



# BOSE COLLOQUIUM

**Friday, 16 May 2014**

**4:00 pm**

**Fermion**

**Speaker:**

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**Title:**

**Dependence of Diffusion as a function of Diffusant Diameter in  
Condensed Matter Phases**

**Abstract:**

Self-diffusion of neutral as well charged solutes in solutions are of considerable interest over more than hundred years since Einstein's theory of Brownian motion. Work carried out in the past two decades suggest that the reciprocal relation between self-diffusivity and the diffusant diameter suggested by the theory of Brownian motion is not valid except in ideal solutions. Early results on diffusion in zeolites led to this discovery which was then extended to neutral solutes in simple liquids. This was later shown to be valid for ions in polar solvents where presence of long-range interactions lead to stronger deviation from reciprocal dependence. The reason for this will be discussed. Recent studies show that the dependence of self-diffusivity on the density of medium in which the diffusant is diffusing can show surprising behavior. We shall briefly discuss reaction-diffusion coupling. Lastly, a judicious combination of the levitation effect with the blow-torch effect is shown to lead to very high degree of separation of liquid as well as gaseous mixtures. The levitation effect therefore provides an unified understanding of diffusion in all of condensed matter phases and provides an explanation not only for size dependence but also density/pressure dependence as well as temperature dependence.

- [1] P. Santikary and S. Yashonath (1994), "Diffusion of Sorbates in Zeolites Y and A Novel Dependence on Sorbate Size and Strength of Sorbate -Zeolite Interaction", J. Phys. Chem., 98, 6368.
- [2] A.V. Anil Kumar, S. Yashonath and G. Ananthakrishna (2002), "Source of Reaction -Diffusion Coupling in Confined Systems due to Temperature Inhomogeneities", Phys.Rev. Lett., 88, 120601.
- [3] P. K. Ghorai; S. Yashonath, (2006) "Evidence in support of levitation effect as the reason for size dependence of ionic conductivity in water: A molecular dynamics simulation", J. Phys. Chem. B, 110(24), 12179.
- [4] Srinivasa R. Varanasi, P. Kumar and S. Yashonath, "Dependence of diffusivity on density and solute diameter in liquid phase: A molecular dynamics study of Lennard-Jones system" J. Chem. Phys. 136, 144505 (2012).
- [5] S. Yashonath and P. K. Ghorai (2008), "Diffusion in Nanoporous Phases: Size Dependence and Levitation Effect", J. Phys. Chem. B, 112, 665.
- [6] P. Kumar, S.R. Varanasi, S. Yashonath, (2013) "Relation between the diffusivity, viscosity and ionic radius of LiCl in water, methanol and ethylene glycol : A molecular dynamics simulation, J. Phys. Chem. B, 117, 8196-8208.

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