Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Precession in Stokes flow: spin and revolution of a bacterial flagellum[1] TAKUJI ISHIKAWA, YOICHIRO SAWANO, HIROMICHI WAKEBE, YUICHI INOUE, Tohoku University, AKIHIKO ISHIJIMA, Osaka University, YUJI SHIMOGONYA, Tohoku University — The bacterial flagellar motor is an ion-driven rotary machine in the cell envelope of bacteria. When we performed a bead assay, in which the cell body was affixed to a glass surface to observe the rotation of a truncated flagellum via the positioning of a 250 nm-diameter gold nanoparticle, we often observed that the filament motion consisted of two types of rotation: spin and revolution, which resulted in precession. Since the mechanism of flagella precession was unknown, we investigated it using numerical simulations. The results show that the precession occurred due to hydrodynamic interactions between the flagellum and the wall in the Stokes flow regime. We also developed a simple theory of the precession, which validity was confirmed by comparing with the simulation. The theory could be utilized to predict both the filament tilt angle and motor torque from experimental flagellar precession data. The knowledge obtained is important in understanding mechanical properties of the bacterial motor and hook.

[1]This work was supported in part by a Japan Society Promotion of Science Grants-in-Aid for Scientific Research (JSPS KAKENHI) (Grant Nos. 25000008 and 26242039).

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Date submitted: 20 Jul 2016 Electronic form version 1.4