GPU-accelerated Searches for Gravitational Waves from Compact Object Binary Coalescence

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**Objectives**
To provide gravitational wave triggers within tens of seconds of the event to allow prompt electromagnetic follow up observations of Compact Binary Coalescence (CBC) event.

**Astrophysical Motivation**
- Transient electromagnetic emission from GW sources could happen within tens to hundreds of seconds of GW events
- Example: prompt Optical/X-ray emission of short-hard GRBs from NS-NS merger

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>Typical or Predicted Observing Time window (relative to Gamma-ray trigger)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-rays (prompt)</td>
<td>tens of seconds</td>
</tr>
<tr>
<td>Optical (prompt)</td>
<td>hundred of seconds</td>
</tr>
<tr>
<td>Optical (afterglow)</td>
<td>thousands of seconds</td>
</tr>
<tr>
<td>X-rays (afterglow)</td>
<td>hours</td>
</tr>
<tr>
<td>Radio (prompt)</td>
<td>seconds</td>
</tr>
<tr>
<td>Radio (afterglow)</td>
<td>minutes</td>
</tr>
</tbody>
</table>

- GWs will provide essential triggers to alert EM telescope to catch these event in the post-SWIFT era or when gamm-rays are beamed away

**GPU-accelerated time-domain search**
- With proper choice of coefficients, simplest Infinite Impulse Response (IIR) filtering can be equivalent to filtering data with damped sinusoid
- The sum of such IIR filters at various frequencies can retrieve 99% optimal matched filtering SNRs (Shaun Hooper’s poster)
- Perfect for GPU processing. Each thread process one filter

- **GPU vs CPU:** x 50 speed-up

**Performance**
- GeForce 8800 vs 2.5 GHz Intel quad 9300 CPU
- Inspiral search with realistic parameters: x 4
- Inspiral search+chi-square test: x 16

**Summary**
- Significant speed-up can be achieved with GPUs for inspiral search+chi-square test
- Implemented a new GPU-accelerated time-domain inspiral searches using IIR filterbank
- With GPUs, desktop real-time low-latency processing of inspiral search is possible even with advLIGO
  (Chung, S. et al 2010 CQG)

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