ISSA 2015 Keynote speaker

Fabrizio Pinto

Biography

Fabrizio Pinto obtained his Laurea *cum laude* from the University of Rome, "La Sapienza," in 1984 and his Ph.D from Brigham Young University in Provo, Utah, U.S.A. in 1989 with a Sigma-Xi award-winning dissertation on the theory of globular star cluster formation in galaxies and the application of supercomputers in the numerical solution of the gravitational N-body problem in stellar dynamics. He held several faculty positions in the U.S., published research in astrophysics, quantum physics, general relativity, pedagogy, and science popularization, and he received awards from the Gravity Research Foundation and from the Griffith Observatory of Los Angeles. In 1996, Dr. Pinto joined the Navigation and Flight Mechanics section of NASA's Jet Propulsion Laboratory at Caltech in Pasadena, California. In that capacity, he carried out pre-launch research in support of the Stardust and Deep Space 1 missions to comets Wild 2 and Borrelly, respectively, and he was the orbit determination specialist during the Galileo orbiter E19 Europa flyby in 1999. He was a member of the JPL Interstellar Program and contributed to defining the core technologies necessary for future robotic missions to extrasolar planetary systems. In 1999, Dr Pinto left JPL to lead the first startup company in the world entirely devoted to the development of novel, market disruptive micro- and nano-electro-mechanical systems made possible by the manipulation of Casimir forces. As a California physicist-entrepreneur, he obtained ten US patents, some of which have also issued in the EU and Japan, representing the largest existing portfolio of intellectual property in the subfield he created and often referred to as dispersion force- or quantum vacuum-engineering. In 2013, under an agreement with Jazan University, he relocated his R&D effort from California to the Kingdom of Saudi Arabia and he is now at the Laboratory for Quantum Vacuum Applications, which he founded and codirects with Ali Al-Kamli. Dr. Pinto has been invited to lecture on different aspects of dispersion force engineering, spanning from theoretical physics to business development, at such venues as the Kavli Institute for Theoretical Physics, the Foundation for the Future, the International Space Development Conference, and the Euro Asia Economic Forum. At Jazan University, Dr. Pinto is pursuing advanced technological demonstrations of breakthrough dispersion force-enabled devices with applications in nanoparticle space propulsion, high density energy storage with hyperfast discharge/recharge, nanorobots and nanooscillators, adaptive optics, and sensing involving membranes and multiwalled nanotube arrays.

Recent Links:

http://www.kfupm.edu.sa/departments/phys/SitePages/en/EventDisplayForm.aspx?CUSTOMID=95
http://mse.kaust.edu.sa/Pages/November%206,%202014.aspx
http://colleges.jazanu.edu.sa/sites/en/sci/physics/Pages/fpinto.aspx
http://www.americanscientist.org/authors/detail/fabrizio-pinto
http://scitation.aip.org/content/aip/journal/jap/114/2/10.1063/1.4812495
http://arc.aiaa.org/doi/abs/10.2514/6.2012-3713
http://www.sciencedirect.com/science/article/pii/B978145577863800027X

ISSA 2015 Keynote talk

On van der Waals force engineering and its role in breakthrough space propulsion systems

Fabrizio Pinto

Abstract

In this Keynote lecture, we shall explore three dimensions of the rapidly developing and exciting field of quantum vacuum engineering: the historical motivation, the fundamental science, and the now ongoing process of technology transfer into breakthrough engineering applications and market disruptive products. Far from being perpendicular to one another, these components unpredictably intertwine as the main threads of a fascinating story of discovery and progress leading to previously unthinkable applications in aerospace, energy, medicine, communications, and optics. Following the historical thread, we shall explore some of the early commentary by Greek philosophers, and, much later, Galileo and Newton regarding the mysterious force that causes neutral objects to adhere thus allowing gecko lizards to cling to perfectly smooth surfaces. This path will lead us to such architects of modern physics as van der Waals, London, and Casimir as we follow the development of relativistic quantum electrodynamics. The fundamental physics track will provide the needed logical elements to visualize such apparently counterintuitive facts as the attraction of two neutral, parallel conducting planes as well as the even more startling appearance of repulsive van der Waals forces. This journey will lead us to the earliest experiments pioneering the manipulation of dispersion forces in excited semiconductors and, eventually, the invention of thermodynamical cycles at the basis of quantum vacuum engineering. The third dimension features a microdevice failure mode anticipated early on by Feynman but now recognized as a unique technological opportunity. We shall follow the unfolding transfer of knowledge at the cutting edge of modern physics into the design of breakthrough devices with entirely novel capabilities, including demonstrations being developed in our laboratory at Jazan University. The extremely high magnitude of dispersion forces and of the van der Waals energy density when the interboundary distance falls into the subnanometer range, as in nanotubes, makes it possible to contemplate entirely novel mechanisms for non-chemical, non-electromagnetic spacecraft propulsion and for energy storage based on neutral particle actuation, acceleration, and ejection. We shall conclude with reflections on the potential implications of quantum vacuum engineering in deep space robotic exploration and the colonization of the solar system particularly from the standpoint of orbital dynamics.