

VON KARMAN INSTITUTE FOR FLUID DYNAMICS

An International Center for Advanced Training in Research through Research

Founded by Theodore von Karman in 1956

Located near Brussels, capital of Europe



CALL FOR APPLICATIONS

SHORT TRAINING PROGRAMME FOR UNDERGRADUATE STUDENTS

The von Karman Institute for Fluid Dynamics (VKI) offers a hands-on training for a period of three up to six months to university students in engineering, physics or mathematics, involving **active participation in a guided research project**.

This experience will provide practice in the use of top-level experimental test facilities, computational and laboratory techniques. Added benefits are the exposure to methodology of research and team work in an international, multicultural environment.

In many cases, this programme can also be used to prepare a MS graduation thesis at the home university.

Subjects for research projects include:

Environmental and applied fluid dynamics

Fluid mechanics and heat transfer in industrial processes

- wind effects on buildings
- vehicles aerodynamics
- wind energy
- heat transfer and two-phase flows

Fluid mechanics in industrial processes

Non-intrusive instrumentation

Biological flows

Aeronautics and aerospace

Aeronautical flows

- from low speed to hypersonic aerodynamics

Aeroacoustics

Space applications

- atmospheric entry aerothermodynamics
- plasma flows

Computational methods for flow simulation
(CFD and uncertainty quantification)

Small satellites development

Turbomachinery and propulsion

Axial and radial compressors, gas and steam turbines

- aerodynamic design, optimisation and analysis
- unsteady flows and blade row interactions
- heat transfer and cooling
- fast-response instrumentation

Training period: 3 up to 6 months to start anytime except in September. A working knowledge of English or French is required. More information about fellowships is available on our website:

<http://www.vki.ac.be>

Application forms can be downloaded from the website in the educational section.

Further information may be obtained by writing to:

von Karman Institute for Fluid Dynamics

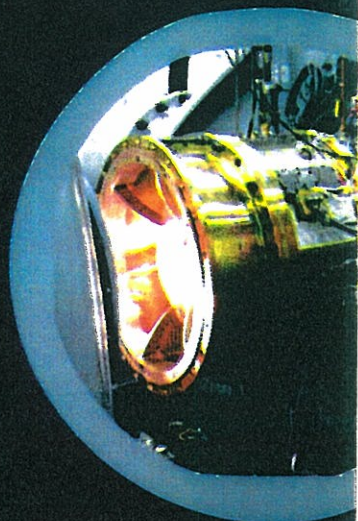
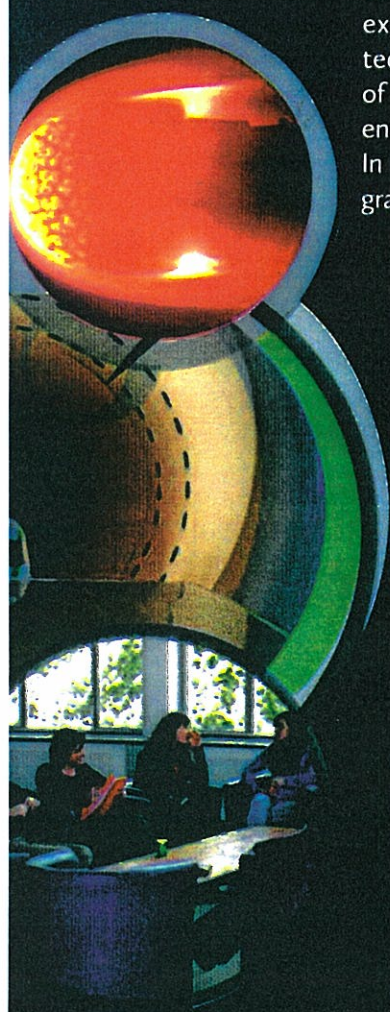
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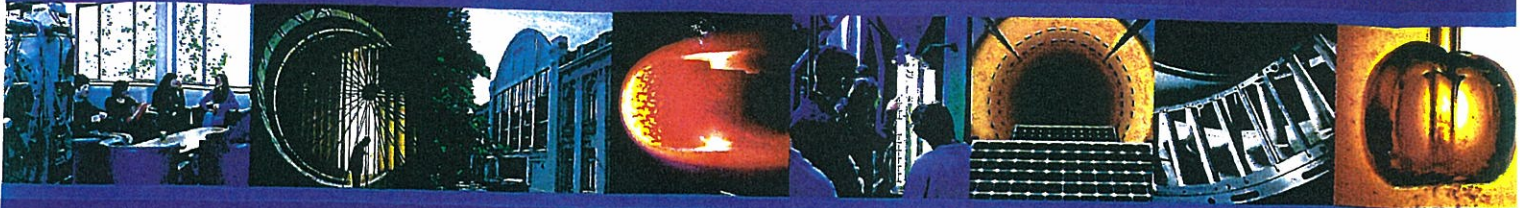
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VON KARMAN INSTITUTE FOR FLUID DYNAMICS



www.vki.ac.be

An International Center for Advanced Education and Research in Fluid Dynamics

VKI is a non-profit international educational and scientific organisation, hosting three departments: aeronautics and aerospace, environmental and applied fluid dynamics, and turbomachinery & propulsion.

Post-graduate Education

It provides post-graduate education in fluid dynamics (research master in fluid dynamics, phd programme, short training programme and lecture series) and encourages "training in research through research".

Accredited by NVAO

NVAO ensures the quality of educational programs following the Bologna agreement for higher education in Europe.



World unique test facilities

The von Karman Institute undertakes and promotes research in the field of fluid dynamics. It possesses about fifty different wind tunnels, turbomachinery and other specialized test facilities, some of which are unique or the largest in the world (Mach 14 free piston hypersonic, 1200 KW induction coupled, annular cascade facility and the famous 3m diameter free test section wind tunnel).

Consulting and Research

Extensive research on experimental, computational and theoretical aspects of gas and liquid flows is carried out at the VKI under the direction of the faculty and research engineers, sponsored mainly by governmental and international agencies as well as industries.

Well-known Lecture Series

Each year 8 to 12 one-week Lecture Series are organized on specialized topics in the field of aerodynamics, fluid mechanics and heat transfer with application to aeronautics, space, turbomachinery, the environment and industrial fluid dynamics. These courses have gained over the years world wide recognition for their high quality which is the result of a careful choice of subjects of current interest and lecturers known for their excellency in that field and willing to co-operate in building up well-structured courses.

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The von Karman Institute for Fluid Dynamics An International Excellence Center for Education and Research in Fluid Dynamics

Green technologies such as noise reduction, reduction of pollution (NO_x releases) as well as global warming (CO₂ release) are the drivers for revolutionary changes in century old industries like aerospace, car industry or energy conversion. New ideas like using micro satellites for in orbit technology demonstration and debris mitigation, advances in new propulsion concepts and qualification of new reusable materials will make future high speed travel affordable.

These are some of the topics that bring young engineers and scientists from all over the world to the von Karman Institute to study, improve their skills and perform their research. Located in Sint-Genesius-Rode near Brussels, this non-profit international educational and scientific organization is specialized in fluid dynamics (flows of liquids, gases and plasmas) in the area of Aeronautics and Aerospace, Environmental and Applied Fluid Dynamics, and Turbomachinery and Propulsion. The von Karman Institute prides itself in providing "advanced training in research through research".

What are the VKI's key figures?

VKI has a permanent staff of approximately 100 persons, among them 21 research engineers and 16 professors. Besides the permanent staff about 190 students and temporary researchers are involved in the different academic programmes. Students involved in these programmes have been recently awarded numerous prestigious grants such as those provided by the Belgian agencies FNRS, FRIA, FWO, IWT and the European Union ERC and Marie-Curie.

Furthermore, this Center of Excellence operates about fifty different wind tunnels, turbomachinery and other specialized test facilities; some of them being unique. The facilities of the Institute are renowned and VKI is recognized as a world-class research center of excellence by its peers. As an example, VKI and the European Space Agency (ESA) have signed a Memorandum of Understanding (MOU) in November 2011 under which VKI acts as a reference laboratory for ESA. This agreement involves 10 research staff and more than 20 PhD students in a continuous effort devoted to the present space transportation missions and the challenges of the future space explorations.

What's your expertise in Aeronautics and Aerospace?

For more than 20 years, the Aeronautics and Aerospace Department is developing a research program on **planetary entry and Earth re-entry phenomena** related to the aerospace missions driven by the European Space Agency (ESA) and the Space Industry. It mainly concerns investigations on aerothermodynamics (ATD) for the design and qualification of the Thermal Protection System (TPS) for aerospace vehicles.



*Dr Jean Muylaert, Director of the von Karman Institute
at the Graduation Ceremony*

Unique facilities such as the LongShot (hypersonic wind tunnel, Mach 14) and the Plasmatron (plasma wind tunnel, 1.2 MW) are dedicated to the studies of laminar to turbulent transition in hypersonic regime and gas-surface interaction in high enthalpy flows. Fundamental and numerical activities are intimately linked to this research program with the development of specific numerical simulation (CFD) platforms and physical modeling to compute non-equilibrium flow phenomena in shock layers.

Beside its traditional fields of expertise, the VKI has been involved since quite a few decades in a challenging field of research that deals with multiphase flows. Initially, this activity had been mainly driven by the demand from the industrial sector as there was a need for R&D support to solve issues encountered in the fabrication processes. The resulting expertise has not only been incorporated in the program of education and research but also made available to projects from other sectors. Over more than a decade, most of these projects may be grouped in the thematic of solid and liquid propulsion. Just to cite few examples, the VKI has studied the flow inside the Ariane 5 solid boosters, the phenomena occurring during the priming of liquid propulsion lines, the monitoring of sloshing events in satellite propellant management devices or the characterization of cryogenic valves.

For several years, the Turbomachinery and Propulsion Department has been broadly specialized in activities related to aero-propulsion and energy conversion by means of rotating machinery. At the present time, the department teams up with the major European engine manufacturers, either in European Commission co-funded projects, or in bilateral focused programs. The department has been recognized as

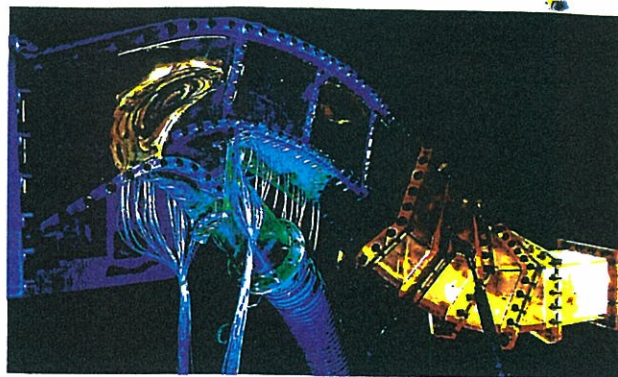
COMPANY PROFILE

one of the main research partners of Snecma, the French aero-engine manufacturer. Advanced aero-thermal research is carried out on the colder fan and compressor side, as well as on the hotter turbine extremity. On the energy side, the department recently completed the aero-mechanical design of the primary cooling pump of the Myrrha reactor for SCK•CEN in Mol, and contributed to product development in several sectors of the energy conversion industry (steam turbines, turbochargers, etc.).

Over the past 10 years, the VKI has also dedicated important efforts to the field of **aeroacoustics**. This field deals with the aerodynamic noise generation and propagation, which has very important implications in sectors such as surface and air transportation, domestic applications, renewable energies and industrial processes. Through national or EU-funded research projects, the VKI has built a strong expertise in modeling and measuring noise emitted by low-speed cooling fans for the automotive and locomotive industries. A specific facility has been designed and built for this purpose, allowing simultaneous aerodynamic and aeroacoustic performance certifications.

What's the added value of the von Karman Institute?

The Institute pursues two goals: education and research both fundamental and applied to problems in industry. The main educational programme offered by the von Karman Institute is the annual Research Master at the "Master after Master" level. Approximately 35 engineers and scientists from twelve countries attend this course of study taking place in a unique international environment. The students are offered a wide selection of specialized courses on various aspects of fluid dynamics and are given the opportunity to perform a personal, original research project under close guidance of Faculty members. The projects may be experimental, theoretical, or numerical in nature. The VKI Research Master in fluid dynamics, focusing on teaching research by doing research, is accredited by the NVAO (Accreditation Organisation of The Netherlands and Flanders). After completing the Research Master, the best candidates are



Periodic high speed test sector of an aeroengine by-pass duct

enrolled in the doctoral programme. Presently VKI hosts 56 PhD's taking advantage of the unique experimental infrastructure and/or using the numerical capabilities of the Institute. Other academic programmes are available such as: short trainings for qualified university students, a post-doc programme to further valorize PhD research, an applied research programme for Research Master graduates, a master thesis programme for university students, the one-week Lecture Series for lifelong learning focusing on specialized topics for professionals and academia in the field of aeronautics, space, propulsion, energy conversion, turbomachinery components and propulsion.

The knowhow of the VKI is made available to Belgian and international industry and public services through many collaborative projects, some involving very practical support in developing new products or studying actual problems e.g. in renewable energy.

Acknowledgement

The VKI acknowledges the sustained support from BELSPO and its international consortium of member states, which has allowed the VKI to reach the present level of competence and its worldwide recognition as a true center of excellence in fluid dynamics.



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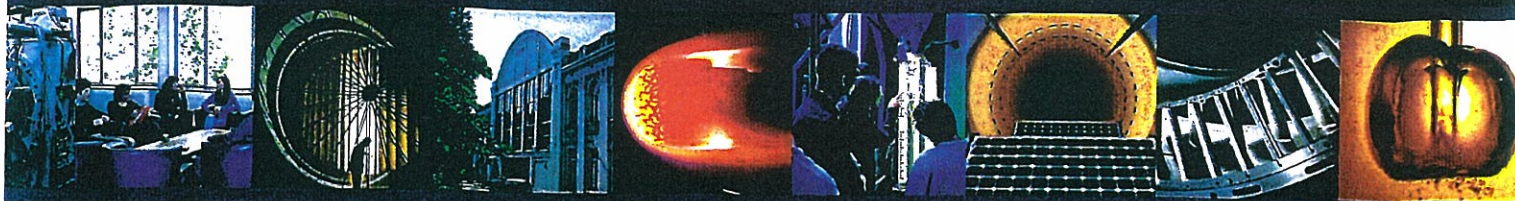
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Visit of the laboratories at the occasion of the MoU agreement between SCK•CEN and VKI in January 2011. From left to right Mr. Yves Leterme (Former Belgian Prime Minister), Dr Jean Muylaert (VKI Director), and Prof. Jean-Pierre Contzen (Chairman of the VKI Board of Directors)



VON KARMAN INSTITUTE FOR FLUID DYNAMICS



www.vki.ac.be

Research Master in Fluid Dynamics

Departments

**Aeronautics and Aerospace,
Turbomachinery and Propulsion,
Environmental and Applied Fluid Dynamics**

Accredited by NVAO

NVAO ensures the quality of educational programs according to the Bologna agreement for higher education in Europe.



The complete curriculum involves a minimum of 30 ECTS of courses and 30 ECTS for an independent research project,

**Fellowships available and no tuition fees required
for many NATO states**

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Master after Master level

The Research Master of the von Karman Institute (VKI) is a one-year postgraduate course at the level "Master-after-Master" (former VKI Diploma Course) with a 55 years tradition. Approximately thirty-five engineers and scientists from ten or more countries attend this programme taking place in a unique international highly valuing team spirit. They are offered a wide selection of specialised courses on various aspects of fluid dynamics and are given the opportunity to perform a personal research project under close guidance by members of the faculty. The project may be experimental, theoretical, or numerical in nature.

**Access to an extraordinary set of wind
tunnels covering all regimes, from low
subsonic to hypersonic flow (Mach 14)**

Graduates of the VKI Research Master find a career in the research departments of industry (Airbus, Automotive, GE General Electric, Rolls-Royce, SNECMA, ...), in government agencies and international research centers (ESA, DLR, NASA, ONERA, ...), or pursue their education in a doctoral programme.

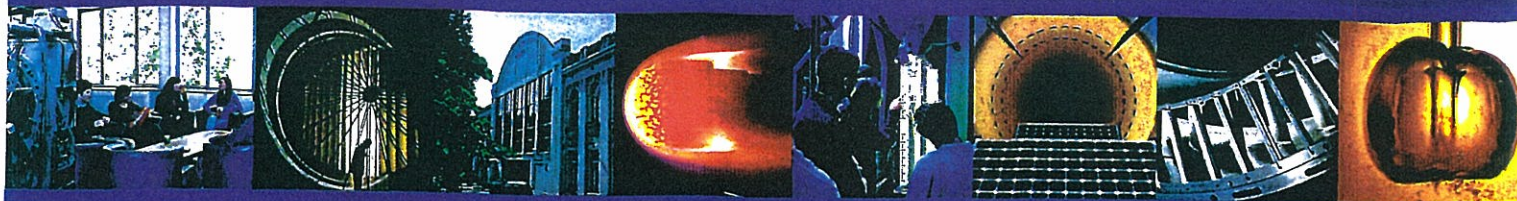
The VKI Research Master in Fluid Dynamics complements the master programmes of universities with a profound research oriented specialisation.

**FREE access to the internationally
recognised VKI Lecture Series**

For more information
consult our website: <https://www.vki.ac.be>



VON KARMAN INSTITUTE FOR FLUID DYNAMICS



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Short Training Programme

The von Karman Institute for Fluid Dynamics (VKI) offers university students in engineering, physics or mathematics a hands on training for a period of two or three months, involving **active participation in a guided research project**.

This experience will provide practice in the use of experimental test facilities or computational and laboratory techniques. Added benefits are the exposure to methodology of research and team work in an international, multicultural environment.

In a number of cases, this programme can also be used to prepare a MS graduation thesis at the home university.

No fee associated with this programme.
Limited number of fellowships available for highly qualified students.

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Fluid mechanics in industrial processes

Non-intrusive instrumentation

Biological flows

Aeronautics and aerospace

Aeronautical flows

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Aeroacoustics

Space applications

- atmospheric entry aerothermodynamics
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Computational methods for flow simulation (CFD)

Turbomachinery and propulsion

Axial and radial compressors, gas and steam turbines

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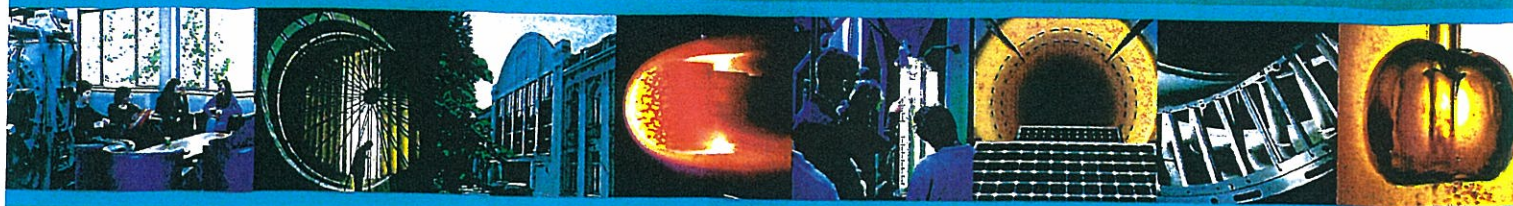
Access to an extraordinary set of wind tunnels covering all regimes, from low subsonic to hypersonic (Mach 14) flow

Free access to the internationally recognised lifelong learning programme: the VKI Lecture Series

For more information
consult our website: <https://www.vki.ac.be>



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PhD Programme

Options

**Aeronautics and Aerospace,
Turbomachinery and Propulsion,
Environmental and Applied Fluid Dynamics**

**Access to an extraordinary set of wind tunnels
covering all regimes, from low subsonic to
hypersonic (Mach 14) flow**

**FREE access to the internationally recognised
VKI short course programme:
the VKI Lecture Series.**

Continuation of research master

Candidates typically enter this programme after completing the research master in fluid dynamics.

Collaboration with universities

The PhD thesis may be presented in English, French or Dutch at any Belgian university or at a university abroad leading to a degree of doctor in applied sciences. The collaboration between university and the VKI leads to considerable benefits, allowing to perform research based on the outstanding facilities and unique experience available at the VKI and to work in an international excellence center with colleagues from all over the world.

International environment

Presently, about 60 candidates are enrolled in the doctoral programme of the VKI, representing more than ten countries from Europe and America.

Center of Excellence

The von Karman Institute for Fluid Dynamics operates a comprehensive range of experimental and computational facilities covering virtually all aspects of fluid mechanics. Support is provided by facility engineers, electronic laboratory, a computing centre, a technical library and a publishing office with photolab, a computer-aided drawing/design office and well-equipped workshops.

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