

## **Involving Students in Outreach Activities: The Wilhelm Macke Award**

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### **Introduction**

Outreach activities can have a number of distinct aims. In this contribution I shall discuss in particular activities directed mainly at high school pupils. In such activities the main purpose is to correct misunderstandings on what physics is about and what physicists actually do. A secondary purpose is to interest students in choosing science in general, and physics in particular, as their future field of study. Finally, it is always an advantage when outreach activities receive attention in the local and national media.

The activity I shall discuss was successful in all three respects. The main reason is that a central role is played by students, who present their work on a diploma thesis, for which they have received a prize, before a general audience. The event is open to the public, with special invitations going to high school pupils and their teachers, as well as to the local media.

For high school pupils, students are more plausible role models than university teachers or researchers. The fact that the subject of the presentation is research performed by the students helps in presenting physics not as a study of established knowledge, often centuries old, but as a problem solving activity. An additional advantage is that the subject of the talks is a topic from recent research performed at our department (or sometimes in industry); hence the audience has an opportunity to become acquainted with recent research performed at the university.

In this report I shall first give the historical background concerning the Wilhelm Macke Foundation that awards the prizes. Then I shall describe in more detail the event during which the award is bestowed. Subsequently, I shall report on our experiences, in particular on the reception we obtained, and speculate on the reasons for the success. Finally, I shall briefly mention some other outreach activities of our department in which students and high school pupils are involved.

### **The Wilhelm Macke Foundation and the Wilhelm Macke Prizes**

Wilhelm Macke (1920-1994) was the founding professor of the physics department in Linz University. After World War II he was able to resume his study of physics because of financial support from Max Planck, who donated entrance fees for public lectures as scholarships for two gifted students (see Fig. 1). Macke obtained his PhD with Werner Heisenberg and soon became a professor in Sao Paulo and Dresden. He was the author of a series of modern physics textbooks [1] in German, widely considered the first modern post-war texts in that language, and widely used by universities in the German language area. In Linz, where he was called in 1969 to set up the newly established physics department at what is now the Johannes Kepler University, he was renowned for his clear lectures, in which his excellent sense of humour was put to good effect.

At his death, according to his wishes, a considerable sum from his estate was used to establish a Foundation for the support of gifted physics students from Linz University; this

generous gesture was also meant as a form of thanks for the support he himself had obtained from Max Planck.

The Wilhelm Macke Fund has two main activities. The largest sums of money are spent to support students and recent alumni for scientific stays abroad, lasting from one month to one year. In addition, every year up to three “Wilhelm Macke Prizes” are awarded for the best diploma (masters) theses by physics students at the Johannes Kepler University either in technical physics or in our programme for future high school physics teachers. .



**Fig. 1:** Wilhelm Macke receiving a scholarship funded by public lectures held by Max Planck.

The Prizes were first awarded in 1997, and in the first three years they were presented in the context of a graduation ceremony. Each winner receives a sum of at present € 1.200, --, as well as an official certificate that could be helpful with future job applications.

Starting in 2001 (for the prizes of 2000) the prizes are bestowed in a public ceremony, to which the university community, the media, and in particular all high school pupils of the highest three grades of secondary schools in the area and their physics teachers are invited. The prize winners give short talks on their work for this predominantly lay audience. After the presentations all attendants except university physics staff and graduate students take a vote to select the winner of the “Wilhelm Macke Award” (originally called “Physics Oscar”: the name was changed after the event obtained rather wide publicity and the Academy of Motion Picture Arts and Sciences objected). The Award consists of a trophy, designed and crafted by technicians from the department machine shop, from copper rings as used in building ultra high vacuum equipment (see Fig. 2); the winner also has his or her prize money doubled to € 2.400, --. The event has been held in this format yearly since 2001.

### **Organisational Details**

Candidates for the prizes may be proposed by all faculty members; students may also apply themselves. The Board of the Foundation, consisting of three physicists, assisted by referees mostly from our department, awards up to three prizes; the selection takes place on the basis of the scientific merit of the theses, with special emphasis on originality, as well as of the clarity of the writing and the exposition of the physics involved. No attempt is made to give preference at this stage to candidates with “sexy” subjects, or with a reputation as good communicators.

The award ceremony is scheduled for a date suitable to schools (in the Easter week, after a short break in the school year, so that few collisions with tests and other activities occur, but also well before the end of term tests). Invitations go to all secondary schools in the state of Upper Austria and separately to the spokespersons for the physics teachers at these schools (In the Austrian system there are different types of high schools; our invitations are sent to all schools that qualify their pupils for a university education). The candidates are asked to write a short resume of their talk to be sent to the press a few weeks before the event. The talks may last no larger than 20 minutes (including time for a few questions). Candidates are also asked to make their power point presentations or other materials available for posting on the Macke Foundation website, from where they can be downloaded, e.g., by high school physics teachers for classroom use.

The attendants to the award concerning are welcomed by the Vice-Rector for Teaching and by a (junior) faculty member, who gives a presentation of the Linz physics department with a short (20 minutes) survey of the various topics on which our research is focused. Then the candidates give their presentations; this part of the programme should take not much more than 90 minutes.



**Fig. 2:** The 2004 winner, Ms. Ingrid Graz, with the trophy (Copyright Oberösterreichische Nachrichten).

After the talks there is a short break during which refreshments are served; upon leaving the lecture hall the attendants (physics staff and graduate students excluded) cast their votes using prepared ballots, which are then counted. During the break, the candidates can discuss their work informally with interested pupils and other attendants (as far as the representatives of the media let them); for this purpose they have prepared small stands with posters, often accompanied by simple demonstration experiments or computer simulations. After the break, candidates and public are invited back into the lecture hall for the announcement of the winner and the presentation of the trophy and the handing over of the checks for the prize money. After the official programme, there is a possibility for visiting laboratories, or for arranging dates for such visits at a later time.

### **Our Experiences**

Thus far, the public award ceremony has been held five times. Right from the beginning, the interest exceeded our expectations: the number of attendants has been fluctuating between 150 and 300, among them between 80 and 160 high school pupils. Most teachers and high

school pupils came from Linz and neighbouring towns, but a number came from further away (up to 80 km). In general the reactions were positive; from several high schools regular “delegations” visit the event every year. The schools at which a candidate has graduated are usually especially well represented.

The media interest was another positive surprise. The main local newspaper (Oberösterreichische Nachrichten) typically has a short story with a picture of the winner on the next day, and a longer article with details on his or her personal background and a report on the thesis project in the following weekend edition. Several times, the event was also reported on local radio and television (including a longer interview with the winner on a radio breakfast programme). A few longer articles, dealing both with the winners and with their work, appeared in national newspapers.

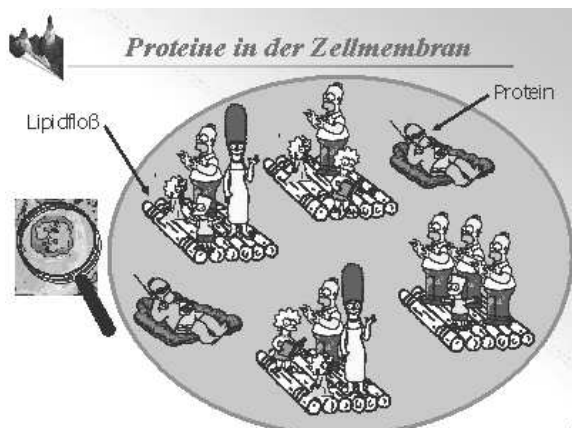
Another positive feature was the in general high quality of the presentation by the candidates. Almost all used professional presentation material, sometimes with animations that were both entertaining and truly functional from a pedagogical point of view. Virtually all succeeded in explaining their work without using technical jargon. One candidate included a simple “live” demonstration experiment. A number of candidates enlivened their presentation by cartoons; an example presented by the 2005 winner is shown in Fig. 3.

A few times the physical phenomenon was illustrated by a comparison with “everyday” analogues. For example, the reorientation of electric dipoles in a varying electric field was compared with a politician trying to adjust his positions to public opinion; the comparison was carried through to discuss the losses, dielectric or political, that occur when the relaxation time of dipoles or political positions becomes non-negligible compared with the changes in field or (perceived) public opinion. Another presentation concerned the hypothesised “rafts” in cell membranes, also shown in the cartoon in Fig. 3. These structures are postulated to be enriched in certain membrane proteins, maybe to facilitate the formation of bonds and associations between them; this was compared with a party host(ess) who installs different types of bars (for wine, beer, fruit juices, etc.), to further contacts between guests with similar tastes. (The raft hypothesis was strongly supported by work done in the Linz Institute for Biophysics, with significant contributions from the two Macke Award winners of 2003 and 2005, Manuel Mörtelmair and Mario Brameshuber).

The reactions of the pupils showed that the presentations were effective in correcting the views on what a physicist does: our goal is not acquiring book learning, but solving novel and concrete problems, to which students in the last stage of their studies can make significant contributions (though, in the introductory talk, it is also admitted that during the first years, a student must master a lot of technical material as well). Some pupils remarked that the candidates (or at least most of them) did not correspond to their preconceptions of “what type of person a physics student would be”. Also, several high school teachers judged the presentations to be suitable for use in class; they asked for copies of the material and in a few cases asked the candidates to discuss their work in more detail in their classes.

### **Some special reasons for our success**

Though I expect similar initiatives could be successful at other institutions, there are a few favourable local factors that may have contributed to the success.



**Fig. 3:** A cartoon used by Mario Brameshuber (Macke Award Winner 2005) to illustrate his presentation. The title reads “proteins in the cell membrane”; “proteins” and “lipid rafts” are identified by arrows. A “serious” representation of this structure was shown as well [2].

The main factor is our teacher training group, which is quite active in providing in-service training for teachers. This programme is designed in cooperation with an active local organisation of physics high school teachers. Thus, many high school physics teachers regularly visit our department on other occasions. These contacts are enforced by other outreach activities mentioned in the last section of this report. Clearly, teachers who know the university well and come there regularly to update their knowledge of physics and physics teaching methods are more likely to encourage their pupils to visit events such as the Wilhelm Macke Award contest and to accompany them there.

The favourable media response is caused in part by the fact that Linz has in a sense just the right size. The city is large enough to have local newspapers, radio and television stations. On the other hand, there are less competing events than would be the case in a large metropolis. The university was founded forty years ago with important support by state and city government (universities in Austria are controlled by the federal government). Relations with the local community have been good ever since, which is reflected in media relations. The competition element, with mostly local contestants, also helps attracting more press coverage than a straight science event would obtain.

The nature of our physics programme may also be a positive factor. We have a technical physics programme in which subjects relevant to applications; e.g., solid state physics and biophysics, are prominent. This helps in explaining the relevance of the research to a lay audience. Our curriculum also emphasises communication skills, e.g., by a number of obligatory seminars. Several research groups are also active in outreach activities, and regularly offer excursions for high school classes.

The money we can draw from the Macke Foundation does of course help, but the costs besides the prize money (trophy, publicity, refreshments and travel costs by public transport for pupils and teachers from out of town) are modest, and should be affordable for a typical physics department.

### **Other outreach activities**

In addition to the Wilhelm Macke Award, our department offers, or participates in, a number of further outreach activities. Every year, in the week just before classes begin, there is a so called “studies fair” where all local institutions of post-secondary education, including all

departments of the university, present themselves by means of small exhibits, half hour presentations of the various fields of study, and public “trial” lectures. This event takes place on our campus and is well attended by pupils from the highest grades of secondary schools and by some parents as well. Thus many students already know our campus. At the fair, attendance at events specifically related to physics is more restricted to those who already have physics as one of their options for further studies; the Macke Award ceremony attracts a broader audience and can convey more information.

Another programme at several Austrian universities (FIT, *Frauen in die Technik*) is directed specifically at female pupils to draw their attention to scientific and engineering fields of study. This programme includes information days on campus, and a system of “ambassadors”, female students who regularly visit high schools to inform female pupils about science and technology (The 2004 Macke Award winner, Ingrid Graz, was one of these, and may thereby have learned to communicate effectively with high school pupils). Since the start of this programme there has been a modest but significant increase in the number of female students in physics.

Both the university and several high schools used the World Year of Physics to present themselves to the general public. School pupils presented experiments, mostly using self-made equipment, at a show downtown. On a Saturday at the end of the school and academic year, we held a full day “physics party” at our campus, where these experiments by high school pupils were shown again, side by side with demonstration experiments prepared by university institutes. The programme also included short talks (one of them by the 2005 Macke Award winner) and tours of laboratories. Many pupils had convinced their parents (and a surprising number of grandparents) to attend this event. In all about 100 pupils and 250 other visitors came to our campus for the occasion.

### **Concluding Remarks**

Though, as mentioned above, there are a number of favourable factors in Linz that contributed to the success of the activity reported. I expect that similar initiatives elsewhere would also have good chances to succeed. In particular, I want to stress that it is unwise to neglect one of our best public relations resources, our students, in designing an outreach programme.

### **Acknowledgement**

It is a pleasure to thank Dr. Helga Böhm and Dr. Peter Bauer who, as my fellow members of the Macke Foundation Board, contributed to the design and execution of the activities reported here. Dr. Böhm is also in charge of our web page [2].

### **References**

- [1] W. Macke: Wellen (1958), Quanten (1959), Elektromagnetische Felder (1960), Mechanik der Teilchen, Systeme und Kontinua (1962), Thermodynamik und Statistik (1962), Quanten und Relativität (1962), all: Akademische Verlagsgesellschaft Geest & Portig, Leipzig.
- [2] <http://www.tphys.jku.at/macke/Welcome.shtml> (in German). This page contains additional information about Wilhelm Macke, about the Wilhelm Macke Foundation and about the prize winners, including abstracts of their work and, for the last few years, the power point presentations.