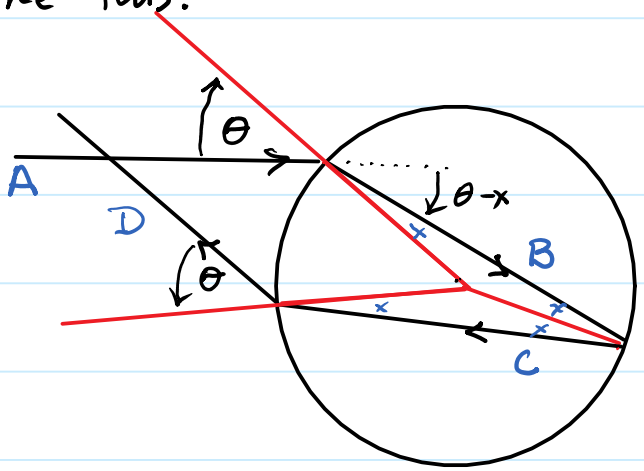
Rainbow

Friday, July 23, 2021 8:34 PM

The geometry is a little intricate, but it works like this:



The angle $x = \sin^{-1}\left(\frac{1}{n}\sin\theta\right)$ $n = 1.33$

The angle between lines A and B is $\theta - x$

At the backside the angle between B and C is $\pi - 2x$

The angle between lines C and D is $\theta - x$

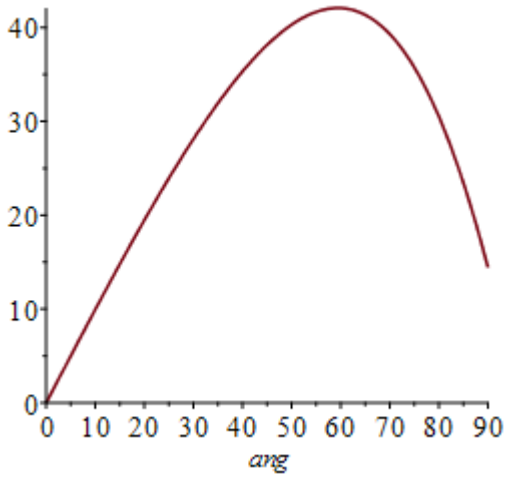
Adding all these together, the angle between A and D is $\theta - x + \pi - 2x + \theta - x = \pi + 2\theta - 4x$

However, the angle we quote is between the direction A is going and the direction D is coming from, so

φ = Deviation angle = $2\theta - 4\sin^{-1}\left(\frac{1}{n}\sin\theta\right)$

Here's a graph of the relationship between θ and φ:

θ and φ:



The maximum deviation is 42°. The parameter θ determines the impact parameter $R \sin\theta$; having the maximum deflection for $\theta \approx 60°$ means there is a relatively large differential cross section in this region of angles.

A slightly larger n (which happens for blue light) gives smaller maximum deviation, so in a rainbow the blue is on the inside.