PREFACE

NINTH CAROLUS MAGNUS SUMMER SCHOOL ON PLASMA AND FUSION ENERGY PHYSICS

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The ninth edition of the Carolus Magnus Summer School on Plasma and Fusion Energy Physics was held in “Eurovillage-Herbeumont,” a holiday resort surrounded by bucolic woods in the south of Belgium.

This summer school is a teaching initiative of the three partners of the Trilateral Euregio Cluster (TEC): Laboratory for Plasma Physics, Ecole Royale Militaire-Koninklijke Militaire School, Brussels (Belgium); the Institute for Energy Research/Plasma Physics, Forschungszentrum, Jülich (Germany); and FOM-Institute for Plasma Physics Rijnhuizen, Nieuwegein (The Netherlands). It is organized once every 2 years and targets graduate and postgraduate students active in or becoming active in controlled thermonuclear fusion. Now that energy prices have risen to levels that painfully remind people of the dependence of our modern society on the sustained availability of inexpensive energy, this field of research (until very recently considered to be somewhat exotic) is now becoming one of the focal points of society’s attention as it tries to offer a base load energy production scheme for many future generations. The knowledge that the large-scale use of fossil fuels (currently by far still the most used energy source worldwide) gives rise to vast quantities of greenhouse gases that are set free in the atmosphere and that potentially can irreversibly harm the world ecology further makes controlled fusion a worthwhile topic of study.

A total of 68 participants (some coming from as far as the United States, the Russian Federation, and Japan) were given courses on the physics governing the behavior of plasmas in experimental thermonuclear fusion devices. As in the previous summer schools of this type, the accent was on machines relying on magnetic confinement of the highly energetic particles that spontaneous fusion requires. The scope of the Carolus Magnus schools is rather wide. The treated subjects range from basic principles of magnetic confinement, heating, equilibrium and instabilities, and classical and neoclassical transport as well as fundamental kinetic theory to leading-edge and occasionally far from fully understood fusion physics topics such as anomalous transport and transport barriers. Aside from describing the actual processes in the plasma, various speakers also explain how the dynamics of the hot plasma medium can be diagnosed. Now that seven partners (China, the European Union, India, Japan, the Russian Federation, South Korea, and the United States) have launched themselves into the big adventure called ITER, a discussion on the difficulties related to neutron bombardment and material activation was thought to be a necessary component of the school and thus was added to the school’s curriculum. Neutron diagnostics is another topic thought to be inescapable.

In Latin, “iter” signifies “the way.” The ITER machine is meant to be the way to fusion. Because its goal to demonstrate that the fusion fire can produce significantly more power than is needed to ignite the fusion fuel in a machine capable of withstanding fusion-born neutrons, its performance is very likely to determine if fusion stands a chance of being the energy source for many coming generations that we fusion scientists believe it to be.

The preparations of the construction in Cadarache (France) of the buildings in which this machine will be housed have been initiated; actual operation of the machine is thought to be about a decade away. Because we are at a critical point in the history of controlled fusion, teaching the new generation of scientists joining our research community is not only an academic exercise in plasma physics but also a necessary ingredient to realize the fusion dream: By the time the balance of ITER will be made, most of the present-generation researchers will have passed on their torch to the—at present—youngest of our colleagues. To optimally transfer knowledge to the new generation, the school has always had a large number of lecturers, each speaking about his or her own field of interest and specialization. Most of the speakers are from one of the three partners of the TEC, but to meet the high standards the school imposes on itself, subjects falling outside the main focus of the TEC are necessarily explained by specialists from other European laboratories.

I am grateful to all lecturers of the organizing research centers and am happy to acknowledge the efforts of the external specialists Drs. D. Bartlett (European Commission, Brussels), K. Crombé (Ugent, Gent, Belgium), X. Garbet (CEA, Cadarache, France), D. Hartmann (IPP, Greifswald, Germany), R. Keppens (CPA, Leuven, Belgium), V. Kiptily (UKAEA, Culham, United Kingdom), P. Lamalle (ITER, Cadarache, France), S. Putvinski (ITER, Cadarache, France), M. Rubel (KTH, Stockholm, Sweden), S. Sharapov (UKAEA, Culham, United Kingdom), G. Van Oost (Ugent, Gent, Belgium), B. Weyssow (ULB, Brussels, Belgium), H. Wilson (UKAEA, Culham, United Kingdom), and R. Wolf (IPP, Greifswald, Germany). Two evening lectures—traditionally on topics close to but different from the school's theme—were scheduled. Dr. C. Jacobs (CPA, Leuven, Belgium) gave an enchanting talk on space weather, triggering questions and reactions until well after the foreseen end time. The other evening lecture was not a talk in the traditional sense of the word: Dr. von Keudell (RUB, Bochum, Germany) explained the role played by plasmas in the Hollywood film industry and—at least mentally—took us away from the lecturing room to the film theater.

The 2009 summer school benefited from the support it received from its sponsors: Belgatom, European Physical Society, Gradel, and Stichting OPB.

Many thanks to all who made the summer school possible!