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
    - Haino-san's data used here is the result of only single run for one source parameter set (to save computational cost).
      This could give high statistical error.
      (Multiple runs can also be done with Haino-san's code)
  TaylorF2 waveform

- 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 Waveform (ONLY INSPIRAL)
      PRD 93 044007 (2016)

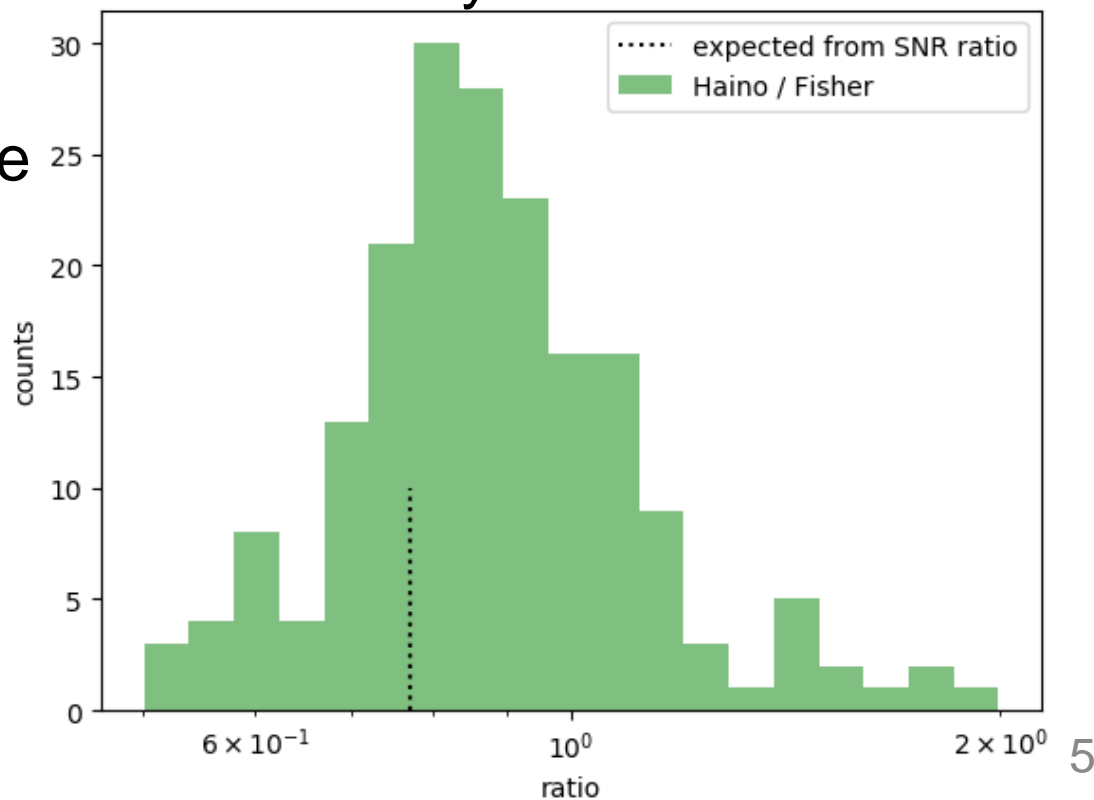# 1σ Sky Localization Comparison

Sky localization error comparison (O3, GW170817-like)
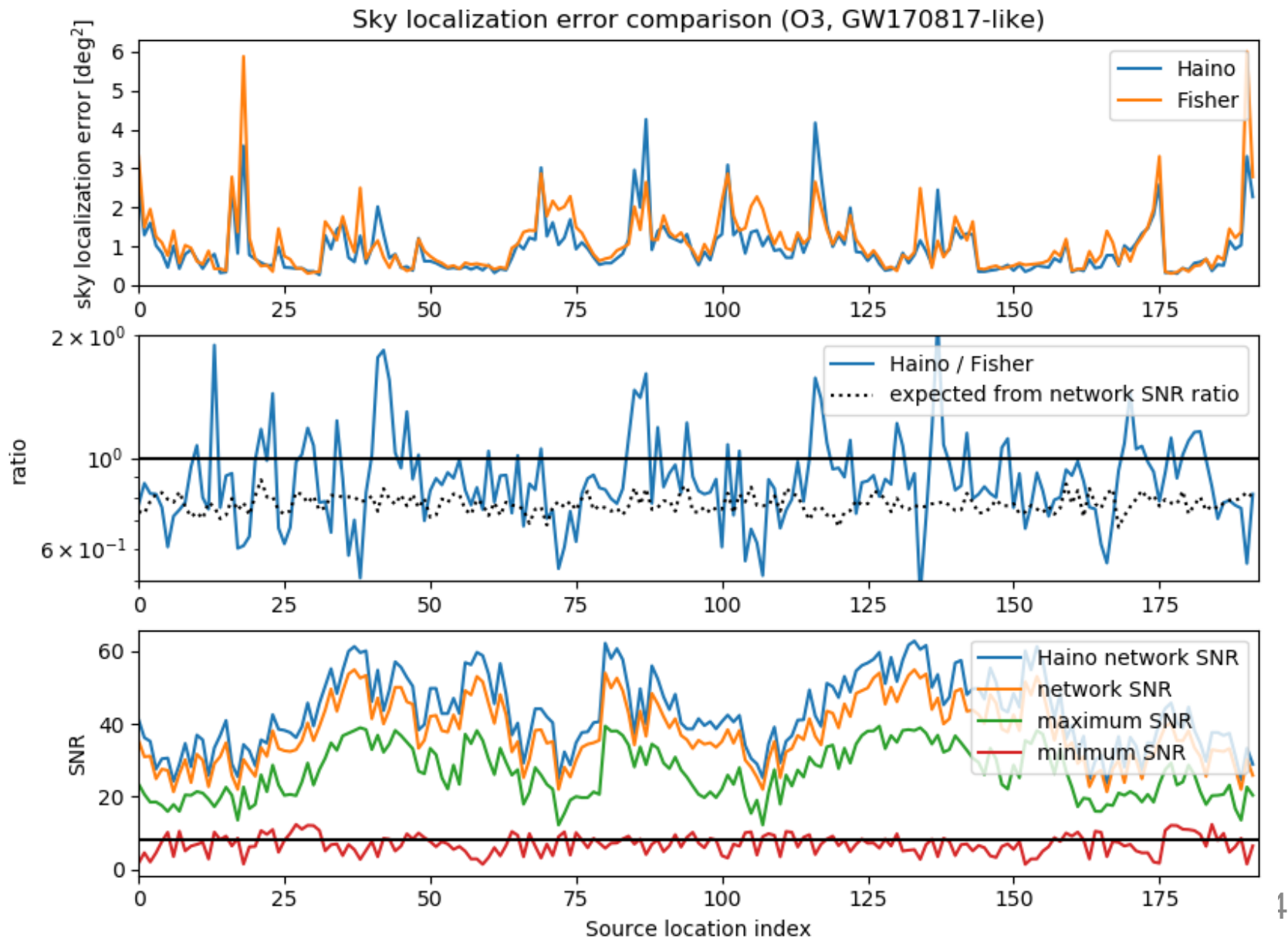
1σ Sky Localization Comparison

- 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
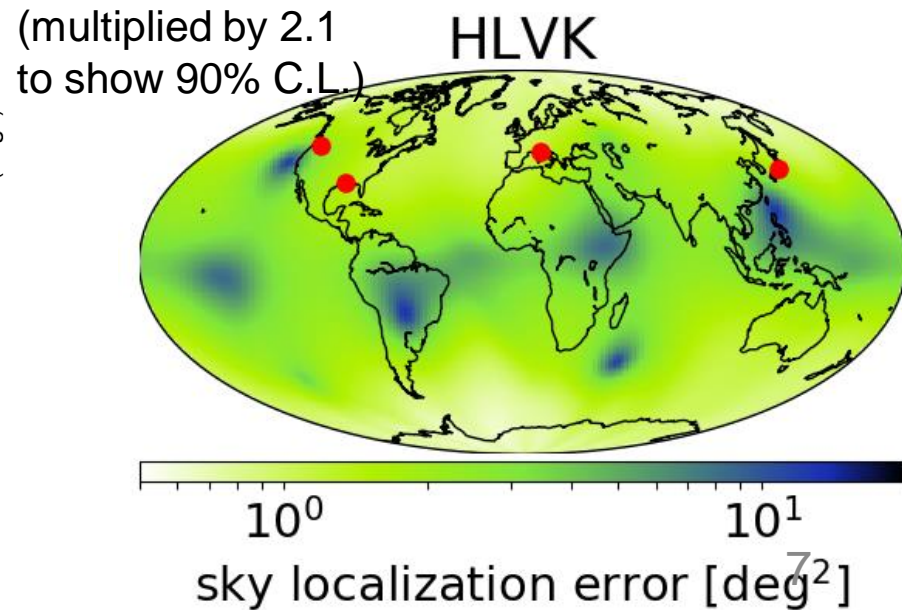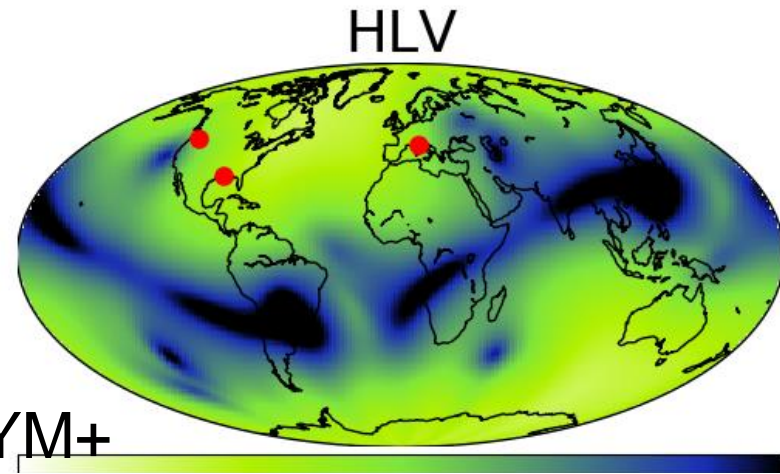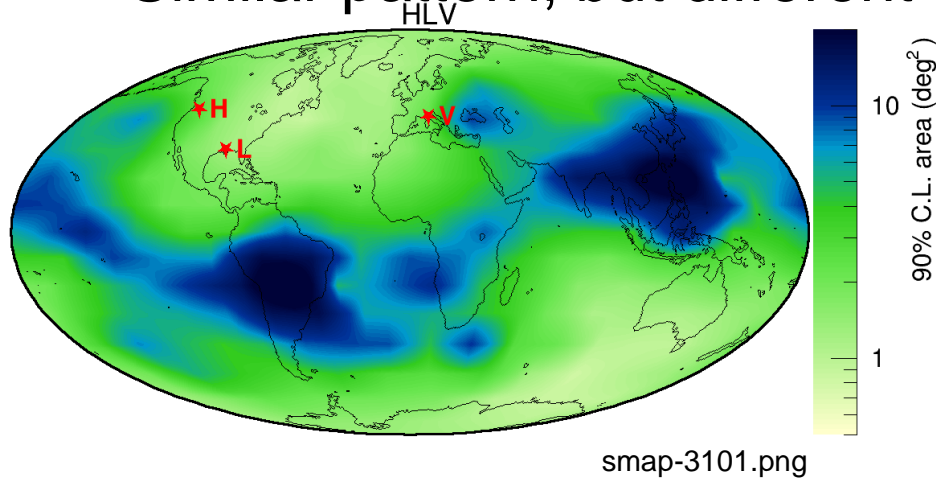
- Sounds reasonable

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?
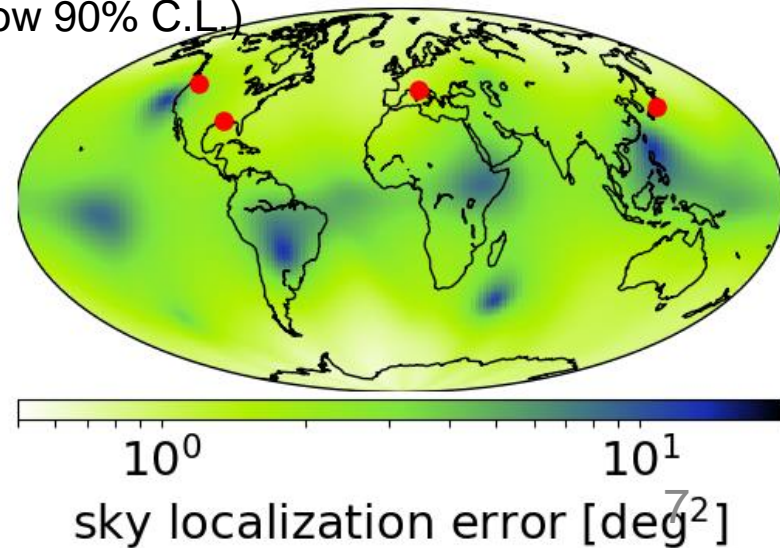- Still under investigation
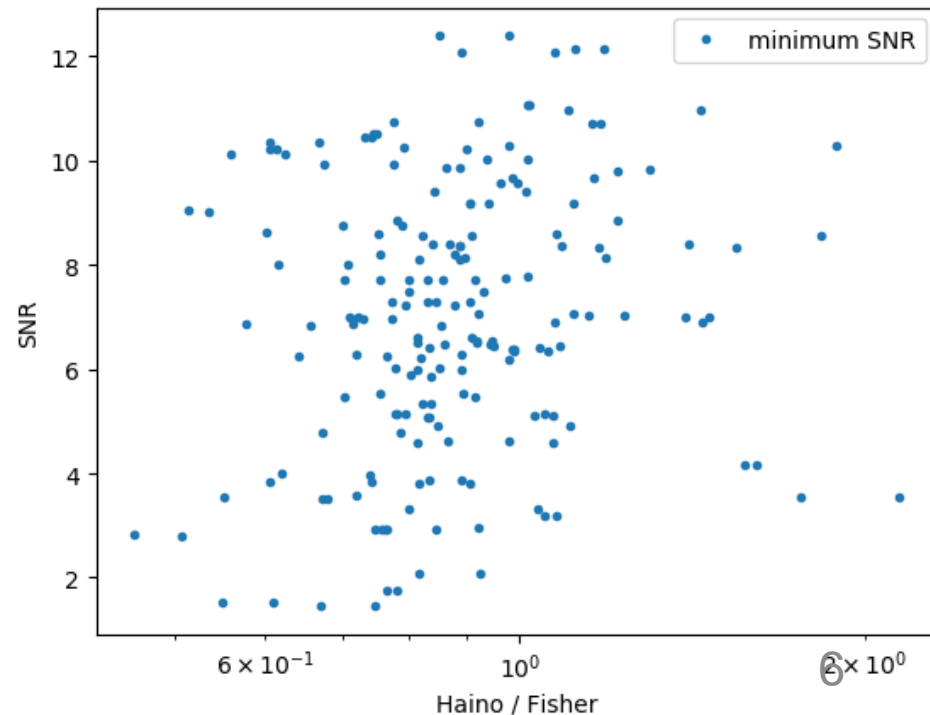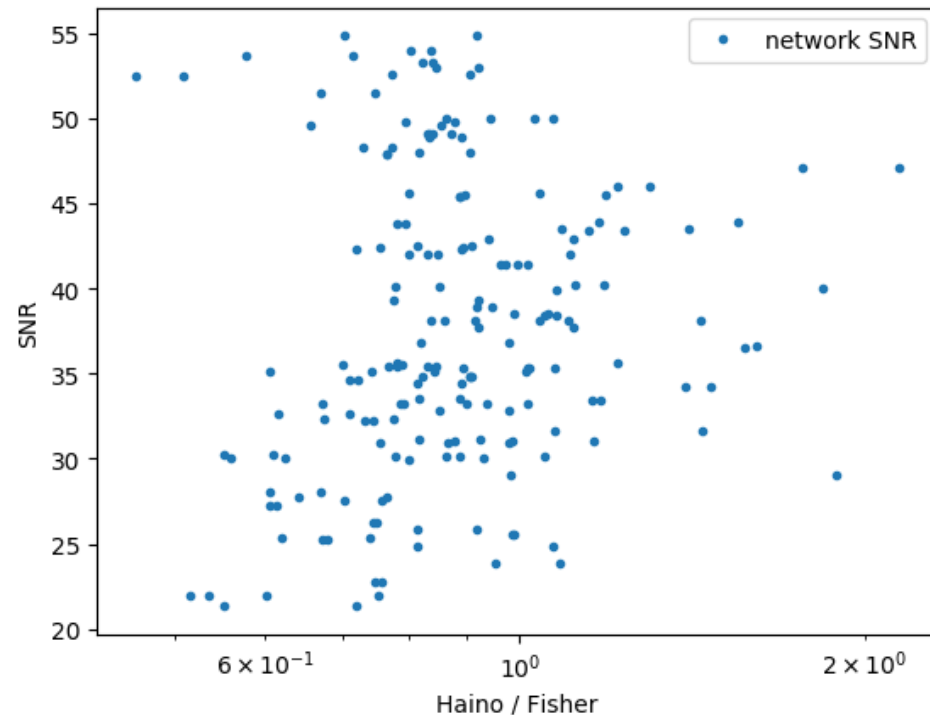
Map Comparison

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

smap-3101.png

smap-3102.png

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

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