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Variational models for partial defects

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I will treat a class of sharp interface models for partial defects, in which partial defects are codimension 2 objects connected by codimension 1 objects. I will present two derivations of such energies. In dimension 2 a discrete model for crystal defects based on nearest neighbours and next to nearest neighbours interaction, via period potentials. In the asymptotic limit as the lattice spacing tends to zero, in terms of Gamma convergence, the model accounts for the formation and interaction of partial dislocations, point defects, and stacking faults, line defects connecting partials. The model falls into a class of discrete models with topological (fractional) singularities. One of the key ingredients is the characterisation of the minimisers for the core energy of the singularities, the so called one-vortex solutions. A second approach, strictly related, consists in a diffuse interface energy, which can be interprete as a semi-discrete model, à la Nabarro Peierls, which has the structure of a phase transition model with a multiple well potential and a non locale singular perturbation. This latter gives rise to the same asymptotics allowing also to treat the three dimensional case, under the assumption that the partial line dislocations lie on a single slip plane.

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