Live Demonstration:

Femto- to-Macro Scale Interdisciplinary Sensing with Tensioned Metastable Fluid Detectors

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Abstract—Live interaction, interdisciplinary multi-physics demonstrations using the tensioned metastable fluid detector (TMFD) sensor systems are proposed. TMFDs utilize centrifugal-acoustic forcing to place ordinary liquids like water into sub-zero (i.e., below vacuum) pressure states of metastability such that interacting subatomic scale particles, or even eV photons can be detected via visible-audible transient bubbles that nucleate from nm scales growing to visible mm scales. Interactive experiments will cover diverse areas such as: nuclear physics (detecting neutrons – tell-tale signal from U/Pu fission using a unique NRC-licensed public use neutron source, study of cosmic rays); health-nuclear medicine (measuring of lung-cancer causing Radon in air at ultra-trace 1 part in 1017); Optics (monitoring and tracking a nanosecond pulsed laser beam); Acoustics-Piezoelectrics-Fluidics-Heat Transfer-Mechanics.

Keywords—TMFD, Fluidics, Acoustics, Radiation, Optics

I. INTRODUCTION & BACKGROUND

Ordinary fluids like water at room temperature can indeed be placed under tension, even negative (Pneg) pressures (yes – even below perfect vacuum) as scientifically confirmed only a few decades ago leading to the novel TMFD sensor class [1]. Briefly, tensioned fluids are in state of metastability; their intermolecular bonds weakened such that, select stimuli types can "poke" holes into them to create transient bubbles that can rapidly (within μs) grow to states that are visible-audible to humans. Amazingly, conventionally hard to detect sub-atomic neutral particles like neutrons or ions (tell-tale signatures from U/Pu nuclear fission) can now be detected with unparalleled intrinsic efficiency [1-2]. Stimuli types may also include ordinary UV-IR photons. The scientific principles and potential transformational uses have been published elsewhere [e.g., 1-2]. Unlike complex/expensive conventional sensors for radiation-photon detection which rely on extensive electronic trains, PMTs, scintillators, etc., TMFDs are based on intuitive, centrifugal force as from common rotary tools, and/or resonant mode acoustic vibrations from piezo-electric elements. Two distinct forms of hand portable, table-top systems: C(Centrifugal)-TMFDs and Acoustic(A)-TMFD systems will be used for demonstrations and hands-on experiences.

Table-top CTMFD and ATMFD sensor setups are shown in Figs. 1a, 1b, respectively – AC/DC powered.

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REFERENCES