Exploring Excitability in Graphene for Spike Processing Networks

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***Abstract*—We propose a novel excitable laser employing passively Q-switching with a graphene saturable absorber for spike processing networks. Our approach combines the picosecond processing and switching capabilities of both linear and nonlinear optical device technologies to integrate both analog and digital optical processing into a single hardware architecture capable of ultrafast computation without the need for analog-to-digital conversion.**

I. Introduction

Spike processing algorithms are well understood in a number of important biological sensory processing systems and are finding growing use in signal processing applications [1]. Spiking signals encode information as *events* in time (rather than bits). Because the time at which a spike occurs is analog while its amplitude is digital, the signals use a hybrid encoding scheme. This inherently exploits the band-

This three-dimensional dynamical system can be described with the output power $P(t)$, the intensity gain coefficient per cavity round trip $g(t)$, and the intensity saturable loss coefficient per cavity round trip $q(t)$, as follows:

$$T_R \dot{P}(t) = [g(t) \quad q(t) \quad l]\, P(t) \qquad (1)$$