CU Physics Department Colloquium

Monday, February 1, 2010 4:10 PM 428 Pupin Hall

What is a laser anyway?

Do we really understand them after fifty years of trying?

This is the fiftieth anniversary of the demonstration of the first optical maser, now known as the laser. This amazing device has become ubiquitous in our culture and is a workhorse for fundamental science, applied science and technology. However recently invented micro and nano lasers have challenged our understanding of lasing and exposed the absence of a fully predictive general theory. Perhaps most surprising is the existence of random lasers, based on multiple scattering between nanoparticles in the presence of gain. While these lasers behave in most respects like conventional lasers, they have no mirrors or cavity of any kind. Further, the linear scattering spectrum reveals no long-lived resonances to support lasing. In the absence of such resonances, conventional laser theory has no starting point. We have recently developed a modern formulation of semiclassical laser theory that elucidates the nature of lasing modes in cavities of arbitrary complexity and arbitrary leakiness, including the case of random lasers. The theory also treats the strong non-linear interaction between lasing modes to all orders, and has been shown to agree with full numerical solutions of the lasing equations with no adjustable parameters. We are thus in a position to understand qualitatively complex modern lasing structures, and to produce in the near future a truly predictive theory for many lasers of applied and fundamental interest.

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Hosted by Boris Altshuler – Meet the Speaker at 5:30 pm in 1124 Pupin