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Collisionless shocks in the solar corona: a mechanism for preferential heating of heavy ions

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The heating of the solar corona to temperatures of the order of 10^6 K and more is one of the fundamental problems of solar physics. Beside the high temperatures, Soho/UVCS observations have shown that heavy ions in polar corona, like O^{5+} and Mg^{9+}, are heated more than protons, and that heavy ion heating is more than mass proportional; further, the perpendicular temperatures are much larger than parallel temperatures. Here, we propose that the more than mass proportional heating of heavy ions in coronal holes is due to the ion reflection at supercritical quasi-perpendicular shocks and to the ion acceleration by the $V \times B$ electric field in the shock frame. The acceleration due to motional electric field is perpendicular to the magnetic field, in agreement with Soho/UVCS observations, and is more than mass proportional with respect to protons, because the heavy ion orbit is mostly upstream of the quasi-perpendicular shock foot. We discuss the mechanism of heavy ion reflection, which is based on ion gyration in the magnetic overshoot of the shock. We also discuss the recent determination of the full set of physical parameters for a fast mode shock observed in the solar corona, which shows how the proposed mechanism could work. Further, we present preliminary numerical simulations of the heavy ion reflection at collisionless shocks.