# Master Thesis (m/f/d) “Antenna-Enhanced Graphene Photodetectors” at Uni Siegen and AMO GmbH

## Context

The development and use of LIDAR (Light Detection and Ranging) systems is a hot topic, driven above all by the increasing degree of autonomy of various vehicles and robots. Current LIDAR systems still have an enormous need for improvements in performance, cost, energy efficiency, reliability, dimensions, and weight. In all these areas, the integration of CMOS logic in combination with circuit-adapted photonic devices can bring significant benefits. Graphene detectors have almost all necessary optical properties and can be integrated with CMOS. The greatest weakness of such detectors, their low absorption of 2.3% per monolayer of graphene, can be overcome by the use of a proprietary and patented antenna configuration developed by the University of Siegen and the National Research Council of Italy. The peculiarity of this antenna is its comparatively simple planar structure, which in combination with its non-resonant design allows manufacturing tolerances suitable for mass production and can be produced using favorable lithographic processes.

## Project

The antenna concept has been experimentally proven for emitters and is expected to work for detectors due to the reciprocity of light paths. The first step in the project is to verify this idea via simulation and to then find an optimal realistic design based on the experimental constraints. It is important to adapt the concept to the materials used, wavelength and technique of the detector in accordance with the experimental work. Through these simulations performed at the University of Siegen, we expect quantitative information about the performance of the detector as well as an analysis of the tolerances of the parameters as input for the fabrication of the best designs. The second phase involves process development for the fabrication of graphene photodetectors with the designed planar antennas as well as the fabrication and characterization of these devices. The work focuses on individual pixels as scalable basic elements of areal detectors and is mainly carried out in the cleanroom of AMO. Finally, an important component of this project is the study of the manufactured detectors by e.g. sensitivity measurements and comparisons with reference structures, the measurement of the acceptance angle and the electrical and optical bandwidth of the detectors.

Interested candidates are expected to have a strong background in physics, electrical engineering or comparable courses and are kindly requested to submit per e-mail a CV, transcripts and a 1-page motivation letter. The application should be sent to jobs@amo.de and Prof. Mario Agio. Feel free to contact one of the joint supervisors mentioned below if you have any questions about the project:

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