Tata Institute of Fundamental Research
Survey No. 36/P, Gopanpally Village, Serilingampally, Ranga Reddy Dist., Hyderabad – 500 046

Seminar

Phase space hydrodynamics method for low dimensional systems: evolution of shock fronts and approach to thermalisation

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I will describe a new method for treating aspects of time evolution of 1+1 dimensional gas of fermions (or hard-core bosons). The differential equations of conventional hydrodynamics, describing the time evolution of fermion density, fail to work beyond the instant when a shock front develops. It has been known, both from experiments with cold atoms as well as from quantum many-body simulations that these systems show thermalisation at long times; because of the singularity mentioned above, conventional hydrodynamics fails to show such long term behaviour. We will present an analytic treatment (originally discovered in a string theory context) in terms of phase space density which remains smooth even when shocks form (topologically, the reason is that a shock in real space becomes a fold in phase space which is smooth). Using this method, we are able to give an analytic derivation of the thermalisation and derive a set of universal exponents characterising the relaxation to thermal behaviour. We also discuss generalisations to some 2+1 dimensional systems.

The first part of the talk is based on Phys.Rev.A 98 (2018) 4, 043610 (with Manas Kulkarni and Takeshi Morita); the second part is based on ongoing work with Manas Kulkarni, Takeshi Morita, Satya Majumdar and Gregory Schehr.

Friday, Oct 20th 2023

4:00 PM (Tea / Coffee 3.45 PM)

Auditorium, TIFR-H