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Report by visiting Professor Edison Liang

Subject: Particle Acceleration and Relativistic Plasmas

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Abstract:

New mechanisms for particle acceleration and production of relativistic plasmas are discussed and explored during Professor Liang's 4-week visit to ILE, Osaka University. Future exchanges and collaborations between ILE and Rice University are also established.

Activities and Accomplishments of Professor Liang's Visit

Edison Liang, the Andrew Hays Buchanan Chair Professor of Astrophysics of Rice University, Houston, Texas, USA, visited ILE, Osaka University from Feb. 1 to Feb. 28, 2004. Professor Liang is the ex-chairman of the Topical Group of Plasma Astrophysics of the American Physical Society and also the Associate Director of Rice Space Institute.

Professor Liang is an expert and pioneer in the field of relativistic plasmas, both in astrophysics and those produced by ultra-intense lasers. The purpose of his visit to ILE are three-fold: 1) to give invited lectures on recent advances in relativistic plasmas and particle acceleration; 2) to interact with and advise students in Professor Takabe's group; 3) to explore future experiments and theoretical research that can be performed at ILE, especially using the short-pulse ultra-intense lasers, that are most relevant to astrophysics.

During his visit Professor Liang gave 1 lecture at ILE, 1 lecture at the Toyonaka campus of Osaka University and 1 lecture at Kyoto University, covering the subjects of gamma-ray bursts, e^+e^- production with ultra-intense lasers,

and particle acceleration mechanisms using electromagnetic pulses. In particular, he reviewed exciting new discoveries related to the Diamagnetic Relativistic Pulse Accelerator, which holds great promise as the physical mechanism for gamma-ray bursts and may be reproducible in the laboratory using ultra-intense lasers irradiating electron-positron plasmas.

Professor Liang discussed particle-in-cell simulations extensively with Dr. Nakashima in Professor Takabe's group. He also went over in detail with Dr. Nakashima his Ph.D. thesis on positron production using ultra-intense lasers. He had extensive discussions with Dr. Sano on his works in MRI disks and with Dr. Misuta on his works in jets. He was introduced to graduate student Shinya Sugiyama of Prof. Takabe's group. As a result Mr. Sugiyama will be visiting Prof. Liang group at Rice University starting September 2004. This opens up a new phase in the exchange program between the two universities.

Professor Liang also attend the High Energy Cosmic Ray and Gamma-Ray Regional Conference in Kobe and renewed his acquaintances with many leading Japanese researchers in this field. During his visit to Kyoto University he gave a lecture on Gamma-Ray Bursts and held scientific discussions with Prof. Mineshige, his students and visitors and students of Prof. Shibata. Much was learnt by both sides.

Prof. Liang toured the Gekko laser facilities and explored future collaborative experiments that can be performed on the Gekko lasers and the nearby smaller ultra-intense laser. He had extensive discussions with students of Prof. Kodama's group about feasible experiments using the high-rep-rate smaller laser relevant to astrophysics. It appears that many useful topics dealing with relativistic plasmas and their interactions with electromagnetic fields can be studied with the smaller laser, as well as the Gekko lasers. Prof. Liang's group has the state-of-art codes and expertise to perform the simulations for such experiments. Hence such collaborations will be very synergistic, benefiting both parties.

During his discussions with Prof. Takabe, Prof. Liang also proposed the idea of forming an International Alliance on High Energy Density Laboratory Astrophysics, which Prof. Takabe supports enthusiastically. Further developments on this concept will be explored in future meetings.

In summary, the three primary goals of Prof. Liang's visit are more than accomplished. We look forward to future fruitful collaborations and exchanges between ILE and Rice University.