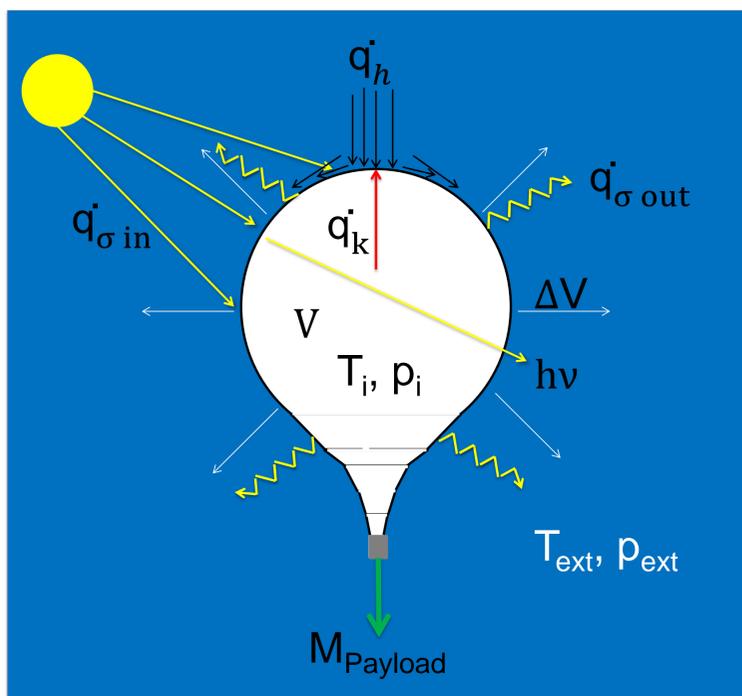# Balloon Diameter Measurement and Altitude Determination through Gas and Thermal Properties

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Proposed heat transfers to and from the balloon.

Overview

Heat transfer and gas law equations can be used to find the temperature and pressure inside a high altitude weather balloon (T_i, p_i). Correlations can be created to relate the volume of the balloon (V) with the inside and outside pressures. These equations can be used to predict when the balloon bursts.

Explanation

This research is relevant because it provides a fundamental understanding of weather balloons in flight to support empirical studies. Modifications can be made to high altitude balloons could improve their effectiveness and flight duration in which they are at altitude minimizes the cost of long term testing at high altitudes.

Impact

The impact of the research done is that a theoretical model can be created to understand the heat transfer from a balloon as a function of its altitude. Further developments using modelling can allow calculations to minimize the amount of insulation needed; therefore, allowing more payloads to fly on one balloon line.

Key Findings
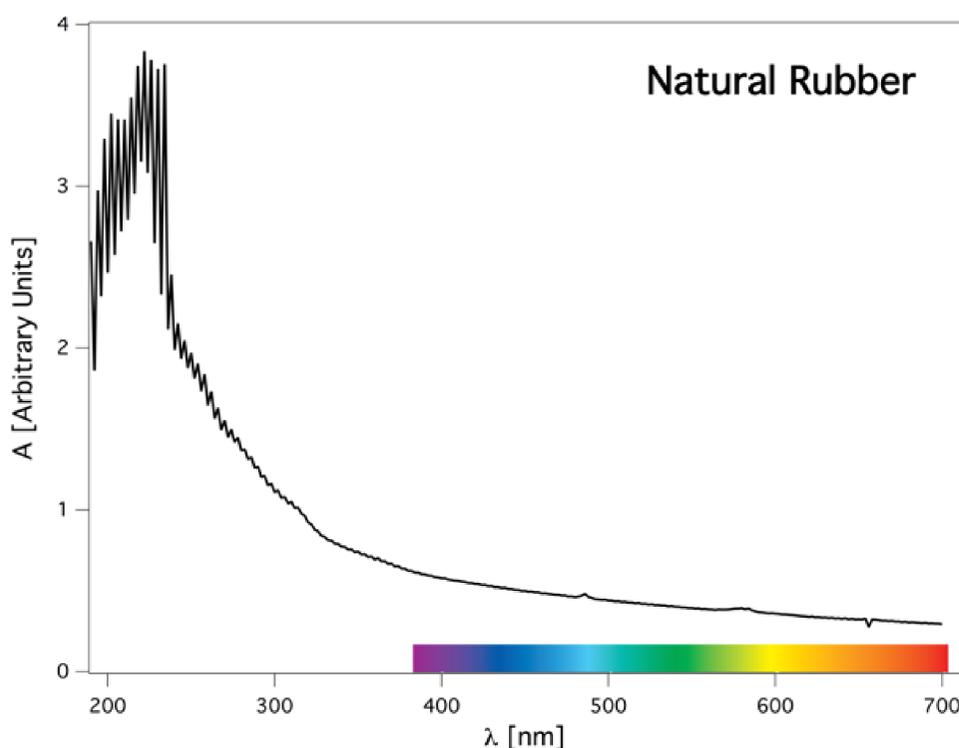
Absorptivity of the balloon material versus wavelength.

Internal Heat Transfer

- $k_{He}(\text{STP}) = 0.146 \ \frac{W}{m\,K}$
- $k_{He}(120000 \ \text{ft.}) = 0.129 \ \frac{W}{m\,K}$
- $\Delta k_{He} = -0.017 \ \frac{W}{m\,K}$
- $\dot{q}_{He} \propto \frac{1}{r_{balloon}}$

External Heat Transfer

- $A \downarrow$ as altitude increases*
- $\dot{q}_{rad} \downarrow$ as altitude increases*
- $\dot{q}_h \gg \dot{q}_{rad}$

Balloon Failure

- When the balloon bursts because it reaches its limit of elastic deformation.
- Quality control of the latex is an important variable for when the balloon bursts.

*The balloon is stretched thinner and becomes more transparent.

Acknowledgements

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