8:00AM R55.00001 Why is Physics Important to Cancer Research?, ANNA D. BARKER, Director, Trans-Formative Healthcare Networks — Cancer is increasingly described as a “disease of the genes”, and while the genome (in fact all of the omes) are important information molecules that drive aspects of the initiation and progression of cancer, they are far from the whole story. Cancer is an extraordinarily complex system (in fact a complex of systems) that occurs in three-dimensional space, across multiple scales and often over extended periods of time. The most challenging issues that plague the cancer field such as metastasis, cellular heterogeneity and resistance to therapy are in large part more rationally explained in the context of the physics of these systems vs. genomics. For example, the biology of metastasis has been studied extensively for decades with little progress. Metastatic disease depends on cells acquiring (or expressing innate information) new properties that enable and sustain their ability to migrate to distant sites. Developing a fundamental understanding of key cancer processes ranging from metastasis to immunotherapeutic responses requires that physicists (and mathematicians and engineers) be integrated into a new generation of cancer research period! The presentation will focus on those areas where physics is essential and the hows and whose of achieving the integration required.

8:36AM R55.00002 Evolution, Physics, and Cancer: Disrupting Traditional Approach, ROBERT AUSTIN, Princeton University — Physicists who were recruited to try and assist with the stubbornly constant mortality rates of cancer world-wide over the past 100 years have basically had the invitation withdrawn by the oncology community. The oncologists became annoyed with the independence of thought and the skepticism of some physicists with continuation of the present paradigm of the cancer genome as the rosette stone as the key to cancer. To quote a recent letter in Physics Today: “Curing cancer is a complex biological problem to be solved by biologists”. Apparently our mission as minions is to be high-level technicians. But! think that is wrong and will lead to continuation of the string of failures and deceptions foisted on the public at large by the Medical Industrial Complex, I think we really need to re-think cancer as a phenomena which is driven by evolution and may be desired by the organism and be a product of both the aging of the proteome and the genome. Further, searching for mutations (The Cancer Genome) may be completely the wrong direction, searching for protected genes may be as important as looking for mutated genes. I’ll try to present the case that physicists should not have been kicked out of the Medical Industrial Complex that keeps the cancer business humming and profitable.

9:12AM R55.00003 Theoretical Physics and Cancer Research, KRUSTAN B. BLAGOEV, Physics Div., National Science Foundation, Arlington, VA and Dept. of Biophysics, Johns Hopkins University, Baltimore, MD — Cancer is a multifaceted disease which involves profound disruptions to biological mechanisms and structures that have evolved since the beginning of life. The most dramatic change is the failure of multi-cellularity and organ homeostasis. Time and time again, this complex disease has evaded the silver bullet cure attempts that rely on simple strategies including targeting dividing cells with broad acting chemotherapies, using radiation to cause DNA damage, and using molecular targeting agents. Even the most recent efforts, such as using immune stimulating agents and activated immune cells, are missing the mark. Against all these efforts, the cancer, even if it retreats, usually returns and often then does not respond to any of our available arsenal. The origin of this persistence is the robustness of life itself. During the past 4 billion years, life has survived many dramatic events and living organisms can be found in the most hostile places on Earth. Based on my research and on analysis of outcomes from several meetings between physicists and cancer researchers, organized by the National Science Foundation, I will argue that we need to integrate theoretical physics approaches to understand the emergence of resistance to treatment and to develop robust and curative interventions in cancer. The adaptive response of living systems to external and internal changes involve many interacting parts and networks. Phenomenological and reductionist approaches must be used synergistically to understand the phenomena at the appropriate spatial and temporal scales. This approach has been successful in understanding inanimate matter in the Universe and should be used in understanding animate matter as well and in particular cancer. I will also argue that public-private partnerships can speed up the process and bring innovation to transform the field.

9:48AM R55.00004 Information, Physics, and Cancer, CHRIS ADAMI, Michigan State University — Many researchers have doubts that a “theory of cancer” can exist, given the fact that there are so many different cancer phenotypes. However, such a situation–many significantly different manifestations of an underlying law—is not at all uncommon in physics. I argue that a unified cause for all forms of cancer is possible, but that such a theory must be cast in terms of information and communication theory. I briefly revisit key concepts of that theory, then discuss possible applications to communication in game theory that could lead us to view cancer as a disease that, at its root, is a cellular failure to properly communicate.

10:24AM R55.00005 The National Cancer Institute’s Physical Sciences - Oncology Network, MICHAEL GRAHAM ESPEY, National Cancer Institute — In 2009, the NCI launched the Physical Sciences - Oncology Centers (PS-OC) initiative with 12 Centers (US4) funded through 2014. The current phase of the Program includes US4 funded Centers with the added feature of soliciting new Physical Science - Oncology Projects (PS-OP) U01 grant applications through 2017; see NCI PAR-15-021. The PS-OPs, individually and along with other PS-OPs and the Physical Sciences-Onology Centers (PS-OCS), comprise the Physical Sciences-Oncology Network (PS-ON). The foundation of the Physical Sciences-Oncology initiative is a high-risk, high-reward program that promotes a ‘physical sciences perspective’ of cancer and fosters the convergence of physical science and cancer research by forming transdisciplinary teams of physical scientists (e.g., physicists, mathematicians, chemists, engineers, computer scientists) and cancer researchers (e.g., cancer biologists, oncologists, pathologists) who work closely together to advance our understanding of cancer. The collaborative PS-ON structure catalyzes transformative science through increased exchange of people, ideas, and approaches. PS-ON resources are leveraged to fund Trans-Network pilot projects to enable synergy and cross-testing of experimental and/or theoretical concepts. This session will include a brief PS-ON overview followed by a strategic discussion with the APS community to exchange perspectives on the progression of trans-disciplinary physical sciences in cancer research.
12:03PM S14.00003 Beller Lecture: Dialogue Across Divides - Physicists and the Iran Dossier

GTZ NEUNECK, Deputy Director IFSH and Chair WG Physics and Disarmament at DPG — For over a decade, the nuclear activities of the Islamic Republic of Iran have been at the center of international concerns and subsequent track II talks. NGOs, think tanks and analysts played a role to help to find technical solutions in a highly political setting. The talk will give an overview about the role of physicists to understand the Iranian sensitive nuclear fuel-cycle and to prepare the ground for the JCPOA. Furthermore, the experience of the work of the Pugwash Conferences on Science and World Affairs will be elaborated.

12:39PM S14.00004 Marshak Lectureship Talk, ANTON V. KHLOPKOV, Director, Center for Energy and Security Studies (CENESS) — .