Line-driven winds near compact objects

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We consider a general physical mechanism which could contribute to the formation of fast line-driven outflows in the vicinity of strong gravitational field sources (black holes, neutron stars). Accretion disks around such objects are observed to be sources of fast collimated and uncollimated winds and jets. One of the most important and efficient mechanisms known to work in such a case is the acceleration of plasma due to absorption of the radiation flux from disk in spectral lines of abundant elements. It was believed that such a line-driven wind can be well described by the standard theory of Castor, Abbott and Klein (1975). We argue that the gradient of the gravitational potential plays the same role as the velocity gradient plays in the Sobolev approximation. When both Doppler effect and gravitational redshifting are taken into account in the Sobolev approximation, the radiation force becomes a function of the local velocity gradient and the gradient of the gravitational potential. The derived equation of motion has properties which are different from those in the standard theory. In particular, it has a critical point that is different from that of the CAK theory. A comparison with the CAK theory is presented. It is shown that the developed theory predicts terminal velocities which can be 50% larger than those obtained from the CAK theory. The developed theory can have an important contribution to the formation of radiation-driven jets/winds near compact objects.