CSU PHYSICS COLLOQUIUM

"Novel noble-liquid radiation-detector concepts"

Amos Breskin

Radiation Detection Physics Laboratory Dept. of Astrophysics & Particle Physics, Weizmann Institute of Science Rehovot, Israel

120 Engineering (Hammond Auditorium)

Monday, September 11th at 4:00 PM

Abstract

Advances in Nuclear- Particle- and Astro-particle Physics have always been linked to the advent of novel radiation-detection concepts. Over the years, we have seen constant progress with gas-avalanche and solid-state imaging detectors that, in addition to the ever-growing particle accelerators permit scientists to hunt for "new physics". The more exotic rare-event searches, like neutrino physics and the search for dark matter, require very sensitive massive detection devices; the leading tools being Noble-liquid radiation detectors. While most of their current concepts rely on known techniques, upscaling of future experiments, particularly the search for dark matter, could benefit from recent advances in instrumentation that might solve some of their current drawbacks, enhancing their sensitivity.

We will introduce novel ideas of radiation-induced ionization-electron and scintillation-photon sensing concepts in *single-phase* (liquid) and *dual-phase* (liquid & vapor) Time Projection Chambers (TPC) detectors. They rely on recording photons and electrons by micro-structured electrodes, including ones undercoated with VUV photocathodes. According to the concept, the electrodes are either fully immersed in the liquid, floating on its surface, located in the gas phase or cascaded in both phases. Radiation-induced electrons in the liquid and primary-scintillation photoelectrons emitted from the photocathode are collected onto thin anode strips or micro-patterned surfaces. Combined electroluminescence and charge multiplication in liquid or gas results in fast UV-photon flashes - detected by nearby photo-sensor arrays.

In particular, some of the proposed concepts permit conceiving detectors expected to resolve current physical and technical issues typical of large-volume *dual-phase* detectors. Light and charge multiplication within the liquid could pave the way towards simpler and more efficient detection tools, with potentially lower detection thresholds – thus, with direct impact on physics results.

Biography

Detector Physicist. Professor Emeritus at Weizmann Institute of Science. Ph.D. (1973) with Georges Charpak at CERN - European Center for Nuclear Research. Founder of the Weizmann Institute's Radiation Detection Physics Laboratory. Expertized in basic phenomena and concepts in detection science, focusing mainly at: Nuclear and Particle Physics, Dark-matter searches and Applied Sciences. Founder and Director (till 2015) of JINST - the Journal of Instrumentation. Member of the Management Board of CERN-RD51 collaboration - on gas-avalanche detector concepts for future experiments.