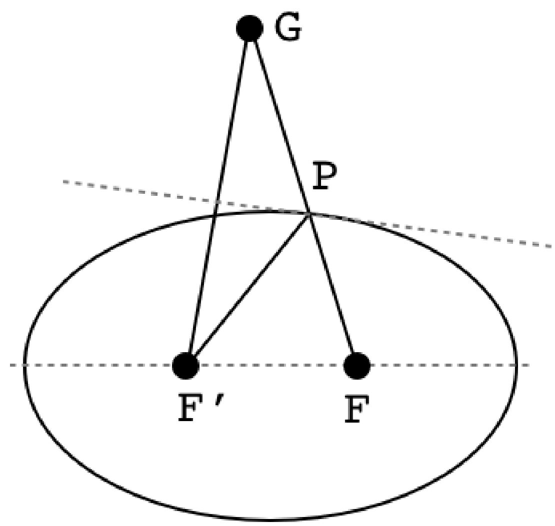
Feynman and Kepler

I am trying to set out the arguments made by Feynman with respect to Kepler's laws, starting with the form in the book *Feynman's Lost Lecture*.

Here is a sketch of an ellipse

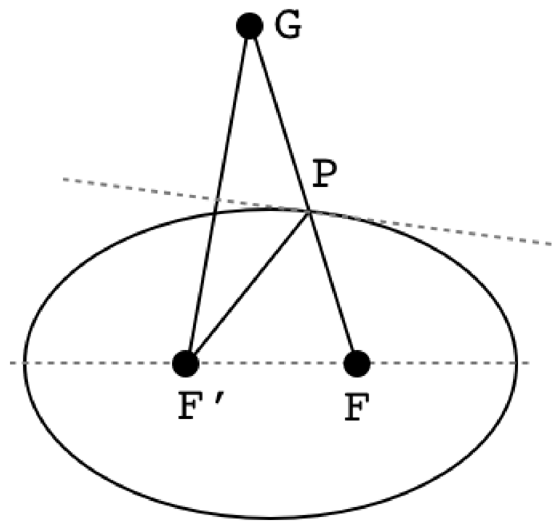


We pick a point P on the graph of the ellipse and draw the tangent to the curve at that point (if it doesn't look perfect, that may be due to the fact that I just estimated the positions of the foci F and F'). Now construct $F'G$ such that it is perpendicular to the tangent line. Draw GP.

The two triangles formed by this construction within $\triangle F'GP$ are congruent. In particular, $F'P$ is equal to GP, and the angle GP makes with the tangent line is equal to the angle $F'P$ makes with the tangent line.

Our intermediate goal is to prove that FPG is a straight line. If this is true then we will have proven that the angle that FP makes with the tangent line will be equal to the angle that $F'P$ makes with the tangent line.

Now, point P is on the tangent line and also on the ellipse, at the point where they touch. No other point on the tangent line is closer to the foci.



To see this, pick another point that is on the tangent line (and outside the ellipse), and is also supposedly closer, Q. But the sum of the distances $FQ + F'Q$ will be greater than for $FP + F'P$ because, Q is *outside the ellipse.*

Since choice of P at the point of tangency minimizes the distance $FP+ F'P$ and since $F'P = GP$, P also minimizes the distance $FP + GP$. Therefore, FG is a straight line. That's the argument for part one.