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Novel Approaches for the Analysis of Extragalactic Magnetic Fields

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In order to give a consistent picture of cosmic, i.e. galactic and extragalactic, magnetic fields, different approaches are possible and often even necessary. Here we present three of them: First, a semianalytic analysis of the time evolution of primordial magnetic fields from which their properties and, subsequently, the nature of present-day intergalactic magnetic fields may be deduced. Second, the use of high-performance computing infrastructure by developing powerful algorithms for (magneto-)hydrodynamic simulations and applying them to astrophysical problems. We are currently developing a code which applies kinetic schemes in massive parallel computing on high performance multiprocessor systems in a new way to calculate both hydro- and electrodynamic quantities. Finally, as a third approach, astroparticle physics might be used as magnetic fields leave imprints of their properties on charged particles transversing them. Here we focus on electromagnetic cascades by developing a software based on CRPropa which simulates the propagation of particles from such cascades through the intergalactic medium in three dimensions. This may in particular be used to obtain information about the helicity of extragalactic magnetic fields.

Author: Dr SAVELIEV, Andrey (University of Hamburg/Keldysh Institute)

Presenter: Dr SAVELIEV, Andrey (University of Hamburg/Keldysh Institute)

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