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*(The Science Program presents)*

# *Hamilton's Turns: a Visual Tool-kit for SO(3) and SU(2) Problems*

*Prof. Rajiah Simon*
*The Institute of Mathematical Sciences, Chennai, India*

## Thursday, October 20, 2011

## 12:00-01:00pm

## Lecture Hall 144 (*Light lunch will be served)*

The rotation group SO(3) pervades nearly all sciences, and this is simply due to the fact that we live in a three-dimensional real world. The group SU(2), the cousin of SO(3), assumes even a more fundamental role in the quantum theory. For instance, it is the group of single-qubit unitary gates. States of a qubit are realized geometrically as points on the Bloch sphere, and SU(2) acts on this sphere geometrically as SO(3) rotations. Though this *geometric picture* is quite impressive, composition of SO(3) rotations or SU(2) gates is traditionally handled *algebraically* and not geometrically.
In the course of his studies on quarternions, Hamilton developed a geometric or visual represention of SU(2) wherein SU(2) matrices are pictured as (equivalence classes of) directed great circle or geodesic arcs on the unit sphere. The product of a pair of SU(2) matrices is then correctly given by `addition' of the corresponding directed arcs, resulting in a group composition law which is perfectly analogous to the parallelogram law of vector addition familiar in the context of the Abelian translation group. This beautiful geometric construct seems to be not as widely known as it deserves. The talk will develop this construct into a powerful visual tool-kit for handling visually and effectively problems involving the groups SO(3) and SU(2). The power of this pictorial representation will be demonstrated through several examples. The talk will assume no prior knowledge of group theory or quantum mechanics.

Dr. Rajiah Simon leads the Optics and Quantum Information group at the Institute of Mathematical Sciences, Chennai, India, and holds the title of Professor I, the "Outstanding Scientist" grade of the Department of Atomic Energy, Government of India. He is also an elected Fellow of the Indian National Science Academy and has been awarded the Shanti Swarup Bhatnager Prize for Physical Sciences. He has made significant contributions to Quantum Optics, Geometric Phases, and Quantum Information Theory producing about 140 published papers in major physics journals. His research works are remarkably well cited in the community and provide important tools for further studies by other researchers. Imprints of his passion for Classical Optics and Group Theory can be seen virtually in all his research publications.

## FOR MORE INFORMATION:

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