

PHYSICAL MATHEMATICS SEMINAR

Optical "Bernoulli" forces

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ABSTRACT:

By Bernoulli's law, an increase in the relative speed of a fluid around a body is accompanied by a decrease in the pressure. Therefore, a rotating body in a fluid stream experiences a force perpendicular to the motion of the fluid because of the unequal relative speed of the fluid across its surface. It is well known that light has a constant speed irrespective of the relative motion. Does a rotating body immersed in a stream of photons experience a Bernoulli-like force? We show that, indeed, a rotating dielectric cylinder experiences such a lateral force from an electromagnetic wave. In fact, the sign of the lateral force is the same as that of the fluid-mechanical analogue as long as the electric susceptibility is positive ($\epsilon > \epsilon_0$), but for negative-susceptibility materials (e.g. metals) we show that the lateral force is in the opposite direction. Because these results are derived from a classical electromagnetic scattering problem, Mie-resonance enhancements that occur in other scattering phenomena also enhance the lateral force.

This is a joint work with Steven G. Johnson Phys. Rev. A 88, 023829 (2013)

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2:30 PM

Building E51, Room 149

(MIT-Tang Center)

*Reception following in Building E17, Room 401A
(Math Dept. Common Room)*

<http://math.mit.edu/pms/fall13/>



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