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Data Analysis and Astrophysics from the Inspiral Analysis Group

Eirini Messaritaki
California Institute of Technology
LIGO Laboratory

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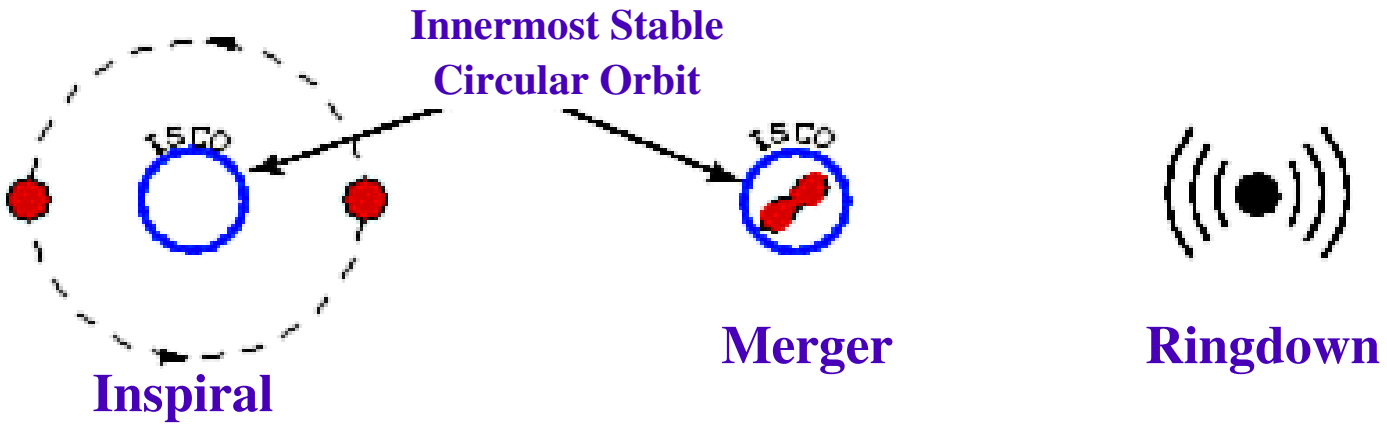
Outline

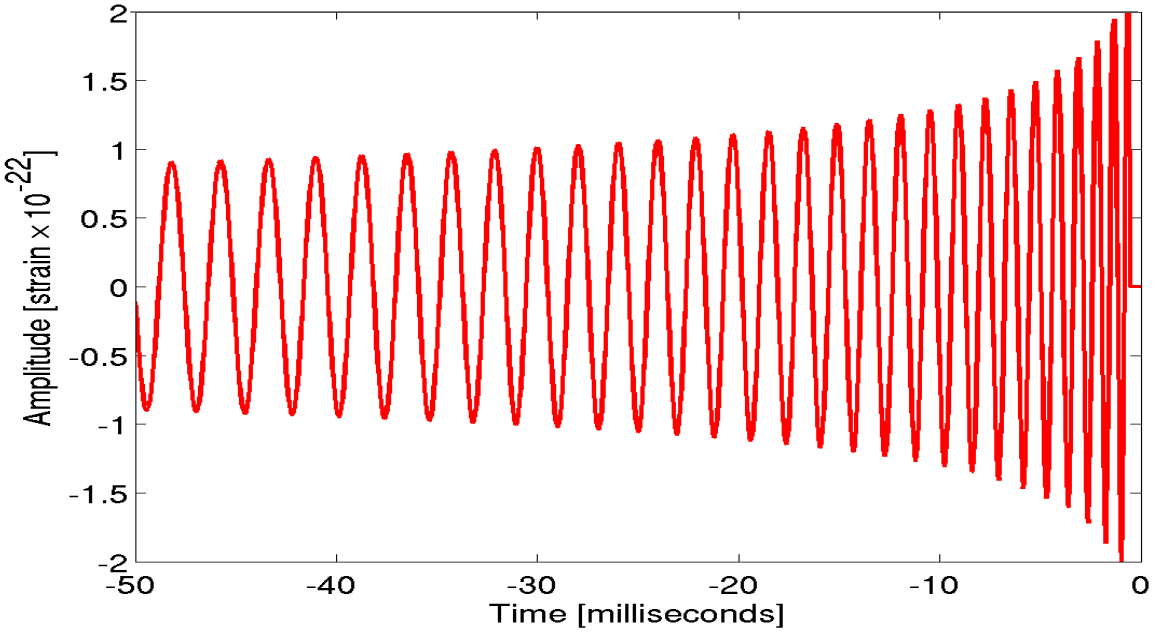
- Target sources
- Analysis method
- Status of the searches
- Astrophysical results
  - » ... if we *do not* make a detection
  - » ... if we *do* make a detection
- Other projects
  - » Coincidence with burst and ringdown triggers
  - » LIGO – Virgo collaboration
  - » Follow-ups of short Gamma Ray Burst events
  - » Interaction with the numerical relativity community

Target sources

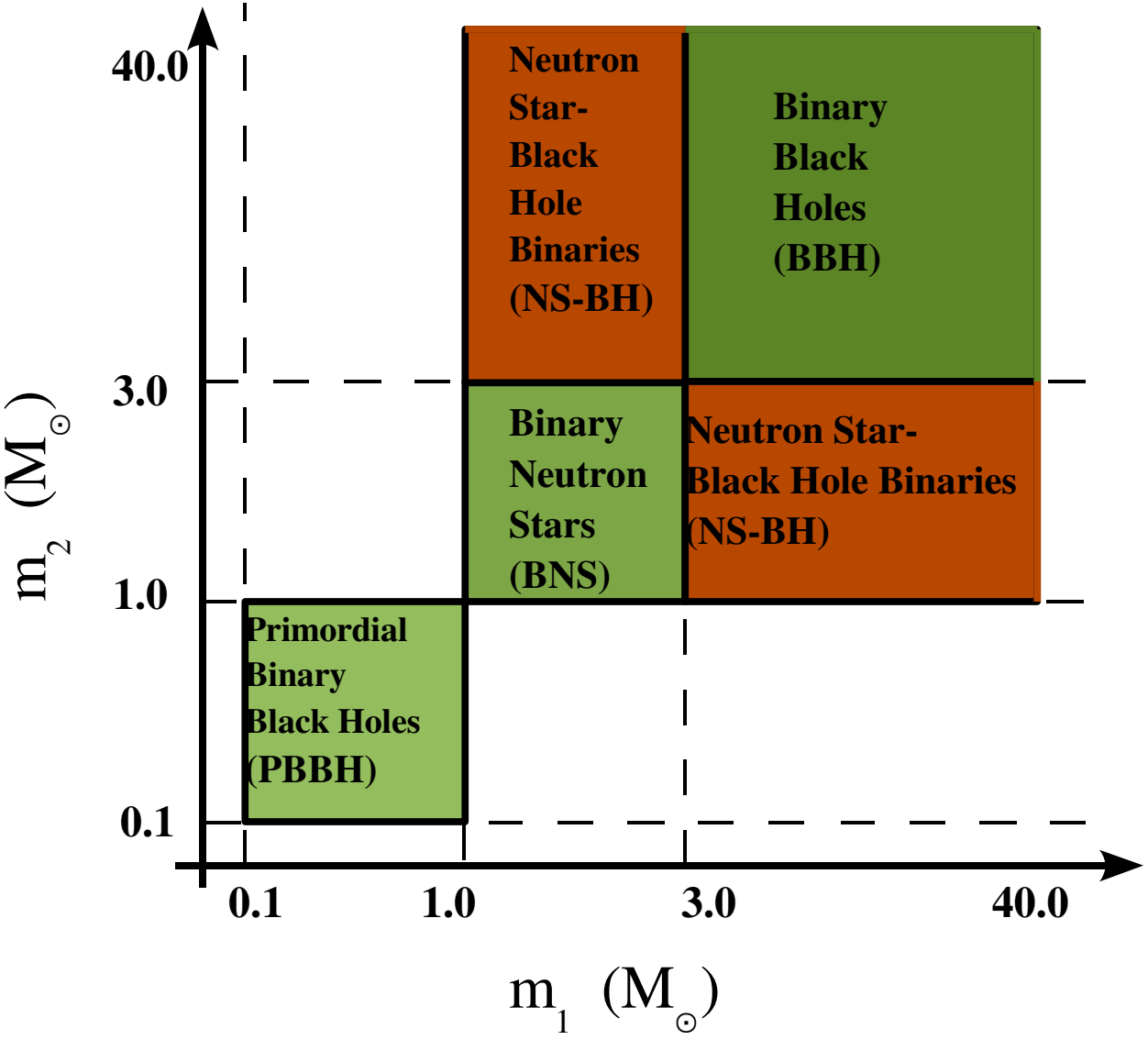
- Coalescences of binary systems of compact objects
  - » Neutron stars (NS) and black holes (BH)



We search for the inspiral phase by using theoretical (standard post-Newtonian) inspiral waveforms



Target sources



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Analysis method

- For each interferometer
  - » Generate bank of template waveforms that covers the mass space
  - » Match-filter the data against each template
    - – Calculate the overlap between template and data
  - » Apply a waveform consistency test
  - » Record *triggers* (masses, time of arrival, etc) that pass all thresholds
- Test for coincidence between interferometers
  - » Mass parameters of template, time of arrival of signal
  - » Amplitude consistency between H1 and H2 triggers
- Follow up on candidate events
  - » Data quality checks, auxiliary channel follow ups
- Estimate the rate of accidental coincidences via time slides
- Test the analysis method by injections of simulated signals

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Status of the searches

- Searches in the data up to S4:
  - » S1: BNS search complete
    - – **results published**
  - » S2: BNS, BBH, PBBH searches complete
    - – **results published**
  - » S3: BNS, BBH (non-spinning and spinning), PBBH searches complete
    - – **results under internal review**
  - » S4: BNS, BBH, PBBH searches complete
    - – **results under internal review**

- Searches in S5 data:
  - » Online analysis throughout S5
  - » First epoch: data collected from Nov. 4, 2005 until Feb. 6, 2006
  - » BNS search in first epoch data complete
    - – **astrophysical interpretation in progress; internal review pending**
  - » BBH search in first epoch data nearing completion
    - – **will have the results by mid-November 2006**

Slide intentionally left blank. Content includes results that are currently undergoing internal review.

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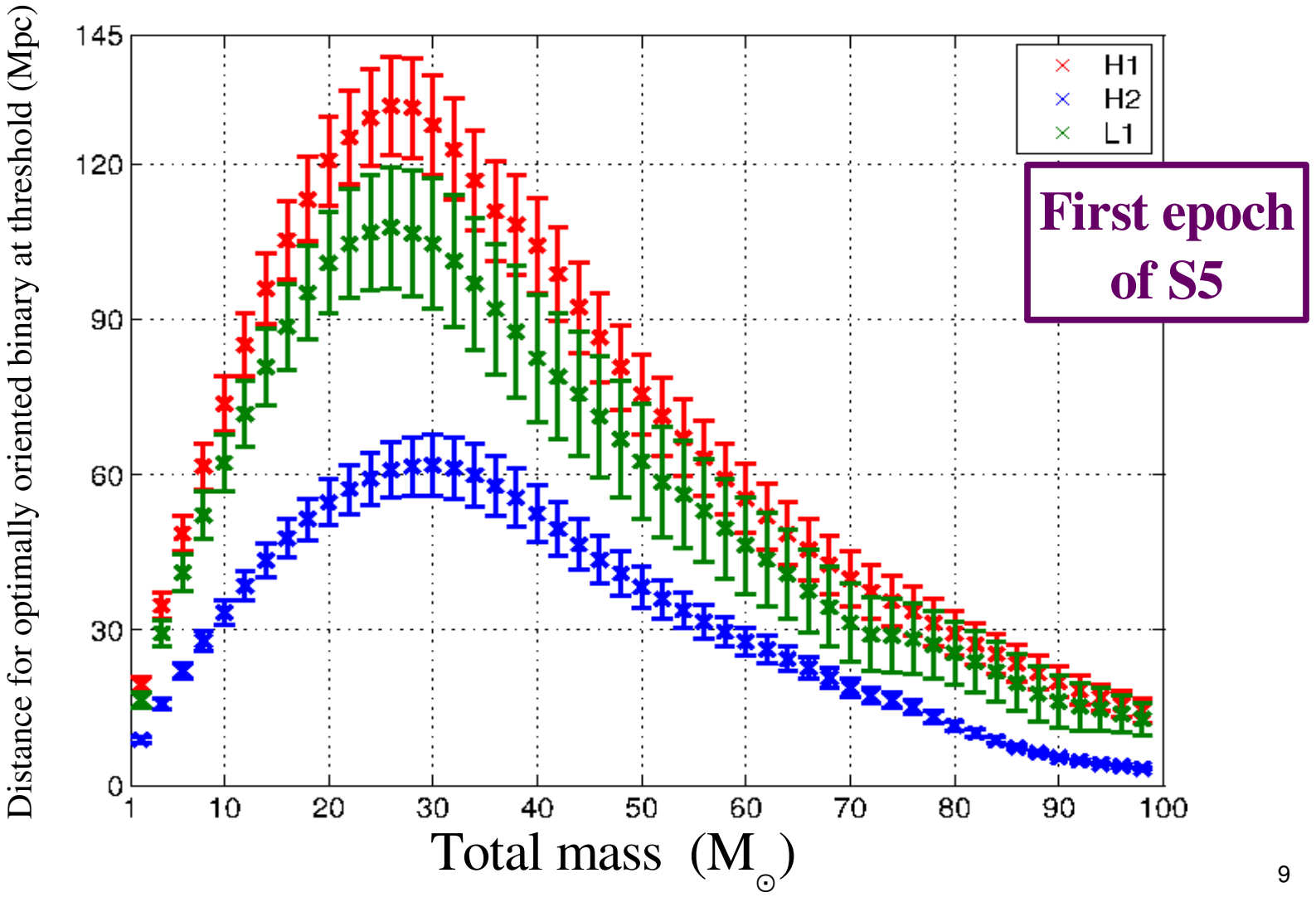
If we do not make a detection...



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If we do make a detection...

- Look for burst and ringdown triggers
  - » Get information about the durations and times of those signals
  - » Get information about the energy radiated in each
- Follow up with theoretical (other than standard pN) and numerical waveforms
  - » How do those compare; which match the signal better?
  - » Does including spin effects give better match?
- Get information about neutron star structure
- Test alternative theories of gravity
  - » Different theories give different phasing for the waveforms

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Other directions

- LIGO-Virgo collaboration
  - » Smaller false-alarm probability
  - » Greater sky coverage
  - » Better parameter estimation
- Merger and ringdown coincidences
  - » Coincidence with burst triggers is under development
  - » Ringdown search on S4 data nearing completion
- Gamma Ray Burst follow-ups
  - » NS-BH and BNS systems are prime candidates for such events
  - » NS-BH search is under development
- Collaboration with the numerical community
  - » Numerical relativity – data analysis meeting next month
  - » Interaction has started