数学与系统科学研究院

计算数学所学术报告

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报告题目：

The guiding center Lagrangian differential forms in De Rahm cohomology

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计算数学所报告厅

Abstract:

The essential physics of guiding-center (of charged particles) can be well depicted by the Littlejohn's Lagrangian in the 4-dimensional configuration space, which was adopted to build up geometric algorithms[1] based on the discrete variational principle[2,3], and later also practiced on other discrete variational approaches[4-6]. The key to success is believed to verify the conditions supposed to be satisfied by the Lagrangian differential forms, which are collectively referred to be (De Rahm) cohomology, as emphasized in Ref.5. Among others it is performed on the Euler-Lagrangian 1-form E_L, the canonical 1-form Θ_L and the canonical 2-form $\omega_L := d\Theta_L$ for both the single particles and the guiding-center. The up-to-date efforts, however, did not see the way for guiding-centers, by which either E_L is shown to be closed or ω_L is shown to be conserved within the framework of Lagrangian system unless restricted to the solution space. On the other hand, since ω_L is closed and non-degenerate, the global Hamiltonian vector fields X_H are derived on the symplectic manifolds defined by the ω_L along which ω_L is invariant, dictated by the so-called non-canonical Hamiltonian equations. The geometric algorithms based on alternative variational approaches are also presented for guiding-centers; one in attempt to incorporate into the energy conservation by making use of total variational approach[4,6], and the other of using difference variables introduced into the discrete variational principle[5], however, for comparison purposes only. Also discussed is the possibility of extending the geometric algorithm to physical law, *e.g.* reducing the current conservation to volume preservation of guiding-centers via coordinate transformation.

References

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[5] H.Y.Guo, Ke Wu, JOURNAL OF MATHEMATICAL PHYSICS, **44** 5978 (2003)

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