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SUSY model and dark matter determination in the compressed-spectrum region at the ILC. (15' + 5')

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It is an appealing possibility that the observed dark matter density in the universe can be fully explained by SUSY. The current experimental knowledge indicates that this possibility favours a co-annihilation scenario. In such scenarios, the mass difference between the next-to-lightest SUSY particle (the NLSP) and the lightest one (the LSP) is quite small, which assures that the annihilation cross-section is sufficient not to predict a too large abundance of dark matter. However, the small mass difference also means that observing SUSY becomes hard at hadron colliders, where the observation hinges on the tell-tale signature of missing transverse energy: if the mass difference NLSP-to-LSP is small, only little energy is carried away by the invisible LSP. This is also true even if several other SUSY particles are within the kinematic reach, since these states would to a large extent decay via cascades ending with an NLSP to LSP decay. A lepton collider does not have this problem. The clean environment and known initial state at such machines assures that SUSY can be detected even if the mass difference is very small, provided the centre-of-mass energy is sufficiently high. We present prospects for observation and precision characterisation of SUSY with small mass differences at the ILC, based on detailed simulations of the ILD detector concept. The resulting possibility to predict the dark matter relic density is evaluated and compared to the precision obtained from the Planck mission. Taking a specific model as an example, we also discuss the synergies from combining ILC and HL-LHC results.

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