

## Research Report (September, 2020 - March, 2023)

### In the SGU course of Mathematical Physical Science: September 2020-March 2023

Conferring university	Degree name (by completing a course / by thesis only)	Date of conferment
Waseda University	Doctor of Science	03, 15, 2023

Enrollment from  
September 2020

Department of Pure and Applied Mathematics

Fumitaka WAKABAYASHI

#### I. List of Papers

1. ○ Wakabayashi, F., The Keller-Segel system of parabolic-parabolic type in Morrey space, Journal of Differential Equations, published online November 2018, Volume 265, Issue 9, Pages 4661-4686.
2. ○ Kozono, H., Ushikoshi, E., Wakabayashi, F., Removable time-dependent singularities of solutions to the Stokes equations, Journal of Differential Equations, published online January 2023, Volume 342, Pages 472-489.

#### II. Record of Awards

Nothing

#### III. List of Talks

1. 少林文孝. The Keller-Segel system of parabolic-parabolic type in Morrey space, 日本数学会 2018 年度秋季総合分科会, 岡山大学, 2018 年 9 月.
2. 少林文孝. Removability of moving singularities in the Stokes and Navier-Stokes equations, Waseda Workshop on Partial Differential Equations, 早稲田大学, 2019 年 12 月.
3. 少林文孝. Removability of time-dependent singularities in the Stokes equations, International Workshop on Multiphase Flows: Analysis, Modelling and Numerics, 早稲田大学(オンライン), 2020 年 12 月.
4. 少林文孝. Removability of time-dependent singularities in the Stokes equations, 第 14 回 若手のための偏微分方程式と数学解析(オンライン), 2021 年 2 月.
5. 小園英雄・牛越恵理佳・少林文孝. Removability of time-dependent singularities in the Stokes equations, 日本数学会 2021 年度年会, 慶応義塾大学(オンライン), 2021 年 3 月.
6. 小園英雄・牛越恵理佳・少林文孝. Removability of time-dependent singularities of the Navier-Stokes equations, 日本数学会 2021 年度秋季総合分科会, 千葉大学(オンライン), 2021 年 9 月.
7. 少林文孝. Removability of time-dependent singularities in the Navier-Stokes equations, 若手による流体力学の基礎方程式研究集会プログラム(オンライン), 2022 年 1 月.

#### IV. Research Results in AY 2022

In the Navier-Stokes equations, I showed the existence of the solutions with the time-dependent singularities or the higher dimensional sets. Then, I summarized my study into my doctoral thesis. I also obtained the optimality of the sufficient conditions to remove the time-dependent singularities

in the Stokes equations in a sense.

## **V. Summary (From April 2020 to May 2023)**

The study in the sufficient conditions to remove the time-dependent singularities in the Stokes and the Navier-Stokes equations until 2021 went well as scheduled. I also actually obtained the singular solutions with time-dependent singularities or the sets in the Navier-Stokes equations, and obtained the optimality of the sufficient conditions to remove the time-dependent singularities in the Stokes equations in the sense that there exists singular solutions with time-dependent singularities in the class  $L^{\frac{n}{n-2},\infty}$ . I need the new method to show the removability of the time-dependent singular sets in the Navier-Stokes equations since I cannot apply the method in the heat equation to the Navier-Stokes equations. But, it is difficult for me to find the new method alternative to that of the heat equation. Because of this, I couldn't do my study from 2022 well.