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Beyond Graphene: Electronic and Mechanical Properties of Defective 2-D Materials[1]

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One of the challenges in the production of 2-D materials is the synthesis of defect free systems which can achieve the desired properties for novel applications. However, the reality so far indicates that we need to deal with defective systems and understand their main features in order to perform defect engineering in such a way that we can engineer a new material. In this talk I discuss first, the introduction of defects in a hierarchic way starting from 2-D graphene to form giant Schwarzites or graphene foams, which also can exhibit further defects, thus we can have several levels of defectiveness. In this context, it will be shown that giant Schwarzites, depending on their symmetry, can exhibit Dirac-Fermion behavior and further, possess protected topological states as shown by other authors. Regarding the mechanical properties of these systems, it is possible to tune the Poisson Ratio by the addition of defects, thus shedding light to the explanation of the almost zero Poisson ratios in experimentally obtained graphene foams. Second, the idea of Haeckelites, a planar sp2 graphene-like structure with heptagons and pentagons, can be extended to transition metal dichalcogenides (TMDs) with square and octagonal-like defects, finding semi-metallic behaviors with Dirac-Fermions, and even topological insulating properties.

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