Session:	**[B2C-5] S5 : Compact Objects, High Energy and Particle Astrophysics**
Date:	August 19, 2014 (Tuesday)
Time:	16:00~17:25
Room:	Room E (Room 107)
Chair:	Tatehiro Mihara (RIKEN)

[B2C-5-1] **16:00~16:20**

[Invited] Neutron Star Structure and Related Astrophysical Problems

Chang-Hwan Lee (Pusan National University, Korea)

Recent observations on 2 solar mass neutron stars in neutron star-white dwarf binaries, PSR J1614-2230 and PSR J0348+0432, have given strong constraints on the maximum mass of neutron stars. On the other hand, all well-measured neutron star masses in double neutron star binaries are still less than 1.5 solar mass. In this talk, I would like to discuss the implications of recent neutron star observations to the neutron star equations of states and the related astrophysical issues. I also would like to discuss the possibilities of super-Eddington accretion during the binary evolution of neutron star progenitors.

[B2C-5-2] **16:20~16:40**

[Invited] Multi-Messenger Astronomy of Compact Binaries

Chunglee Kim (Seoul National University, Korea)

Within a decade, gravitational waves (GWs) will provide us with a new probe to explore the Universe and heavenly bodies. GW astronomy will be complimentary to photon- and particle-based astronomy and multi-messenger astronomy can be done with a network of observatories and satellites. Among the predicted GW sources, compact binaries (NS-NS and BH-BH binaries) are one of the most promising ones to be detected on Earth using laser interferometry. Analyzing GW data based on Bayesian Inference will allow us to measure physical parameters of compact binaries, such as masses, location, distance, spin(s), etc. Most interestingly, GWs is a unique tool to study black hole binaries, which are inaccessible by other methods. Focusing on compact binaries, we overview the recent progresses made in the field of GW astronomy. We also discuss strategies and prospects of multi-messenger astronomy in order to study compact objects.

[B2C-5-3] **16:40~16:55**

Switching States in Pulsar Magnetosphere

Phrudth Jaroenjittichai (National Astronomical Research Institute of Thailand, Thailand) and Michael Kramer

Switching emission states in intermittent and moding pulsars are suggested to be related via changes in the charge current flows above the polar cap, which are responsible for both radio emission and pulsar’s spin derivative (or `spin-down'). Because the charge current flows depend on the geometry of the magnetic field lines, the change in the spin-down is predicted to depend on the inclination angle α, measured between the magnetic and spin axes. Using a pulsar's beam model, assuming a dipole geometry, we estimate α of three intermittent pulsars, PSRs B1931+24, J1841+0500 and J1832+0029, and found the results to be consistent with the predictions. Despite the suggested connection between the two phenomena, the changes in the spin-down of moding pulsars can be difficult to measure due to their faster switching timescales. Here, we present a new approach for estimating the variation in the charge current density of moding pulsars, which involves determining the plasma perturbation on the polarisation position angle of each mode. The correlation between the spin-down changes and α can be realised with a sample of moding pulsars using this method, offering another supporting evidence to this picture.

[B2C-5-4] **16:55~17:10**

The Electron Fraction and the Fermi Energy of Relativistic Electrons in a Neutron Star

Z. F. Gao (Xinjiang Astronomical Observatory, China) and Q. H. Peng

The electron fraction and the Fermi energy of relativistic electrons in the circumstance of a neutron star (NS) are two important physical parameters influencing directly weak-interaction processes including MURCA reactions, electron capture and so on. This influence will change intrinsic equations of states (EOS), interior structure and heat evolution of a NS, and even affect whole properties of the star. Based on the currently popular and reliable EOSs, we investigate the relationship between the electron fraction and matter density in a wide density range by fitting numerically, and deduce a uniform formula for the Fermi energy of degenerate and relativistic electrons in the weak-magnetic field approximation, from which we can obtain the value of electron Fermi energy given a matter density. By comparing with other classic theoretical models, our methods with the characters of simplification and accuracy can be universally suitable for millisecond and common radio pulsars.

[B2C-5-5] **17:10~17:25**

New Relativistic Magnetohydrodynamic Codes Based on Upwind Schemes

Hanbyul Jang (Ulsan National Institute of Science and Technology, Korea) and Dongsu Ryu

High energy astrophysical phenomena are ubiquitous in the universe, i.e. relativistic jets originated from AGNs, accretion disks around black holes, gamma ray bursts, and etc. Relativistic flows are commonly involved and magnetic fields play important roles in these energetic astrophysical events. Therefore building a robust and reliable code for relativistic magnetohydrodynamic (RMHD) is important to correctly interpret the physics of the observed high energy phenomena. Because of complexities in the formulism of RMHD, however, building a code based on upwind schemes has been a challenging project. We present the Jacobian matrix for the RMHD system in laboratory frame which enables to describe the eigenvalues and eigenvectors in considerably simple forms. With the general solutions for quartic equations for the compressible mode, we obtained the full sets of analytic expressions for eigenvalues. We then obtained the analytic forms for the left and right eigenvectors which are well defined in all possible physical states including degenerate ones. Using this newly derived eigen-system for RMHD, we successfully built new RMHD codes based on a total variation diminishing (TVD) scheme and weighted essentially non-oscillatory (WENO) scheme which are second and higher order accurate extensions of upwind schemes, respectively. We compared our codes with HLL-type codes which do not utilize the full eigen-system of RMHD. One dimensional numerical tests demonstrate the performance and robustness of new RMHD.