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Future of Nano Technology in Quantum Physics

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Abstract

Quantum Physics has given lots of wonderful things to humanity within the previous few decades. From the technology with that you'll be able to track cheating spouses, to accurately scanning broken bones and muscles within the hospital, there are literally several sensible applications of natural philosophy. however if you think the words of these nerdy scientists United Nations agency are literally finding out the discipline, a lot more revolutionary discoveries are nonetheless to return (and that doesn't simply embrace more weird sci-fi movies).

In the most elementary of terms, natural philosophy basically studies the character and rules of the tiniest famed particles of the universe: those who really form up the atoms and ar loosely referred to as sub-atomic particles. However, a lot of of the discipline remains a mystery, even among the foremost practiced of Physicists, with several occupation it a 'weird science'.

The study line in quantum engineering focuses on the understanding, control and design of complex quantum systems for applications in emerging quantum technologies such as extremely sensitive sensors, quantum communication systems and quantum computers. The methods involved range from quantum mechanical calculations and simulations of e.g. electron transport in two-dimensional materials like graphene to the theoretical and experimental development and investigations of new optical systems, solid-state systems, electronic systems and mechanical systems that are designed to harness the fundamental properties of quantum mechanics – such as quantum superposition and entanglement.

Nanotechnology has developed by leaps and bounds due to potential high impacts of its application in the world today. Nanotechnology has many potential benefits including energy savings, alternative energy supplies, efficient use of raw materials, environmental protection, agriculture applications and medical breakthroughs. All of these applications are related to engineering. Thus, it is important that nanotechnology should be understood.

Introduction

The world has witnessed several cognitive and technological advances since the third millennium. This is a natural result of scientific breakthroughs and wide-spread technology applications, which had drastic impacts on life styles. These impacts led to more problems pertaining to health, environment and society which require more and more advances in science and research to solve them. Those scientific advances brought the future nearer to the present and added to the accumulation of human civilization in all respects of knowledge. There has been past reform attempts in contemporary Science curricula, which started in most developed nations to cope with scientific and technological advances. There reforms aimed at promoting a culture of science and a community of scientific practice as a main purpose of science education. They also aimed at developing scientific enquiry, technological design, problem-solving, critical thinking, creativity, and decision making from personal and social perspectives. In spite of those past reforms, prior research indicated that the current science education programs hardly prepare cultured learners who are capable of critical and creative thinking. That is, much emphasis is placed on the cognitive domain of Science issues aloof from their social and personal contexts of use (El-Saadany&Oda, 2006).

Literature Review

Nanoscale science and engineering is believed to provide for convergence of disparate science and engineering disciplines. If this is the case, such convergence has important implications, not only for nanoscale science but also for governance and regulation of these emerging technological areas (Roco 2006, 2008; Ziegler 2006). MihailRoco introduced the concept of convergence of multiple disciplines and fields at the nanoscale. His work on "convergence at the nanoscale" put forth the concept of convergence of four broad fields, namely, nanotechnology, biotechnology, cognitive science, and information technology (NBIC) (Roco 2002, 2003, 2004, 2006; Roco and Bainbridge 2003). Research, education, and infrastructure are among the factors that contribute to unification "at the confluence of two or more NBIC domains" (Roco 2004). This convergence of fields was presaged in the National Science and Technology Council's study of nanotechnology across the globe; this study reported that nanotechnology encompasses a wide range of disciplines, including materials science, physics, chemistry, biology, mathematics, and engineering (National Science and Technology Council 1999).

Convergence of diverse nano fields has been conceptualized in various ways, reflecting even the divergent top-down and bottom-up approaches of nanotechnology itself. Loveridge et al. (2008) view nanoscale convergence through the lens of nanoscaleartefacts (nano-artefacts). Nano-artefacts form the basis for the migration of nanomaterials such as nanotubes into commercial applications in information technology, energy, and nano-medicine. Schmidt (2008) characterizes nanoscale convergence as "techno-object oriented interdisciplinarity." That is, shared use of instruments and technologies (such as atomic force microscopes, scanning tunneling microscopes, simulation tools, and the like) leads the way for convergence by addressing problem-oriented issues at the boundaries of NBIC fields. In more of a top-down approach, Khushf (2004) suggests that a systems-oriented framework best facilitates the type of convergence represented in the NBIC domain.

However, evidence of an emerging convergence of fields in nanoscale research and commercialization has been mixed. Schummer (2004) conducted co-author analysis and visualization research of 600 publications published in journals deemed nanotechnology-oriented in 2002 and 2003, using the journal subject categories from the Science Citation Index (SCI) of Web of Science. He compares research collaboration patterns in nanotechnology with those of traditional disciplinary research. The results do not show distinctive patterns of interdisciplinarity. He concludes that nanotechnology is an aggregation of otherwise disconnected "mono-disciplinary" fields, rather than multidisciplinary convergence. Meyer (2006) contends that nanotechnology's conceptualization of converging technologies represents a possible misinterpretation. Cluster analyses of patent data from the US Patent and Trade Office and SCI publications from 1992 to 2001 suggest that there are inter-related and overlapping nanotechnologies connected via instrumentation.

Nanotechnology is very important in our society. Its concepts pertaining to study the unique characteristics of nano-scale material, which, in turn, helps in producing new materials that can be used in the fields of medicine, industry, engineering, agriculture, drugs, communications, defense, space, among others (Ban &Kocijancic, 2011).

Nanotechnology and Nanoscience are highly interdisciplinary fields, so in addition to the core studies of a physics , fundamental aspects of how physics, photonics, electronics, chemistry, and biochemistry, relate to nanotechnology and its numerous current and potential future applications.

Overview

Nanotechnology and Nanoscience involve the study of matter and machines down to scales of a billionth of a meter. It is one of the most dynamic areas of research and development as it plays a critical role both in basic physics and applied physics and engineering.

Key areas of study include:

- quantum devices
- nanoscience
- light and matter
- molecular materials
- processing of devices
- molecular basis of life

Extreme Computing

While computing technologies have come back a protracted manner within the last century, computing is simply just setting out to catch up the skills of the human brain. Today's Silicon-chips based mostly computing technologies square measure presently expected to be shy in handling the stress of the longer term, wherever machines and humans square measure expected to be interconnected during a huge network which will be many times larger than today's overall net infrastructure. during this regard, Quantum Computing is presently being known because the prime technology to exchange the present one. The technology primarily manipulates the natural properties of the atom to store and method information in real time.

In fact, experimental models of Quantum Computers have already yielded eager results, though scaling identical to economically possible units have tried to be rather difficult. However, scientists expect that the technology may begin dominating the world landscape by as presently as 2030. With the technology, processing skills square measure expected to create such nice leaps that calculation that current take supercomputers over 2 years is also completed by Quantum Computers during a few seconds.

From small diamond sparklers creating huge advances in medicine imaging technology, to boosting durable quantum level signals, to making gauge boson triplets for the terribly 1st time, physicists at SMP are busy gap new frontiers of analysis in applied science and physical science. Their discoveries, printed recently within the prestigious and high-impact Nature stable of publications, set the tone for important sensible applications in years to return.

Light-emitting nano-diamonds

SMP lecturer DrTarasPlakhotnik, in conjunction with scientists from Macquarie University, the Australian National University, and Commonwealth Scientific and Industrial analysis Organisation (CSIRO), have discovered that the properties of sunshine emitted from small isolated nano-diamonds square measure fully totally different from their larger counterparts.

The study, printed within the could 2010 issue of Nature applied science, could probably pave the manner for the longer term development of more practical bioimaging techniques wherever light-emitting nano-diamond probes can be wont to additional accurately diagnose and track advanced biological processes within the body.

"Existing medicine imaging techniques use 'fluorescent probes' that always picture bleach and should be toxic during a body. lightnano-diamonds, on the opposite hand, have the potential to be used effectively during a biological surroundings as low toxicity molecular probes," explained DrPlakhotnik.

Interestingly, application of such diamonds isn't restricted to molecular pursuit however additionally includes quantum IP and "nano-sensing" (a nickname for the technology of activity electrical and magnetic fields, temperature and different properties with metric linear unit resolution).

"For the primary time, we've shown that the scale of light nano-diamonds is reduced all the way down to five nm. this is often a vital milestone for variety of technologies wherever the scale could be a important parameter. additionally to illustrious options, our little crystals product of solely ten thousand carbon atoms possess variety of attention-grabbing new properties. above all, they demonstrate with chemicals controlled luminescence unregularity (blinking). Our groups in state capital and state capital presently explore implications of those findings for chemical sensing and different applications," DrPlakhotnik aforementioned.

Boosting the signal

Another recent study, conducted by researchers from SMP and movie maker University, and printed within the March 2010 issue of Nature Photonics, demonstrates a completely unique answer to the matter degradation once amplifying signals at the quantum information level.

Traditionally, amplifiers take AN input and multiply its size by a collection quantity, for instance, music at a live gig may be doubled in volume through a P.A.. In current applications mistreatment optical fibres, lightweight carrying info is amplified persistently while not serious degradation.

In distinction, once we get all the way down to the extent of elementary particles like atoms or photons, the principles of quantum physics that govern the behaviour of such particles, disallow ideal amplification.

However, a team LED by academician Tim Ralph at SMP has currently found that it's potential to create a tool that performs ideal amplification at the quantum level while not degradation. The loophole is that the device essentially generally fails. However, the device continues to be helpful as a readout tells the user once the amplification has been successful .

According to academician Ralph, nobody had antecedently noticed that quantum systems can be amplified during this manner, thus this discovery will increase our information of however quantum systems work. A key application of the device is that the ability to use it to increase quantum communication protocols like transfer, that successively may create ultra-secure communication sensible within the next few years.

Generating gauge boson triplets directly

SMP analysis fellow Dr Alessandro Fedrizzi, in conjunction with different researchers from the University of Waterloo (Canada) and therefore the Austrian Academy of Sciences (Austria), have created a major breakthrough in quantum optics analysis by making gauge boson triplets directly.

The discovery can change researchers to check new quantum correlations and have applications in quantum communication and photonic quantum computing.

“By making gauge boson triplets, we will currently for the primary time extend quantum correlations over quite simply 2 photons while not mistreatment any tricks. This unveil a number of attention-grabbing applications that were antecedently deemed not possible. It additionally highlights the speedy advance of the sector of nonlinear optics.”

In the past, generating gauge boson pairs had revolutionized quantum optics and created potential advanced technologies like quantum cryptography and quantum computing. The gauge boson pairs were typically generated from lasers passing via a crystal.

Defining the future: quantum info and applied science

QNC building Just as advancements in electronics LED to the semiconductor, the pc, the net, and today’s smartphones and mobile devices, quantum info and applied science square measure reworking ensuing generation of data technologies.

The application of discoveries borne out of elementary analysis at the University of Waterloo in advanced fields of arithmetic, physical science, and chemistry guarantees to deliver technologies within the twenty first Century which will be as revolutionary in their impact because the historic period of the nineteenth Century or the knowledge revolution of the twentieth Century.

One of the centres at the forefront of discovery at Waterloo is that the Institute for Quantum Computing (IQC). conveyance along internationally recognized researchers from the schools of arithmetic, Science, and Engineering, IQC is one in all the foremost advanced analysis facilities within the world, wherever the largest concepts square measure regarding what happens on the tiniest of scales.

Harnessing the principles of quantum physics

As the size of the semiconductor approaches the atomic scale, the principles modification.quantum physics inherit play and rule the globe of atoms and molecules. Quantum informatics provides the language to control information-using systems at these scales and to navigate the nanoscale world. By harnessing the principles of quantum physics, info is processed with unimaginable efficiencies; efficiencies with no counterpart in today's classical computers. Quantum analysis at Waterloo has already LED to commercialised quantum technologies in areas like oil exploration and scientific devices, ANd guarantees to still revolutionize an ever increasing range of fields through its application. Exciting applied science analysis is current within the colleges of Engineering and Science. The intersection of applied science with several different fields is leading to nearly unlimited opportunities for novel analysis. Waterloo's footprint during this space is generally based mostly and includes experience in organic optoelectronics, photonics, electrical phenomenon devices, semiconductor quantum devices, nanoelectronics, micro- and nano-fabrication, microfluidics, nanomaterials, and micro-electromechanical systems. Applications of applied science at Waterloo embrace the event of strategies for targeted drug delivery within the physical structure, the employment of magnetic nanoparticles for water treatment, and nanocomposite membrane fabrication to be used in fuel cells. At the Waterloo Centre for Automotive analysis (WatCAR), researchers square measure exploring the likelihood of reducing the scale of automotive parts and elements to the nanoscale, which can directly contribute to reduced vehicle weight and improved fuel economy.

Conclusion

Quantum Physics has given lots of wonderful things to humanity within the previous few decades. From the technology with that you'll be able to track cheating spouses, to accurately scanning broken bones and muscles within the hospital, there are literally several sensible applications of natural philosophy. however if you think the words of these nerdy scientists United Nations agency are literally finding out the discipline, a lot more revolutionary discoveries are nonetheless to return (and that doesn't simply embrace more weird sci-fi movies).

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