Alexander Burinskii (Moscow)

"Rotating Black Holes in the Kerr-Schild Approach: Structure of the Solution and Astrophysical Applications"

Two lectures are assumed.

In the first lecture we consider in Introduction the role of the rotating black holes in astrophysics.

Then we consider the peculiarities of the Kerr-Schild approach and geometrical structure of the Kerr solution, the Kerr principal null congruence which determines the flow of e.m. radiation, and also the electromagnetic and Newton analogues of the Kerr solution, the structure of the electromagnetic field in the charged Kerr-Newman solution.

Next we consider the convenient graphical representation of the Kerr solution allowing one to easy determine the positions of the rotating black hole horizons, ergosphere and fixe the case of critical rotation ($a = M$). We discuss the structure of the quickly rotating sources of the Kerr metric and a hypothetical scenario of collapse of the rotating cloud with a frozen in magnetic field, which yields the formation of the rotating Kerr black holes and sources with $|a| > M$.

In the second lecture we start from discussion of the astrophysical problem of QPO's phenomena. Returning to the Kerr solution we consider electromagnetic excitations of the rotating black holes and sources with $|a|>M$, and describe obtaining of the exact solutions for the aligned electromagnetic excitations on the Kerr background. We show that these excitations are connected with formation of the chiral stringy structures in the Kerr geometry and connect the possible oscillations of this strings with QPO's phenomena. We discuss also the conjecture that the nature of astrophysical jets may be linked with formation of the unstable stringy structures, and consider the field structure of the stable strings, showing that they can be described by the Witten field model for cosmic superconducting strings.