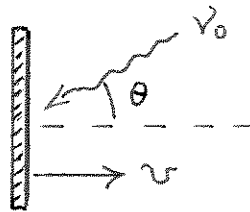


Homework #7

1. A mirror moves perpendicular to its plane with velocity v . If light of frequency ν_0 is incident at angle θ from the normal, at what angle will it be reflected? What will be the frequency of the reflected ray? (The easier method is to Lorentz transform the wave 4-vector before and after the reflection.)



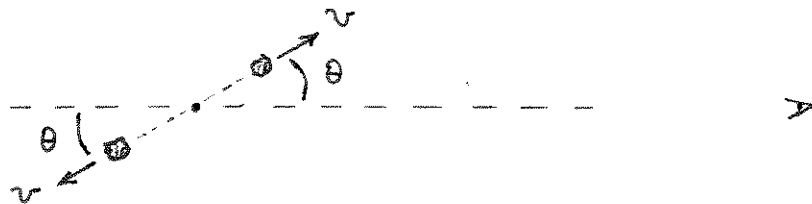
2. (a) Derive the expression for apparent superluminal velocity,

$$v_{\perp, \text{app}} = \frac{v \sin \theta}{1 - \beta \cos \theta}$$



- (b) Maximize $v_{\perp, \text{app}}$ with respect to θ , and show that its maximum value is $v\gamma$. At what value of θ does this maximum occur?

3. A quasar ejects a pair of blobs from its core in opposite directions at equal speed v , at an angle θ from the line of sight.



- (a) Show how both v and θ can be inferred from the proper motion (angular velocity $v_{\perp, \text{app}}/d$) of the blobs if the distance d to the source is known.
- (b) Show that if Doppler-shifted emission lines are ever detected from such blobs, then an independent measurement of the distance d results.