



Fig 1, a) Applications of SAW, b) SAW driven graphene studies in the group of Prof. Blick in CHyN, c) Initial COMSOL simulations of SAW in the group of Prof. Blick in CHyN.

Surface Acoustic Wave (SAW) is versatile with applications i.e., wireless chips in telecommunication industry, acoustofluidics in bio-engineering, quantum studies in fundamental research.¹ Since the invention of interdigitated transducers (IDTs) in 1960s, people can manipulate the nanoscale earthquakes on chips by the means of SAW using various kinds of waves interference just like what is happening in real word, i.e., surfer's favorite shock waves, destructive tsunami etc.^{2,3}

In the group of Prof. Robert H. Blick in CHyN (Center for Hybrid Nanostructures), we are implanting SAW to integrate with monolayer and (twisted) bilayer of vdWs 2D materials for studies of magnetotransport, electron spin resonance, spin transport, superconducting studies. Initial studies has proved that SAW can be used to probe the Landau oscillations in CVD graphene measure at liquid helium temperature in high magnetic fields. What is more attractive is that some peculiar fine structures are observed, which never show up in traditional AC-current measurements, and are still under being understood.⁴

The project provided in the group of Prof. Blick for a bachelor thesis or a Hiwi-student is using FEA (Finite Element Method) software to understand the formation of SAW on various piezoelectric materials, i.e., GaAs, LiNbO₃, LNOI-LiNbO₃ on SiO₂, and suspended LiNbO₃ to under the interference and transmissions under different conditions and the determinable parameters for resonant features. You will start your work based on some previous model (2D/3D Model) started in the group.

In the group of Prof. Blick in CHyN, you can experience a state of art clean room environment required semiconductor industry, you will have access to FEA software—Multiphysics COMSOL, and you will have introduction to various microwave facilities i.e., microwave generator, sweeper, wave analyzer which are crucial to start with SAW, and this project will not only contribute to the work in the group, but will also assist you either if you want to go to industry or stay in science for research afterwards.

Project for Bachelor or Hiwi-student

1. P. Delsing etc., The 2019 surface acoustic waves roadmap, *J. Phys. D: Appl. Phys.* 52, 353001 (2019)
2. R. M. White etc., Direct piezoelectric coupling to surface acoustic waves, *Appl. Phys. Lett.* 7, 314 (1965)
3. F. W. Beil etc., Shock waves in nanomechanical resonators, *Phys. Rev. Lett.* 100, 026801 (2008)
4. P. Zhao etc., Acoustically driven Dirac electrons in monolayer graphene, *Appl. Phys. Lett.* 116, 103102 (2020)