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Thin current sheets in the diffusion region of reconnection process

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Recent works on kinetic simulation of reconnection clearly indicate that the internal structure of an X-point and neighbouring outflow region are different from those derived from scaling of the fluid Ohm‘s law. Ion diffusion region, in which long electron diffusion region is embedded, stretches up to 10s of the ion inertial length holding the thickness of only about 1/2 inertial length. Elongated diffusion region in the case of collisionless plasma appears to be an uncommon thin current sheet (TCS), to which the kinetic approach should be applied in all its magnitude. Such anisotropic TCS have long been the subject of the intent research in application to such problems like tearing instability or bifurcation of the neutral sheet in the Earth‘s magnetosphere. Theory of TCS demonstrates that the non-adiabatic motion of ions in the presence of a finite normal component of magnetic field naturally leads to self-consistent solution dissimilar to Harris current sheet. In this work we report on results of the kinetic simulation of reconnection using the particle code P3D [Zeiler, 2002] with open boundary conditions. In particular, we pay attention to the diffusion region, in which formation of bifurcated current is clearly visible. The study of distribution functions shows their strongly non-Maxwellian behaviour. Embedding of electron current within ion current, and intense in-plane electric field are typical features of diffusion region. Moreover, it strongly resembles anisotropic TCSs at the same time.