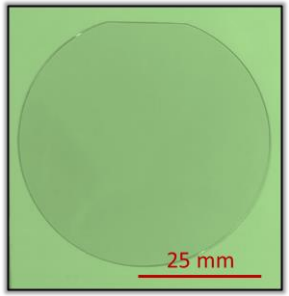
Stochastic Resonance In MoS_2 Photodetector

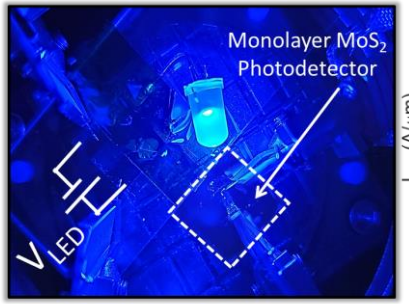
Akhil Dodda, Aaryan Oberoi, Amritanand Sebastian, Tanushree H Choudhury, Joan M Redwing, Saptarshi Das (Pennsylvania State University)

In this project, we use a novel approach for next generation ultra-low-power sensor design by embracing the evolutionary success of animals with extraordinary sensory information processing capabilities that allow them to survive in extreme and resource constrained environments. Stochastic resonance (SR) is one of those astounding phenomena, where noise, which is considered detrimental for electronic circuits and communication systems, plays a constructive role in the detection of weak signals. Here, we show SR in a photodetector based on wafer-scale monolayer MoS_2 for detecting ultra-low-intensity subthreshold optical signals from a distant light emitting diode (LED). We demonstrate that weak periodic LED signals, which are otherwise undetectable, can be detected by a MoS_2 photodetector in the presence of a finite and optimum amount of white Gaussian noise at a frugal energy expenditure of few tens of nano-Joules. The concept of SR is generic in nature and can be extended beyond photodetector to any other sensors.

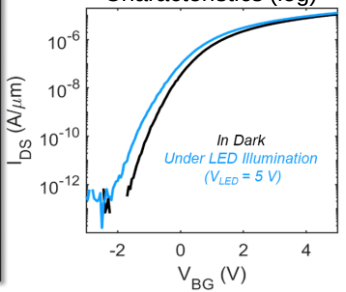
Wafer Scale MoS_2 film



Experimental Set-up



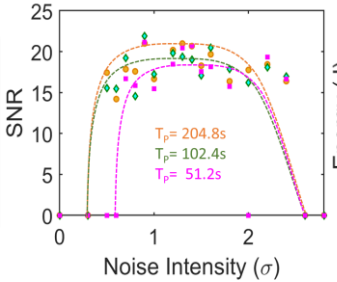
Transfer Characteristics (log)



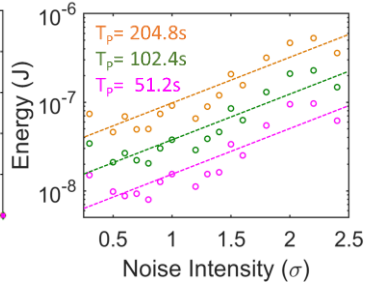
Detection Limit of MoS_2 Photodetector

V_{LED}	ON	Sub-threshold	OFF
5.0 V	No	Yes	Yes
3.0 V	No	Yes	Yes
2.8 V	No	No	Yes
2.4 V	No	No	No

Signal to Noise Ratio



Energy Expenditure



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