

1. Introduction

The book you are holding in your hands strives to give you, in the form of a series of scientific papers written for interested laymen, an insight into a number of modern physical disciplines that are at present the subject of active research at the *Faculty of Nuclear Sciences and Physical Engineering (FNSPE)* of the Czech Technical University in Prague. Its publishing is an attempt to enlighten the general public and in particular the students at secondary schools considering higher education of that field of human activity so fascinating that we chose it as the main *raison d'être* of our lives. In spite of our never-ending efforts to inform the general public regarding Faculty activities via *Open Days* and other promotional events and published materials, our Faculty is for many students shrouded in a mysterious haze, like an inaccessible and impregnable fortress, on the doors of which it is inadvisable to knock. Let me therefore first open our doors, be it only slightly ajar, and to invite you in for a short visit.

The Faculty of Nuclear Sciences and Physical Engineering was established in 1955. Its brief has been to prepare highly qualified graduates in mathematics and chemistry working on the grey line which marks the boundary between engineering and science. Thorough theoretical studies are supplemented by specialised laboratory training and, in the higher grades, the reading of lectures is combined with an actual *research* work. Due to its structure, size, and staff, FNSPE could easily adapt to advances in science and technology as well as to the changes in demands by opening new courses and new fields of study. The original curriculum in *nuclear, nuclear-chemical and physical engineering* was extended incrementally to *mathematical engineering and information science*. FNSPE was also the very first faculty in the Czech Republic to introduce the degree of bachelor in addition to the degree of engineer. FNSPE is traditionally a faculty with substantial *activities in scientific research*. Graduates of FNSPE can find employment in many fields, ranging from research institutes, both at home and abroad, to industry and finance. FNSPE is a faculty with nation-wide curriculum of activities. Its unique position in the Czech Republic follows from the fact that many disciplines entering into its curriculum could be studied only at this faculty. FNSPE has a very active *Students' Union*. Every year its members organise a number of interesting social events, such as "*Nuclear Fusion*" – a ball, with a theatrical introduction written by students themselves, "*The Matriculation of Freshers*" into the ranks of real "nuclears", *Kite Launching*, etc.

Let us now focus our attention to the book itself. As already mentioned its contents present a cross section of the research activities in FNSPE, both in general aspects and concrete topics. *Doppler's Institute of Mathematical Physics* is the first institution that is presented in the book. Here, the reader is familiarised with the history and objectives of the mathematical physics in general and with the activities at DIMP in particular. The next two chapters deal with the description of the *Doppler effect* in modern physics and investigate the interchangeability of source and observer. *Solid-state physics* is the next topic. The text describes the conditions under which it was incorporated into the curriculum of FNSPE and outlines some studies of solid state properties, particularly in the application of *X-ray structural analysis*. The next two contributions come from the field of the applied ionising radiation. The first concerns the use of the ionising radiation in so-called *archeometry*, i.e., for the determination of the age of cultural relics. The second describes the principles and application of the *radionuclide X-ray fluorescence analysis*, e.g., for the investigations into the surface elemental composition of the planetoid EROS by space probe.

FNSPE has a long tradition in the development of *lasers* and laser applications. Particular attention has been paid to the *laser distance meter for satellites*, a device developed in various forms at FNSPE that has been successfully applied at many locations worldwide. The *ultrashort* light pulses of the so-called *femtosecond* lasers make it possible, amongst other things, to study *ultrafast* processes proceeding in nature.

So-called *diffraction structures* constitute a very interesting field of research (*holograms* are a special case) with a broad spectrum of applications. They can be used particularly for the optical treatment of information (image recognition, optical memory, etc.). *Fractography*, i.e., the investigation of the physical nature of the crack formation and spreading in materials subject to stress, is a research field with extraordinary economic impact. Other research is directed at so-called *intermetallics*, special compounds that, due to a different atomic arrangement, differ in physical properties with respect to disordered alloys and pure metals. *Magnetic properties of rare earth intermetallics* are also being studied.

The next three contributions deal with the problems of the fourth state of matter – *plasma*. The first describes *complex interferometry* for diagnostic purposes, developed to measure plasma properties in experiments to achieve the *controlled laser-induced nuclear fusion*. The second contribution is devoted to the detailed description of the plasma characteristics,

including *plasma technology* applications. Finally, in the third article, a *plasma source of hard UV radiation* in the form of a special discharge tube is investigated.

FNSPE is a unique educational institution in the whole of Europe that, even as public opinion turned against nuclear power, maintained its course and retained the term *nuclear* in its name. The penultimate contribution in this book should convince the reader that this decision and the philosophy it reveals were no foible but an honest expression. The properly functioning *school reactor VR-1 "Vrabec" (i.e. "Sparrow")* is perhaps the most convincing argument. The fact that, along to the description of the reactor itself, you will be informed on the nuclear safety rules, radiation and physical protection, emergency measures and the in-house safety culture manifests our serious approach to nuclear technology.

The last contribution, somewhat more theoretical, is a detailed discussion of the term "entropy". Its aim is not to present new discoveries in physics or mathematics but rather to highlight some unexpected relations using methodically *distant* mathematical approaches.

In conclusion, this book would perhaps never have been written but for the original initiative of doc. RNDr. Zdeněk Kluiber, CSc., principal of the Christian Doppler Gymnasium in Prague, the main instigator of this collection of works. His longstanding and very fruitful co-operation with our faculty finally found its fulfilment, even in the form of a printed publication. I hope that the articles contained in this book will inform and inspire those at the crossroads contemplating their future career path. If that path finally leads them to us, I am firmly convinced that they will not regret it.

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