1. **Developing a pulsed electron spin resonance spectrometer with arbitrary pulse shaping capability**

Pulsed electron spin resonance (pESR) is a technique for manipulating quantum spins coherently with microwave pulses and has versatile applications in physics, chemistry, biology and quantum information. Conventional pESR experiments are conducted by simply switching the microwave signal between on and off to form square excitation pulses. In recent years, the development of high-frequency arbitrary waveform generators (AWG) has introduced the possibility of engineering pulse shapes (including amplitude and frequency) to gain much greater control over the spins.

In this project, the student will design and build a pESR spectrometer with AWG pulse shaping options that will match (and potentially exceed) the performance of the state-of-the-art commercial pESR spectrometers. This involves programming the AWG to generate required waveforms and use them to modulate high frequency (~ 10 GHz) microwave signals. The student will also perform pESR experiments with molecular nanomagnets to test the performance the spectrometer. The project demands good programming skills (in Python) and basic microwave electrical engineering knowledge.

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Proposal for USTC student vacation project

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The Infrared Atmospheric Sounding Interferometer (IASI) is a remote sensing

instrument on the MetOp satellites. It measures the infrared spectra emitted by

the earth surface and atmosphere and, from these spectra, the concentration of

various atmospheric gases can be derived.

The aim of the project will be to analyse the results from the IASI instrument

over China, with particular regard to monitoring air quality: comparing the

results of the new Oxford algorithm with more established data from the same

satellite.

Ideally the student will have a good knowledge of scientific computing in a

linux environment, together with a knowledge of the physics of infrared

radiative transfer and remote sensing.