frederik Severin Grundtvig (1783–1872). Grundtvig's ideas are still an important parameter in the culture and mentality in Denmark, especially in the Folk High Schools, where his visions for education still influence the main content of the curriculum. This explains why only a few schools include physics and astronomy in their curriculum, since those subjects were not

an important part of the education when Grundtvig described the idea of the Danish Folk High School.

However, at Silkeborg Højskole (consult the homepage for Silkeborg Højskole for details on this school) – a small group of astronomers and teachers planned and held a summer school on astronomy for the general public. The summer school has been attended by 30–35 students each year in the summers of 2002, 2003 and 2004 (student ages are between 14 and 80 years. The average age is about 50 years.). The programme during the summer school is built around morning lectures by professional astronomers, while the afternoon programme contains a series of workshops where the students are able to select a more specific topic of their own interest. At night we use telescopes to observe – despite the bright summer skies in Denmark! We have also performed daytime observations of the Sun. In this paper I describe the content of the summer school on Astronomy and discuss the general idea of such courses. Finally, I will also relate this course to the general public outreach activities which are being offered by the astronomy group at Aarhus University in Denmark.

2 The astronomy course at Silkeborg Højskole

Silkeborg Folk High School (Silkeborg Højskole) is a typical Danish Folk High School situated in the outskirts of Silkeborg (a town in central Jutland, Denmark having 40 000 inhabitants). The Folk High Schools, which are unique in the Scandinavian cultural tradition, are a sort of popular university – intended to open people's minds and broaden their views. As such, Folk High Schools are non-formal educational institutions with no exams. Each school is different and at Silkeborg Højskole the emphasis is on subjects such as Nature and Outdoor Life, Music, Theatre, Art, Sports, Third-World Studies, Philosophy, Religion, Literature, Psychology, Ecology and Politics. In 2002 it was decided by the School Principal and the teachers at the Folk High School to expand the curriculum in order to broaden the subjects offered.



Fig. 1. Lectures during the summer school at Silkeborg Højskole offer a great possibility for discussions between students and researchers. Here Professor Jens Martin Knudsen is explaining why we should search for life on the planet Mars (Silkeborg Højskole, 2002; Photo by: M. Edinger).

Although Philosophy, Religion and Literature are the traditional subjects included in the curriculum, these subjects do not cover all aspects of the society. Science is one subject that is important, but normally not focused on in the Folk High School curriculum. As a result of this it was decided by the School Principal to offer a special one-week summer course at Silkeborg Højskole with focus on Astronomy.

2.1 The programme of the astronomy course

Since the course attracts students from all over Denmark (in fact, a few participants have come from abroad), they all stay at the school during the whole week. Each day begins with a morning assembly (a tradition at the Folk High Schools) including music and songs. The assembly is followed by morning lectures given by professional astronomers (see Fig. 1). Those lectures are not just overview talks, since the focus is on new research results and the lectures are therefore given by leading scientists in Denmark. Students interact and discuss a lot during the morning lectures – for them, it simply can't be detailed enough! The criterion for selecting the content of the lectures is two fold: (1) we aim at describing new research results and (2) we aim at presenting the leading scientists in the Danish astronomical research fields. In order to give an idea about the curriculum content, I give below the titles of the lectures for the 2004 course:

- The life of Galileo – a talk on Galileo and his research.
- Stellar Music and the Dance of Planets – a talk on latest results from studying stellar oscillations (asteroseismology) and searching for extra-solar planets (see Bedding and Kjeldsen, 2003 for a review on the asteroseismology part of this talk).
- Life on Mars? – the latest results from the Mars Rovers and the relation between the research done on Mars by



Fig. 2. For the course we have installed telescopes that can be used to perform white light visual observing as well as H-alpha observing. (Silkeborg Højskole, 2002; Photo by: M. Edinger).

the Rovers and research done at the Mars Lab at Aarhus University (see the Mars Lab homepage for more details on this research facility).

- Life in the Universe? – could there be life in outer space and is life a natural result of the laws of physics?
- The evolution of the Universe – latest results from observing the cosmic microwave background radiation (CMB). Focus on the WMAP results and the impact on cosmology.
- The telescope – how do we observe the stars, the planets and the Moon?

After the lectures it is time for observing the Sun. During the course we installed telescopes that can be used to perform white-light visual observing as well as H-alpha observing (see Fig. 2). In white light, sunspots are followed throughout the course and simultaneously we follow solar activity such as prominences in H-alpha light (see Fig. 3).

In the afternoon a series of Workshops are held where the students are able to select a more specific topic of their own interest (see Sect. 2.2). Finally, the programme also includes excursions, night time observing and extensive discussions between the students and between students and professional researchers.

2.2 The workshops

The afternoon workshops are focused on three different areas of astronomy. The first addresses basic astronomy and the history of astronomy. In this workshop the students discuss aspects of Greek astronomy (e.g. how did the Greeks observe the sky? how did they develop models for the world? how did they measure the distances to the Moon and the Sun?), the Heliocentric model of the Solar System, as well as basic observables that any given observer on the surface of Earth should be able to measure (e.g. the latitude of the observer).

The second workshop focuses on Modern Astrophysics, aimed at describing the latest news about the Universe and especially describing how researchers achieved the new results. In this workshop the students are also trained in using the Internet to obtain astronomical information. The third workshop focuses on practical astronomy. In this workshop students construct models (in 2002 the students constructed a 1:2 000 000 000 model of the solar system and in 2003 they constructed a simple Planetarium showing the major constellations) and build simple astronomical instruments such as the Gnomon. The Gnomon was then used to determine the time of local midday for Silkeborg as well as the latitude of Silkeborg Højskole.

The overall aim of the workshops is to stimulate discussions between teachers and the students. While the lectures are more formal talks, the workshops should allow the students to interact in a more lively way and to open their minds by detailed discussions. The workshops are therefore held in smaller groups.

3 Lessons learned from the first three years

At the end of each course the students are asked to evaluate the course, the aim being to improve the content of future courses. Based on those evaluations, as well as evaluations by lectures, teachers, organizers and researchers, we have collected the following “lessons learned” that are outlined below. The student evaluation was informal and was done simply by asking the students in the classroom and during a coffee break about their impression of the course. The discussion during the evaluation session was focused on the quality of the lectures and the workshops, as well as the overall impression of the course. We were especially interested in learning why the students decided to attend the course in the first place. We also asked the students to point to the most important aspect of such a course. It should be noted that the students gave many and, to some extent, conflicting statements, however the two points described below can be taken to express the majority of the student impressions:

1. There is a “market” for an astronomy summer school at Silkeborg Højskole – the course is well attended and some of the students have attended two or three times (although the aim of the course is that it should not be necessary to attend more than once).
2. The students focus on three aspects in their evaluation: (1) The possibility to meet people that do research. This is the most important aspect of the whole course and should be seen as the key factor for the success of this course. Meeting scientists and being able to discuss interesting subjects is the most important aspect of the astronomy course at Silkeborg Højskole. (2) The possibility to study a selected topic under supervision. Again the key aspect is the discussion between the scientist and the student. (3) The fact that the course is 24 h/day.



Fig. 3. In white light (left) sunspots are being followed throughout the course and simultaneously (right) we follow solar activity such as prominences in H-alpha light (Silkeborg Højskole, 2004).

The main reason that the long and uninterrupted discussions can take place is the fact that all students stay at the school during the entire course. Several of the researchers and teachers are also present during the whole course.

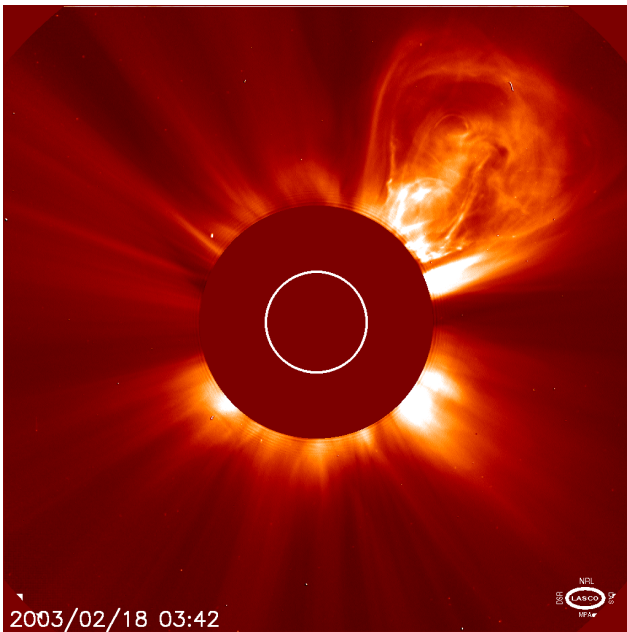


Fig. 4. The High School outreach programme is focused on the Sun, especially the use of SoHO and TRACE satellite data. The figure shows a giant Coronal Mass Ejection (CME) observed by the LASCO instrument onboard the SoHO spacecraft (for details see the SoHO homepage). Images like those are used extensively in our High School outreach programme.

4 General astronomy outreach activities at Aarhus University

The course on Astronomy at Silkeborg Højskole is organized by a committee that includes researchers from the Department of Physics and Astronomy at Aarhus University in Denmark. While the course is not organized by the Department (the idea was developed by the Folk High School and the main organization was done by Silkeborg Højskole), one could see this course as a part of the public outreach activities that are being offered by Aarhus University. In addition to this course, those public outreach activities are centred on outreach for primary and high schools and outreach planned in collaboration with the Planetarium at the Steno Museum at Aarhus University (see the homepage for the Steno Museum for more information). Evaluation of the general outreach activities is not currently done in any coordinated manner, however if we should stress why we find outreach important, we can to a large extent repeat the list given above concerning the lessons learned from the course at Silkeborg Højskole. The list below represents the average evaluation of the different activities. We have at present no statistics that can be used to justify how large a fraction of the people who took part in the activities are in fact covered by those statements. A number of people have, of course, expressed different views on the activities, however the list below is believed to represent the average person. So why is outreach important and what are the most important aspects?

1. **The possibility to meet a researcher.** As stated above, this is a key aspect of outreach. However, we should remember that discussions with a researcher should not only be one-way communication where the researcher gives a lecture to, e.g., 200 children in a given primary school. The optimum science communication is two-way, where the child or student will find themselves in an authentic discussion with a researcher on a scientific subject.
2. **Role models.** Related to the above and equally important is the possibility to present a role model for children and students. Many children and students see a researcher as a “strange” person that performs work of little interest to them, for example work that will ultimately destroy our world or be a threat to mankind, e.g. production of nuclear weapons, manipulation of human genes etc. (and who would like to be a new Dr. Frankenstein?), or work that has no practical importance, e.g., useless results that are very theoretical or to some extent stupid (and who would like to be a new Professor Tournesol, known from Tintin?). In planning outreach activities we should not underestimate the role model aspect.
3. **Showing why research is important.** Modern society relies on scientific research and technology. However, research is not just related to applied physics and technology development and we need to present scientific questions that do indeed relate to the student and that the student finds fascinating and interesting. Astronomy should, for example, present the big picture and the big questions and demonstrate how research activities may lead the way towards answering those fascinating questions.

4.1 Primary school activities

At the Department of Physics and Astronomy at Aarhus University we offer, as is done at many other Universities around the world, a number of activities focused on primary and high schools. About 30 classes per year (in primary schools all over Jutland in Denmark) will have a visit from a research scientist who will stay together with the class for three to four hours. The visits focus on scientific questions related to rockets, satellite orbits and the microgravity environment onboard a spaceship. We also focus on the planet Mars and the search for life in the Universe. Another aspect that we discuss in the classroom is the formation of the planets and the Sun, especially the formation of the Earth, and we include a discussion on solar and stellar evolution.

4.2 The high school programme

The High School outreach programme is focused on the Sun, especially the use of SoHO and TRACE satellite data. The students work one full day at the University, during which

they do simple research on satellite data aimed at understanding solar rotation, solar activity, the solar wind (see Fig. 4), space weather and the Sun as a star.

4.3 The planetarium show

In a collaboration between the Department of Physics and Astronomy, Aarhus University and the Planetarium at the Steno Museum in Aarhus, we have produced a show for the planetarium that focuses on describing the Danish use of the ESA space missions. The work was funded by the Danish Research Ministry. The planetarium show is called “Stellar Music and the Dance of Planets” and the main focus is asteroseismology and the search for exo-planets. The script was produced by research scientists at Aarhus University and the show itself was produced by the planetarium staff. The premiere of the show was on 30 April 2004.

5 Conclusions

The present paper describes the experience gained from running a public summer school on astronomy at Silkeborg Højskole. Part of this school can be seen as outreach initiatives carried out by the University of Aarhus and shows how various initiatives have developed into a coordinated effort to promote science, and astronomy in particular, among the general public. The central aspects of the outreach as described in this paper are that: (1) One can show why research is important. (2) Students and children have the possibility to meet people that do research. (3) One can present authentic role models. (4) Students have a possibility to study a selected topic under qualified supervision.

Acknowledgements. I wish to thank Carsten Kolby Kristiansen and Erik Lindebjerg at Silkeborg Højskole and Hans Buhl and Ole J. Knudsen at The Steno Museum for a long and productive collaboration related to the Astronomy Summer School. I also wish to thank Tim Bedding at the University of Sydney in Australia for valuable discussions related to the present paper.

Edited by: N. Crosby

Reviewed by: I. Porro and N. Crosby

References

- Bedding, T. R. and Kjeldsen, H.: Publications of the Astronomical Society of Australia, 20, 203–212, 2003.
- MarsLab homepage: <http://www.marslab.dk/>, 2004.
- Silkeborg Højskole homepage: <http://www.silkeborghojskole.dk, 2004>.
- Silkeborg Højskole, foreign students: http://www.silkeborghojskole.dk/05_foreignstudents_01.htm, 2004.
- SoHO homepage: <http://sohowww.nascom.nasa.gov/, 2004>.
- Steno Museum: <http://www.stenomuseet.dk/engelsk/planet/index.htm, 2004>.