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We prove the unique existence and exponential decay of global in time classical solutions to the special relativistic Boltzmann equation without any angular cut-off assumptions with initial perturbations in some weighted Sobolev spaces. We consider perturbations of the relativistic Maxwellian equilibrium states. We work in the case of spatially periodic box. We consider the general conditions on the collision kernel from Dudyński and Ekiel-Jeżewska (Commun Math Phys 115(4):607–629, 1985). Additionally, we prove sharp constructive upper and coercive lower bounds for the linearized relativistic Boltzmann collision operator in terms of a geometric fractional Sobolev norm; this shows a spectral gap exists and this behavior is similar to that of non-relativistic case as shown by Gressman and Strain (Journal of AMS 24(3), 771–847, 2011). This is the first global stability result for relativistic Boltzmann equation without angular cutoff and this resolves the open question of perturbative global existence for the relativistic kinetic theory without the Grad’s angular cut-off assumption. (Received September 16, 2015)