Capitalizing on GW polarization bias for a pair of interferometric detectors To increase parameter estimation speed and Investigate the potential implications for stellar evolution models.

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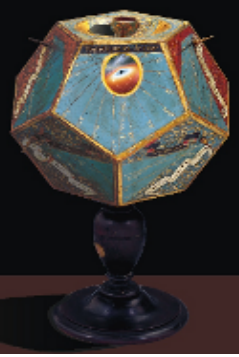

Astrophysics

- Obtaining astrophysical information (search)
  - Externally triggered GW search
  - GW band only identified GW event
- Signal information
  - Infer system parameters
  - Localize sky position

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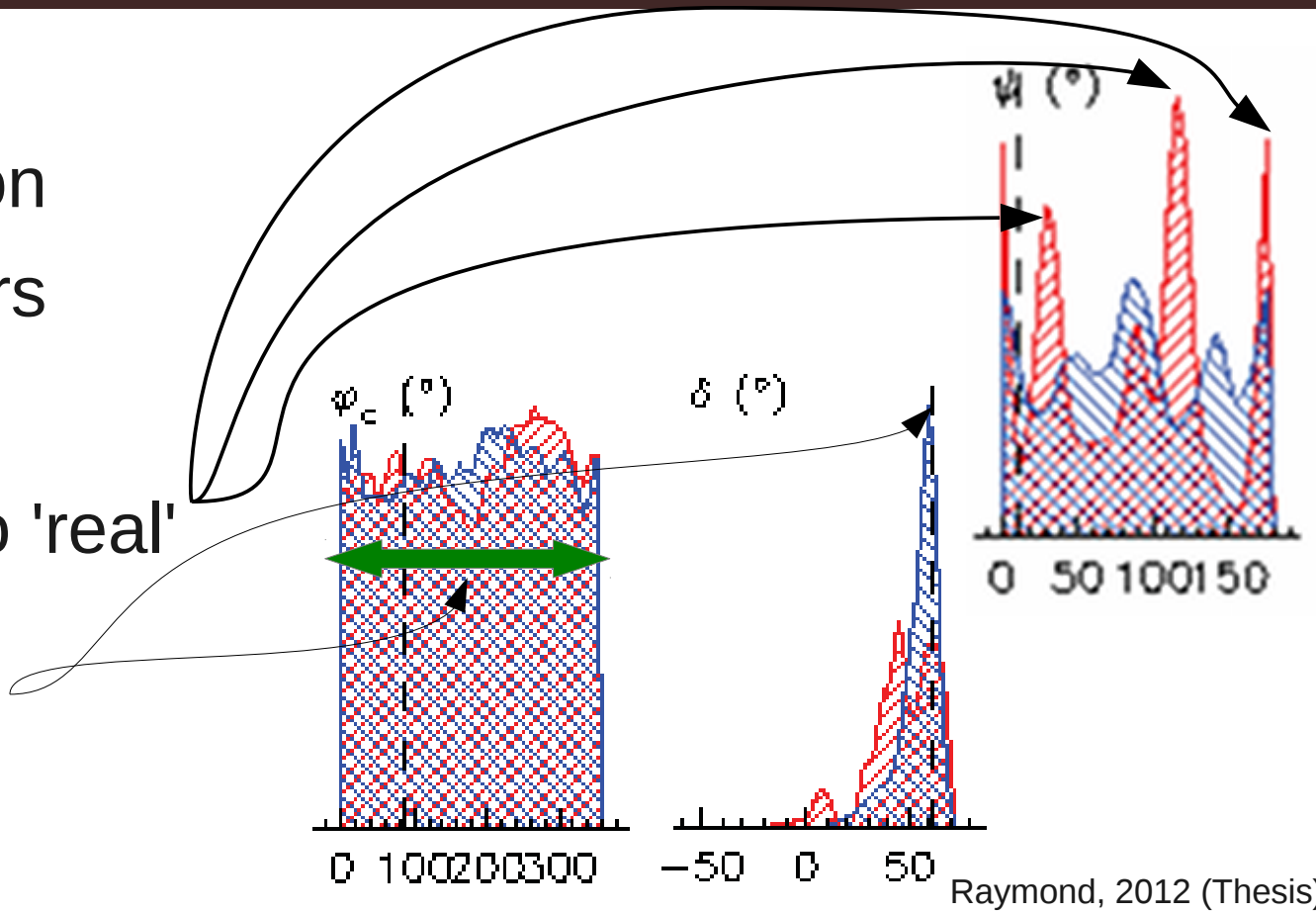
Sky localization

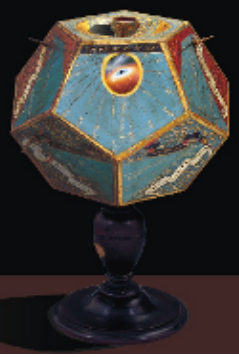
- Detection method
  - Matched filter
  - Excess power
- Triangulation
  - indirectly SNR dependent
  - Network configuration dependent

Parameter Estimation

- Requires
  - time of detection
  - parameter priors
- Results
  - convergence to 'real' parameters
  - most likely sky position (non triangulation)

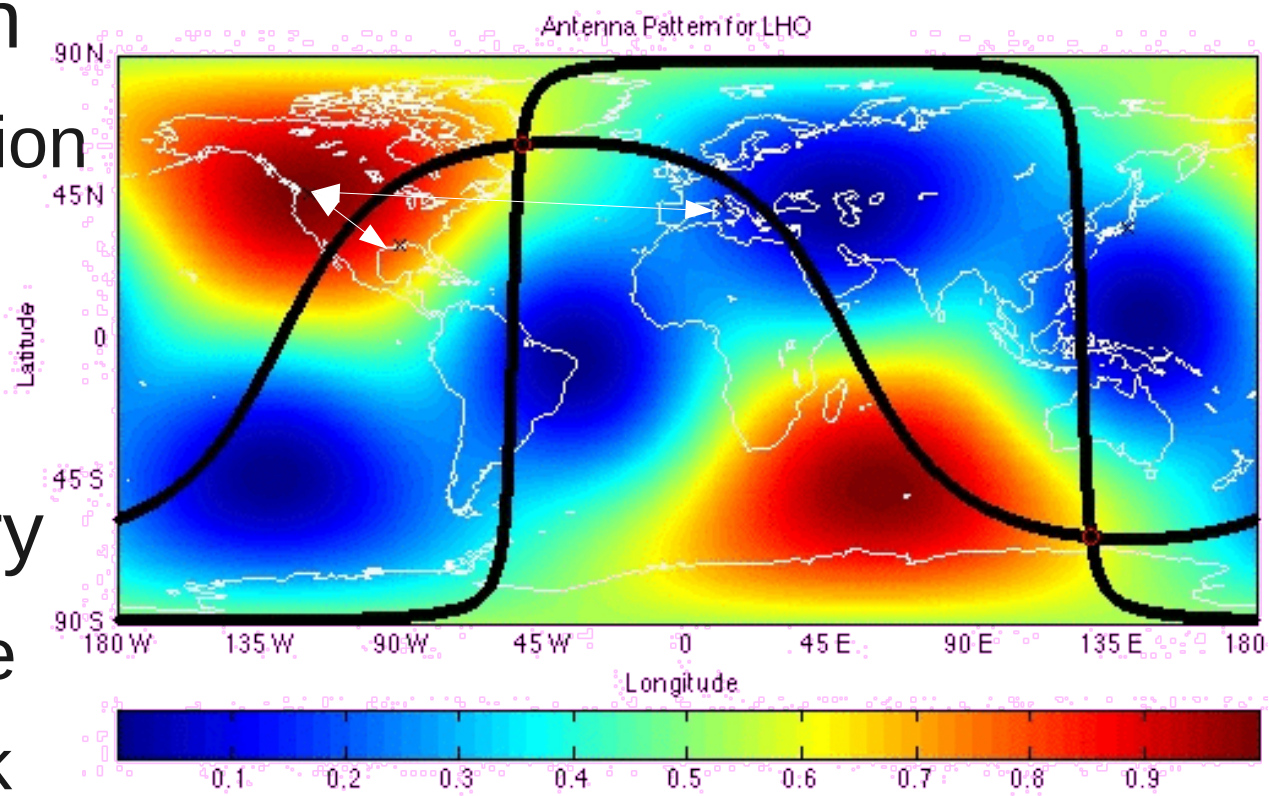


Raymond, 2012 (Thesis)



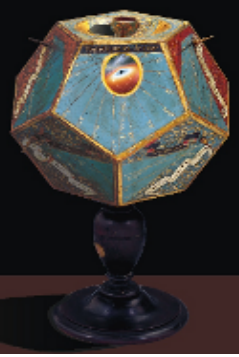
Source Sensitivity

- Signal polarization
  - Network polarization sensitivity
  - Single detector sensitivity
- Detector Geometry
  - Simple, single site
  - Complex, network configuration



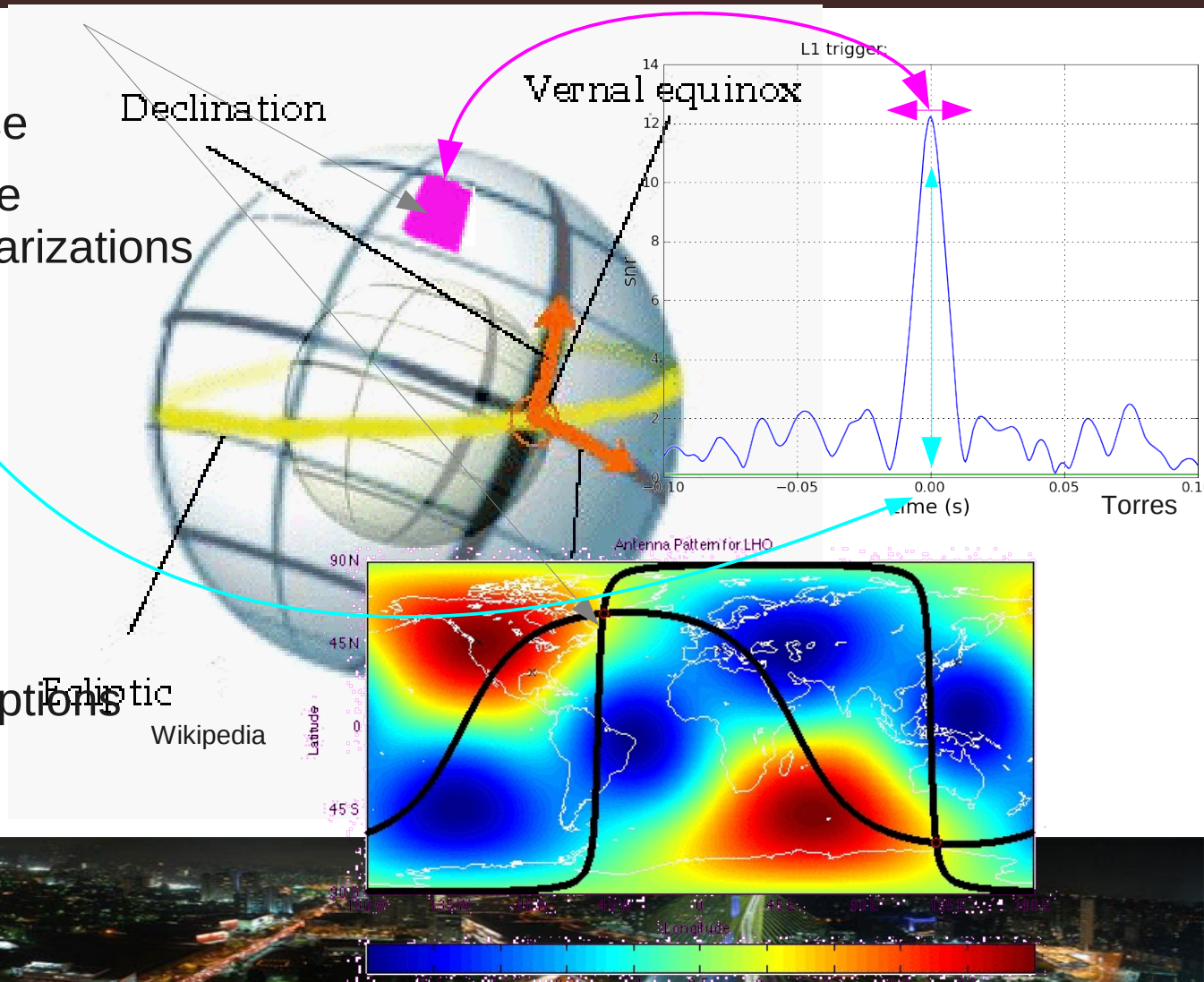
L1H1:H1V1
Effective Network Antenna Response

Stuver

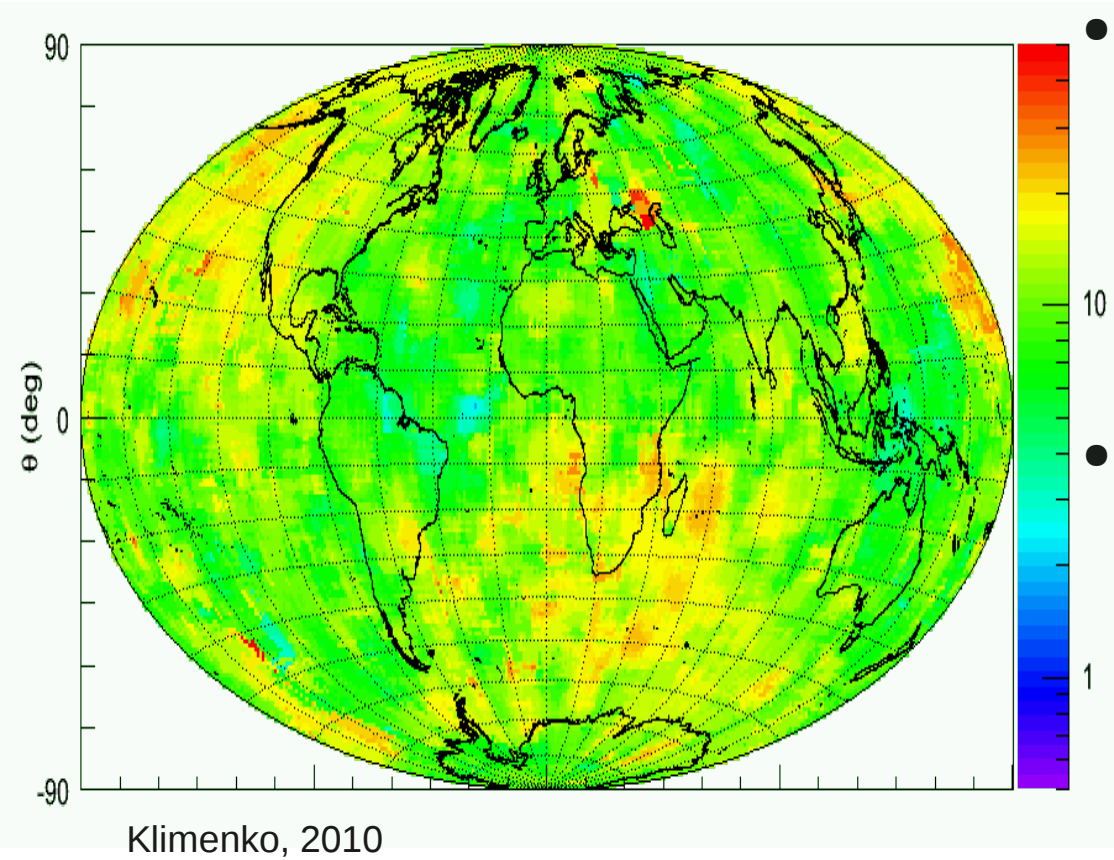


Errors in Sky Pointing and Distance

- Sky Pointing: “timing”
  - Template choice / phase
  - Is network blind at some (RA,DEC) for given polarizations
- Est. Distance: “SNR”
  - Data quality
  - PSD estimates
- “Ignored” errors
  - Source polarization
  - “Simple” search assumptions

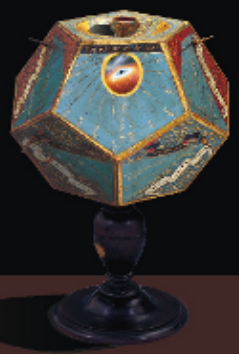


Source sampling 'deafness'



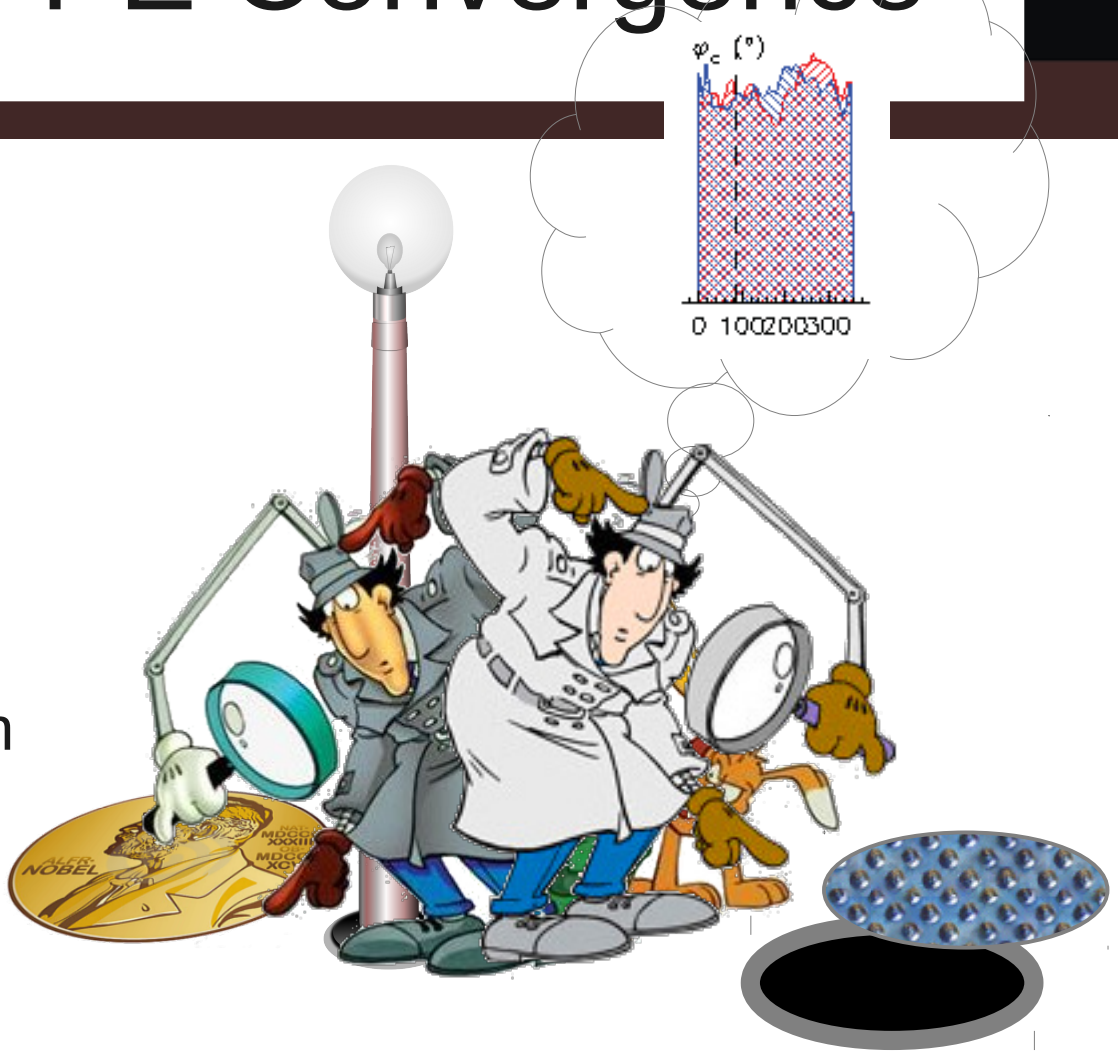
Klimenko, 2010

- Past observing epochs
  - Polarization average ideal orientations
  - not triangulation limiting
- Future observing epochs
  - Polarization 'deafness' may be an issue (5x)
  - address via hierarchical filtering



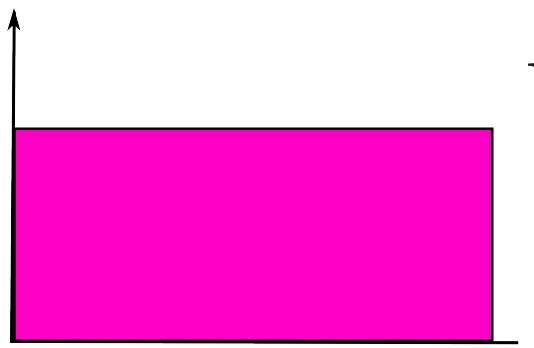
Improving PE Convergence

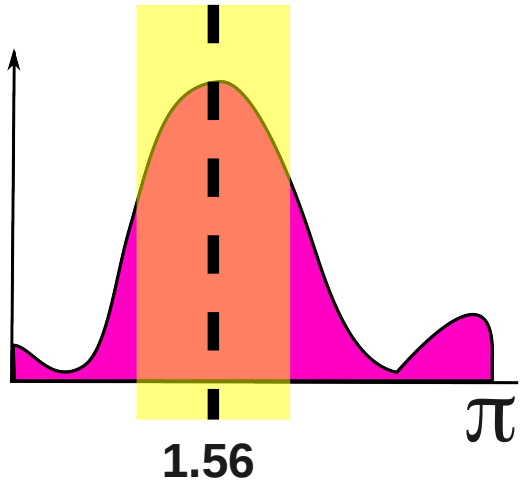
- PE can triangulate signal
- Convergence timescale
  - subspace dimensionality: masses, spin, mass ratio, etc
  - domain breadth
  - initial 'guess' or information



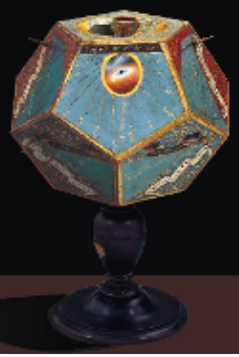
Case Study:GRB100328A

- Externally trigger GW search
- Stats:
  RA 10h23m45s
  DEC 47d02m
  953781779
- LIGO detector pair
- Traditional PE run via Monte Carlo Markov Chains





GW Stats:
Pair: LLO-LHO
Posterior (mu,sigma):
89,57



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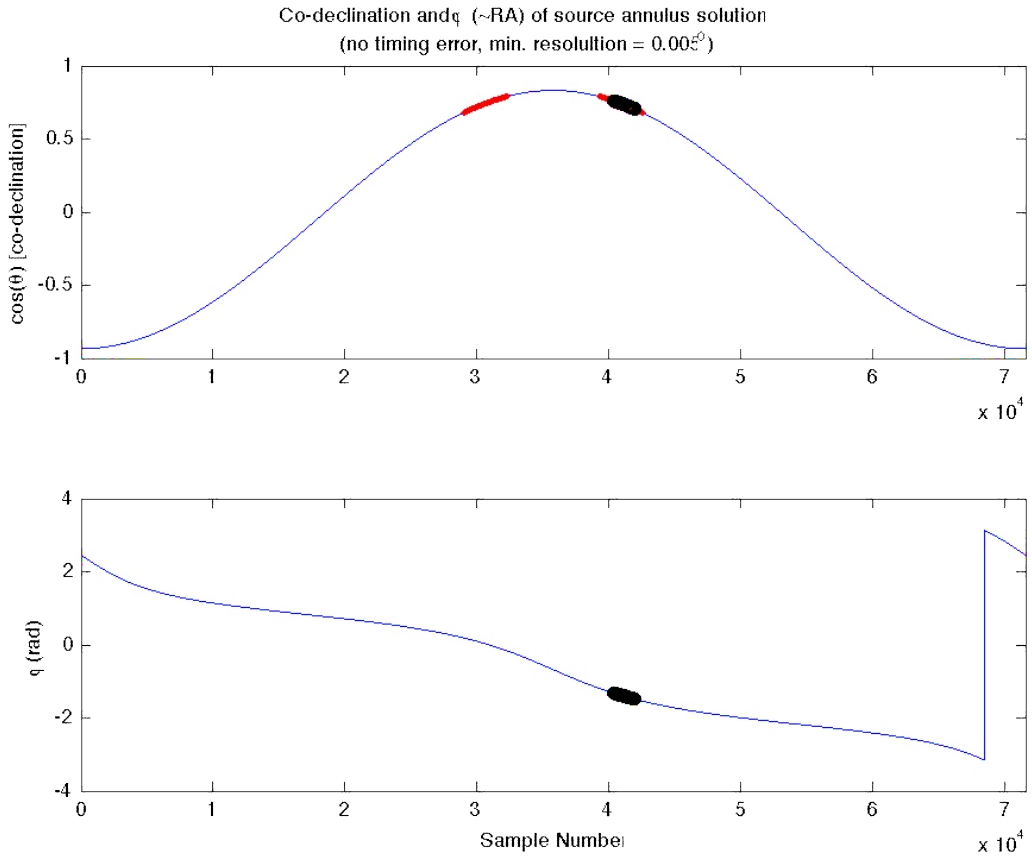
- *Using polarization bias*
- Predicts 'deafness' in polarization
- Intelligent MCMC prior
  - improve convergence timescales
  - RA,Dec
  - instrument pairing
- Geometrically determined



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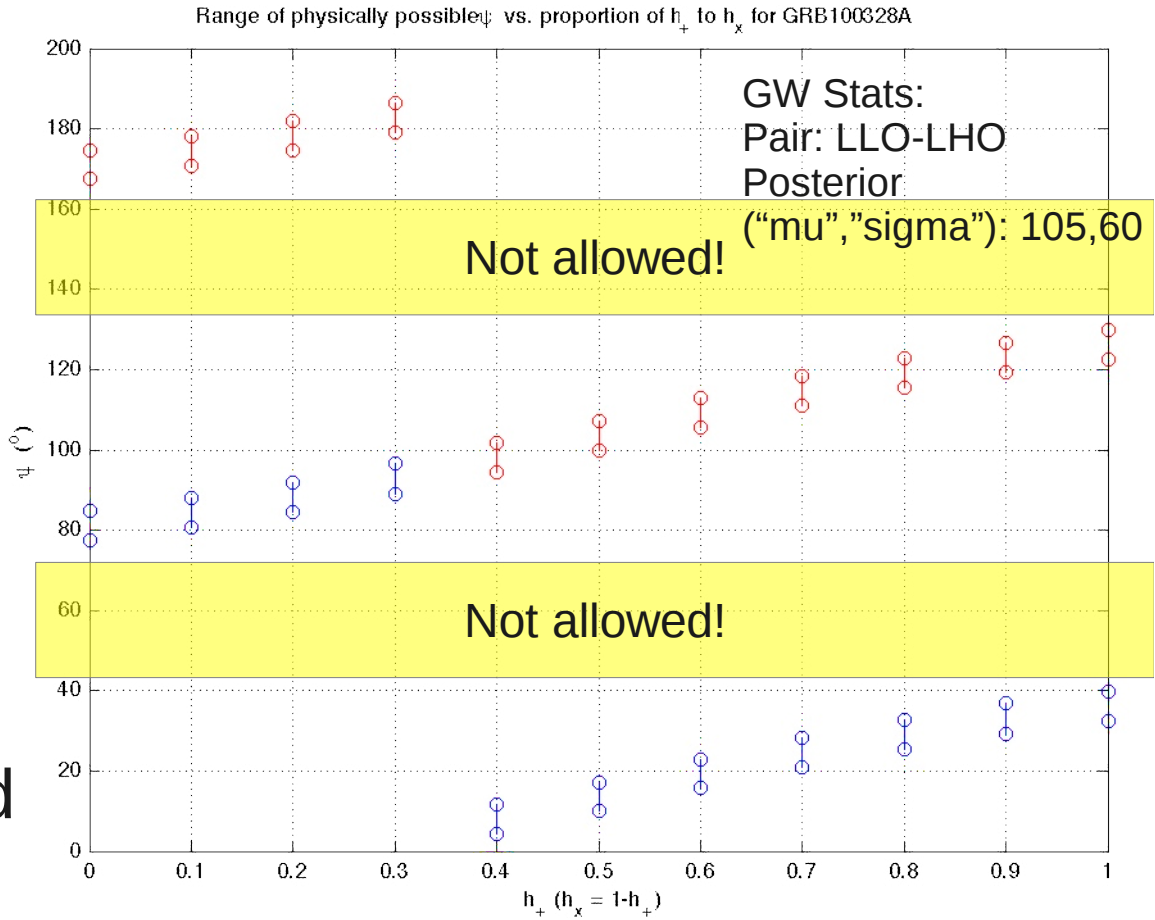

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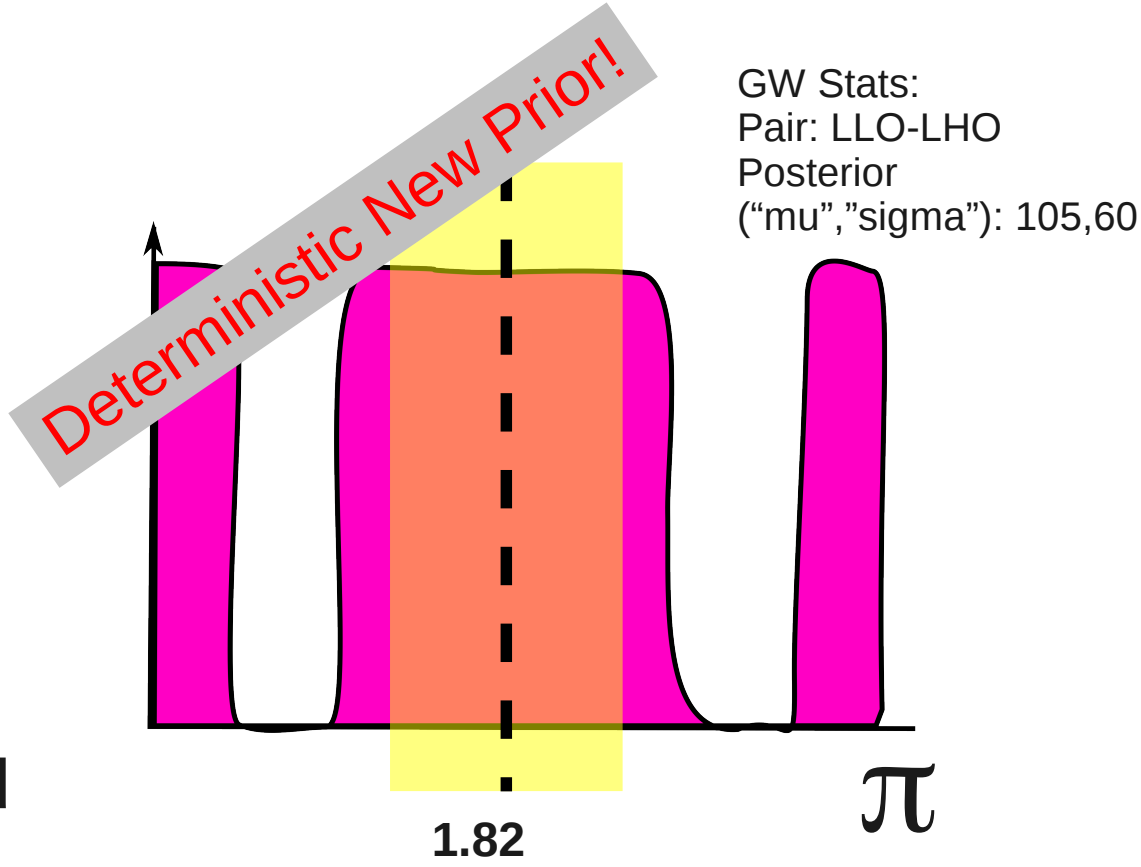

Leveraging Potential

- Detection 2 LIGO detectors
- Cuts 80 possibly more degrees of psi space
- **N** detector network
  - cuts >=80deg Psi prior
  - convolution of n!/2(n-2)! simple pair priors

Polarization bias = Sampling Bias

- Potential polarization 'bias' mask across sky
- NS-NS polarization distribution knowledge limited (@ 40/yr)
- 'Bias' maps calculable per object in Virgo super-cluster

Conclusions

- Polarization sensitivity/bias affects
  - Rapid source reconstruction
  - MCMC convergence time
  - Sampling of NSNS orientations
- Capitalizing on polarization bias
  - 2 stage search (NSNS) could be more sensitive
  - MCMC Prior bank, may effectively remove 1 PE DOF
- Things to do
  - Determine polarization sensitivity impact for 2, 3, and 4 GW detectors across entire sky
  - For Virgo super-cluster (LIGO obs sphere), investigate potential methods to de-convolve polarization sensitivity mask form observational data

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