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O3 Sky Localization Calculation Comparison between MCMC and Fisher Analysis

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Network Configuration and Source

- Network sensitivity
  aLIGO: Late Low (116 Mpc) LIGO-P1200087
  AdV: Mid Low (63 Mpc) LIGO-P1200087
  KAGRA: O3-40 (42 Mpc) JGW-T1707556
- Source parameters (GW170817-like)
  masses: 1.5-1.24 Msun
  redshift: z= 0.009 (~40 Mpc)
  inclination angle: 30 deg
  polarization angle: 0 deg
  no spins
- Source locations (192 locations)

  see Haino-san's list: dst-3102.txt

Calculation Method Comparison

- S. Haino (see JGW-G1807674, JGW-G1808042)

  Nested sampling with MCMC sub-chains

  - supports non-linear correlations between source parameters
  - In Haino-san's code, only single run for one source parameter set was done to save computational cost. This could give high statistical error.

  TaylorF2

- Y. Michimura et al.

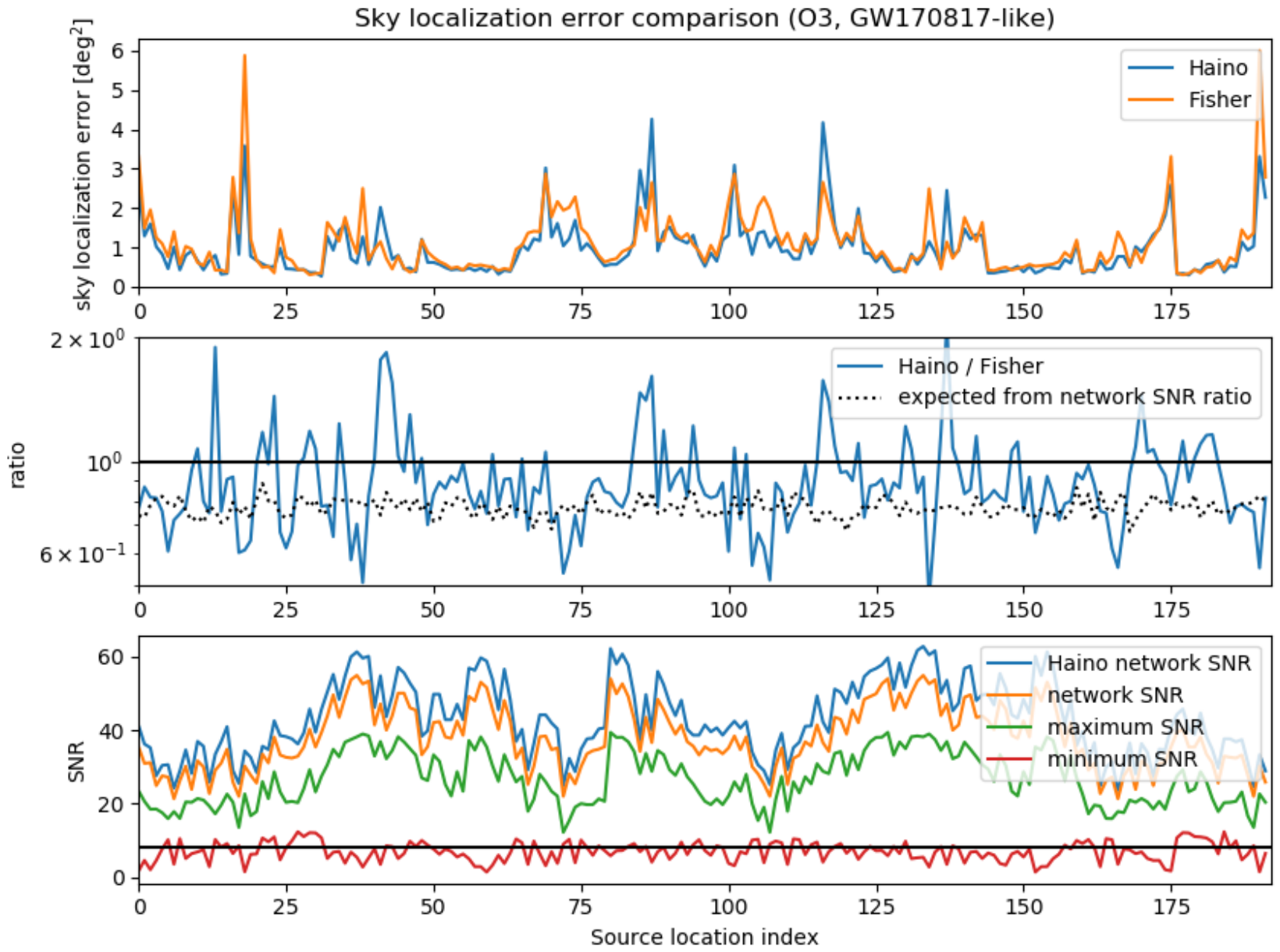
  Fisher analysis

  - faster than MCMC
  - assumes Gaussian distribution of source parameters
  - not reliable if SNR is low

  PRD 77, 042001 (2008) , PRD 88, 084013 (2013)

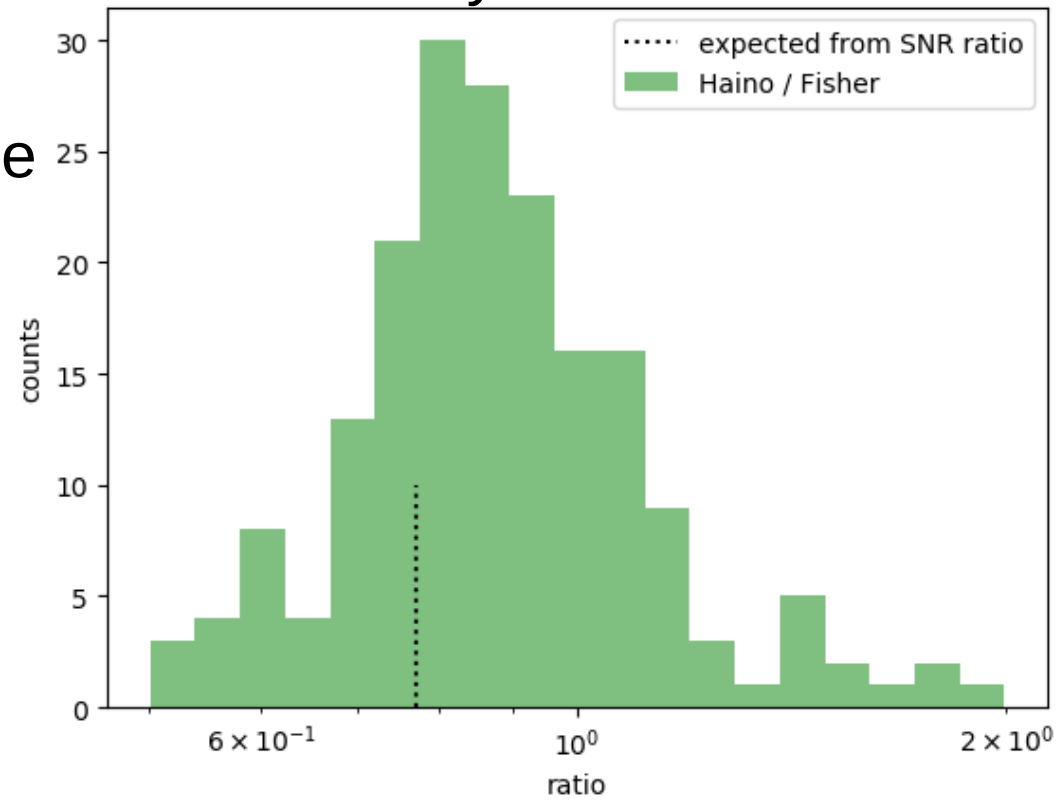
  PhenomD (PRD 93 044007 (2016)) ONLY INSPIRAL

1σ Sky Localization Comparison



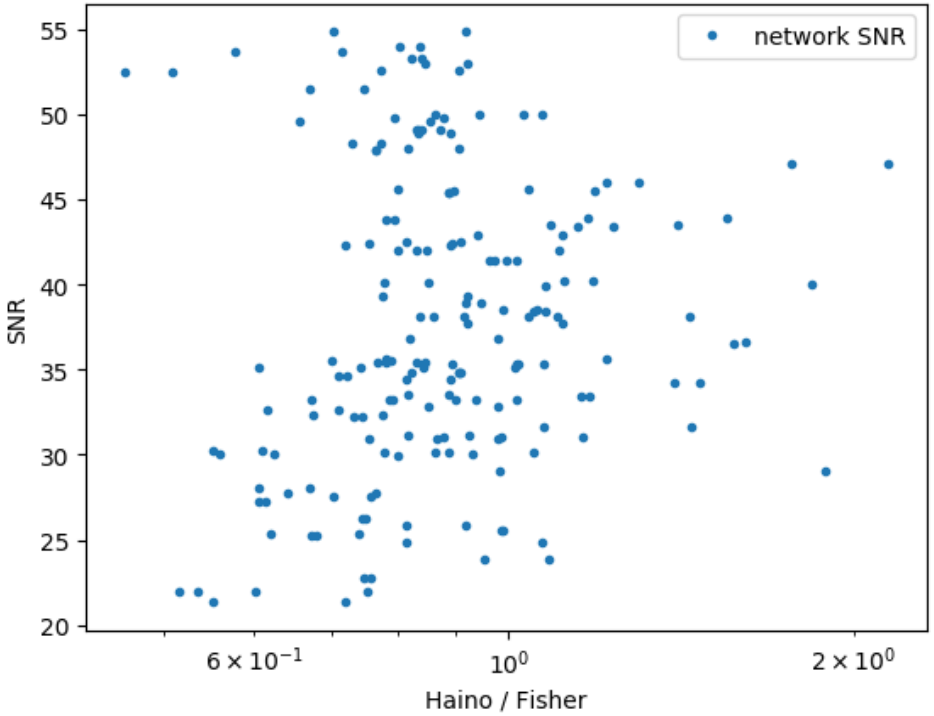
1σ Sky Localization Comparison

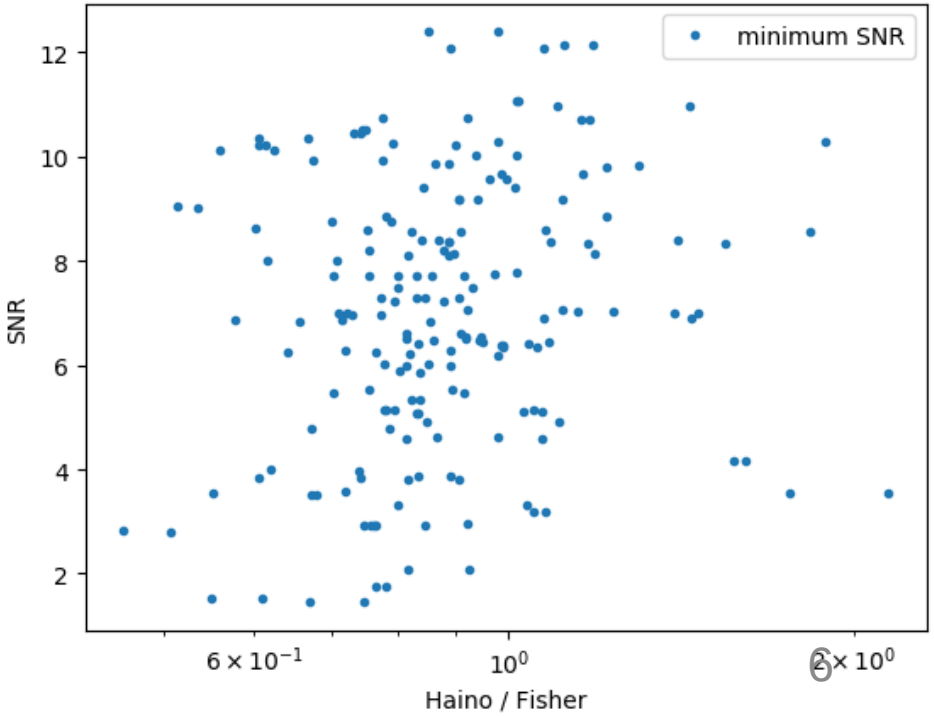
- Agreed within x2
- Haino-san's result is 9 +/- 2 % smaller than Fisher result
- Network SNRs by Haino-san is 12 +/- 2 % higher (probably because YM+ uses only inspiral waveform) and this should give 22 +/- 4 % difference in the sky localization error
- Sounds reasonable



Discussion

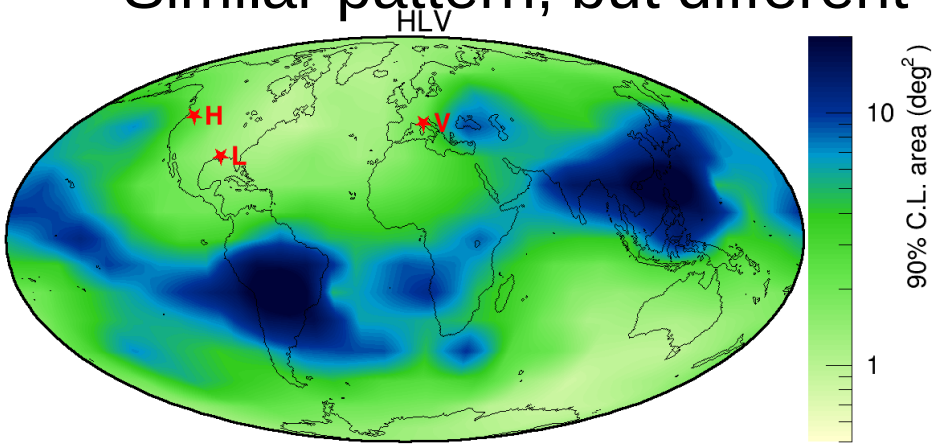
- Fisher analysis assumes that SNR is high enough
- But there seems no correlation between SNR and sky localization error difference
  - possibly because SNR is still not enough?
- Still under investigation



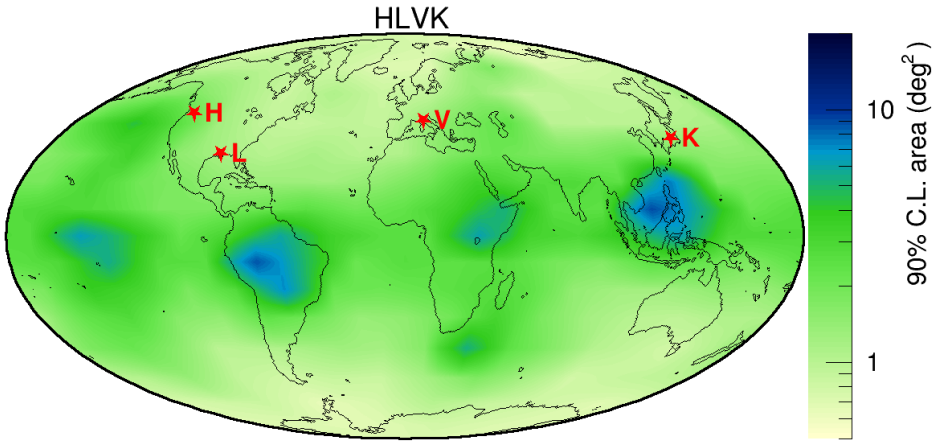


Map Comparison

- NOTE that color bars are not exactly the same!
- Similar pattern, but different



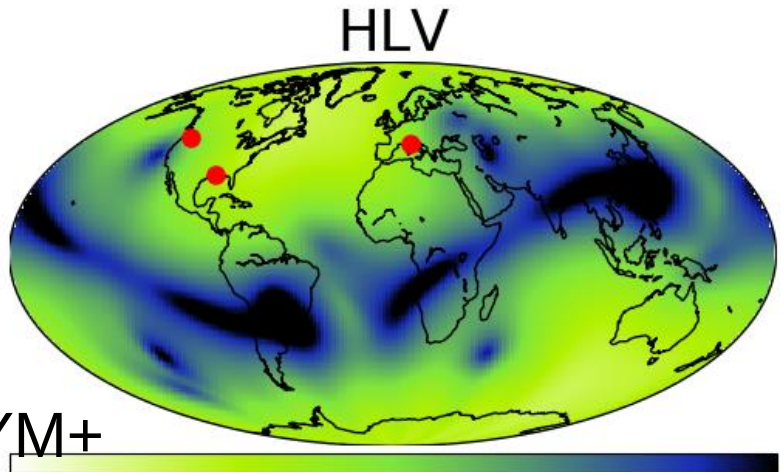
smap-3101.png



smap-3102.png

by S. Haino

(http://www.icrr.u-tokyo.ac.jp/~haino/gsim/gsim.html)



by YM+

(multiplied by 2.1
to show 90% C.L.)