Usage Report for Fiscal Year 2017

Project Title:

Theory of Spintronics in Antiferromagnets

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Description of the project

1. Over the past years, antiferromagnets have played a very important but passive role in magnetic storage devices in which they have been used primarily as pinning layers. Recently, emerging technologies have been proposed with antiferromagnetic materials playing an active role such as, governing the transport properties of the devices. This is principally due to the fact that antiferromagnets (i) can easily be integrated with ferromagnetic components, (ii) no stray fields and (iii) are characterized by ultrafast response (~ THz range, while ferromagnets' response is in the ~ GHz range). Fundamental to the understanding of current-induced motion of antiferromagnets is the detailed knowledge of the influence on dynamics of inhomogeneous magnetic textures by current.
2. This project was geared at providing an accurate description of spin transport in antiferromagnetic textures vis-a-vis a theoretical investigation of the nature of spin torque and magnetic damping in such systems. Based on tight-binding model, the local spin transfer torque will be calculated using the local non-equilibrium spin densities, while the damping will be extracted from the scattering matrices. Since real systems are usually characterized by impurities which, my objectives were to model impurities via a random energy. To ensure converses of my results there is need to take a macroscopic impurity averages (100 000) to ensures converses. This requires enormous computational time and therefore the needed the Supercomputers.
3. However, after several exchange of emails and visit to the HPC team, I could not get the KWANT software (https://kwant-project.org) correctly installed in the HPC computers to use for this calculations. I was so frustrated, gave up, and resulted to using my local machine to carry out all my computations which took enormous time to get it done and could only succeeded to doing 10000 impurities averages.
4. For the future, it would be great to have the KWANT code correctly installed in the HPC (at least the administrators can provide help in installing it locally). This could greatly enhance the efficiency of my calculations which as of now is based on my local desktop.