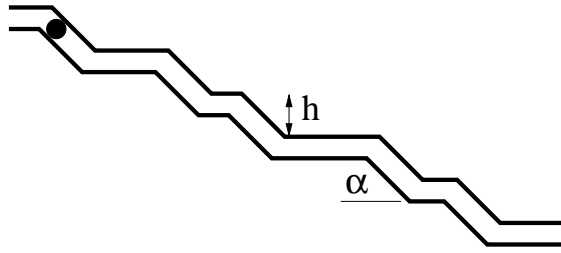# Random pipe

A ball starts sliding inside frictionless but absolutely inelastic randomly-sectioned pipe, containing very many sections. The ball's diameter is equal to the inside diameter of the pipe. Find the eventual speed of the ball in the horizontal sections of the pipe. How does it depend on the initial speed of the ball? Height difference between two horizontal sections is h, inclined sections make angle α with the horizon.

After many-many sections

$$v_f \approx \frac{\cos\alpha}{\sqrt{1 - \cos^4\alpha}}\sqrt{2gh}$$

independent of initial speed.

The key: at each turn (knee) of the pipe, momentum perpendicular to the next section of the pipe is completely lost. Use conservation of energy on the slopes.