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Deriving Quantum EM Solutions Using Classical Knowledge—An Overview

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In this presentation, we will discuss how solutions of quantum Maxwell's equations can be simplified by deriving them from the classical solutions of Maxwell's equations.

Classical Maxwell's equations have been with us for over 160 years now. With it, we have developed a tremendous knowledge base whereupon electromagnetics technologies can develop. Classical electromagnetics, together with semiconductors, have been the main drivers of enabling modern technologies for almost a century. We can use this knowledge to further energize the growth of modern nanotechnologies. This will help drive down the cost of memory chips, expedite speeds of computers, and enable cheap wireless communications. These technologies have enabled the sharing of new knowledge around the world, spawn new industries where we use our brains instead of our brawns, and lifted hundreds of millions of people out of poverty, creating a more peaceful world.

Classical computational electromagnetics (CEM) has seen leaps and bounds progress since the 1960's, shortly after the advent of the digital computer. As a result, this knowledge has transformed how classical electromagnetics engineering has been performed. Virtual prototyping using CEM is routine in many areas of technological development related to classical knowledge. In fact, simulation has taken over 90 percent of modern design process. After over 50 years of development, a healthy knowledge base has emerged that many practitioners in the field can rely on. Quantum computational electromagnetics, however, is much younger, and the corresponding knowledge base much thinner. It thus presages a knowledge base growth for quantum electromagnetics, which is an emerging field of growing importance. This knowledge base is instrumental for the growth and success of many quantum technologies including quantum computing, sensing, communications, encryption, imaging, and metrology.

By capitalizing on our past achievements in the classical arena, we can help propel the growth of quantum technologies due to their increasing demand and their promise for further growth. This can produce surprise new technologies in the areas of computers, networking, communications, and computing.