Distributed Pararell Processing Laboratory

Stanislav G. Sedukhin
Special Honorary Professor

Naohito Nakasato
Senior Associate Professor

Hitoshi Oi
Associate Professor

Refereed academic journal

[nakasato-204-005-01:2016] Yushi Sato, Naohito Nakasato, Ataru Tanikawa, Ken'ichi Nomoto, Keiichi Maeda, and Izumi Hachisu. The Critical Mass Ratio of Double White Dwarf Binaries for Violent Merger-Induced Type Ia Supernova Explosions. *Astrophysical Journal*, 821(1):67, 2016.

Mergers of carbon-oxygen (CO) white dwarfs (WDs) are considered as one of the potential progenitors of type Ia supernovae (SNe Ia). Recent hydrodynamical simulations showed that the less massive (secondary) WD violently accretes onto the more massive (primary) one, carbon detonation occurs, the detonation wave propagates through the primary, and the primary finally explodes as a sub-Chandrasekhar mass SN Ia. Such an explosion mechanism is called the violent merger scenario. Based on the smoothed particle hydrodynamics (SPH) simulations of merging CO WDs, we derived more stringent critical mass ratio (qcr) leading to the violent merger scenario than the previous results. We conclude that this difference mainly comes from the differences in the initial condition, synchronously spinning of WDs or not. Using our new results, we estimated the brightness distribution of SNe Ia in the violent merger scenario and compared it with previous studies. We found that our new qcr does not significantly affect the brightness distribution. We present the direct outcome immediately following CO WD mergers for various primary masses and mass ratios. We also discussed the final fate of the central system of the bipolar planetary nebula Henize 2-428, which was recently suggested to be a double CO WD system whose total mass exceeds the Chandrasekhar-limiting mass, merging within the Hubble time. Even considering the uncertainties in the proposed binary parameters, we concluded that the final fate of this system is almost certainly a sub-Chandrasekhar mass SN Ia in the violent merger scenario.

Refereed proceedings of an academic conference

[nakasato-204-005-02:2016] Kohei Nagasu, Kentaro Sano, Fumiya Kono, and Naohito Nakasato. Performance and Power Evaluation of FPGA-based Tsunami Simulator using Floating-Point DSPs. In *IEEE Symposium on Low-Power and High-Speed Chips COOL Chips XIX*, pages 1–3, 2016.

Simulation of tsunami, a series of waves caused by asubmarine earthquake, is strongly demanded to forecast itsdamages for an emergency evacuation order.

To carry outfast but accurate simulation with unstable power suppliedafter a major earthquake, we need high-speed but low-powercomputing machines. Although GPUs are capable of high-performance computing, their power consumption is also high.

[nakasato-204-005-03:2016] Kohei Nagasu, Kentaro Sano, Fumiya Kono, Naohito Nakasato, Alexander Vazhenin, and Stanislav Sedukhin. Parallelism for High-Performance Tsunami Simulation with FPGA: Spatial or Temporal? In *2016 IEEE 24th Annual International Symposium on Field-Programmable Custom Computing Machines (FCCM)*, page 1, 2016.

To carry out fast but accurate tsunami simulation after a major earthquake, we have developed an FPGA-based custom computing machine for high-speed but low-power tsunami simulator. We design a stream processing element (SPE) which is hardware based on pipelining and data-flow for tsunami computation. This paper presents design-space exploration for spatial and temporal parallelism of SPEs.

Advisor for undergraduate research and graduate research

[nakasato-204-005-04:2016] Syunsuke Sekiguchi. Graduation Thesis: Assessment of Numerical Errors in a-few-Body Problems, University of Aizu, 2017.

Thesis Advisor: N. Nakasato

[nakasato-204-005-05:2016] Yui Tanaka. Graduation Thesis: Performance evaluation of embedded ARM processors, University of Aizu, 2017.

Thesis Advisor: N. Nakasato