



e-conversion



# Special Seminar

Monday, September 5, 2022

11 am

WSI, Seminar room S 101

## “Semiconductor dielectric metasurfaces: Ultrafast emission control and nonlinear optics”

Metamaterials and their 2D implementation – metasurfaces – have been used extensively for wavefront manipulation since their inception two decades ago. This has led to a revolution in optics due to the ability to design optical components with functionality and form factor that was unthinkable not long ago. Another use of metasurfaces relies on the ability to tailor distributions and intensities of local electromagnetic fields to study a variety of fundamental phenomena in light-matter interaction and create novel tunable and active devices.

Dielectric metasurfaces made from III-V semiconductors are particularly attractive for nonlinear optics, ultrafast and emission control applications. Lower dimensional emitters such as quantum dots can be embedded inside the metasurface resonators during epitaxial growth. I will show results of Purcell enhancement and recent results on beam steering of spontaneous emission on a sub-picosecond timescale.

In the context of quantum and nonlinear optics, III-V semiconductors have among the highest optical nonlinearities but cannot be used in conventional phase-matched processes due to the symmetry of their nonlinear susceptibility tensor. However, as phase matching is relaxed when resonant nanoscale resonators are used, III-V semiconductor metasurfaces can be used for harmonic generation, harmonic mixing and parametric down-conversion in ways that have no equivalence when using macroscopic nonlinear media. Some of the results that I'll present include harmonic generation and generation of complex quantum states using spontaneous parametric down-conversion.

**Biography:** Dr. Igal Brener is a Senior Scientist at Sandia National Laboratories in Albuquerque, NM. He received his doctorate degree in physics from the Technion (Haifa) in 1991. He was postdoc and then research staff at Bell Laboratories in NJ from 1991 until 2000. He also spent several years in industry founding startups (Spectralane), working for startups (Tellium, Prealux) and for medium to gigantic companies (National Semiconductors, Amersham Biosciences, GE Healthcare). He joined Sandia National Laboratories, Albuquerque, NM, in 2004. He is Thrust leader for nanophotonics at the Center for Integrated Nanotechnologies (a nanoscience user facility for the Department of Energy), and is also research full professor at the University of New Mexico. He has authored more than 200 refereed publications and has received 29 patents. Dr. Brener is a fellow of the Optical Society of America, the IEEE and the American Physical Society.

**Prof. Dr. Igal Brener**

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