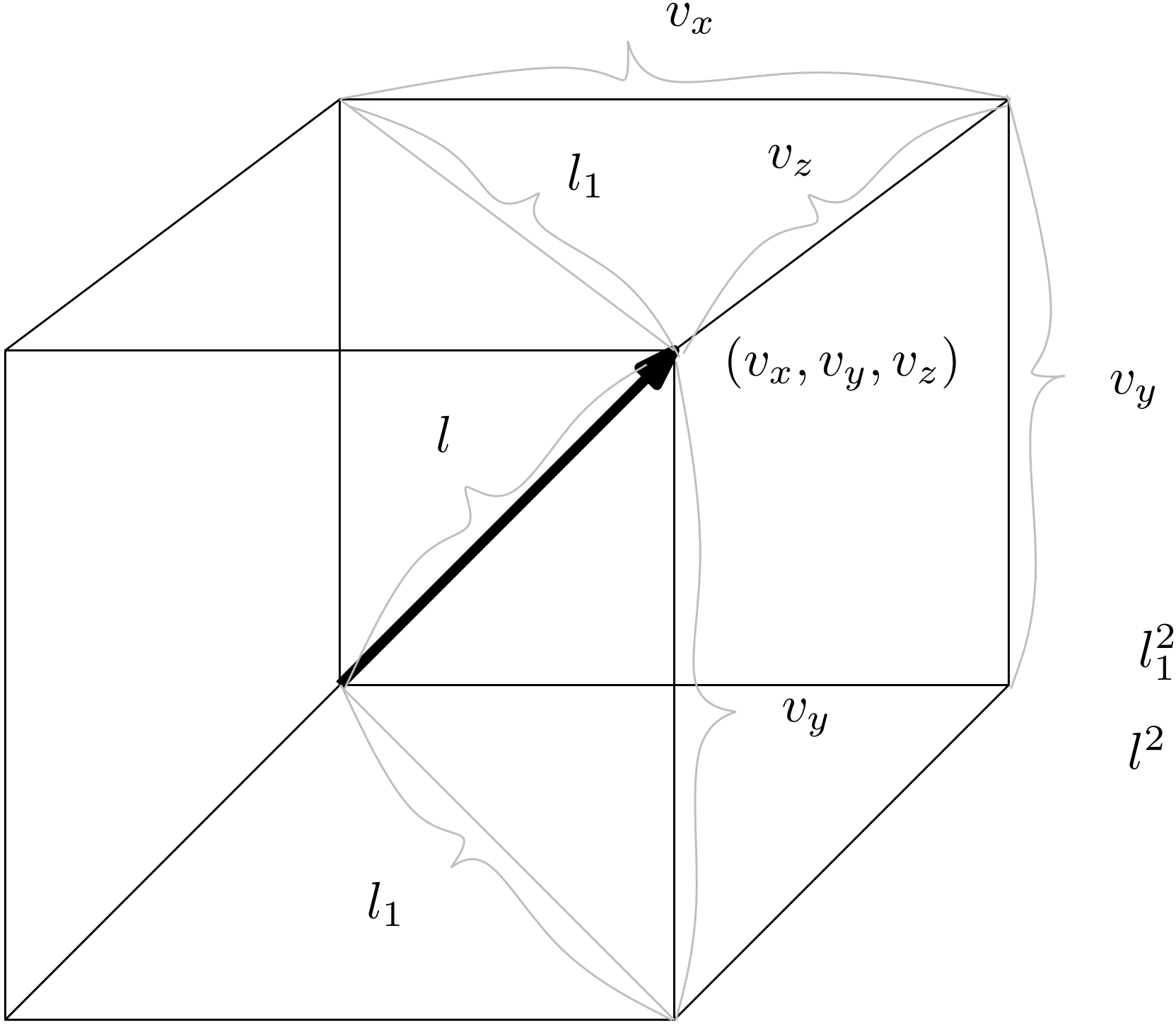

$$l_1^2 = v_x^2 + v_z^2$$

$$l^2 = l_1^2 + v_y^2$$