The idea of the experiment is to determine the complex index of refraction of pulverized walnutshell particles. To achieve this goal, 15 particles were examined in a scattering experiment:

Description of the experiment:

In the experiment single pulverized walnutshell particles are kept contactless in position by an acoustic levitator. Then the particles are irradiated by a broadband source (Thorlabs SLS203L), emitting radiation for a wavelengths 500 – 9000 nm. More details about the radiation source are described in the Paper *Experimental determination of the optical properties of walnut shell particles* or published by Thorlabs (https://www.thorlabs.com/thorproduct.cfm?partnumber=SLS203L/M). The radiation interacts with the particle and is partially absorbed and redistributed into different directions (which is called scattering). The scattered radiation is collected in different scattering angles. Here, the scattering angle is defined as the angle between outgoing/scattered radiation and incoming radiation. Therefore, scattering angle of zero means forward and scattering angle of 180° means backward. The scattered radiation is then evaluated with a FT-IR spectrometer for wavelengths ranging from 2000 - 6000 nm (MIR Rocket from ArcOptix, https://arcoptix.com/FTIR-spectrometer.htm). The scattered radiation is measured for angles from 21° - 114° (each 3°), which results in a scattering pattern depending on the investigated particle and the evaluated wavelength. Here, the scattering patterns were investigated for the wavelength 2050 – 5450 nm (each 50 nm), and thus, for 69 different wavelengths. To summarize the most important facts:

- **15** pulverized walnutshell **particles** are investigated at **69** different **wavelengths** (2050 – 5405 nm with a stepsize of 50 nm)
- The result is 15 x 69 = 1035 phase functions
- Each phase function is build from **32 angles** (21° - 114° with a stepsize of 3°)

Each phase function was analyzed applying an inverse mie theory, resulting in an index of refraction for each phase function. The Mie theory calculates a phase function depending on the index of refraction. Then this calcualted phase function is compared to the measured phase function. The difference is minimized by adjusting the index of refraction.

Description of results and data:

The result of this experiment is a wavelength dependent complex index of refraction of walnutshell particles. The folder "IOR_Solutions" contains 15 matlab-files (.mat). Each file contains the following files, which describe the results of the 15 particles:

- IOR – IOR is a 69x2 array and contains the real part and imaginary part of the complex index of refraction.
- Pf_meas – Pf_meas is short for "Phase function measured". It is a 69x32 array and consists of the measured phase function for the 69 wavelengths depending on the 32 scattering angles.
- Pf_calc – Pf_calc is short for "Phase function calculated". It is a 69x32 array and constist of the calcualted phase function for the 69 wavelengths depending on the 32 scattering angles applying Mie theory and the determined index of refraction saved in IOR.
- ReadMe – ReadMe is a struct with important boundary conditions about the experiment:
    - Date – The date of the measurement
    - Fuel – The investigated fuel (here, it is always Walnutshell)
    - Seeving – The seeving of the used particles

- EqDiameter – The equivalent diameter of the used particle. This diameter is used in the calculation of the Mie theory.
- AspectR – Aspect ratio of the particle
- Angles – The scattering angles (always 21° - 114°)
- AnglesB – The scattering angles, where the detector was also irradiated directly by the source
- D_Lense – The diameter of the lense collection the radiation (always 0.0254 m)
- FocalLenght – The focal length of the collector (always 0.04 m)
- Cutoff_low/Cutoff_high – Some parameters for the FFT, described in the paper
- WL_disc_infr – Array of the investigated wavelengths (always 1x69, 2050 – 5450)