

STEPS Students Report

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During our correspondence prof. Kenji Fukushima has suggested me interesting problem which I could study. Prof. Kenji Fukushima is a specialist in high-energy nuclear theory and hadron physics, so my research was also related to that area.

The subject of my research was theoretical investigation of baryonic matter in external magnetic field and phenomena related to that. This investigation had to be done in terms of effective field theory (Nambu-Jona-Lasinio model), in which baryons are represented as non-topological solitons. The interest of this research is due to generation of strong magnetic fields during collision of nuclei. Also there are evidences that in such process quantum anomalies could come into play. It should be noted that anomalous processes are sensitive to external fields, namely to strong magnetic fields. Moreover, chiral magnetic effect (anomalous process) can be driven by dynamics of non-topological solitons such as baryons. Nambu-Jona-Lasinio model is also useful for studying high-density nuclear phenomena (for example, in neutron stars). There are two commonly used approaches of studying baryons and baryonic matter: in terms of topological solitons and non-topological ones. Properties of both such solitons are well studied, but there were no articles about properties of non-topological solitons in external magnetic field. The investigation requires study of articles, formulation of the problem, theoretical analysis, writing equations and finding a solution using numerical techniques.

I would like to note that prof. Kenji Fukushima and his group are very hospitable, polite and participating people. Prof. Kenji Fukushima advised me interesting material to study, and had time for discussions when we spoke about problems (both related to my research and not). Also there were interesting discussions inside the group.

During my stay I learned a lot of material. The problem was formulated and equations to solve were written down. But one thing remains unsolved – namely, numerical investigation of the problem. This is almost impossible to finish during approximately one month, so I hope I will be able to continue this investigation since January when it seems I will have enough time.

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I am very grateful to prof. Kenji Fukushima for interesting research problem, participation and hospitality. I also would like to thank the group for hospitality and warm welcome.