

53. (a) The spatial separation between the two bursts is vt . We project this length onto the direction perpendicular to the light rays headed to Earth and obtain $D_{\text{app}} = vt \sin \theta$.
- (b) Burst 1 is emitted a time t ahead of burst 2. Also, burst 1 has to travel an extra distance L more than burst 2 before reaching the Earth, where $L = vt \cos \theta$ (see Fig. 38-22); this requires an additional time $t' = L/c$. Thus, the apparent time is given by

$$T_{\text{app}} = t - t' = t - \frac{vt \cos \theta}{c} = t \left[1 - \left(\frac{v}{c} \right) \cos \theta \right] .$$

- (c) We obtain

$$V_{\text{app}} = \frac{D_{\text{app}}}{T_{\text{app}}} = \left[\frac{(v/c) \sin \theta}{1 - (v/c) \cos \theta} \right] c = \left[\frac{(0.980) \sin 30.0^\circ}{1 - (0.980) \cos 30.0^\circ} \right] c = 3.24 c .$$