プログラム名：量子人工脳を量子ネットワークでつなぐ高度知識社会基盤の実現
PM 名：山本　喜久
プロジェクト名：量子シミュレーション

委 託 研 究 開 発

実 施 状 況 報 告 書（成果）

平成 27 年度

研究開発課題名：

現代コンピュータに実装できる量子多体系の新計算手法の開発

研究開発機関名：

国立研究開発法人理化学研究所

研究開発責任者：

ノリ　フランコ

Ⅰ　当該年度における計画と成果

１．当該年度の担当研究開発課題の目標と計画

To improve and expand several exist open-quantum system solvers within QuTip, as well as develop new libraries and functions.

２．当該年度の担当研究開発課題の進捗状況と成果

2-1 進捗状況

Our initial goals for 2015 were to improve and expand several exist open-quantum system solvers within QuTip, as well as develop new libraries and functions. For the latter we made several significant breakthroughs:

2-2 成果

1) We successfully implemented methods for the calculation of counting statistics and large deviation functions, allowing us to calculate the full statistics of photonic and electron transport through nanostructures. We are still refining these functions for generic use, and have not made them available with a release version of QuTip yet. However, as an application, we used them to investigate the statistics of lasing in hybrid-QED in the article "Bistable Photon Emission from a Solid-State Single-Atom Laser", N. Lambert, F. Nori, and C. Flindt, Phys. Rev. Lett. 115, 216803 (2015).

2) We made preliminary versions of two non-Markovian open quantum systems solvers, the reaction co-ordinate (RC) method, and the hierarchy method (HEOM). As yet these are rudimentary but functional, and can be found in the QuTip development version, at: https://github.com/qutip/qutip/blob/master/qutip/rcsolve.py
and
https://github.com/qutip/qutip/blob/master/qutip/hsolve.py
respectively.

2-3 新たな課題など

Plans for 2016:

1) Refinement and expansion of the counting statistics functions described above, so that they are easy to use and apply to generic nanoscale systems. This will include the development of example codes for common systems.

2) Further development of the RC and HEOM functions. This will include improvements in functionality and efficiency, and generalization to arbitrary spectral densities. We will also begin development of variants of these codes for Fermionic environments. This will allow us to tackle problems like Kondo physics in quantum dots and other strongly-correlated electronic phenomena in small-dimensional systems.

3) Further development of a quantum information processing (QIP) module, for the analysis of quantum algorithms realized in different physical systems.

３．アウトリーチ活動報告

特になし