

Listening to cells with photonic crystals

Institution	The University of Queensland
Project details	This internship will focus on the development of photonic crystal-based acoustic probes capable of detecting the minute motions and vibrations of single cells. These devices operate by transducing nanoscale stresses, induced by cellular activity or externally driven acoustic fields, into measurable optical signals. Acting as “stethoscopes” at the microscale, photonic crystal resonators allow researchers to listen to how individual cells move, push, and interact with their environment. Understanding these subtle mechanical signatures is important because cell motion and mechanics underpin key biological processes, including migration, division, mechanotransduction, and disease progression. For example, altered mechanical activity is a hallmark of cancerous cells, while neuronal and muscular cells exhibit distinctive vibrational behaviors linked to their function. By providing a non-invasive, label-free method to probe these dynamics, photonic crystal sensors could open new pathways for studying cellular health, disease, and drug response. Students will work with a team of researchers to test photonic crystal sensor prototypes, measure their responses to acoustic signals at the cellular scale, and identify dominant noise sources such as laser fluctuations or environmental vibrations. The project will also explore design refinements and signal- processing approaches to improve sensitivity and selectivity for biological applications. Expected Aims and Outcomes • Gain practical experience in designing and testing photonic crystal acoustic sensors. • Quantify the ability of these devices to resolve cellular-scale acoustic and mechanical signals. • Characterize noise sources and develop strategies to enhance detection at the single-cell level. • Contribute to a roadmap for applying photonic crystal probes in mechanobiology and biomedical diagnostics.
Who can apply	Undergraduate students in their 3rd or 4th year, ideally with a background in physics, biomedical engineering, or electrical engineering. Experience with optics, nanophotonics, acoustics, or signal processing will be advantageous.
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