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Defects and Disorder in the Drosophila Eye[1] SANGWOO KIM, University of Illinois at Urbana-Champaign, RICHARD CARTHEW, Northwestern University, SASCHA HILGENFELDT, University of Illinois at Urbana-Champaign — Cell division and differentiation tightly control the regular pattern in the normal eye of the Drosophila fruit fly while certain genetic mutations introduce disorder in the form of topological defects. Analyzing data from pupal retinas, we develop a model based on Voronoi construction that explains the defect statistics as a consequence of area variation of individual facets (ommatidia). The analysis reveals a previously unknown systematic long-range area variation that spans the entire eye, with distinct effects on topological disorder compared to local fluctuations. The internal structure of the ommatidia and the stiffness of their interior cells also plays a crucial role in the defect generation. Accurate predictions of the correlation between the area variation and the defect density in both normal and mutant animals are obtained without free parameters. This approach can potentially be applied to cellular systems in many other contexts to identify size-topology correlations near the onset of symmetry breaking.

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