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The redistribution of the regions in radiative and convective equilibrium of the stars of the main sequence with rotation

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Abstract. We study the redistribution of the mechanisms of the energy transport with rotation in the interiors of young stars of the Main sequence. In that purpose, we did numerical modelling of the structure of zero age stars of the Main sequence for 26 stellar masses in the interval 0.8–120 Solar masses ($M_{\odot}$), with constant chemical composition X = 0.75, Y = 0.23, Z = 0.02 (N = 0.3 Z). Rotation of a solid body type with angular velocity varied from zero (spherically symmetrical models) till critical one (models at the border of dynamical stability) for each stellar mass is considered. For numerical integration of the differential equations we used Henyey's method for spherically symmetrical stars, modified by the technique of Kippenhahn and Thomas for rotating stars, with the algorithm used by J. Petrovic. Additional algorithms determine the mass and radius of convective core.

Analysis of the results shows that the radius rf of the convective core decreases with increase of the angular velocity and has the lowest value for critical rotation. The radius of convective core has the lowest value for 1.2 $M_{\odot}$ for spherically symmetric models, and in the interval 1–1.3 $M_{\odot}$ for rotating stars at the border of dynamical stability. Absolute values (rf are in a range from 0.03–0.08, and increase with increase of the stellar mass for m >1.2 $M_{\odot}$, while the relative changes are in the interval 15–22%. The lowest value of the mass qf of the convective core coincides with the lowest values of the radius. The change (qf >0, and increases with increase of the stellar mass for m >1.4 $M_{\odot}$, while the greatest relative change with rotation is 7%. We show the dependence of qf from the structural parameters in the centre and on the surface of the star.

We emphasize a "critical" mass of the star, or a characteristic interval of stellar masses (1.2–1.4 $M_{\odot}$), in which a qualitative change in the local structure and the distribution of mechanisms of energy transport of both, spherically symmetric and rotating stars occurs. It is connected with the change of the heat regime of the star in hydrostatic equilibrium. Rotation additionally changes the structure and redistributes the regions in radiative and convective equilibrium.

Keywords. Convection, stars: evolution

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