# DMRG Studies for Itinerant Ferromagnetism in a Two-leg Optical Lattice System

M. Okumura[1,2], S. Yamada[3,2], M. Machida[3,2], and H. Aoki[4]

[1] CCMP, RIKEN, Wako, Saitama 351–0198, JAPAN

[2] CREST(JST), Kawaguchi, Saitama 332–0012, JAPAN

[3] CCSE, Japan Atomic Energy Agency, Taito-ku, Tokyo 110–0015, JAPAN

[4] Department of Physics, The University of Tokyo, Hongo, Tokyo 113–0033, Japan

Density matrix renormalization group (DMRG) is one of the most powerful methods for investigating strongly correlated systems. Recently, three of the present authors have developed a parallel DMRG code [1] that enables us to calculate the ground state of $n$-leg lattice models efficiently. We can thus explore multi-leg ladder systems to look for intriguing physics that is speci c to ladder structures, e.g., ferromagnetism in the Hubbard model.

It has been well-known that the lattice structure in addition to strong on-site repulsion is responsible for non-trivial ground state. A typical example is the itinerant ferromagnetism, which still de es full understanding. Besides electron systems, cold Fermionic atom systems is an ideal test-bench for such studies due to its flexibility and controllability on lattice structures. In fact, three itinerant ferromagnetism, i.e., Stoner's, Nagaoka's, and flat-band mechanisms have been so far discussed in ultra-cold atom experiments, and the  rst one has been reported very recently [2].

With this background, here we propose that a two-leg ladder optical lattice system should accommodate a stable itinerant ferromagnetism for cold fermionic atoms with  nite hole densities [3], which may be regarded as an extended Nagaoka's ferromagnetism. A special interest in the cold atom system is that, on top of the optical lattice potential, we have a trapping potential. We predict that this causes an interesting phase separation into magnetic and nonmagnetic phases in real space. We show the phase-separated magnetism speci cally in spin-imbalanced situations, and the phase diagram obtained here indicates that the required strength of correlation is realistic.

## References

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