CfA Gravitational Wave Astrophysics Group

CGWAG

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LIGO-G000285-00-D

Astrophysical Sources of Gravitational Waves

Astrophysics  GW Data Analysis

CGWAG Current Members:

Vicky Kalogera —— CfA Clay Fellow

Chris Belczynski —— Graduate student

Collaborators: H. Apostolatos (U. Athens), D. Lorimer (Arecibo),
(non LSC members) R. Narayan (Harvard U.), and others.

WORK PLAN

Binary Inspiral

(1) Rates

* formation
* detection

(LIGO I and II)

(2) Binary Properties

* spin-orbit misalignment
* precession-modified waveforms

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(1) Coalescence Rates

* Empirical (NS/NS) :
w/ R. Narayan, D. Spergel, J. Taylor

— Sources of uncertainty
— Rate estimates with systematic and random errors

* Theoretical :

(NS/NS, BH/NS, BH/BH)

— Large scale population syntheses with focus on:

- extensive parameter study
- calibration of models with observational constraints

with goals:

- obtain conservative ranges
- identify most important sources of uncertainty

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(2) Spin-Orbit Misalignment and Inspiral Waveforms

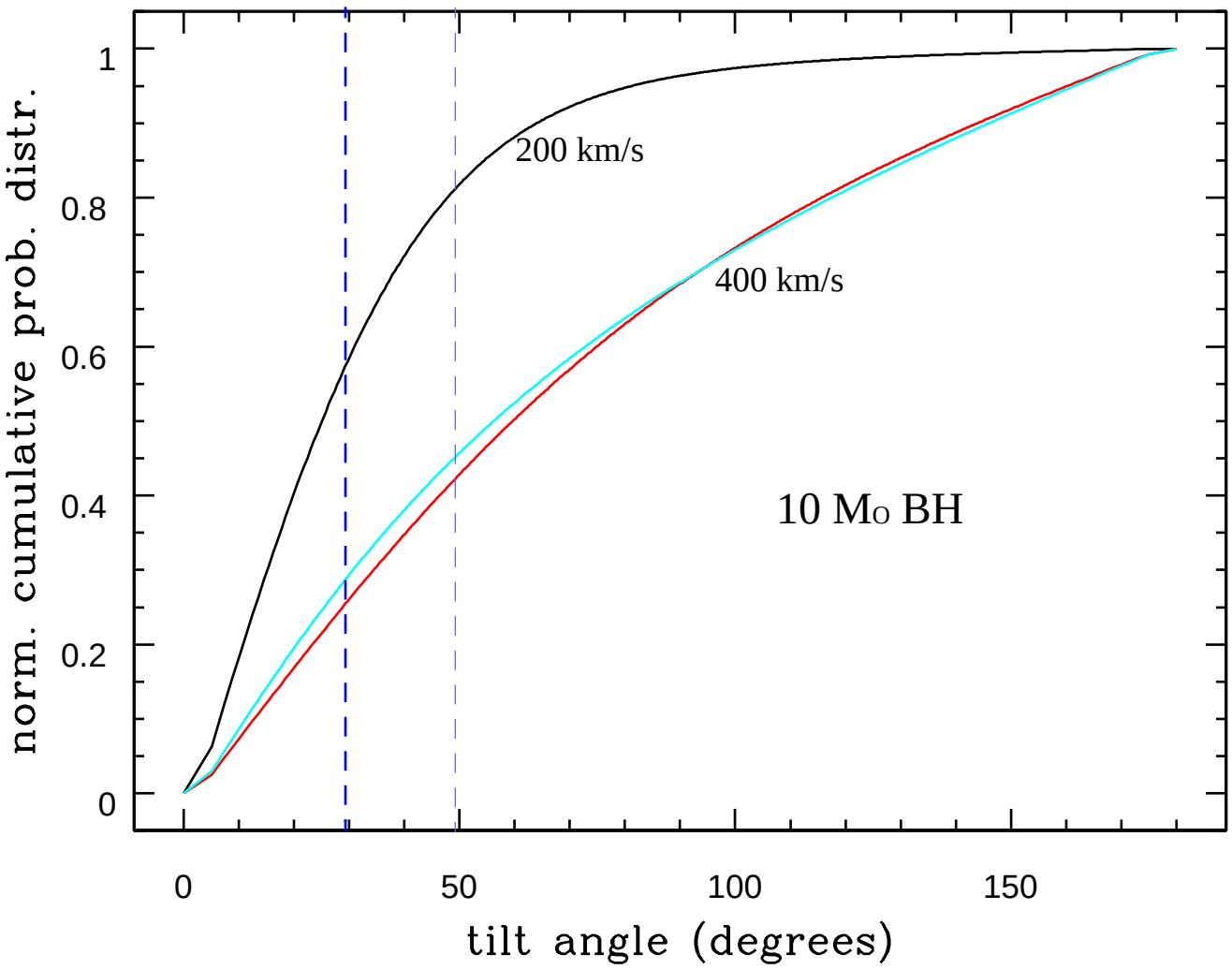
- **Important for BH/NS binaries only**
- **Detection rate decreased by a factor up to ~4 (**Kalogera 2000**)**

— Collaborative effort (with H. Apostolatos, B. Owen, A. Vecchio) to:

1) **identify the regions of the parameter space over which the template database must be expanded.**
2) **estimate the number of templates needed and the associated computational costs.**
3) **for a given choice of templates, calculate the expected decrease in the detection rate as a function of the detection threshold.**

→ Include a realistic spectrum of BH masses

→ Examine BH spin evolution


norm. cumulative prob. distr.
1
0.8
0.6
0.4
0.2
0
0
50
100
150
tilt angle (degrees)
200 km/s
400 km/s
10 Mo BH

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(3) <u>CW Source Catalog</u>

(ongoing effort with A. Vecchio)

Goal: Compile a complete catalog of known

radio, X-ray, and gamma-ray sources

with source classification, position, distance, etc.