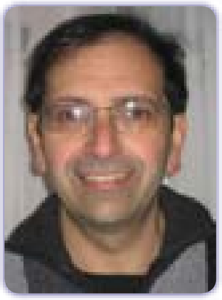
Alain Ghizzo, J Astrophys Aerospace Technol 2017, 5:2 (Suppl)
DOI: 10.4172/2329-6542-C1-007

2nd International Conference on

Atomic and Nuclear Physics

November 08-09, 2017 | Las Vegas, USA



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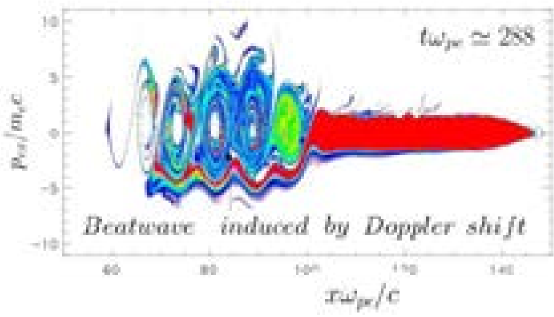
Non-particle vlasov codes: Key issues and impact on plasma turbulence modeling for thermonuclear fusion

Often referred to as “the fourth state of matter”, plasmas comprise over 99% of the visible universe and are rich in complex nonlinear and collective phenomena. The quest for harnessing fusion energy is a major component of research in the field of plasma physics. Thus the development of fusion as a secure and reliable energy system that is environmentally and economically sustainable is a formidable scientific but also technological challenge today. Although the fundamental laws that determine the behaviour of plasmas, such as Maxwell's equations and those of classical statistical mechanics are well known, obtaining their solution under realistic conditions is a scientific problem of extraordinary complexity. The use of fundamental equations often retains the full nonlinear effects, and space charge and other collective effects can be included self-consistently by coupling charged particles to the field equations via the source terms. For collisionless plasmas, the kinetic model is based on the vlasov equation (supplemented by the Poisson or Maxwell equations). Its numerical integration is one of the key challenges of computational plasma physics. This keynote summarizes the concepts and the latest developments in collisionless semi- Lagrangian vlasov plasma simulations and their impact on phase space topology and on turbulence modeling. Recent advances in simulations of hot fusion plasmas are reviewed, with illustrative examples, chosen from associated research areas as relativistic laser-plasma interaction or micro turbulence in tokamak plasmas. These examples illustrate the challenges in modeling wave- particle interactions in fusion plasmas. High accuracy and resolution are required to correctly model such Landau-type resonances. The challenging nature of plasma physics in general and fusion research in particular leads to establish an inter-disciplinarily research that targets the development of capabilities that “bridge” various areas of plasma physics together with computer science and applied mathematics.



Biography

Alain Ghizzo has received his PhD degree in Plasma Physics in 1987. He is currently a Professor at the University of Lorraine at the Institue Jean Lamour (UMR 7198). He has been performing research in the field of computer experiments in plasma physics. His recent research includes laser-plasma interaction and gyrokinetic models for plasma core physics in tokamaks and astrophysics.

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