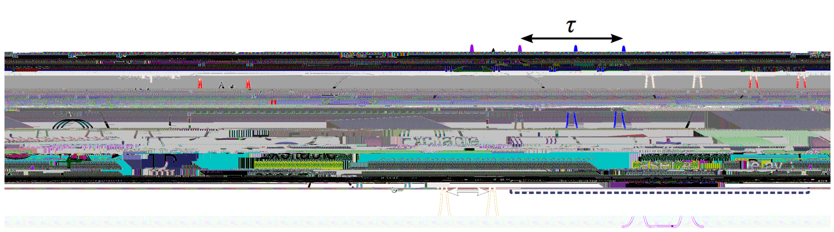

Fig. 1. Spatiotemporal pattern recognition circuit with two cascaded graphene excitable lasers.

In our case the objective is to distinguish (i.e. recognize) a specific input pattern: a pair of pulses separated by time interval t (equal to the delay between the excitable lasers). These analog inputs are directly modulated with an arbitrary waveform generator and are incident on both the lasers. The outputs from the first laser are fed to the second laser via a single-mode fiber (SMF), which acts as a delay element, and a photodetector (PD) to modulate the laser diode (LD) (allowing wavelength conversion from 1560 to 1480 nm). It has recently been shown [15] that such an excitable laser and PD system can emulate both a leaky integrate-and-fire neuron and a synaptic variable, completing a computational paradigm for scalable optical computing. The dynamics introduced by the PD are analogous to synaptic dynamics governing the concentration of neurotransmitters in between signaling biological neurons. The second laser is biased such that it requires stronger perturbations to fire; it will not fire unless two excitatory pulses (original input and output from the first laser) are temporally close together; that is, when t . Synchronous arrival of these two spikes causes enough excitation above the threshold causing the laser to fire a pulse. The system therefore only reacts to a specific spatio-temporal bit pattern. The resulting experimental data—output pulse profile as a function of the normalized time interval between the two input pulses—is shown in Fig. 2.

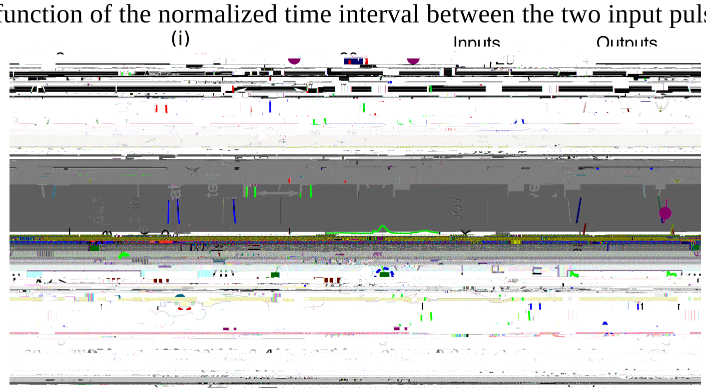

Fig. 1. Measured output pulse peak power, pulse duration, and input and output waveforms as a function of the time interval between the two input pulses. Output pulse energy is the largest when t showing the system only reacts to a specific spatiotemporal input pattern.

In conclusion, we have demonstrated a spe 2( )-231(p) a-(e)-2(2( )2(sp)-1((a)-20.08(n)-3(c)-2(l)1(ua-3(c)-2(l)2(s)h373(c)-2(l)c