The Chemical and Biological Engineering Department of the University at Buffalo School of Engineering and Applied Sciences is Proud to Announce

The 2012 Eli Ruckenstein Lecture

“Effect of Severe Wall Hindrance on Brownian Motion and Mobility: Is The Ratio Still kT as Predicted by Einstein?”

Dennis C. Prieve
Center for Complex Fluids Engineering
Department of Chemical Engineering
Carnegie Mellon University

Monday, April 23, 2012
11:45 a.m.
Screening Room
First floor, Center for the Arts
UB Amherst Campus
Reception to follow
About Eli Ruckenstein:

Eli Ruckenstein, SUNY Distinguished Professor, has been on the faculty of the University at Buffalo for nearly forty years. Over this time, his prolific and imaginative research has advanced almost every area of interest to chemical engineering. Ruckenstein spent his formative years behind the Iron Curtain, in Romania, where — with a combination of native intellect, genuine scientific curiosity, and sheer strength of will — he prepared himself for a lifetime of achievement in engineering and science. His work quickly gained international recognition, and he escaped to the West in 1969, joining UB in 1973.

Eli Ruckenstein has received countless honors paying tribute to work across many fields of research. From the American Institute of Chemical Engineers he won the Alpha Chi Sigma Award for his work in transport phenomena, the Walker Award for his work in catalysis, and the Founders Award for his overall contributions to science. From the American Chemical Society he received the Kendall Award for his research in colloids and interfaces, the Langmuir Lecture Award for his contributions to macromolecules, the Schoellkopf Medal for his work in supported metal catalysts, and the Murphree Award in Industrial and Engineering Chemistry. He was given the Humboldt Award by Germany for his work in surfactants, and the Creativity Award by the National Science Foundation for his work in biomolecules. In addition he has been invited numerous times to present named lectures around the world. These contributions and more were further recognized with the National Medal of Science, bestowed in a White House ceremony in 1999. Ruckenstein was elected to the National Academy of Engineering in 1990 and he received the Founders Award from the Academy in 2004. He is a fellow of the American Institute of Chemical Engineers, which, with the occasion of its 100th anniversary, designated him as one of 50 Eminent Chemical Engineers of the Foundation age.

The UB Department of Chemical and Biological Engineering

offers a world-class undergraduate education while pursuing integrative research and graduate training at the frontiers of chemical engineering, in the main areas of nanoscale science and engineering; computational science and engineering; and biochemical and biomedical engineering.

The Department was founded in 1961 and is among the youngest in the Nation. From the start its founders inculcated it with a deep respect for scholarship, and as a consequence the Department quickly grew to the national prominence that it continues to enjoy today. Visit: www.cbe.buffalo.edu.

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Abstract:

In his classic 1905 paper on Brownian motion, Einstein realized that by separately measuring mobility $m$ and diffusion coefficient $D$ of the same particle, one could obtain the value of Avogadro’s number from $RTm/D$, where $R$ is the universal gas constant and $T$ is temperature. In 1920 Perrin performed such experiments and obtained a good value for Avogadro’s number. This success laid to rest any remaining doubts about the molecular theory of matter. Today we write Einstein’s relation as $D = mkT$ ($k$ is Boltzmann’s constant) and substitute $m$ obtained from Stokes equation. As a rigid sphere approaches a rigid wall, Brenner (1961) showed that wall hindrance causes $m$ to approach zero. Does Einstein’s equation still hold such that $D$ approaches zero also? In this talk I will show direct measurements of $D$ and $m$ obtained using Total Internal Reflection Microscopy. Both quantities are found to be a few percent of their bulk values when the gap between the spherical particle and the wall is a few percent of its radius.