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On Lorentz invariance and the minimum length[1)]

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It was shown by Kirzhnits and Chechen [1], following an earlier paper by Mead [2], that the minimum length scale l is constrained by the Mössbauer effect [3], which leads to the result $l \lesssim 10^{-20}$ cm, assuming the Snyder discrete space-time [4] and conventional nuclides. Here, we note, firstly, that some recently discussed nuclides, for example ${}^{189}_{76}$Os, have much narrower natural line widths, which, if excited by synchrotron radiation, could potentially decrease the limiting value to $l \lesssim 10^{-24}$ cm in future experiments. The Snyder space-time and the superstring theory are both locally Lorentz invariant, and give rise to the same form of generalized indeterminacy principle, if we set $l \approx 2\sqrt{\pi\alpha'}$, where α' is the Regge slope parameter, which is thus also constrained by the Mössbauer effect. For the heterotic superstring, in particular, $\sqrt{\alpha'} = 4\sqrt{2\pi G_{\mathrm{N}}} \approx 10^{-32}$ cm, apparently beyond experimental reach. A hadron string theory at energy ~ 250 MeV, however, would be ruled out, since then $l \sim 10^{-13}$ cm. We emphasize that these results all presuppose a de Sitter momentum space, for the alternative anti-de Sitter momentum space implies no minimum length scale, and therefore seems unphysical.

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