Posudek práce

předložené na Matematicko-fyzikální fakultě
Univerzity Karlovy v Praze

❑ posudek vedoucího ☑posudek oponenta
☑ bakalářské práce ❑ diplomové práce

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Název práce: Visualization of liquid Helium flows generated by an oscillating rectangular cylinder
Studijní program a obor: Fyzika a Obecná fyzika
Rok odevzdání: 2015

Jméno a tituly vedoucího/oponenta: Dr. Martin James Jackson, PhD
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Odborná úroveň práce:
☑ vynikající ❑ velmi dobrá ❑ průměrná ❑ podprůměrná ❑ nevyhovující

Věcné chyby:
☑ téměř žádné ❑ vzhledem k rozsahu přiměřený počet ❑ méně podstatné četné ❑ závažné

Výsledky:
❑ originální ☑ původní i převzaté ❑ netriviální kompilace ❑ citované z literatury ❑ opsané

Rozsah práce:
❑ veliký ☑ standardní ❑ dostatečný ❑ nedostatečný

Grafická, jazyková a formální úroveň:
❑ vynikající ☑ velmi dobrá ❑ průměrná ❑ podprůměrná ❑ nevyhovující

Tiskové chyby:
☑ téměř žádné ❑ vzhledem k rozsahu a tématu přiměřený počet ❑ četné

Celková úroveň práce:
❑ vynikající ☑ velmi dobrá ❑ průměrná ❑ podprůměrná ❑ nevyhovující

Slovní vyjádření, komentáře a připomínky oponenta:

This thesis is an excellent, clear and concise report of a very high standard, summarizing a novel experiment performed in the Department of Low Temperature Physics. The student was responsible for designing, performing and interpreting visualization studies of macroscopic vortex structures shed from a rectangular cylinder in liquid ^{4}He. This material represents a significant contribution to the field of quantum turbulence research and is suitable for publication in a peer-reviewed journal.

This body of work directly compares mechanical flows in both the viscous and inviscid flows of normal and superfluid helium, respectively. The work highlights a qualitative difference between macroscopic flows in He-I & He-II and the student convincingly demonstrates the quasi-classical nature of the experiment.

The data processing performed in this study clearly required a significant amount of work, and the interpretation of the analysed results demonstrates that the student has a clear understanding of the relevant physics.

Regarding criticism, I have made many comments and suggestions throughout the thesis, and an annotated copy has been made available for the student to consider. Here, I summarize the main criticisms, which do not affect the overall high standard of this work, significantly.

- It was not obvious how the mesh was constructed. This should have been made clearer.
- It should have been explicitly stated what the oscillation frequency was for each measurement.
- The parameter, R_{max} should have been defined as soon as it was introduced (page 25), as opposed to page 40.
- It would have been useful to have plotted the particle trajectories which correspond to the maps of the θ-parameter presented.
- In several plots, two or more data sets are compared. However, the data ranges do not always match.
- During the discussion where three possible Reynolds numbers are introduced, the student rightly states that the kinematic viscosity is difficult to define and depends on the type of flow. However, I believe the values measured in previous steady-state experiments as well as those performed using vibrating objects should also have been considered. Also, the first definition of the kinematic viscosity outlined states that it is equal to the quantum of circulation, κ. However in this model, it is actually equal to $\kappa/6$.

Případné otázky při obhajobě a náměty do diskuze:

Are the tracer particles affected by the laser sheet and if so, would they affect the flow?

By what mechanism does a tracer particle approach and attach to a vortex and how is the kinetic energy of the vortex reduced by trapping the particle?

Can it be shown that the θ-parameter is related to the vorticity?

Please comment on the dimensionless numbers used to characterize oscillatory flows of superfluid ^{4}He and what their limiting factors are. Why did you use those described in the work and are there any other suitable numbers which could be used instead?

For the cylinder used, what is the high frequency limit where the flow velocity changes on the scale of the viscous penetration depth? Is this frequency attainable with the current set-up? Can it be visualized and what does this frequency mean in regards to the use of dimensionless numbers?

Práci
☑ doporučuji
❑ nedoporučuji
uznat jako diplomovou/bakalářskou.

Navrhuji hodnocení stupněm:
☑ výborně ❑ velmi dobře ❑ dobře ❑ neprospěl/a

Místo, datum a podpis oponenta:

Praha 07.06.2015