Study on polarization of high-energy photons from the Crab pulsar

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ABSTRACT: We discuss polarization characteristics of high-energy photons from the Crab pulsar. The polarization measurement will play an important role to discriminate the various models that have successfully explain observed spectrum or light curve. We calculate the polarization predicted by the **synchrotron emission** in the framework of the outer gap model (Cheng et al. 2000) and the two-pole caustic model (Dyks et al. 2004), and compare the results with the Crab optical data.

We assume that the emitted photons are linearly polarized at degree of $(p + 1)/(p + 7/3)$ in the direction of particle acceleration. Emission direction and Stokes parameters Q and U are appropriately treated with the effects of particle's gyration and aberration.

The degree of polarization predicted by the synchrotron emission in general is more consistent with observation than that of curvature radiation. Relatively constant of the polarization position angle in the bridge and off-pulse phases may be consistent with the data. We find, however, the pattern of the polarization degree in a period is not similar with the data.

The curvature radiation model predicts too high a degree of polarization (Dyks et al. 2004) and no successful spectra have been achieved up to date. On the other hand, although various models are examined with the synchrotron emission, which is favored for the Crab spectrum, none of the models was able to exactly reproduce the Crab optical data. This indicates that the Crab polarization data reflect more detailed structure of the magnetosphere of the Crab pulsar.