**Harold’s Physics Doppler Effect**

**“Cheat Sheet”**

19 April 2016

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| **Doppler Effect – Sound** |
| Diagram |  |
| $$f=frequency \left(pitch\right)of sound wave$$$v=speed of sound in the medium$  [343.2 m/s; 1,126 ft/s; 1,236 km/h; 768 mph]$$v\_{s}=speed of the sound source$$$v\_{r}=speed of the listener$ / receiver | **Source Velocity (**$v\_{s}$**)** | **Receiver Velocity (**$v\_{r}$**)** | **Observed Frequency Equation** |
| Source and receiver are both stationary | • | • | $$f\_{r}=f\_{s}$$ |
| Source moving away from the receiver | ← | • | $$f\_{r}=f\_{s}\left(\frac{v}{v+v\_{s}}\right)$$ |
| Source moving towards the receiver | → | • | $$f\_{r}=f\_{s}\left(\frac{v}{v-v\_{s}}\right)$$ |
| Receiver moving towards the source | • | ← | $$f\_{r}=f\_{s}\left(\frac{v+v\_{r}}{v}\right)$$ |
| Receiver moving away from the source | • | → | $$f\_{r}=f\_{s}\left(\frac{v-v\_{r}}{v}\right)$$ |
| **General Equation** | ← → | ← → | $$f\_{r}=f\_{s}\left(\frac{v\pm v\_{r}}{v\mp v\_{s}}\right)$$ |
| **Tip:** Towards use top sign, away use bottom signPick sign so observed frequency increases when towards (big numerator, small denominator) |

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| **Doppler Effect – Light** |
| http://a-levelphysicstutor.com/images/waves/dopp-redshift03.jpg | http://www.exploratorium.edu/hubble/tools/images/doppler1.gif |
| $$f=frequency of light wave at the source$$$$c=speed of light$$$$v=speed difference between two objects$$ | **Source Velocity Relative to Receiver (**$v$**)** | **Receiver Velocity (0)** | **Observed Frequency Equation** |
| Both objects are moving at the same velocity | • | • | $$f\_{r}=f\_{s}$$ |
| Redshift: Source object moving away from the earth | ← | • | $$∎ f\_{red}=f\_{s}\left(\frac{c}{c+v}\right)$$ |
| Blueshift: Source object moving towards the earth | → | • | $$∎ f\_{blue}=f\_{s}\left(\frac{c}{c-v}\right)$$ |
| $$f=\frac{c}{λ}$$ | $$λ=\frac{c}{f}$$ |
| $$λ=wavelength of light wave at the source$$$$c=speed of light$$$$v=speed difference between two objects$$ | **Source Velocity Relative to Receiver (**$v$**)** | **Receiver Velocity (0)** | **Observed Wavelength Equation** |
| Both objects are moving at the same velocity | • | • | $$λ\_{r}=λ\_{s}$$ |
| Redshift: Source object moving away from the earth | ← | • | $$∎ λ\_{red}=λ\_{s}\left(\frac{c+v}{c}\right)$$ |
| Blueshift: Source object moving towards the earth | → | • | $$∎ λ\_{blue}=λ\_{s}\left(\frac{c-v}{c}\right)$$ |