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A look at graphene's atomistic geometry and electronic properties from the perspective of discrete differential geometry

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A host of amazing properties of graphene originate from *geometry*. A prime example being actively pursued nowadays is the creation of gauge fields on graphene's conduction electrons, solely from mechanical strain [1-5]. This perspective is remarkable: Indeed, from an applied point of view, and just as an example, strain can help furnish large (pseudo-)magnetic fields, in excess of the ∼100 Tesla limit reached so far in state-of-the-art facilities [4]. From a fundamental perspective, graphene is a medium for discussion of (effective) relativistic Dirac-fermion Physics, so curved membranes make it necessary to uncover and revise our understanding of the Physics of Dirac fermions on curved spaces [2]. The theory (References [1-3] and a larger host of work) has been expressed in terms of an effective continuum media. Since graphene is an atomic membrane, our group is realizing a complementary and unique route [6-9] to study the relations among Dirac electrons and graphene's geometry, by applying concepts of Discrete Differential Geometry [10] to graphene. Essentially, the idea is to build the theory for electronic properties up from unit cells and atoms, so that the atomistic conformation is never lost, and no continuum limit is to be applied. The insight gained from this new perspective enters into basic checks of theory [1-3], the furnishing of electronic 'mass,' [7] and other geometrical aspects [9]. An extensive discussion of this approach and salient results will be given on this talk.

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