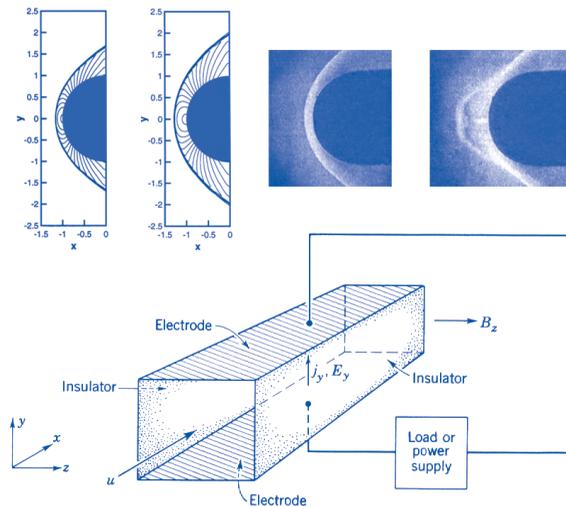




VON KARMAN INSTITUTE  
 FOR FLUID DYNAMICS

# INTRODUCTION TO MAGNETO- FLUID DYNAMICS

*for aerospace applications*



This lecture series is realized with the support of the United States Air Force European Office of Research and Development (EOARD), London, England.



27 - 30 October 2003

VON KARMAN INSTITUTE FOR FLUID DYNAMICS

72, Chaussée de Waterloo  
 1640 Rhode-Saint-Genèse, Belgium  
 Tel: 32 2 359 96 04 - Fax: 32 2 359 96 00  
 e-mail: secretariat@vki.ac.be - web site: <http://www.vki.ac.be>

## INTRODUCTION

The objective of this Lecture Series is to introduce magneto-fluid-dynamics (MFD) fundamentals and to report on the current state-of-the-art research for future aerospace applications. MFD is described as the interaction and coupling between the flow of a conducting fluid, such as plasmas, and an applied electromagnetic field. This multiphysics field has recently been rejuvenated with recent innovation of experimental and computational activities. The lecture series is aimed towards recent investigators as well as advanced researchers in this field.

The lectures will begin with the fundamentals, governing equations of motion and a historical perspective on relevant MFD research and developments. Subsequent lectures will address specific numerical and experimental applications of MFD, such

as flow control, propulsion, high enthalpy ground test facilities and energy management. International experts from Europe, Russia and the United States will discuss their respective activities in these areas.

At the conclusion of the course, an attendee will be familiar with the terminology of this field, the current state-of-the-art and the tools necessary to initiate MFD research for both experimental and computational activities.

The Director of this lecture series is Assistant Professor Olivier Chazot and the Coordinator is PhD candidate Matthew Zuber of the von Karman Institute.

## Timetable

Monday 27 October 2003 .....	Tuesday 28 October 2003 .....	Wednesday 29 October 2003 .....	Thursday 30 October 2003 .....
08:45 <i>Registration</i>			
09:00 <i>Welcome address</i> Prof. M. Carbonaro, Director, von Karman Institute	09:00 <i>Coupling Between Electro- Magnetics &amp; Fluid-Dynamics: Physical &amp; Numerical Aspects</i> Prof. Domenic D'Ambrosio, Dip. di Ingegneria Aeronautica e Spaziale, Italy	09:00 <i>Experimental Approach to Plasma Physical Aspects of Traditional MHD</i> Prof. Abraham Veefkind, University of Eindhoven, Netherlands	09:00 <i>MFD Technologies for Space Propulsion Applications</i> Prof. Mariano Andreucci, University of Pisa, Italy
09:30 <i>Historical Perspective</i> Dr. Joseph Shang, Wright-State University, Dayton, OH, United States	10:45 <i>Upwind Numerical Method for Magneto-Fluid-Dynamics</i> Prof. Maurizio Pandolfi, Dip. di Ingegneria Aeronautica e Spaziale, Italy	10:45 <i>Prospective of MHD Interaction in Hypersonic &amp; Propulsion Technologies</i> Dr. V. A. Bityurin, Institute of High Temperatures RAS (IVTAN), Russia	10:45 <i>Russian Efforts in MHD Aerospace Applications</i> Dr. V. A. Bityurin
11:00 <i>Magneto &amp; Electromagneto Fluid Dynamics</i> Prof. Jacques Nihoul, Liege University, Belgium			
~	~	~	~
14:00 <i>Introduction to the Governing Equations of MFD : Macroscopic Approach</i> Dr. Domenico Giordano, ESA/ESTEC, Netherlands	14:00 <i>Numerical Modeling of Electromagnetic Control Techniques for High-Speed Flow</i> Dr. Jon Poggie, US Air Force, United States	14:00 <i>Plasma Flow Control for Boundary Layers</i> Dr. Roger Kimmel, US Air Force, United States	14:00 <i>US Activities in MHD Aerospace Applications</i> Dr. Joseph Shang
15:45 <i>1D Equations &amp; Analysis / Channel Flows</i> Prof. Jacques Nihoul	15:45 <i>Numerical Fully Coupled Example - MHD Scramjet</i> Prof. Claudio Bruno, University of Rome, Italy	15:45 <i>Design &amp; Implementation of a Magnetoaerodynamic Channel</i> Dr. Roger Kimmel	15:45 <i>European Activities - ESA &amp; Italian Perspective</i> Dr. Domenico Giordano, Prof. Carlo Borghi, University of Bologna, Italy
17:00 <i>Reception</i>			

~ Lunch will be taken from 12h05 to 13h45. Coffee breaks are scheduled each morning and afternoon.

*Please pass this announcement to someone who may be interested if you are unable to attend the Lecture Series yourself*



INTRODUCTION TO MEASUREMENT TECHNIQUES  
(OCTOBER 6-10, 2003)

INTRODUCTION TO MAGNETO-FLUID DYNAMICS  
FOR AEROSPACE APPLICATIONS  
(OCTOBER 27-30, 2003)

LOW RE AERODYNAMICS ON AIRCRAFT INCLUDING  
APPLICATIONS IN EMERGING UAV TECHNOLOGY - RTO-AVT-VKI LS  
(NOVEMBER 24-28, 2003)

INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS  
(JANUARY 12-16, 2004)

TURBINE BLADE TIP DESIGN & TIP CLEARANCE TREATMENT  
(JANUARY 19-23, 2004)

CLEAN COMBUSTORS FOR INDUSTRIAL GAS TURBINES  
(FEBRUARY 9-13, 2004)

ADVANCED MEASUREMENT TECHNIQUES FOR  
AERO ENGINES & STATIONARY GAS TURBINES  
(MARCH 1-5, 2004)

ADVANCES IN AEROACOUSTICS & APPLICATIONS  
(MARCH 15-19, 2004)

INTRODUCTION TO TURBULENCE MODELING  
(MARCH 22-26, 2004)

34<sup>TH</sup> COMPUTATIONAL FLUID DYNAMICS -  
AEROELASTICITY & MULTIDISCIPLINARY OPTIMIZATION  
(APRIL 19-23, 2004)

HEAT TRANSFER AND INVERSE ANALYSIS - RTO-AVT-VKI LS  
(APRIL 26-30, 2004)

CRITICAL TECHNOLOGIES FOR HYPERSONIC  
VEHICLE DEVELOPMENT - RTO-AVT-VKI LS  
(MAY 10-14, 2004)

## COURSE FEE

The full fee for the lecture series is 1200 €. A fee of 900 € (25% reduction) is applicable to citizens of NATO Countries except Canada, Denmark, Greece, The Netherlands and UK. The fee includes printed notes, transport between VKI and the recommended hotels, lunches, beverages, and administrative costs.

## FELLOWSHIPS

To encourage greater participation in our Lecture Series programme by university members, the Institute has established a limited number of VKI Lecture Series Fellowships for participants from NATO countries\*. The recipient of a fellowship is entitled to attend the Lecture Series at a reduced fee, which will be of 450 € for assistants not having a Ph.D. degree and for Ph.D. candidates, or 225 € for undergraduate students. These reduced fees are also available for NATO citizens\* coming from a university in another country.

The request to be considered for an award must accompany the application to attend the Lecture Series, and the applicant must provide a recommendation letter from his or her professor; if not done so, the request will not be taken into consideration. All possible alternative sources of funding should be investigated before aid is requested under this scheme, so that those most in need will benefit.

\*except Canada, Denmark, Greece, The Netherlands and UK.

## Accommodation & Transport

Participants are advised to make their reservations as early as possible through VKI (secretariat@vki.ac.be) in order to benefit from special rates offered by the recommended hotels listed below. Daily rates include all charges and continental breakfast.

Hôtel des Colonies*** http://www.hotel-des-colonies.be	Single: 90 € / Double: 100 €
Hôtel Vendôme***L http://www.hotel-vendome.be	Single: 95 € / Double: 115 €
Tulip Inn*** http://www.tulipinnbb.be	Single: 99 € / Double: 109 €
Comfort Art Hôtel Siru*** http://www.comforthotelsiru.com	Single: 100 € / Double: 115 €
Hilton Brussels City http://www.hilton.com	Single: 135 € / Double: 161 €

Auberge de Waterloo**** e-mail: aubergedewaterloo@skynet.be	Single: 106 € / Double: 118 €
Fax : +32 (0)2 358 38 06 Tel : +32 (0)2 358 35 80 Chaussée de Waterloo 212 - 1640 Rhode-Saint-Genèse	

## METHODS OF PAYMENT

Payment 2 weeks prior to the beginning of the course (name and course title clearly indicated) by bank transfer to our account Nr 210-0315330-35 at Fortis Bank, avenue de la Forêt de Soignes 322, 1640 Rhode-Saint-Genèse, Belgium, IBAN BE57 2100 3153 3035 (**strongly recommended**).

Late registration can be paid cash in EURO, or by VISA or Eurocard at the beginning of the course.

Payment must be the equivalent of the fee at the prevailing rate of exchange.

## PROCEEDINGS

Lectures will be given in English and printed notes will be distributed during registration.

Proceedings of other lecture series may be purchased at VKI (e-mail : vanhaelen@vki.ac.be or fax : 32 2 359 96 00). Information can be found on <http://www.vki.ac.be>.

## HOW TO REGISTER

It is highly recommended to send the registration/hotel reservation form at the latest 15 days before the beginning of the course. A letter of acceptance and additional information will be sent on receipt of the application form.

Please mail under cover to VKI

## APPLICATION FOR ADMISSION TO VKI LECTURE SERIES

Lecture Series Title : .....

Name : .....

Christian name : .....

Name & full address of organization, institution or university : .....

Nationality : .....

Telephone nr. : .....

Fax nr. : .....

Position or title : .....

e-mail : .....

Asking a reduced fee and joining a recommendation letter as :  Undergraduate student  Ph. D. candidate or University assistant

## HOTEL RESERVATION (if applicable)

I require accomodation at Hotel .....

person(s)

Single : .....

Double : .....

for .....

Date of arrival : .....

Date of departure : .....

I shall require transport to and from the Institute

I do not require transport to and from the Institute

Please indicate any special needs (e.g. vegetarian, ...) : .....

Date : .....

Signature : .....