Project Name: Principal component reduction and interpretation of spectral measurements (PRISM)

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General Topic: Perform Principal Component Analysis (PCA) of absorption spectra (UV-Vis-NIR) of greenhouse gases

Description

1. **Motivation**: Absorption spectroscopy is a useful technique for characterization and quantitative analysis. It works by measuring the intensity of transmitted light as a function of (typically) wavelength. Since most materials have distinct absorption peaks depending on the composition, the absorption spectra can be measured and used to fingerprint and identify the material. This technique can be further enhanced by performing PCA analysis on a training set to determine the principal components (superposition of wavelengths) necessary to classify the material. By performing dimensionality reduction of principal components, this can lead to shorter scanning time by only measuring the range of wavelengths that correspond to high variance.

2. **Approach**: The group will have access to a dataset of absorption spectra of various greenhouse gases at different concentrations. PCA will be used to perform dimensionality reduction to identify critical wavelengths that will fingerprint the material. A model will then be trained on a training set to predict concentration based on the principal components, and will be evaluated on a test set.

3. **Analysis of Results**: The predicted concentrations from the test set should give a reasonable measure of accuracy. Additionally, the principal components should roughly correspond to the superposition of known peak absorption spectra of the material.

4. **Key Takeaway**:

GitHub Repository: https://github.com/vpjuguilon/Physics-215_Project-PRISM