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Ultrasound Modulation on TRP Channels

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The grand goal of the project is to develop an acoustogenetic technique for truly noninvasive and cell-type specific neuromodulation. Ultrasound sensitive ion channels will be expressed in mouse brain and focused ultrasound will be used to stimulate brain activities by opening the ultrasound-sensitive ion channels. Our aim during the summer is to identify ion channels that are highly sensitive to ultrasound and suitable to activate excitatory neurons. We aim to test different types of ion channels. The ion channel should be permeable to Ca2+ and Na+ ions because the opening of these channels will depolarize the membrane and excite neurons. The potassium channels already tested in Dr. Cui's lab are not candidates because they are leak channels and their opening hyperpolarizes the cell membrane. Our designed experimental method, including the experimental setup, is shown in the diagram below. Different channel proteins will be expressed in Xenopus oocytes for current measurements. We will apply ultrasound onto the cell containing the ion channel protein of interest and observe if any difference in current flowing occurs between applying ultrasound and without applying ultrasound. Our targeted channels are TRP channels (Transient receptor potential channels), which had been proved to be mechanosensitive channels previously. We have proved some of those channels (Trpv4, Trpc6, Trpv2) can be opened by hypotonic solution, and those current can be significantly enhanced when ultrasound is applied. Our next goal is injecting virus vector containing those DNA into mouse brain for further neuron modulation investigation.