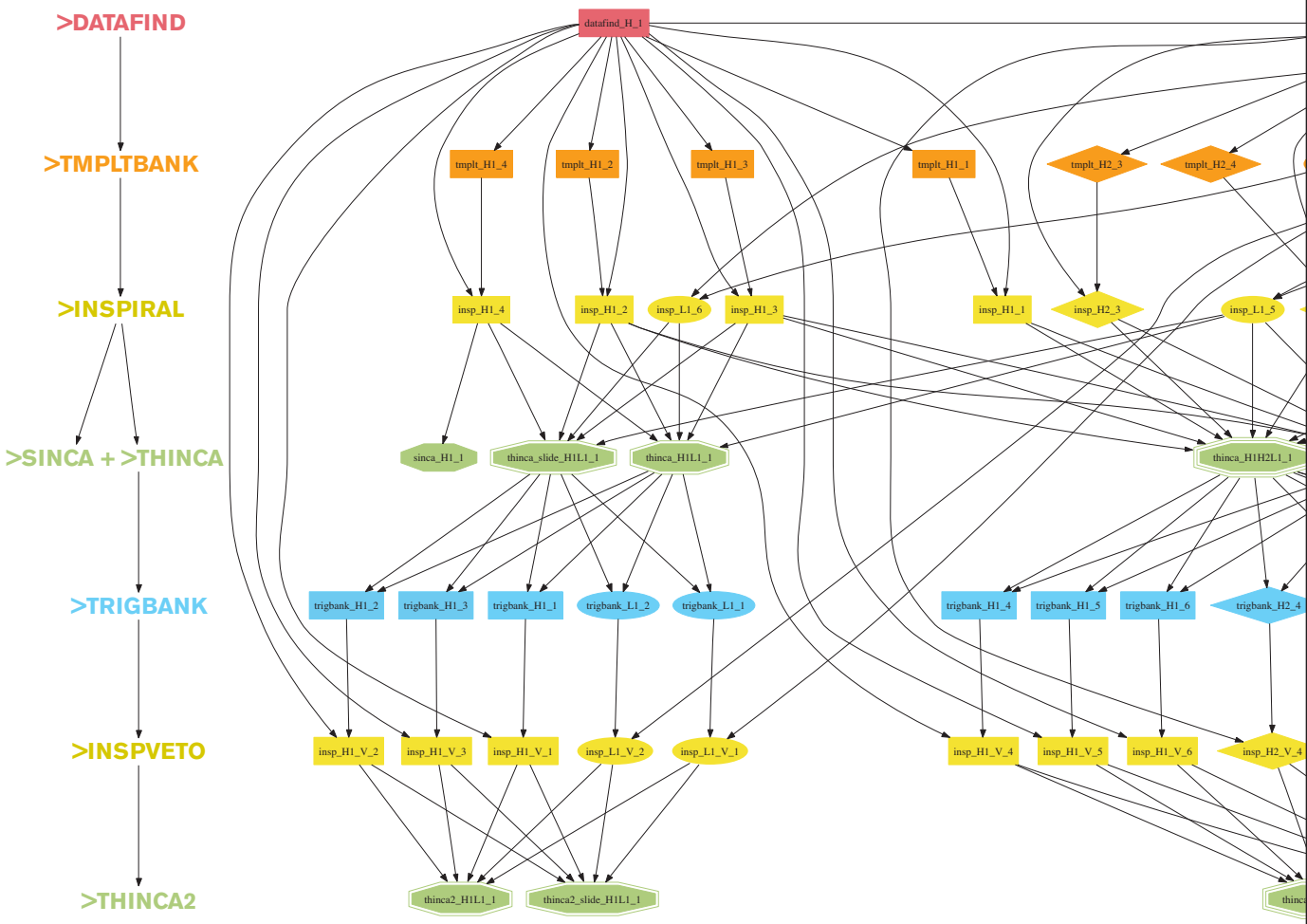
deconstruction: LIGO analysis

Scientists at the Laser Interferometer Gravitational-Wave Observatory (LIGO) are hoping to catch a wave—a gravitational one. With computer-coupled observatories in Richland, Washington, and Livingston, Louisiana, LIGO has been analyzing data since 2002 in an effort to detect and measure cosmic gravitational waves. LIGO's L-shaped detectors uses laser beams and mirrors in hopes of detecting changes in distance between its test masses as small as one-hundred-millionth of the diameter of a hydrogen atom. That change



>DATAFIND: Data from each of LIGO's three detectors, H1 and H2 from Washington, and L1 from Louisiana, are distributed across six LIGO computing centers. "Datafind jobs" query catalogs to locate needed data. The depicted inspiral workflow is performed on every 2048-second parcel (about 34 minutes) of data.

>TMPLTBANK: Using parameters such as mass and spin, and accounting for detector sensitivity, theoretical models are used to make a bank of expected waveforms, or templates, for binary inspiral events.

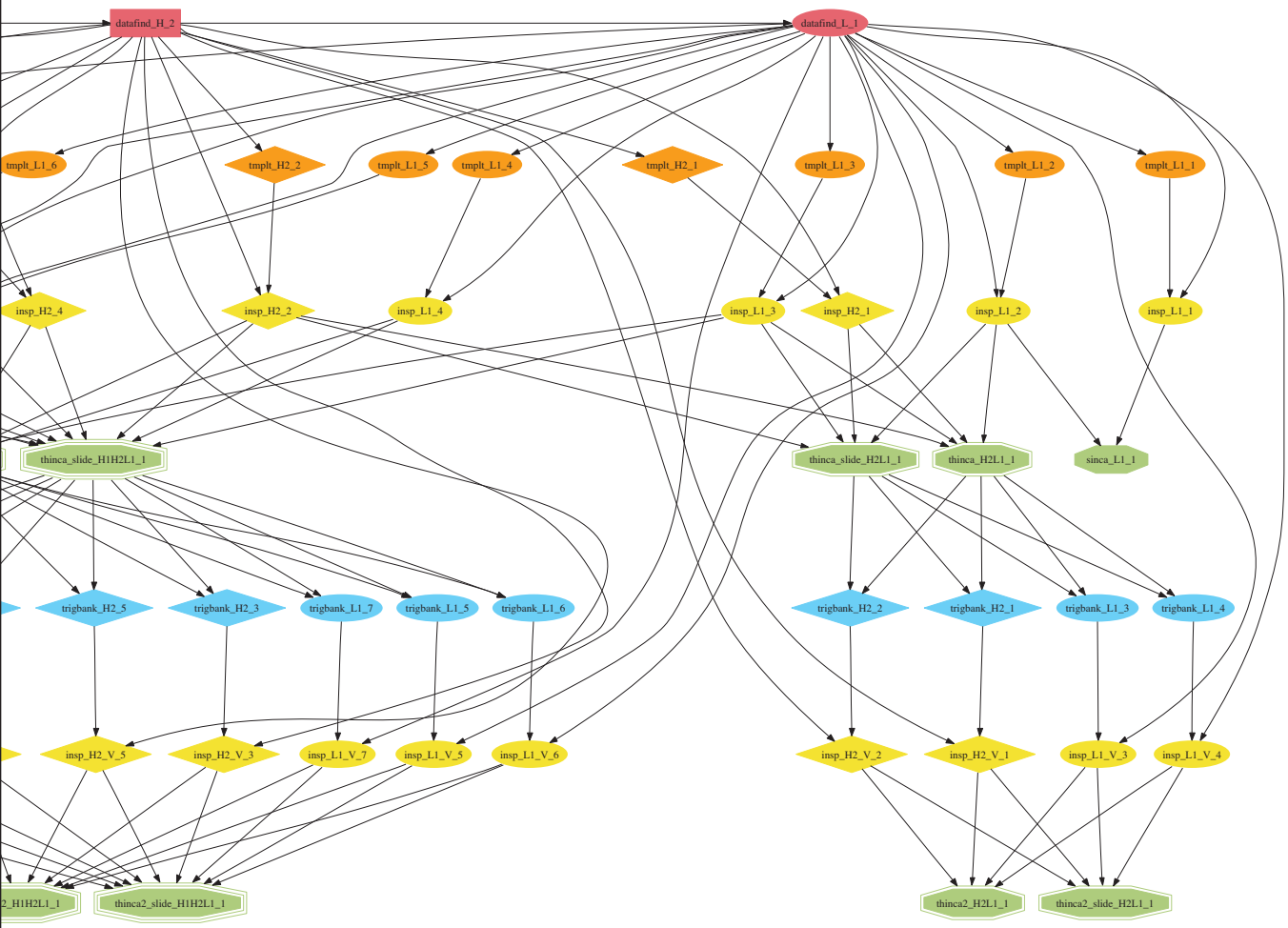
>INSPIRAL: Data recorded by LIGO are compared with the waveforms in the template bank and those that match within some statistical threshold are stored for further analysis.

>SINCA + >THINCA: Programs look for coincident events, observed at the same time and with the same mass parameters in two or more detectors.

>TRIGBANK: The events that survive in coincidence from the Thinca program are converted back into template waveforms.

would indicate a wave's presence.

The LIGO experiments use grid-computing technologies to handle the collection and analysis of data. This workflow analyzes data looking for inspiral signals, which can occur when two compact objects, such as neutron stars or black holes, form binary systems. Over time, the objects spiral in toward one another, producing gravitational radiation. This diagram illustrates the steps required to turn the raw data collected from those signals into interpretable observations.



>INSPVETO: Additional tests are performed to verify that the data matches a template waveform. These tests are computationally costly, so they are only performed on candidate events observed in at least two detectors.

>THINCA2: The coincidence step is repeated to find a final list of candidate events. The result of the series of programs is an upper limit on the expected rate of binary inspiral events within the surveyed portion of the galaxy. Once the statistics are calculated using the workflow, LIGO scientists begin to interpret the results. LIGO has performed four science runs since 2002 with the fifth scheduled for late 2005, during which the LIGO instruments will operate at design sensitivity and will collect one year of observational data.

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Source: LIGO Collaboration