Exercise for week 5: Light force on a bubble
07.10.2024

Imagine a spherical soap bubble in the air. In the usual case, it falls due to gravity. Is it possible to prevent it from falling by illuminating it with a 1-Watt laser beam at $\lambda = 532\,nm$, *polarized horizontally*, if the bubble is filled with smoke that totally absorbs the laser beam inside the bubble ?

Consider the thickness of the bubble wall uniform and equal to $\delta = 500$ nm. The density of the bubble layer $\rho_{\text{layer}} = 1000\,{}^{\text{kg}}/_{\text{m}^3}$, and the density of the air and the smoke $\rho_{\text{air or smoke}} = 1.28\,{}^{\text{kg}}/_{\text{m}^3}$. The radius of the bubble $R = 2{,}5$ cm, the laser beam is parallel to the x-axis and the photons hit the bubble at $\alpha = -45°$ below the x-axis (see the figure). Consider that 5 % of the laser beam is reflected at each air-bubble interfaces.