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Ion acceleration by electro-magnetic plasma waves in the vicinity of SLAMS boundary observed in the front of the Earth's quasi-parallel bow shock

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A well known feature of collisionless shocks which are formed in space plasmas is their capability to accelerate particles to high energies. On the other hand, the exact mechanism how this acceleration takes place is still unknown. This is especially true in the case of the so-called seed particle population, i.e. those particles which are being injected into the process of acceleration. In our study we present a case study of Gyroresonant Surfing Acceleration (GSA) observed on the quasi-parallel side of the Earth's bow shock. For our analysis we use simultaneous multi-spacecraft measurement data provided by the Cluster spacecraft ion (CIS), magnetic (FGM) and electric field and wave instrument (EFW) during a time period of large inter-spacecraft separation distance. Our results show evidence that the gyroresonance surfing acceleration takes place as a consequence of interaction between monochromatic (or quasi-monochromatic) electromagnetic plasma waves and short large amplitude magnetic structures (SLAMS). The magnetic field inhomogenity mirror force keeps the ions trapped by the wave in resonant condition which results in effective particle velocity increase and thus energy gain. Since monochromatic wave packets with circular polarization and various magnetic structures are very commonly observed in the front of the Earth's quasi-parallel bow shock, the gyroresonant surfing acceleration proves to be an effective particle injection mechanism resulting in the formation of the seed particle population.