WestVirginiaUniversity.
BENJAMIN M. STATLER COLLEGE OF ENGINEERING AND MINERAL RESOURCES

MATERIALS SCIENCE AND ENGINEERING (MS&E) SEMINAR SERIES

Friday October 22, 2021 at 3:00 pm via Zoom

https://wvu.zoom.us/j/96511600696?pwd=Q2lwNUxuanlMNlA5TFNqU0YrcUlpQT09

Meeting ID: 965 1160 0696 Passcode: **F5ZWe0W7**

Christopher Papile, Ph.D. Founder: BraneCell

Inventor/Co-inventor: Molecular qubits | CO2-free Vinyl chloride monomer (PVC) | Energy-efficient polycarbonate monomer | Small-scale fuel reforming to hydrogen | Magnetobaric | Green Ammonia 24/7 | *in situ* CO2-free Power

"Quantum Repeaters: Materials and Applications"

Quantum repeaters are necessary for future pliant mesh networks, such as, the data-transfer between essential, sensitive assets. BraneCell has developed a molecular-photoluminescent qubit-based quantum repeater for through-atmosphere and tamper-proof communication between aircraft and command and control. This seminar will explore the basics of quantum communications and repeaters, as well as, the state of the art for QKD and keyless quantum communications.

We will delve into the best-known photonic qubit systems, their materials, functionality and capabilities to meet needs in the Aerospace Industry, including satellites and future unconditionally secure date-transfer performance metrics. Recent quantum communication systems use end-to-end entanglement starting from cavity-enhanced quantum memories (for example, ^{87}Rb) to initiate atom-photon entanglement. Polarization of the write-out photon and ^{87}Rb ensemble are entangled; and the polarization must be maintained over a long distance, while also undergoing quantum frequency conversion. Quantum frequency conversion is often applied since the atom's natural emission and the fiber's sweet-spot are not aligned or through-atmosphere transmission has several prohibited frequency ranges. Typically networks of more than one repeater also need memory both to wait for sender and receiver photons to arrive and to wait for heralding photons announcing a repeater has completed entanglement swapping. These various challenges can be overcome in a number of ways; yet, QSDC quantum communications also require pairs of polarized photons to be generated and reunited. The quantum system takes advantage of quantum thermodynamic properties, which may be designed, such that, said photon pairs or memory-photon pairs behave as a "single thermodynamic entity".

While the challenges are numerous and the fundamental physics supporting the devices are still emergent, the benefits of quantum mesh networks or even a quantum Internet would bring humanity to a new plateau or an ultimate level of communication---without the data-set's exposure to local (Bell's Theorem) interception, with physics-based (eavesdropping decoherence) tamper protection. Dr. Papile was the former Head of the Global Renewable Business (green H_2, NH_3, DRI Steel, eMethanol & Batteries) and Management Team Member co-leading 350-professionals for ThyssenKrupp (in Germany), where he led 4 Billion € qualified prospects towards 800 MM € sales. He is a frequent international speaker (1, 2, 3 and H_2 and industrial battery spokesperson) on these technology themes. He was Director Portfolio Development ExxonMobil/Technip licensing

50/50 JV, where he and his team commercialized the catalyst for the multi-Billion-USD polycarbonate market. He co-started Nuvera Fuel Cells (spin-out from, Arthur D. Little, initially Epyx Fuel Cells) and was Management Team member for Epyx, commercializing hydrocarbons to H_2 for Fuel Cell Vehicles. He co-started Solvias AG (from Novartis) > 100 Ph.D.s offering catalyst/catalysis and molecular contract R&D. On NATO fellowship, he researched at Ludwig-Maximilians-Universität München, Germany, under Prof. H. Knözinger (research at LMU) and his Ph.D. is from University of Delaware, Chemical Engineering, Center for Catalytic Science & Technology. With dozens of granted and applied patents and peer-reviewed scientific publications on quantum communications, surface science, H_2, NH_3, monomers, nanomaterials, and CO_2 mitigation, his work explores the boundaries of the engineering Zeitgeist. He recently worked with WVU professors on computational modeling.

MS&E Seminar Series is sponsored by the Department of Chemical Engineering, Lane Department of Computer Science and Electrical Engineering, and Department of Mechanical & Aerospace Engineering.

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