**Detailed Project Description**

**Project Title:** Intelligent AOM (Acousto-Optic Modulator)

**Research Group:** Quantum Photonics Group, led by J. Eschner & Team

**Objective:**

Developing an **intelligent control system** for an **acousto-optic modulator (AOM)** using **data science and AI techniques**, improving the **stability, precision**, and **automation** of laser-based experiments.

**Core Components:**

* **AOM (Acousto-Optic Modulator)**: A device that diffracts and shifts the frequency of a laser beam using an RF signal.
* **AWG (Arbitrary Wave Generator)**: Supplies the RF signal (frequency ν) to the AOM.
* **Laser (with frequency f)**: Constant Input, manipulated by the AOM.
* **BS (Beam Splitter)**: Divides the laser beam into two separate beams of same frequencies
* **PD (Photodetector)**: Captures laser frequence to analyse changes
* **HD (Heterodyne Detection)**: Given two lasers of frequencies f and f’ going into a BS, the slitted beams of those frequencies interfere, outputting both of their differences f - f’ & f’ – f, which are detected by a PD each

**Main Idea**:

Given the input frequency f as well as the frequency coming out of the AOM after being non-linear shifted by frequency v, lead them into the HD. Both output frequencies of the HD and the target spectrum of the frequency coming from the AOM are dealt to a **machine learning model** computing the original frequency spectrum v interfering with the input frequency.

**Technological Aim:**

* To apply **machine learning models** or **AI-driven algorithms** for:
  + Real-time monitoring and adjustment of AOM parameters.
  + Stabilization of laser beam characteristics.
  + Predictive maintenance or tuning of the system.

**Machine Learning Approach:**

#LeomachdeinDing