

**SP-533**

December 2003

# **International Workshop on Radiation of High Temperature Gases in Atmospheric Entry**

Nach den Bestimmungen des Urheberrechts darf das  
auf beiliegenden Disketten/CD-ROMs gespeicherte  
Computerprogramm nicht auf einen anderen Daten-  
träger übertragen und insbesondere **n i c h t** zu  
gewerblichen Zwecken genutzt werden.

Die Bibliothek übernimmt **k e i n e Garantie** für die  
Virenfreiheit des Datenträgers.

8-10 October 2003  
Instituto Superior Técnico  
Lisbon, Portugal

SUB Göttingen  
212 196 88X



7

+ 1 CD-ROM

1623

*Sponsored by*

European Space Agency (ESA)  
Centre National d'Etudes Spatiales (CNES)  
Instituto Superior Técnico (IST)

# CONTENTS

## Radiative Heat Transfer

Nonequilibrium radiative heat transfer in conditions of superorbital entry in the Earth's Atmosphere <i>V.A. Gorelov, A.Y. Kireev, S.V. Shilenkov and S.T. Surzhikov</i>	3
---	---

Prediction of radiative heating of internal surfaces of hydrogen and air laser plasma generators intended for aerospace applications <i>M. Filipsky, M. Mokrov, S.T. Surzhikov, M. Capitelli and G. Colonna</i>	11
--	----

## Non-Equilibrium Shock Waves

Analysis of the radiative heat flux during the entry of the Huygens Probe in the Titan atmosphere <i>F. Mazoue, J. Graciano, F. dengra, L. Marraffa, T. Blancquaert and J.P. Lebreton</i>	21
--	----

Prediction of nonequilibrium radiation from CO <sub>2</sub> -N <sub>2</sub> shock waves <i>S.T. Surzhikov</i>	29
--	----

## Ground Facilities

Qualification of TPS components in Martian and Earth atmospheres <i>U. Koch, B. Esser and A. Gühan</i>	39
---	----

Operating characteristics of the SR5 Hypersonic Plasma Wind-Tunnel <i>S. Mazouffre, V. Caubet-Hilloutou, M. Dudeck and E. Pawelec</i>	47
--	----

The Inductively Heated Plasma Wind Tunnel PWK3 as a means for emission experiments to rebuild radiation test cases <i>P. Endlich, M. Auweter-Kurtz, G. Herdrich, S. Löhle and M. Winter</i>	55
--	----

Fluid mechanics calculations as a support tool for experimental investigations using the SR5 Wind-Tunnel <i>M. Lino da Silva, T. Alexandrova, S. Mazouffre, M. Dudeck, R. Reis and J.C.F. Pereira</i>	63
--	----

## PARADE

ESA PlasmA RAdiation DatabasE (PARADE). Development History, Status, Current Developments and Future Prospects <i>A.J. Smith</i>	75
---	----

PARADE – a program to calculate the radiation of atmospheric re-entry in different atmospheres <i>B. Pfeiffer, M. Fertig, M. Winter and M. Auweter Kurtz</i>	85
---	----

## Models

2D CFD/RGD model of space vehicles <i>S.T. Surzhikov</i>	95
---	----

Multigroup model for radiating flows during atmospheric hypersonic re-entry <i>P. Charrier, B. Dubroca, G. Duffa and R. Turpault</i>	103
---	-----

Computing system for solving radiative gasdynamic problems of entry and re-entry space vehicles <i>S.T. Surzhikov</i>	111
--	-----

## Test Case 1

A proposed solution for Test Case One using the SESAM code <i>M. Lino da Silva and M. Dudeck</i>	121
---	-----

Proposal of a new test case for gas radiation modelling: application to a plasma expanding flow in a conical nozzle <i>M. Lino da Silva and M. Dudeck</i>	127
--	-----

## Test Case 2

Rebuilding flowfield and radiation test cases for Mars and Titan atmospheres <i>F.J. Dengra Moya, F. Mazoue and L. Marraffa</i>	137
--	-----

## Test Case 3

Analysis of the results for TC3 presented at the 1 <sup>st</sup> International Workshop on Radiation of High Temperature Gas in Planetary Atmosphere Entry <i>J.-M. Charbonnier</i>	145
--	-----

Modeling sensitivity analysis for TC3 on the orbiter aerothermal properties <i>W. Dieudonné, M. Spel and J.-M. Charbonnier</i>	161
---	-----

Numerical simulation of non-equilibrium hypersonic CO <sub>2</sub> flows for Mars entry application <i>P. Rini, T. Magin, G. Degrez and D. Fletcher</i>	171
--	-----

Development of the PHARAON platform and ONERA numerical solvers for gas radiation <i>O. Rouzaud, J. Hylkema, J.-L. Vérant and L. Tessé</i>	181
---	-----

Line by line and statistical narrow-band calculations of radiative transfer in some atmospheric entry problems <i>P. Riviere, A. Soufiani and M.-Y. Perrin</i>	189
---	-----

List of Participants	197
----------------------	-----