

Special and General Relativity (PHZ 4601) Fall 2018 Solutions**Set 3****6. Mössbauer precision for measuring a gravitational frequency shift (Rindler 1.9).**

Let a 22 [m] long cabin fall freely in the gravitational field g and send a light signal from the top to the bottom. We need to show that when the light signal reaches the bottom, the cabin will already move with velocity $v > 10^{-5}\text{ [cm/s]}$, so that the frequency shift can be detected. This is easily calculated.

Duration of the signal:

$$t = \frac{22\text{ [m]}}{3 \times 10^8\text{ [m/s]}} = 7.33 \times 10^{-8}\text{ [s]}.$$

Velocity reached:

$$v = g t = (980\text{ [cm/s]}) \times (7.22 \times 10^{-8}\text{ [s]}) = 7.2 \times 10^{-5}\text{ [cm/s]}.$$