

The 21 Century COE Project  
Exploring New Science by Bridging Particle-Matter Hierarchy

**Short-term Foreign Researchers**  
**Research Report**

Name: Maria Specovious

Affiliation: Univ. Kassel

Host Researcher in Tohoku University: Hideo Kozono

Your Stay Period in Japan: From 2004. 2. 25 to 2004. 3. 10

Title of Research in Japan:

A pressure stabilization method for the stationary Navier-Stokes system

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Please write a research report of one or more pages and submit it with this cover to your host researcher till the end of this March.

Report of COE research on  
**"Nonlinear artificial boundary conditions for the  
Navier-Stokes equations in an aperture domain"**  
by Maria Specovius-Neugebauer

**Keywords**

Artificial boundary conditions Navier-Stokes equations Jeffrey-Hamel equations

**Abstract**

We consider the Dirichlet problem for the stationary Navier-Stokes system in a plane domain  $\Omega$ , with two angular outlets to infinity. It is known that, under appropriate decay and smallness assumptions, this problem admits solutions with main asymptotic terms in Jeffrey-Hamel form. We will approach these solutions by constructing an approximating problem in the domain  $\Omega_R$ , which is the intersection of  $\Omega$  with a sufficiently large circle. The main difficulty, in contrast to the corresponding linear problem, arises from the fact that the main asymptotic term is not known explicitly. Here, we create nonlinear, but local, artificial boundary conditions which involve second order differential operators on the truncation arcs. Unlike for the analogous three-dimensional exterior problem, we are able to show the existence of weak solutions to the approximating problem without smoothness nor smallness assumptions. For small data, we prove that the solutions of the approximating problem are unique and regular. Finally, we reach the main goal of this work, i.e. we obtain error estimates in weighted Höder spaces which are asymptotically precise as  $R$  tends to infinity

# "Nonlinear P. D. E. in Mathematical Physics"

サテライト研究集会  
国際シンポジウム「物質階層融合科学の構築」

## プロジェクト :

東北大学大学院理学研究科21世紀COEプログラム  
「物質階層融合科学の構築」数理科学研究班

日程 : 2004年3月2日 9:30 — 17:30

場所 : 東北大学大学院理学研究科数学専攻 川井ホール  
(cf. <http://www.math.tohoku.ac.jp/index.html>)

組織委員 : Herbert Amann (Zürich大学)  
柴田 良弘 (早稲田大学)  
小菌 英雄 (東北大学)

## プログラム :

09:30 ~ 10:15 Maria Specovious (Univ. Kassel)

A pressure stabilization method for the stationary Navier-Stokes system

10:25 ~ 10:55 榎本裕子 (早稲田大学)

On a stability theorem of the Navier-Stokes equation in an exterior domain

### ティータイム

11:10 ~ 11:40 久保隆徹 (早稲田大学)

$L^p - L^q$  estimate of Stokes semigroup and its application to the Navier-Stokes equation in a perturbed half-space

11:45 ~ 12:15 山口範和 (早稲田大学)

On an existence theorem of global strong solution to the magnetohydrodynamic system in three dimensional exterior domain

### ランチ

13:45 ~ 14:15 秋山高宏 (早稲田大学)

On the  $L_p$  approach to a stationary and non-stationary problem of the Ginzburg-Landau-Maxwell equations

14:20 ~ 14:50 杉山由恵 (津田塾大学)

Global existence of weak solutions for a quasilinear degenerate parabolic system of chemotaxis

14:55 ~ 15:25 佐藤得志 (東北大学)

On positive solutions to some semilinear elliptic equations with convex nonlinearity involving nonnegative forcing term

### ティータイム

15:50 ~ 16:20 和田出秀光 (東北大学)

Upper bound of the best constant of the Trudinger-Moser inequality

16:25 ~ 16:55 鈴木友幸 (東北大学)

Regularity criterion via pressure and vorticity on weak solutions to the Navier-Stokes equations

17:00 ~ 17:30 Hyunseok Kim (Yonsei University, 東北大学)

Interior regularity criteria in weak spaces for the Navier-Stokes equations