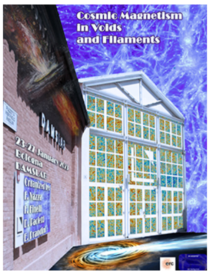

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Messengers from the Early Universe: Magnetic Fields, Turbulence, and Gravitational Waves

Tuesday, 24 January 2023 15:00 (30 minutes)

The abstract is splitted into two paragraphs. The first paragraph is a general description, while the second paragraph gives the description of the primordial magnetism aspects. If you think that the abstract is too long, please use just the first paragraph. It is completely up to you.

Abstract:
The detection of the relic magnetic fields through cosmological or astrophysical observations would provide a wealth of information about the conditions and composition of our universe in the first fractions of a second after the Big Bang. For example, the magnetic field induced gravitational radiation propagates almost freely throughout the cosmic history, and primordial gravitational waves reflect a precise picture of the universe at their time of production. A host of empirical observations are being used to probe cosmological magnetic fields in our universe today. The cosmological signatures include effects on primordial (Big Bang) nucleosynthesis, generation of relic gravitational waves, effects on the cosmic microwave background (CMB) temperature and polarization anisotropies, effects on the CMB energy spectrum via distortions, effects on the formation of stars and galaxies, and effects on the spatial distribution of large scale structure. Although these cosmological observations have not yet uncovered evidence for a primordial magnetic field, they provide valuable constraints on theoretically-compelling models of magnetogenesis. In my talk I will be focused on the origin, evolution and observational consequences of turbulence and magnetic fields, including physical processes in the early-universe.

From the perspective of elementary particle physics, it is natural to expect that a primordial magnetic field may have arisen in the extreme environment of the early universe. Epochs at which the system is susceptible to large amplitude inhomogeneities provide especially strong candidates for magnetogenesis; these include cosmological phase transitions – in a general sense, both the end of the inflation and thermal phase transitions are examples of cosmological phase transitions, The primordial plasma's high conductivity insures a strong coupling between the seed magnetic field and the fluid motions, and the plasma's high Reynolds number makes the plasma susceptible to the development of turbulence. After the seed magnetic field is formed at the magnetogenesis epoch, its subsequent evolution is governed by a coupling to plasma turbulence, decay due to adiabatic expansion and Alfv\'enic unfolding, and resistive dissipation. These effects must be taken into account in order to derive predictions for the

observable signatures of primordial magnetism today. My talk will present a brief overview of different aspects of primordial magnetism.

Presenter: KAHNIASHVILI, Tina (Carnegie Mellon and Ilia State)

Session Classification: Tuesday