

MONDAY

COLLOQUIUM

Primordial magnetic fields and relic gravitational waves: messengers of the first microseconds

Axel Brandenburg (Nordita, Sweden)

23 Nov 2026 (Monday) | 16:00 Hrs (Tea / Coffee 15:45 Hrs) | Venue: TIFRH Auditorium

Our detailed understanding of cosmology rests on only a few firmly established observational probes. One of them derives from the expansion history of the universe and the clustering of galaxies observed in the large-scale structure of galaxies observed today. The other is the measurement of temperature anisotropies and polarization in the cosmic microwave background that formed when the universe was 400,000 years old. Finally, there is the measurement of the abundances of light elements in the universe that constrain the physics within the first three minutes. However, we lack measurements of the first microseconds when weak and electromagnetic forces decoupled and particles attained their masses and quarks got confined inside nucleons. During these times, physics beyond the standard model must have determined the matter-antimatter asymmetry, produced dark matter, and led to the emergence of neutrinos. We can probe these very first moments through measurements of primordial magnetic fields and relic gravitational waves. The evolution of magnetic fields can be traced in an evolutionary diagram of magnetic field versus length scale and it follows a characteristic path. Relating the start- and endpoints to each other is an important theoretical accomplishment. At the same time, observational constraints in radio and gamma ray frequencies begin to narrow down the allowed parameter space in the evolutionary diagram. In this colloquium, I will discuss several of the theoretical and observational discoveries that make primordial magnetic fields and gravitational waves powerful probes of the first microseconds of the universe.