Quasicrystals

Homework assignment No. 1 February 22, 2000

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I. Reading

• M. Senechal, *Quasicrystals and Geometry,* Chapter 1.

and the three articles that were handed out in class:

• D. Shechtman and C. I. Lang, "Quasiperiodic materials: Discovery and recent developments," *MRS Bulletin* **22 No. 11** (1997) 40–42.

• D. Shechtman, I. Blech, D. Gratias, and J. W. Cahn, "Metallic phase with long-range orientational order and no translational symmetry," *Phys. Rev. Lett.* **53** (1984) 1951–1953.

• J. W. Cahn, "Epilogue," *Proc. 5th Int. Conf. Quasicrystals,* Eds. C. Janot and R. Mosery (World Scientific, Singapore, 1995) pp. 807–810.

II. Problems

1. In class we mentioned the so-called *crystallographic restriction,* which says that 5-fold rotational symmetry, as well as any rotational symmetry of order greater than 6, are impossible for periodic patterns in two- or three-dimensional space. This statement assumes that by "symmetry" one means an operation that leaves the pattern invariant. Using this definition for symmetry, show that—

> Any two-dimensional pattern which has more than a single point of N-fold rotational symmetry ($N > 2$) is periodic.

Thus, an infinitely extended quasicrystal can have no more than one point of N-fold "symmetry." Such a point will most likely be absent from a finite laboratory specimen. For this reason, we will need to generalize the notion of "symmetry" when we come to deal with quasicrystals.