

Internship at Institute of Fluid Science Tohoku University

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RESEARCH

For the past nearly three months, with the help of Prof. Maruyama and Dr. Okajima, good progress in micro channel critical fluid flow is achieved. Numerical modeling is established and tested and applied on the super computer of IFS in Tohoku University. Each week discussions with Prof. Maruyama and Prof. Xinrong Zhang and Dr. Okajima always indicate new ideas and novel thoughts.

My research topic is Critical Thermal Relaxation and Supercritical Instability in Near-Critical Micro-Channel Flow. Over the past decades, development in fine manipulation of micro-engineering has enabled a wide set of scientific advances in MEMs, chemical engineering, pharmacology, etc. SCF (supercritical fluid) provides one important contribution in micro-engineering with its preferable thermal physical properties near its gas-liquid critical point. Here we studied a novel kind instability and vortex evolution in micro channel SCF flows suppress of gravity effect. Using numerical analysis on Navier-Stokes equations and detailed description of near critical properties of SCF, multi-scale evolution of micro channel SCF boundary stability in response to a heat impulse under gravity/micro-gravity conditions are performed. We found a new kind of supercritical Kelvin-Helmholtz instability. Analysis on low Reynolds

SCF flow shows high efficiency mixing vortex which grows exponentially with position and time. Together, our work reveals new possibilities for SCF micro dynamics and micro devices/processes, providing novel solutions to micro-engineering as micro mixing/reaction/sensation/manufacturing. Several papers on those findings will be published in international journals.

FUTURE CONCERNS

- (1) Papers soon be submitted to international journals;
- (2) Further development of the analytical solution of the current problem will be continued and discussed still with Professors in IFS;
- (3) Further experimental analysis will be cooperated with Prof. Maruyama; experiment may be done both in Peking University and Tohoku University in the near future;
- (4) Future cooperation is being discussed.



Fig.1 Sashimi

EVENT

JIAOZI PARTY

In November, in Maruyama-lab, we

had very nice JIAOZI PARTY, which is an important tradition in this lab. We made and cooked delicious JIAOZI by ourselves, where communications and friendship is established.



Fig. 2 JIAOZI PARTY

忘年会

YEAR-FORGET PARTY is also one tradition in Japan. At the end of year, all the members of a group/company/lab... will arrange a party to 'forget' the old year and welcome the New Year. Though this New Year is the year of 2012, we still celebrated is with humble and smiling face, that should be a challenging and also fruitful year.



Fig.3 忘年会

FAREWELL PARTY

As it is near the end of the internship period, all lab members hold a party to show gratitude and friendship. This is a happy time rather than a sad one. All the members expressed the ideas of further communications and to

keep in touch in the future.



Fig. 4 野菜煮

TEMPLE VISITING

Winter season in Sendai is also the snow season. Only when we went to 西方寺 temple, we started to know the heavy snow. Together with Prof. Maruyama, we enjoyed very beautiful scenery and good food in the mountain temple.



Fig.5 西方寺



Fig. 6 舍利塔

TOHOKU UNIVERSITY

Tohoku University IFS has a long history in the field of critical fluid dynamics and heat transfer and renowned in the world. Generally, the scientific research in Tohoku University holds high performance and the hard work of the professors and students are also very impressive. With good support from the staffs of IFS and the good apparatus as well as super computer in Tohoku University, well experimental and analytical/numerical work come out, that's very attractive.



Fig. 7 雪国



Fig. 8 鲁迅先生

SENDAI CITY

Sendai city is one of the biggest cities in Tohoku area; Tohoku University is one of the best Universities in northeast Japan. Though not spending much time going around, but the beautiful scenery in Tohoku University (Katahira campus) must be one of the

most beautiful universities in Japan. Also, Tohoku University has once a Chinese student, one of the best novelist in the first half of 20th century, which represents the strong relationship of Tohoku University with Chinese students. In addition, the kind help and good performance from the staffs of GCOE office and IFS will always be remembered.



Fig. 8 国分町

FRIENDSHIP AND GRATITUDE

The friendship with the lab members in IFS is really a treasure and unforgettable experiences both in research and leisure time sports also very valuable. The support of GCOE program and the help of GCOE office staffs should really be acknowledged.



Fig. 10 东北大学 (片平校区)



Fig. 11 初雪の IFS (2011)