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First-order cosmological perturbations engendered by point-like masses: all scales covered

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In the framework of the concordance cosmological model the first-order scalar and vector perturbations of the homogeneous background are derived without any supplementary approximations in addition to the weak gravitational field limit. The sources of these perturbations (inhomogeneities) are presented in the discrete form of a system of separate point-like gravitating masses. The obtained expressions for the metric corrections are valid at all (sub-horizon and super-horizon) scales and converge in all points except the locations of the sources, and their average values are zero (thus, first-order backreaction effects are absent). Both the Minkowski background limit and the Newtonian cosmological approximation are reached under certain well-defined conditions. An important feature of the velocity-independent part of the scalar perturbation is revealed: up to an additive constant it represents a sum of Yukawa potentials produced by inhomogeneities with the same finite time-dependent Yukawa interaction range. The suggesting itself connection between this range and the homogeneity scale is briefly discussed along with other possible physical implications.

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