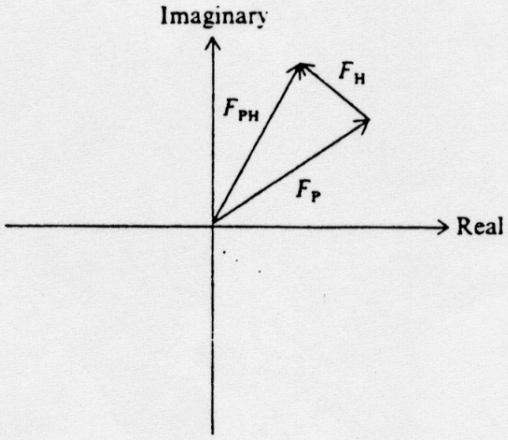
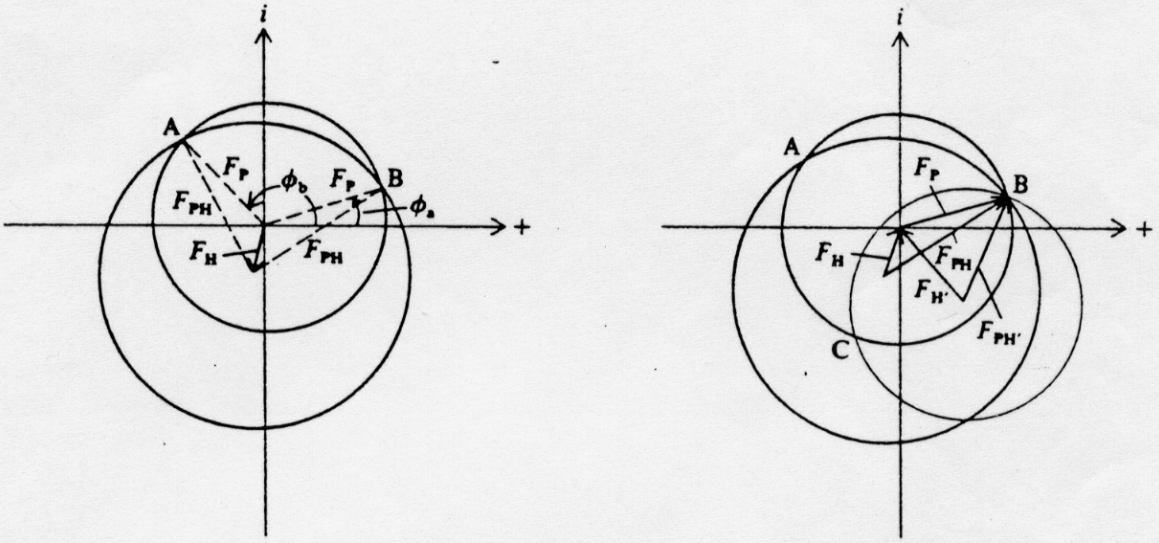
Structure factors plotted in the complex plane, for a parent-crystal diffraction spot, a heavy-atom isomorphous addition, and the expected derivative diffraction spot.





Phase determination by isomorphous replacement. Structure factors are plotted in the complex plane, as in Figure 13-34. **(a)** A single heavy-atom derivative. The circle with radius F_P represents the parent crystal, with measured intensity and unknown phase. The circle with radius F_{PH} represents the isomorphous heavy-atom-containing crystal, with measured intensity and unknown phase. The vector F_H is calculated from the heavy-atom position that had been determined from a difference Patterson synthesis. Because F_H is calculated, both its phase and its amplitude are known. Equation 13-102 will be satisfied by F_P, F_H, and F_{PH} when F_P lies at the origin, but F_{PH} is located at the end of F_H as shown. Therefore, the two circles are displaced, and they intersect at two positions: A and B. These positions define two possible values for the phase of F_P: ϕ_a and ϕ_b. **(b)** Inclusion of a second heavy-atom derivative. Its scattering amplitude yields a circle (*colored*) of radius $F_{PH'}$ centered at the end of the vector $F_{H'}$, which is calculated from the known position of the heavy atom. This circle also intersects F_P circle at two places: B and C. Because one intersection (B) is the same as an intersection found with the first heavy atom, the only phase choice for F_P consistent with both derivatives is ϕ_b. [After D. Eisenberg, in *The Enzymes*, 3rd ed., vol. 1, ed. P. D. Boyer (New York: Academic Press, 1970), p. 1.]