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OPTIMISING A STOCHASTIC APPROACH TO SOLVING THE PARKER COSMIC RAY TRANSPORT EQUATION

In recent years, stochastic numerical solvers for the Parker cosmic-ray transport equation have become indispensable in cosmic ray modulation studies. Such codes, however, rely heavily on the quality of the pseudo-random number generation(PRNG) algorithm implemented in their calculations to model the Weiner processes required in the stochastic differential equations to be solved. The current industry standard PRNG is the widely used and well-tested Mersenne Twister, which passes almost all statistical tests that ensure that randomness is achieved. Here we examine and test whether other PRNG's can be implemented into the modulation code, some of which outperforming the Mersenne Twister algorithm in various statistical randomness tests, in an effort to decrease or match current runtimes whilst maintaining accuracy within the modelling. To do so, six comparable PRNG's were implemented in a 3D stochastic code often employed in cosmic ray modulation studies. By comparing the output of cosmic ray differential intensities yielded by this code, as well as its runtime, it was found that no tested algorithm decreased runtimes relative to the Mersenne Twister. However, two candidates are identified for possible replacement of this algorithm which yielded comparable runtimes and minimal percentage deviations in their output, namely the KISS and XORshift algorithms.

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