THE MILKY WAY LOCAL DYNAMICS

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Abstract. The dynamics of our own Galaxy (the Milky Way) in the solar neighbourhood is analyzed. It is emphasized that in the framework of the classical approach, which involves the steady state and axial symmetry, the main research directions are the determination of the dynamical constants and the explanation of the local kinematics. In spite of this it seems that the classical approach is not sufficient to explain the entire variety of the observed phenomena. Some of them (vertex deviation, velocity-dispersion increasing with age, etc) in the present author's opinion require its generalization towards a triaxial symmetry and a nonsteady state.

1. INTRODUCTION

As usually the notion "local" applied in galactic astronomy means something referred to the solar neighbourhood. Therefore, the Milky-Way local dynamics studies the dynamics of a small Milky-Way region near the Sun. The more abundant observational material existing for the solar-neighbourhood case compared to other parts of our Galaxy offers many questions for stellar dynamics to be answered. It was just the local kinematics which almost seventy years ago initiated the dynamical study of the galactic rotation. The basic ideas of this theory, as well known, are:

1. the steady state and axial symmetry of the Milky Way as a whole;
2. the ellipsoidal distribution of the residual velocities at the Sun for the disc stars.

These ideas have remained much unchanged. Therefore, the local dynamics of the Milky Way can be considered in two approaches - the classical one based on the two assumptions mentioned above and a more general one where the (inevitable) deviations from both steady state and axial symmetry are taken into account.

2. THE POSSIBILITIES OF THE CLASSICAL APPROACH

In the founding of the Milky-Way local dynamics one can choose different ways. In the present author's opinion the best one is, certainly, which introduces the notion of the dynamical constants (Ninković, 1987b). These are the local values of dynamical quantities, i.e. their values taken at the galactocentric position $R = R_0$, $Z = 0$. In the framework of the classical approach the constants of interest are: the local value of the potential, the first radial derivative ($\frac{\partial \Pi}{\partial R}$), the second radial derivative ($\frac{\partial^2 \Pi}{\partial R^2}$) and the second vertical derivative ($\frac{\partial^2 \Pi}{\partial Z^2}$) (in all cases their local values). Higher-order