
PHYSICS MODELS IN THE MARS15 CODE FOR ACCELERATOR AND SPACE APPLICATIONS

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The MARS code system, developed over 30 years, is a set of Monte Carlo programs for detailed simulation of hadronic and electromagnetic cascades in an arbitrary geometry of accelerator, detector and spacecraft components with particle energy ranging from a fraction of an electron volt up to 100 TeV. The status, major developments and new features of the MARS15 (2004) version are described in this paper with an emphasis on modeling physics processes. This includes an extended list of elementary particles and arbitrary heavy ions, their interaction cross-sections, inclusive and exclusive nuclear event generators, photo-hadron and photo-muon production, correlated ionization energy loss and multiple Coulomb scattering of single-charged particles and heavy ions, bremsstrahlung and direct pair production. In particular, the details of enhanced systematics of elementary particle and heavy-ion nuclear cross-sections, a new model for leading baryon production and implementation of advanced versions of the Cascade-Exciton Model (CEM2003), and the Quark-Gluon String Model (LAQGSM03) are given. The applications that are motivating these developments, needs for better nuclear data, and future physics improvements are described.