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New observations of flux ropes in the magnetotail reconnection region

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Magnetic reconnection is a fundamental physical process that enables the rapid transfer of magnetic energy into plasma kinetic and thermal energy in the laboratory, astrophysical and space plasma. Flux ropes have been suggested to play important role in controlling the micro-scale physics of magnetic reconnection and electron acceleration. In this presentation, we report new observations of flux ropes in the magnetotail reconnection region based on the Cluster multi-spacecraft data. Firstly, two consecutive magnetic flux ropes, separated by less than 30 s (Δt < 30 s), are observed within one magnetic reconnection diffusion region without strong guide field. In spite of the small but non-trivial global scale negative guide field ($-B_y$), there exists a directional change of the core fields of two flux ropes, i.e. $-B_y$ for the first one, and $+B_y$ for the second one. This is inconsistent with any theory and simulations. Therefore, we suggest that the core field of flux ropes is formed by compression of the local preexisting B_y, and that the directional change of core field is due to the change of local preexisting B_y. Such a change in ambientB_y might be caused by some microscale physics. Secondary, **w**e will present *in-situ* observations of a small scale flux rope locally formed at the separatrix region of magnetic reconnection without large guide field. Bidirectional electron beams (cold and hot beams) and density cavity accompanied by intense wave activities substantiate the crossing of the separatrix region. Density compression and one parallel electron beam are detected inside the flux rope. We suggest that this flux rope is locally generated at the separatrix region due to the tearing instability within the separatrix current layer. This observation sheds new light on the 3D picture of magnetic reconnection in space plasma.