# **LLAMA-GWHEN Significance** Calculation Flowchart with Code Locations

Code locations and line numbers based on coinc\_significance.py commit 1990b83

#### **CODE LOCATION LEGEND** CoincSignificanceIceCubeLVC.\_generate odds\_ratio CoincSignificanceIceCubeLVC five, five2

## **SEARCH INPUTS**

```
(different for each multi-messenger trigger)
```

## **GW**

- 1 GW trigger
- Skymap (Ω)
- Mean distance (r<sub>GW</sub>)
- SNR (ρ)
- Time

line 860

gw\_skymap =

LVCInitialSkymapHDF5(self)

.get\_healpix()[0]

#### Neutrino

Multiple neutrino triggers

- Sky position mean (RA, Dec)
- Sky position std. dev. (σ)
- Energy
- Time

line 870

neutrinos =

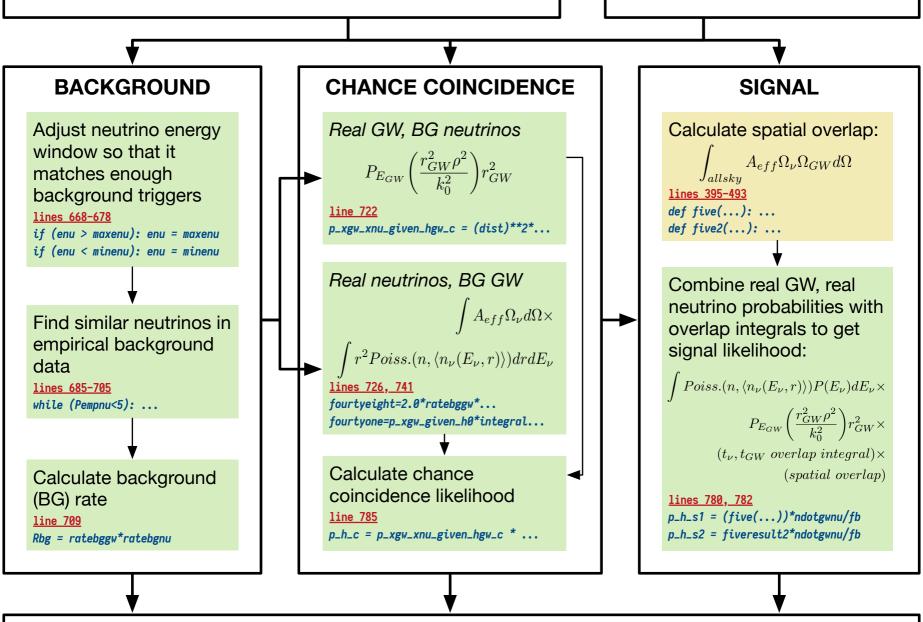
IceCubeNeutrinoList(self).neutrinos

## **SEARCH PARAMETERS**

(constants used for many triggers)

- GW signal-noise ratio (SNR) background distribution
- Background neutrino triggers
- Effective IceCube area
- Integration bounds
- Empirical constants

lines 208-392, 794-817 def Aeff\_skymap(skymap, enu): LVC\_ICECUBE\_SEARCH\_PARAMS = IceCubeLvcSearchParameters(...)



**ODDS RATIO** For any GW+HEN detection on this GW trigger (decomposed into partial fractions)

$$\sum_{i=1}^{N} \frac{P(H_{S}|x_{GW},x_{\nu,i})}{P(H_{0}|x_{GW},x_{\nu,i}) + P(H_{C}|x_{GW},x_{\nu,i})} + \sum_{i,j} \frac{P(H_{S}|x_{GW},x_{\nu,i},x_{\nu,j})}{P(H_{0}|x_{GW},x_{\nu,i},x_{\nu,j}) + P(H_{C}|x_{GW},x_{\nu,i},x_{\nu,j})} + \dots$$
(SINGLE NEUTRINO) (DOUBLE NEUTRINO) (...)
$$\frac{\text{lines 786}}{\text{odds = (p_-h_-s1 + p_-h_-s2) / (p_-h_-c + p_-h_-0)}}$$