The region of anomalous compression in the Bondi-Hoyle accretion

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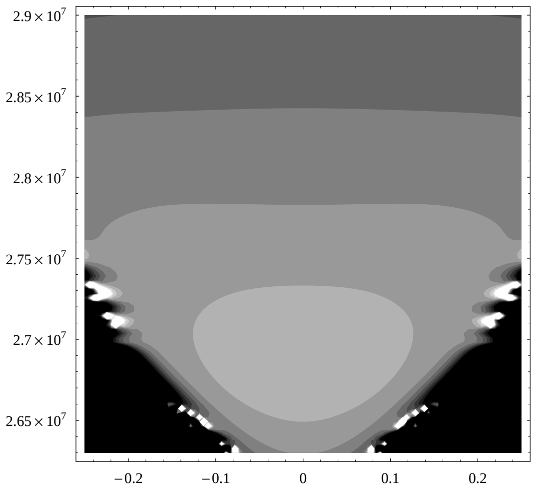

Figure 1: Dependence of the temperature on coordinates in the (θ_0, r) plane. The bright region in the center has the highest temperature, several times larger than the corresponding temperature in the Bondi accretion. r is the distance from the gravitating center, θ_0 is the angle between this radial vector and the symmetry axis for points on the sound surface.

Properties of a gas flow in the Bondi-Hoyle axisymmetric case with zero angular momentum in the supersonic region is explored for accretion onto a small compact object (in particular, onto a Schwarzschild black hole) when the velocity of the object is less than the sound velocity at infinity. It is shown analytically that, for a ballistic flow deep under the sonic surface, flow lines intersect in the front part of the object at some distance r_x from the center at the symmetry axis of the system (caustic forms). An approximate radial size of the region, where flow lines emerged (with angle not exceeding θ_0) from the sound surface intersect themselves, is about $\Delta r = r_x\theta_0^2/3$. The numerical calculation for non-zero pressure gradient is carried out for the detailed elaboration of the flow structure (assuming that the flow is adiabatic). The parameters of the region with anomalously high temperature and matter density are estimated; this compression is accompanied by an enhanced energy release. The effect could highly increase the efficiency of the non-disk accretion.

References

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