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The gapped state of a carbon mono-layer in periodic magnetic and electric fields[1] IZAK SNYMAN, National Institute for Theoretical Physics, South Africa — When smooth, zero-on-average, periodic magnetic and electric fields are applied to a carbon mono-layer (graphene), a gap between the filled valence and empty conduction band is introduced. However, this gapped state does not correspond to a band insulator: a constant electric field induces a quantized Hall current even though the magnetic flux through the sample is zero. The phenomenon is of the same type as in Haldane's model for a quantum Hall effect without Landau levels, although there is the following important difference between the two models: Haldane's model requires control over external magnetic fields on length scales less than an angstrom. For the model studied here, control over external fields on length scales that are larger by several orders of magnitude is sufficient. The Hall effect is explained in terms of the topological theory of Thouless, Kohmoto, Nightingale and den Nijs. A complementary explanation in terms of simple physical principles is also presented.

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Izak Snyman
National Institute for Theoretical Physics, South Africa

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