PEM026-15 Room:101 Time:May 24 18:00-18:15

Performance evaluation of various supercomputer systems with Vlasov code

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More than 99% of the "top 500" supercomputer systems in the world now adopt scalar processors. Almost 90% of the super-computer systems consist of the 64bit x86 processor architecture. The POWER processor architecture has a 8% share, and the SPARC processor architecture has only a 0.4% share. In general, the computational efficiency (the ratio of the effective performance to the theoretical performance) of user applications on a scalar computer tends to be low (less than 10%), although the computational efficiency of the LINPACK sometimes exceeds 80%. Therefore, it is important to develop a high-performance user application for space plasma simulations on scalar-type massively parallel supercomputer systems. In this paper, a performance measurement study of the first-principle Vlasov-Maxwell solver is carried out on various scalar-type supercomputer systems in Japan.

In December 2010, the Solar-Terrestrial Environment Laboratory (STEL) at Nagoya University installed a now supercomputer system, DELL PowerEdge R815. The DELL PowerEdge R815 supercomputer system at STEL has the same specification with the T2K open supercomputers in Japan. The system is a PC-cluster-type supercomputer consisting of 48 nodes, and each node has four AMD 12-core Opteron 6174 processors (2.2GHz, L2: 512KB/core, L3: 12MB/CPU) and 96GB DDR3 memory. As for the internode connections, each node has two InfiniBand QDR links with a bandwidth of 4GB/s per link. The peak performance of the system is 20TFlops. The system has just started pre-operation in January 2011, and the preliminary result of the performance measurement will also be presented.

Keywords: Vlasov equation, supercomputer, plasma, performance measurement