Nonlinear dynamics of microtubules

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Microtubules (MT) are major cytoskeletal proteins. Beside their mechanical role in cells they serve as a “road network” for motor proteins (kinesin and dynein) dragging different “cargos” such as vesicles and mitochondria to different sub-cellular locations. Microtubule is a hollow cylinder formed by protofilaments (PF) representing a series of proteins known as tubulin dimers. We explain three models describing its nonlinear dynamics and we call them u, z and φ -model. Each of them assumes one degree of freedom per dimer. The u-model assumes an angular degree of freedom, while the used coordinate u is a projection of the top of the dimer on the direction of PF. As for the remaining two models, a longitudinal and a radial coordinates are used to describe displacements of the dimers. All the models bring about nonlinear differential equations (NLDE). The solutions of these equations are kink solitons that we understand as signals for the protein to start moving along PF. In addition, one of the solutions of a discrete NLDE, describing the φ-model, is a modulated bell-type soliton, which, we believe, has a profound biophysical meaning.

Distinguishing indirect signatures of new physics at the International linear collider: Z' versus anomalous gauge couplings

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New heavy neutral gauge bosons Z' are predicted by many models of physics beyond the Standard Model. It is quite possible that Z's are heavy enough to lie beyond the discovery reach of the CERN Large Hadron Collider LHC, in which case only indirect signatures of Z' exchanges may emerge at future colliders, through deviations of the measured cross sections from the Standard Model predictions. We discuss in this context the foreseeable sensitivity to Z's of W-pair production cross sections at the e+e- International Linear Collider (ILC), especially as regards the potential of distinguishing observable effects of the Z' from analogous ones due to competitor models with anomalous trilinear gauge couplings (AGC) that can lead to the same or similar new physics experimental signatures at the ILC. The sensitivity of the ILC for probing the Z-Z' mixing and its capability to distinguish these two new physics scenarios is substantially enhanced when the polarization of the initial beams and the produced W bosons are considered.