

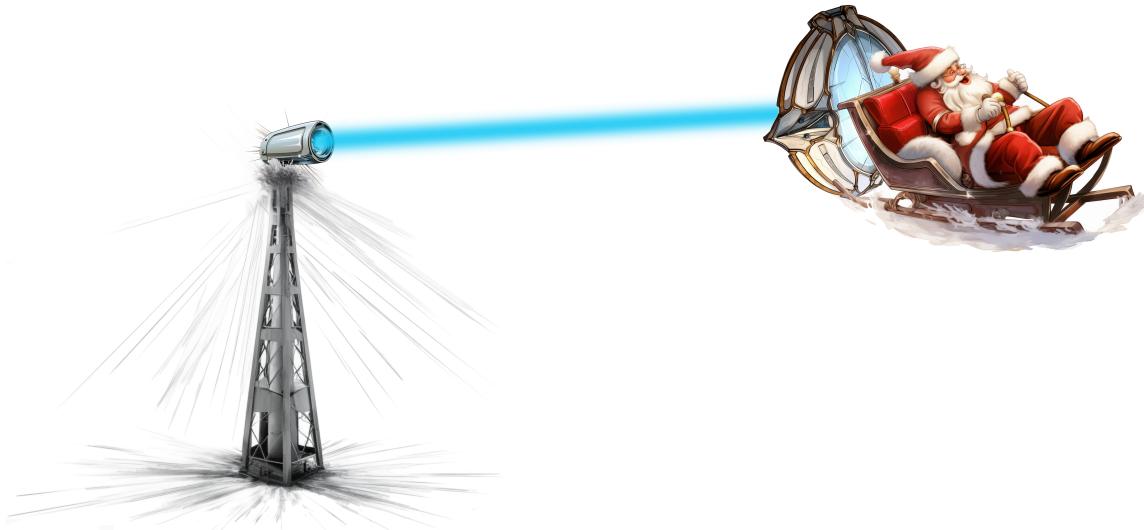
New Santa's Sleigh

Enigma n°7

14th December 2023

Santa's magical reindeer are getting old. In order to have no disruption in the distribution of presents when the reindeer can no longer fly, Santa is testing a new model of sleigh from the future: a laser-powered sleigh.

The concept is simple: Santa Clause needs to ask the elves to construct towers at regular intervals. They will take it in turns to propel the sleigh via ultra-powerful lasers. To prevent the sled from disintegrating, it is fitted with a shield at the rear.



Santa Clause trying his new high-tech sleigh.

If D is the distance between the sleigh and the tower, the energy transmitted by the tower is proportional to $1/D$ (due to interaction of the laser with the atmosphere). The speed of the sleigh is proportional to the energy it receives from the tower (1). Despite the shield, being too close to the tower is dangerous (2). The sleigh is launched via a big spring canon (3). There is a minimum speed, below that speed, the sleigh cannot fly properly (4).

1. We have $V = \frac{\beta}{D}$ ¹, with $\beta = 4\ 000\ 000\text{s}^{-1}$.
2. The sleigh must be at least 8km away from the tower (when receiving energy from the tower)
3. The canon is configured so that the sleigh arrives with a speed of 900km/h (250m/s) at 8km from the first tower (at $t = 0\text{s}$).
4. The sleigh can not fly at a speed below 144km/h (40m/s).

What is the maximal possible distance (in meters) between two towers?

¹With V in m/s and D in m (meters).