

令和 2 年 1 月 28 日

若手研究者海外挑戦プログラム報告書

独立行政法人日本学術振興会 理事長 殿

受付番号 201980083

氏 名 川名 好史朗

(氏名は必ず自署すること)

若手研究者海外挑戦プログラムによる派遣を終了しましたので、下記のとおり報告いたします。
なお、下記記載の内容については相違ありません。

記

1. 派遣先：都市名 エルサレム (国名 イスラエル)
2. 研究課題名（和文）：潮汐破壊現象の発生頻度と検出頻度の研究
3. 派遣期間：令和元年9月20日～令和元年12月27日（99日間）
4. 受入機関名・部局名：ヘブライ大学ラカー物理学研究所
5. 派遣先で従事した研究内容と研究状況（1/2 ページ程度を目安に記入すること）

I have been studying tidal disruption events (TDEs) where a white dwarf (WD) is tidally disrupted by an intermediate-mass black hole (IMBH). I planned to study event rates and detection rates of this type of WD TDEs, but I studied dynamics of the WD TDEs, especially focusing on effects of thermonuclear explosions on dynamics of debris of the disrupted WD. The WD can experience the thermonuclear explosions if the encounter with the IMBH is close enough and if the tidal compression is strong enough. The thermonuclear explosions release nuclear energy, and then significantly affect orbital energy distribution of the WD debris. The orbital energy distribution is a principal value in TDEs: it determines mass fallback rate of the debris on to the IMBHs and velocity profile of the unbound debris. They are expected to be tightly related to observables of WD TDEs. Therefore, it is important to understand how the thermonuclear explosions affect the dynamics of the TDE debris.

First, we checked dependence of the orbital energy distribution on the pericenter radius of the orbit performing hydrodynamical simulations of WD TDEs for various parameter cases. We see that the dispersion and mean of the orbital energy are almost the same as the specific nuclear energy released by the thermonuclear reactions and they are weakly dependent on the pericenter radius. This is inconsistent with a simple picture where the WD is spherically pushed by a nuclear burning frame, which leads to the orbital energy dispersion to be about ten times larger than the results of the simulations. Then we make a hypothesis that the WD is aspherical y pushed by the burning frame because WD is also aspherical at the pericenter due to the tidal disruption. To test the hypothesis, we consider a simpler situation mimicking the WD TDE, where a cylindrical flow is pushed by the sudden increase of the internal energy of the flow within a certain radius. The velocity profile of the flow after the energy increase is our interest because it is analog to how the WD is pushed by the burning flow. I have been developing a code to simulate the situation.

We also revealed that previous knowledge on condition whether TDE happens should be modified. If the encounter between the IMBH and WD is too close, they collide with each other and a part of the WD was

swallowed by the IMBH, which is a different situation from WD TDEs. Previous studies to derive the boundary between the collisions and TDEs ignoring distortion of the WD. We revealed that considering the point, a parameter space where TDEs happen is larger than the previous studies.

6. 研究成果発表等の見通し及び今後の研究計画の方向性 (1/2 ページ程度を目安に記入すること)

I will keep studying the dynamics of the WD TDE debris and aim at publishing journal paper(s). To this end, I keep developing the simulation code of the simplified problem. When we succeed to successfully simulate the problem, I will perform a parameter study varying the energy added to flow and the radius within which the energy is added. Then, I will check the dependence of the velocity profile of the flow after the energy increase on those parameters. I will also study the event rates and detection rates of the WD TDEs, which is the topic initially planned to be studied, keeping in touch with the host researcher, Prof. Re'em Sari with e-mail and/or Skype.

7. 本プログラムに採用されたことで得られたこと (1/2 ページ程度を目安に記入すること)

I had very beneficial experiences with the JSPS Overseas Challenge Program for Young Researchers. My research field and my view of things are broadened by starting the research project which I did not plan to study. I was motivated to study WD TDEs further by Prof. Re'em Sari's deep insights. I had valuable discussions with him and other Israeli researchers on TDEs, which are not available in Japan because there are few TDE researchers in Japan. I gave seminar talks in 4 institutes in Israel during the program, and they were good chances to promote my research and myself to Israeli researchers. They gave me valuable connections to Israeli researchers.