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Study of solitons in plasmas based on Vlasov simulation approach

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Solitons, as the first phenomena discovered in nonlinear physics, has played a decisive role in the study of nonlinear structures. They show two interesting and distinctive properties, including propagation without alteration in their features and stability against mutual collisions. In plasma physics ion-acoustic solitons (IASs) has been the forefront of the nonlinear plasma research field. Here, we are presenting the results of our studies on IASs based on a fully kinetic approach, i.e. utilizing Poisson-Vlasov set of equations to follow the temporal evolution of the plasma species, namely electrons and ions.

Our studies have proven that IASs continue to show their two major properties even when kinetic effects, mainly electron trapping, are present. Furthermore, our study has investigated the process of mutual collisions of IASs on the kinetic level by showing the temporal evolution of distribution functions, for the first time. These resulted in new understanding of solitons behavior during collision. Although on fluid level, the collision process is independent of the relative velocity of solitons, relative velocity plays an important role in the final combination of the trapped population on the kinetic level. For over-taking collisions, the two solitons exchange certain amount of their trapped populations. However, for head-on collisions, the two solitons trap some portion of each others trapped population. Moreover, if the relative-velocity is small enough, solitons repel each other due to the overall charges they carry because of their trapped electrons.

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yes

Level for award (Hons, MSc, PhD, N/A)?

N/A

Would you like to submit a short paper for the Conference Proceedings (Yes / No)?

y

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