NSF Technical Review of the LIGO Project

Advanced R & D Proposal

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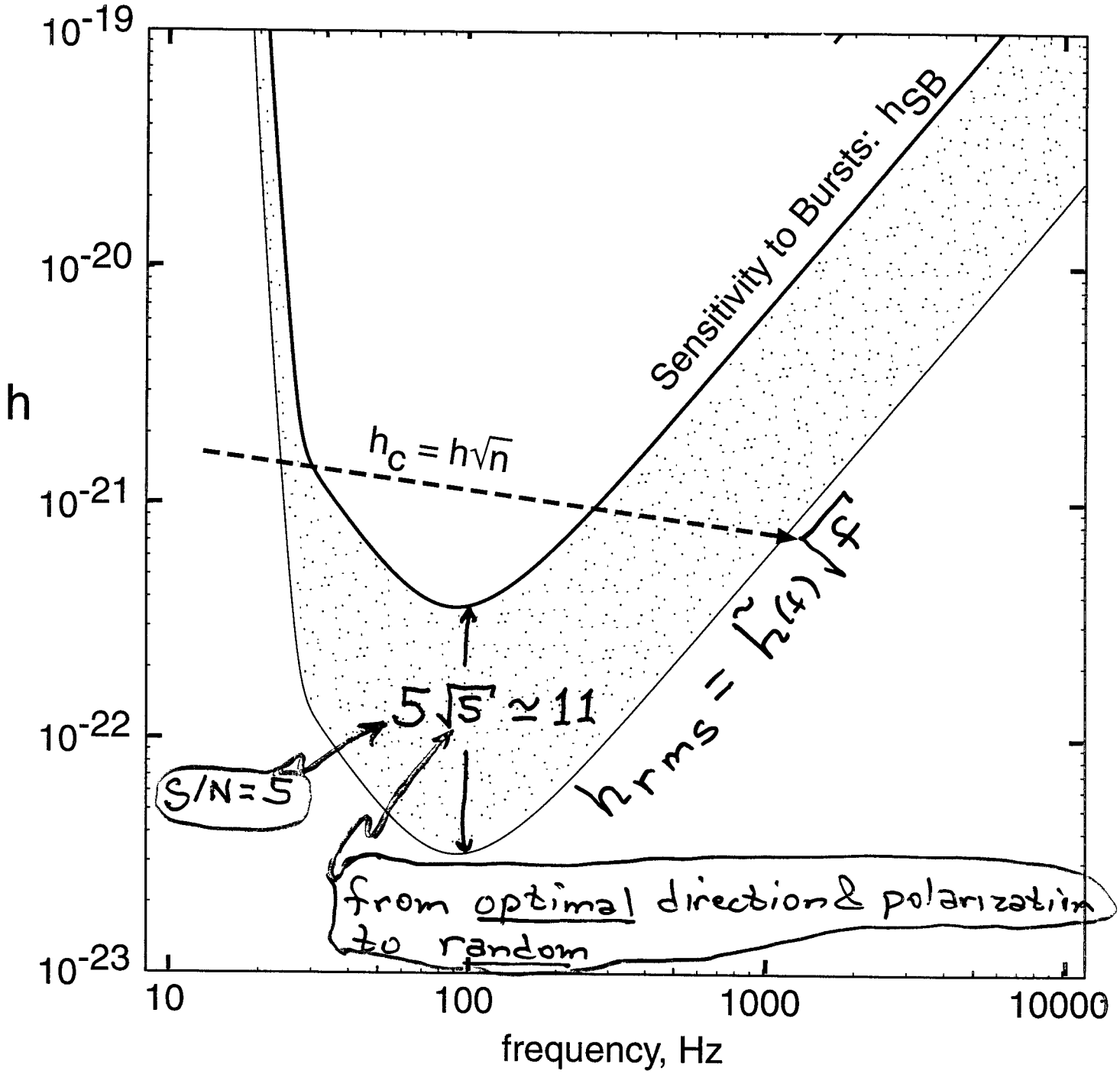
October 22, 1996

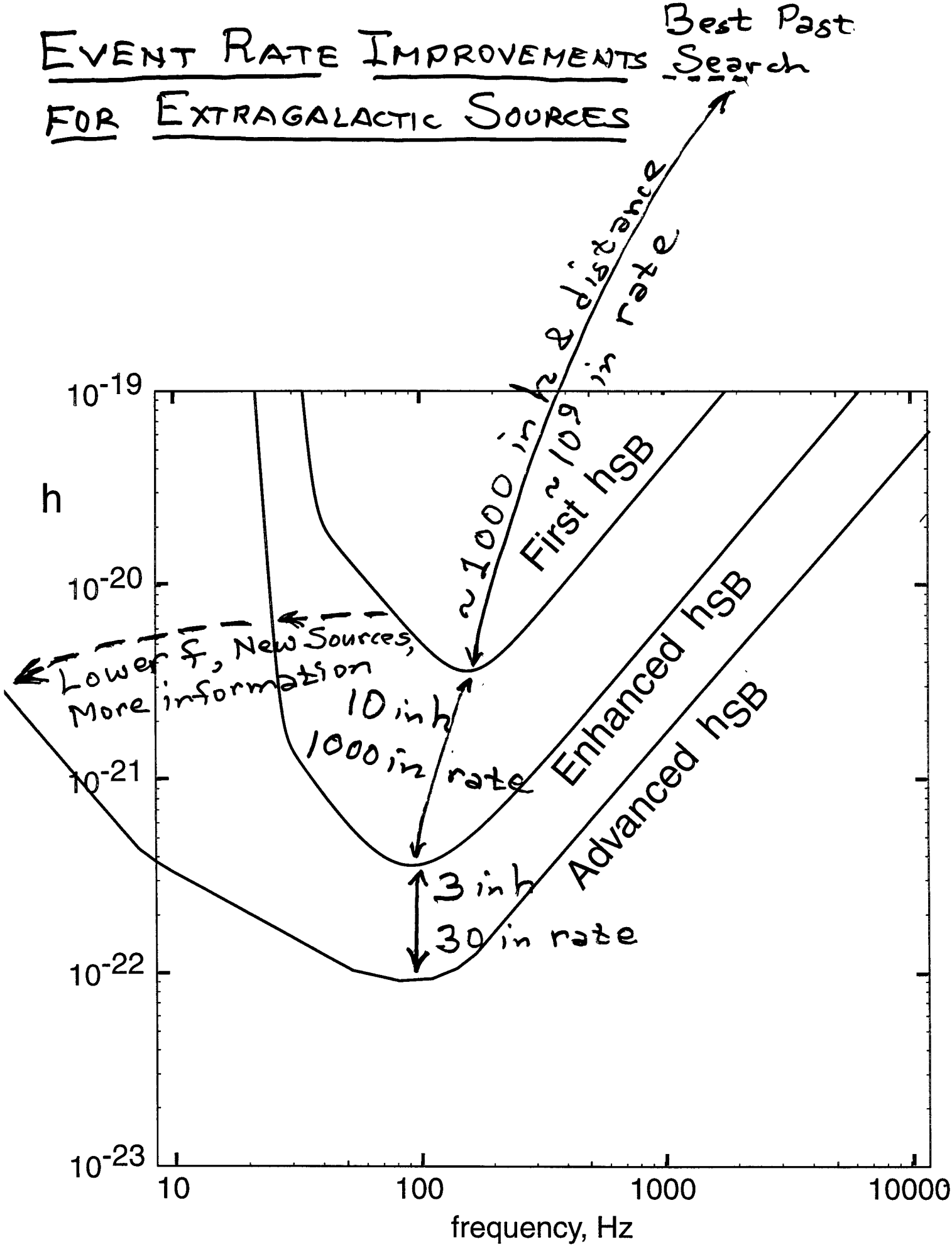
SENSITIVITIES AND SOURCE STRENGTHS



If: Source line h_c anywhere lies above h_{SB},

Then: detectable with high confidence in absence of EM or ν signal.

Event Rate Improvements for Extragalactic Sources

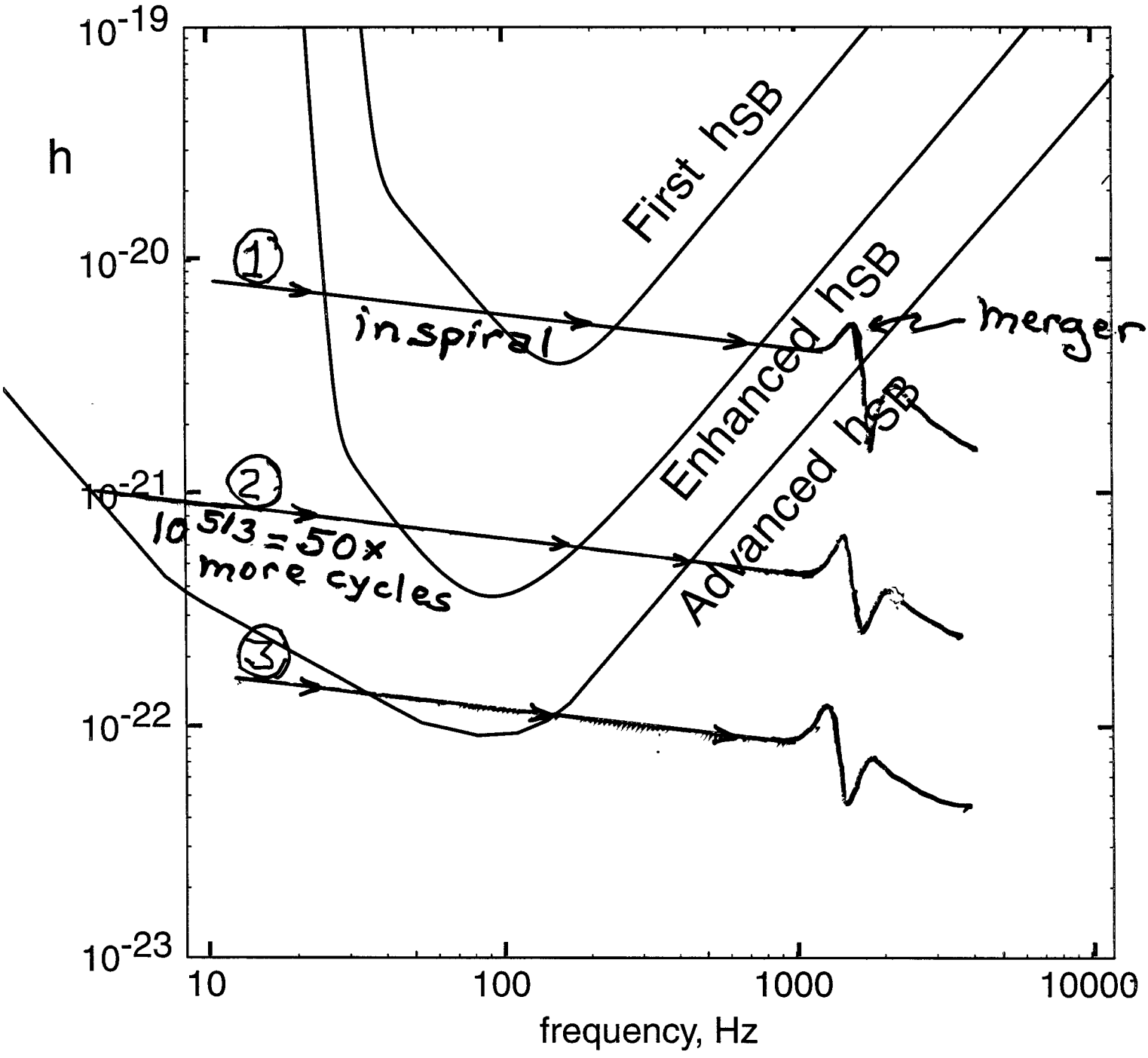


Neutron Star Binary Inspiral & Merger

(our best understood source)

Estimated Distances for One Event Per Year

1. Extreme Optimistic: 50×10^6 l.yrs. (VIRGO)
2. Conservative Best Guess: 500×10^6 l. yrs.
3. Extreme Pessimistic: 2×10^9 l.yrs.



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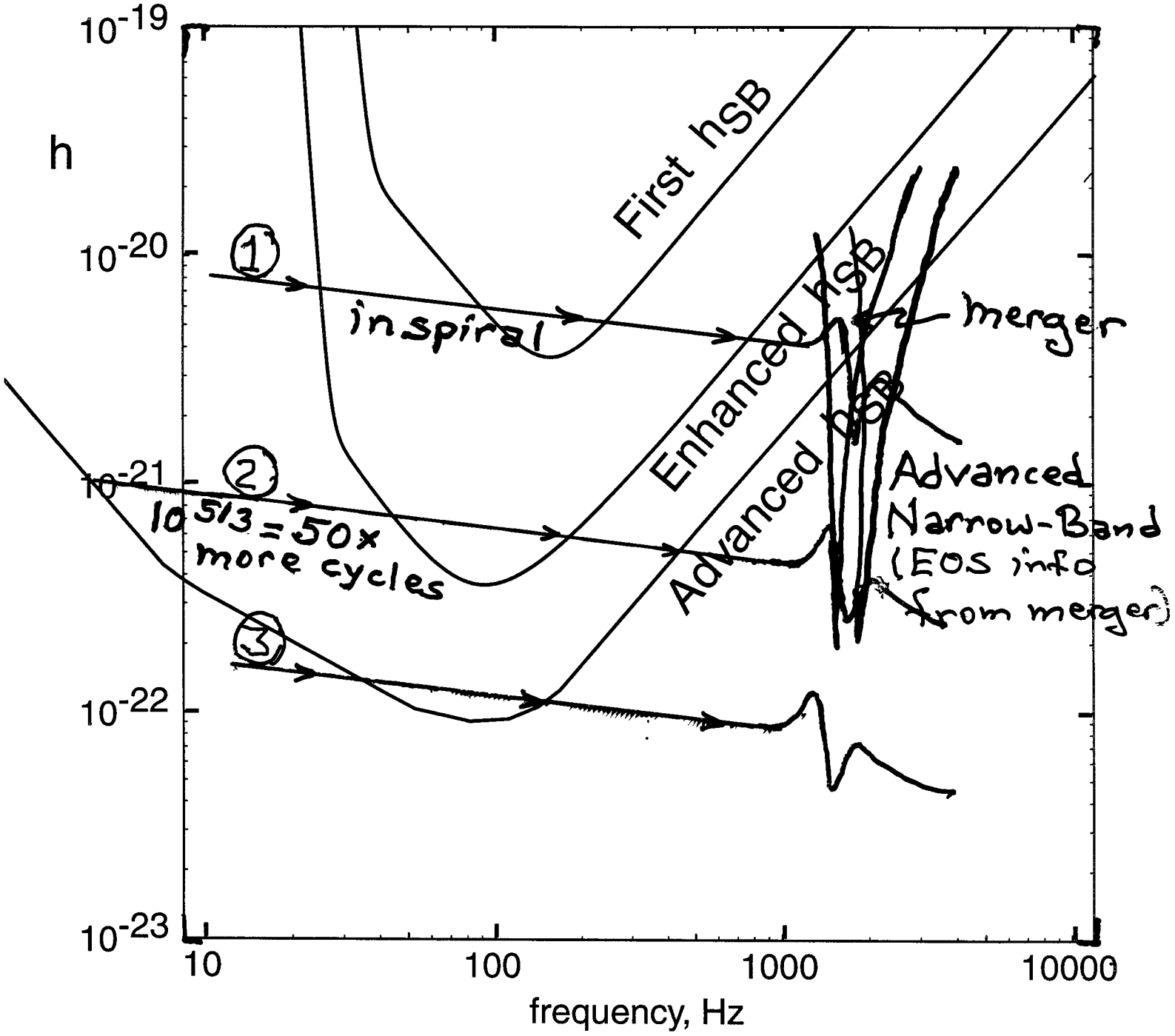
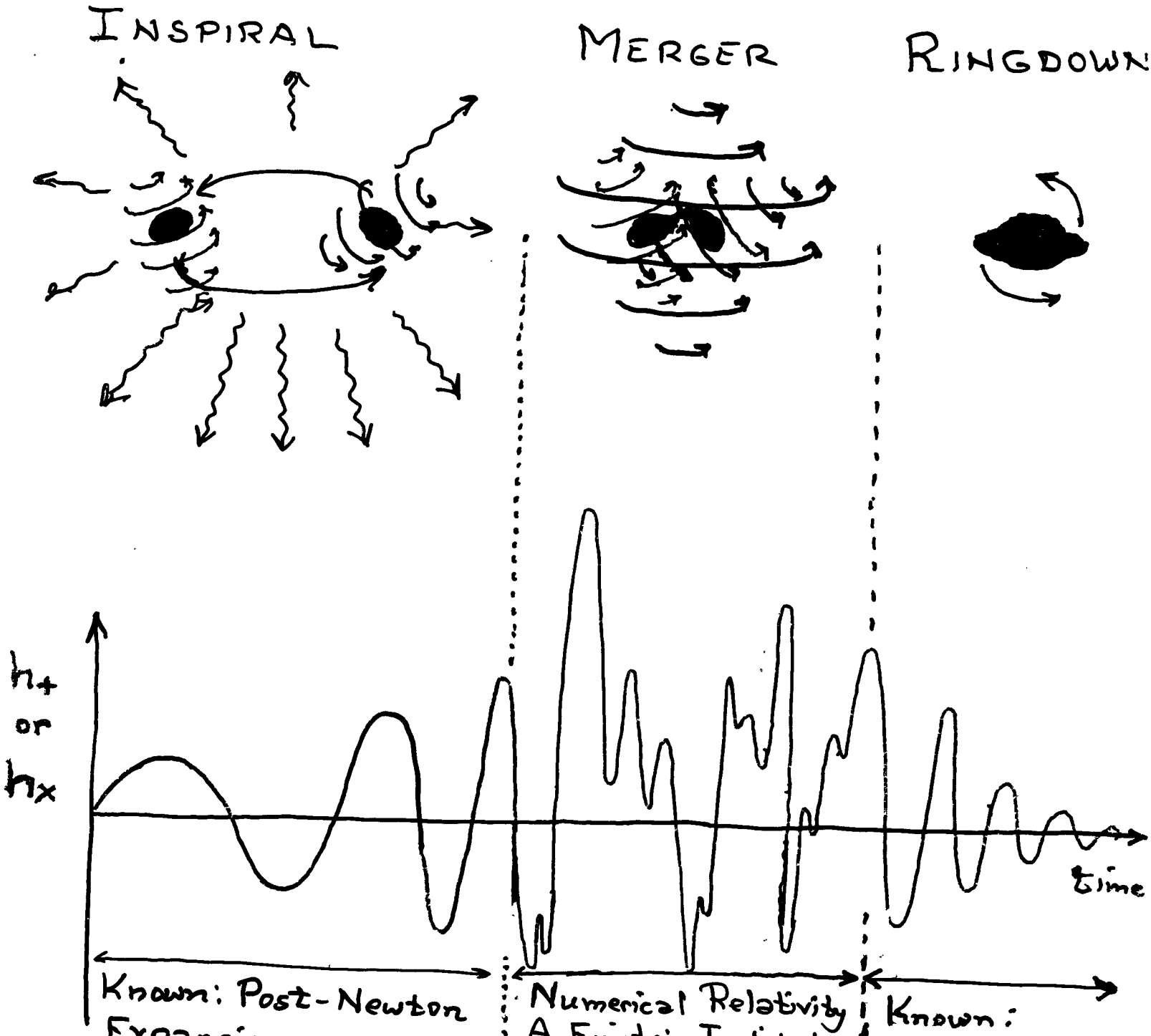


BLACK-HOLE BINARY COALESCENCE, $M_1 \sim M_2$

(Perhaps the Strongest Source)

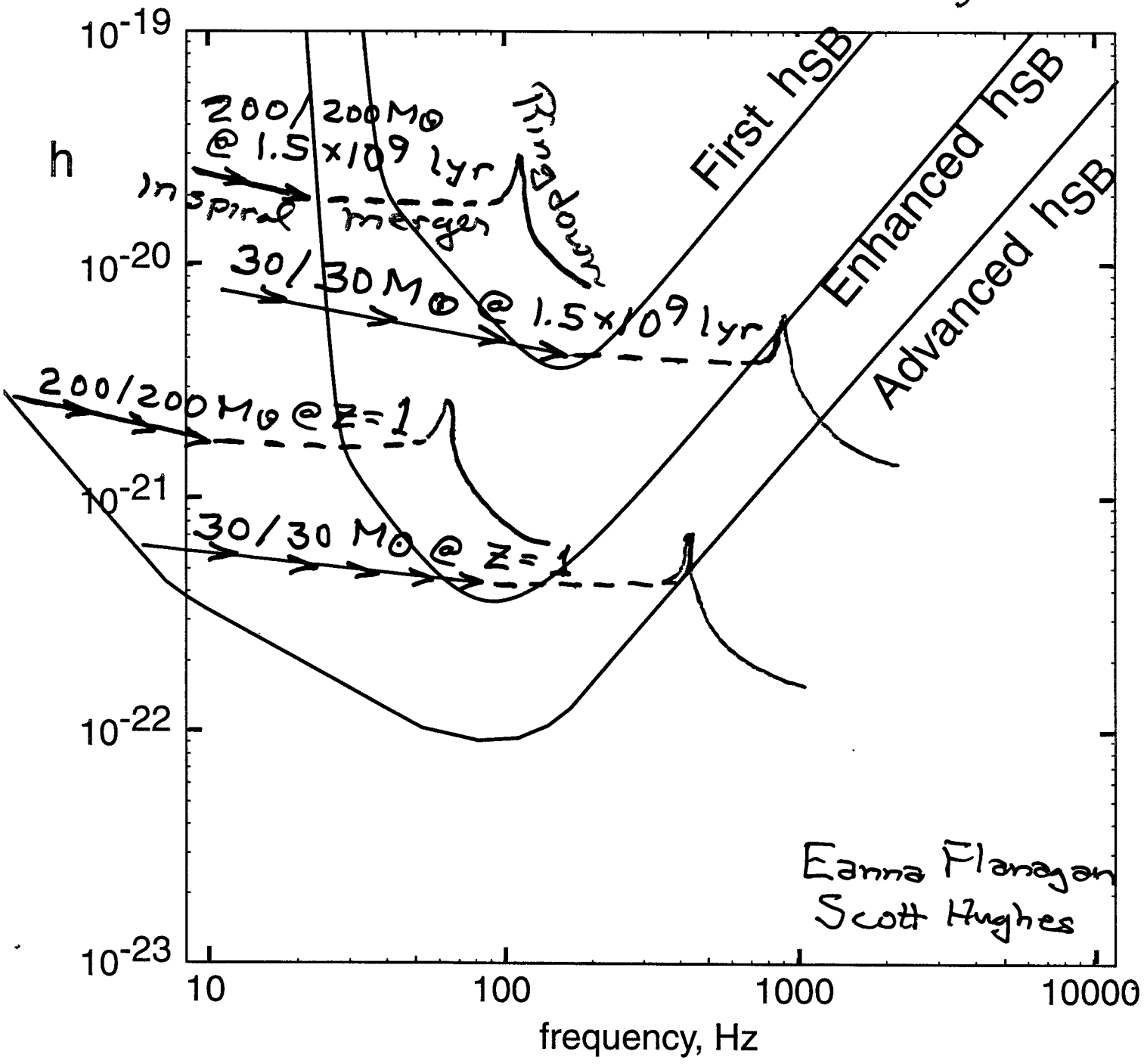


BH / BH

First Interf's : to $\sim 10^9$ l.yrs.

Enhanced Interf's: to $\sim 10^{10}$ l.yrs.

(z = 1)



OTHER SOURCES

Source	First	Enhanced	Advanced
Nonaxisymmetric Stellar Core Collapse (Supernovae) [if can develop near optimal data analysis algorithms]	$\sim 50 \times 10^6$ l.yr.	$\sim 500 \times 10^6$ l.yr.	$\sim 1.5 \times 10^9$ l.yr.
Spinning N.S.'s (pulsars)	$\left(\frac{\varepsilon}{10^{-6}}\right)\left(\frac{30{,}000 \text{ l.yr.}}{r}\right)\left(\frac{1 \text{ msec}}{P}\right)^2 \gtrsim$		
Broad-Band	1	0.2	....
Narrow-Band	....	....	2×10^{-3}
Stochastic Background	$\Omega_g = \left(\frac{\text{GW energy in } \Delta f = f}{\text{Energy to close Universe}}\right) \gtrsim$		
Broad-Band	$\sim 3 \times 10^{-7}$	$\sim 3 \times 10^{-9}$	$\sim 3 \times 10^{-10}$
Narrow-Band	....	....	$\sim 1 \times 10^{-10}$