Detection and estimation of the Shlichter mode based on the data of the Baksan long-base laser strainmeter (the Northern Caucasus, Russia)

Vadim Milyukov, Michail Vinogradov, Alexey Mironov, and Andrey Myasnikov
Moscow State University, Sternberg Astronomical Institute, Moscow, Russian Federation (vmilyukov@yandex.ru)

Slichter mode, the long periodical oscillation of the Earth, 1S1, is caused by the translational oscillations of the solid inner core about its equilibrium position at the center of the Earth. The preliminary estimation of its period was made by Louis Slichter in 1961. Up to now, the generally-accepted interpretation was that the frequency of the Slichter mode is principally controlled by the density jump between the inner and outer core, and the Archimedean force produced by the fluid outer core. According to theoretical calculations based on perturbation theory, its period is thought to be in the range of $3 \sim 9$ hours, quality factor is in the range of $2000 \sim 5000$, and it splits into 3 singlets because of the Earth's rotation. As this translational mode can offer important information about the density jump at the ICB (Inner Core Boundary), much effort has been made to detect it.

The first serious attempts to detect the Slichter mode by superconducting gravimeters were started in the late 90-ies with the development of Global Geodynamic Project (GGP). However, at the moment confirmed experimental data on observation of the Slichter mode are absent. The present work is the first attempt for detection and evaluation of the Slichter mode based on long-term deformation data obtained at the Baksan long-base laser strainmeter.

For detection and evaluation of the Slichter mode some methods of optimal filtration, in particular, the method of maximum likelihood are used. We formulated several hypotheses (the continued availability of the Slichter mode in the deformation data, the existence of the Slichter mode only after major earthquakes, etc.). For each of the hypotheses the corresponding probabilistic evaluations and parameters of detection quality (probability of false alarm and probability of correct detection, depending on the signal to noise relation) are obtained.

Our analysis revealed some periods which can possibly indicate the existing of the Slichter mode in the deformation data, in particular, after major earthquakes. In accordance with the PREM splitting parameters for 1S1 mode, the Slichter mode triplet frequencies for different hypotheses of excitation are evaluated. The parameters (lower limit) of potential discovery of the Slichter mode, depending on the characteristics of the earthquake (moment tensor and location relative to the place of observation) are determined.

The results of the analysis are reported.