Electrodynamics of particle acceleration in pulsar magnetosphere

P. C. Hsu[1], K. Hirotani[2], H.-K. Chang[1]

[1]Department of Physics and Institute of Astronomy, National Tsing Hua University, Taiwan
[2]ASIAA/National Tsing Hua University - TIARA, Taiwan

ABSTRACT: We study on the electrodynamics of particle acceleration in the pulsar magnetosphere. Mechanisms of particle acceleration and resultant γ-ray emission in pulsar magnetosphere have not been completely understood. Electric field along the magnetic field line arises in the charge depletion region (gap) in pulsar magnetosphere. Charged particles are accelerated to relativistic energy by the longitudinal electric field and radiate synchrotron/curvature γ-ray photons. Some γ-ray photons make pairs by the pair-creation process. The new born pairs screen out the electric field. We have to take into account all these physical processes to understand the γ-ray emission mechanism. In this work, therefore, we solve the Poisson equation, the motion of charged particles, and γ-ray distribution together consistently in a two-dimensional poloidal plane. The previous two-dimensional model (Takata et.al. 2004,2006) assumed the particle motion saturated between electric force and the curvature radiation back reaction force. In this work, on the other hand,the unsaturated motion of new born pairs is solved correctly with the radiation back reaction force. We find that the saturation length is not ignorable comparing with the gap length. We also solve the pitch angle evolution and pair-creation process of photons via curvature-synchrotron radiation process.