TG5:
Toward readiness

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Outline

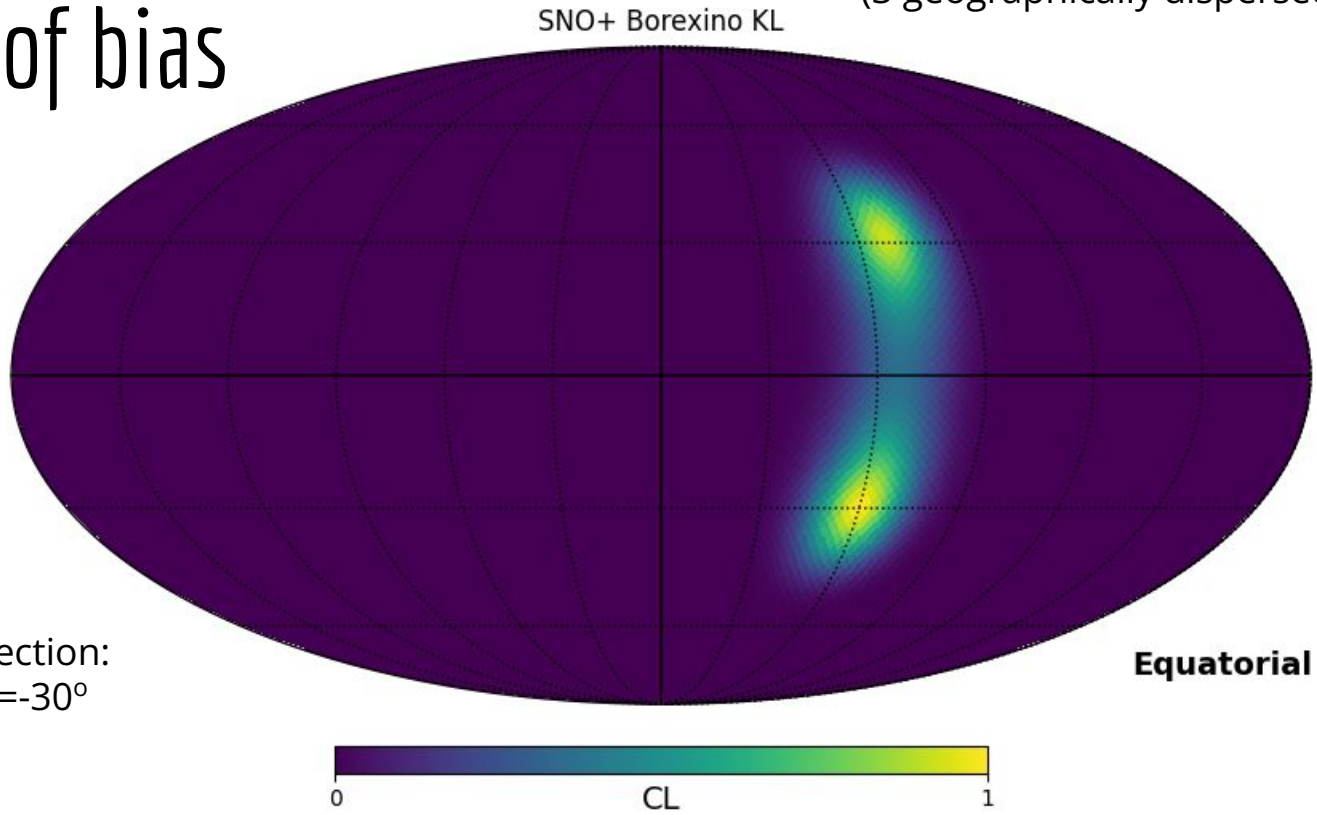
- Things which aren't quite complete/ready for a supernova
  - Calculations
  - Interaction with SNEWS server
  - Robustness
- Current list of experiment recommendations
- Aims for publications
- Steps to fire drills, readiness

Direction

- Triangulation using time differences already works
  - Need to evaluate yield-dependent uncertainties and biases for different situations, distances, etc.
- Top-down triangulation should naturally incorporate yield-dependent experimental uncertainties and biases
  - Methods seem to work, but details and testing are in progress
- Detector synchronization remains a somewhat open issue
  - Assume everyone uses GPS, converts correctly to UTC
  - How much does a 1ms drift between syncs affect results?

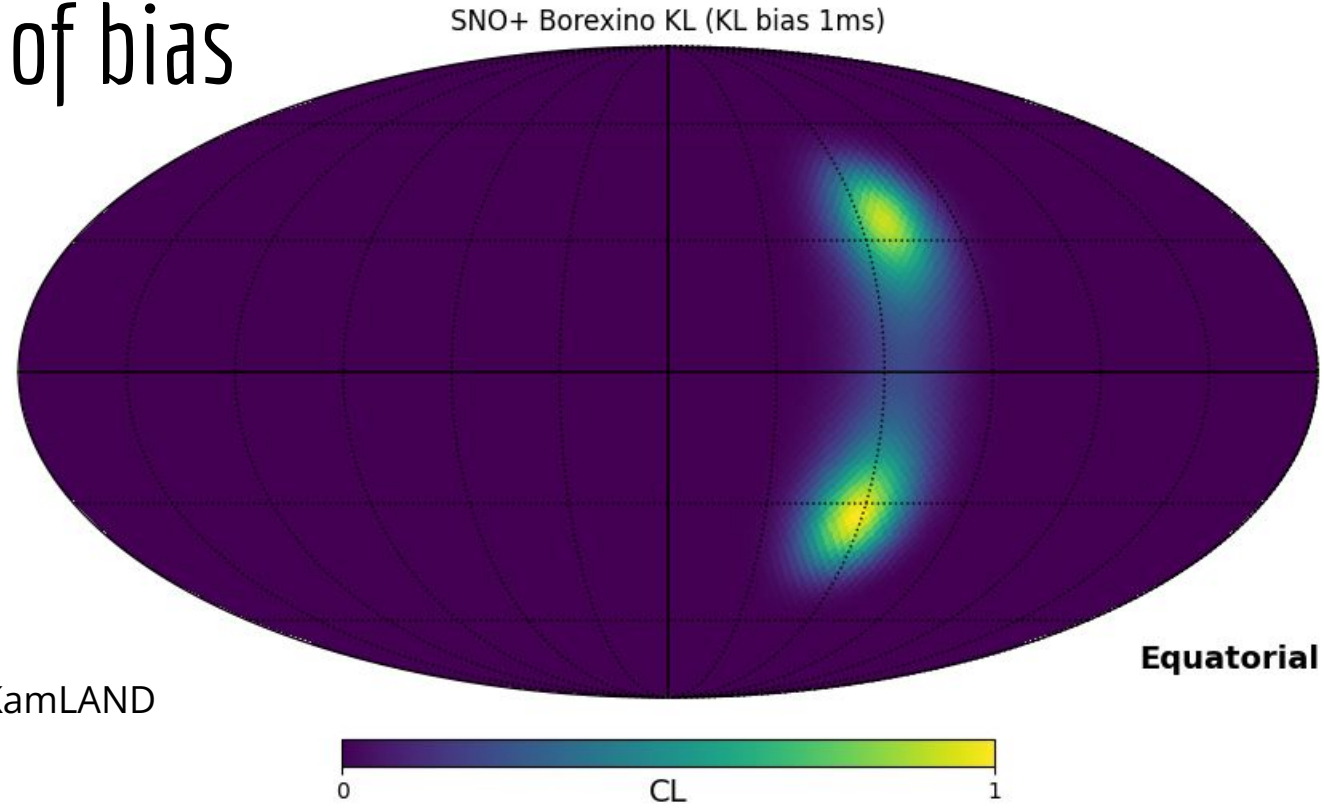
Effect of bias

(3 geographically dispersed experiments)



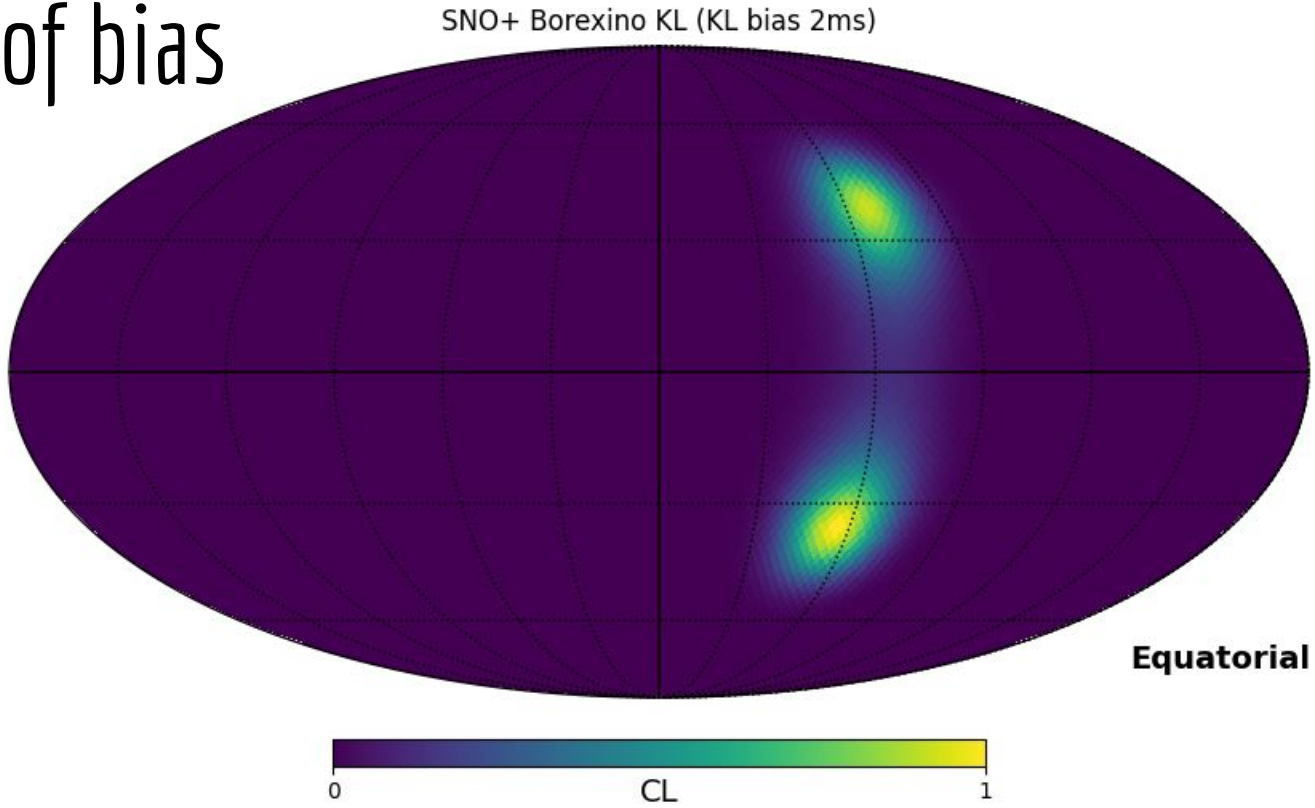
True SN direction:
ra=-60º dec=-30º

Effect of bias

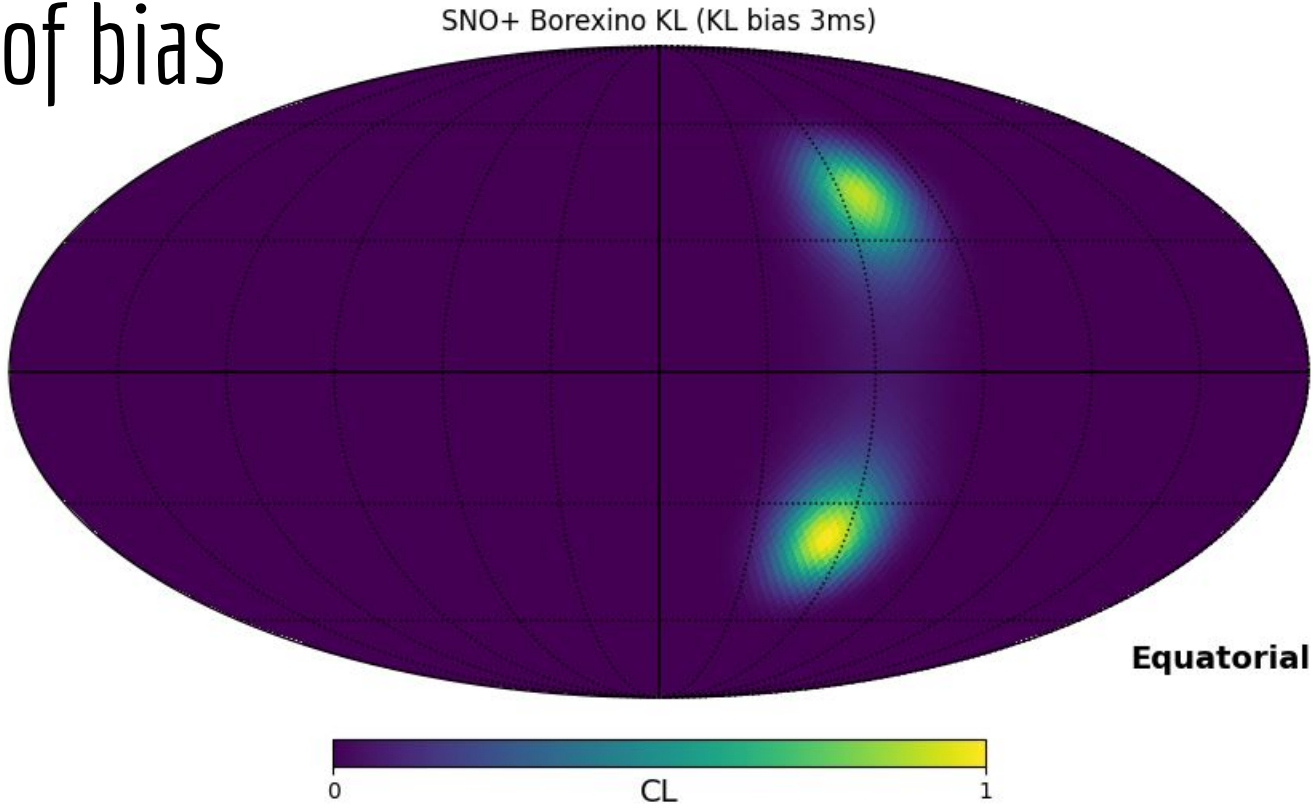


1ms bias in KamLAND

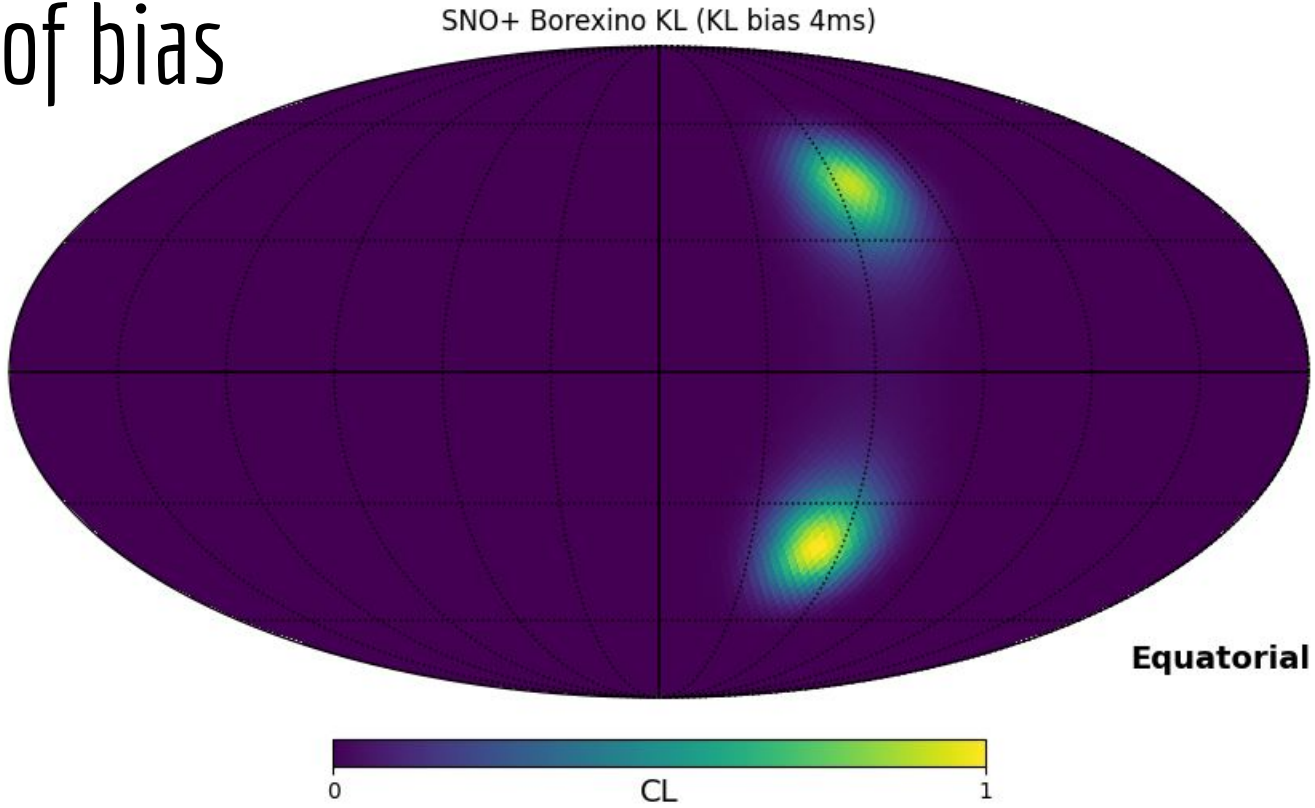
Effect of bias



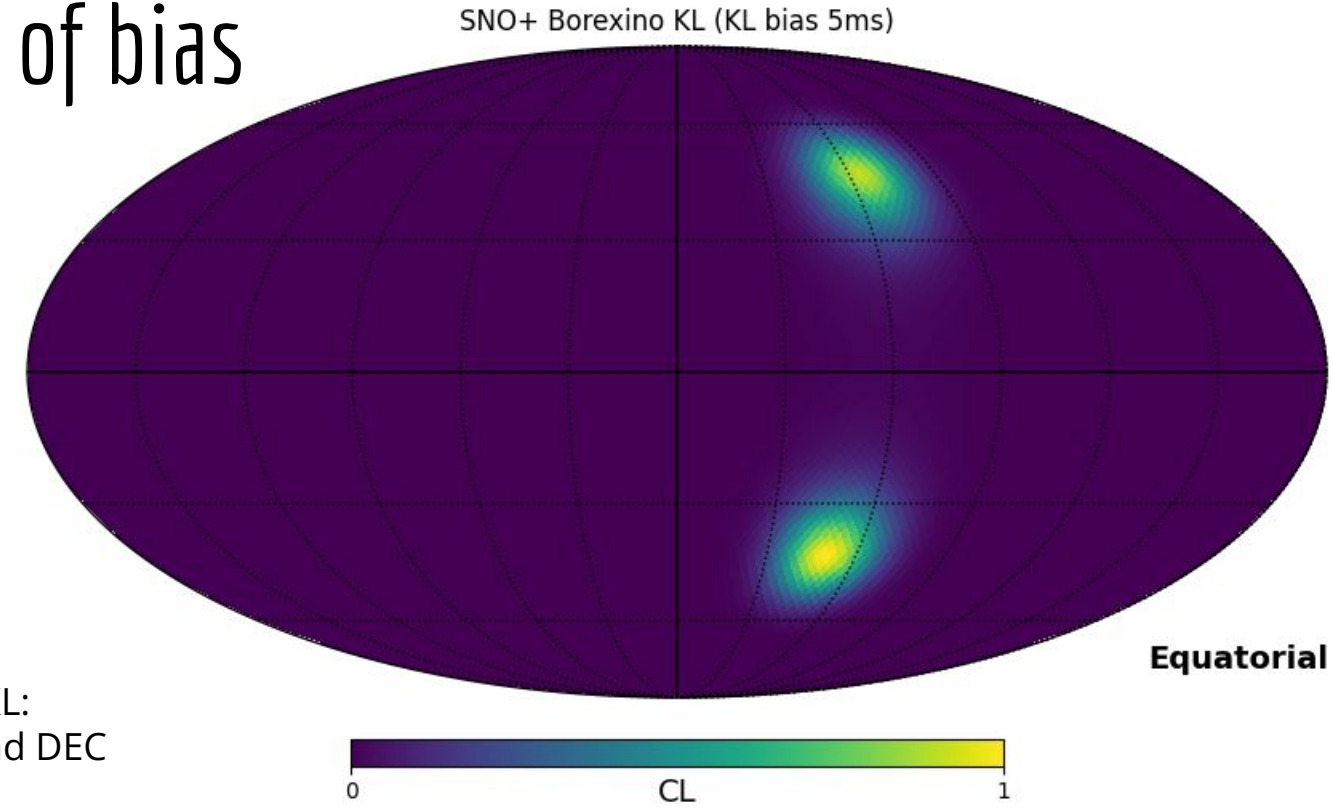
Effect of bias



Effect of bias



Effect of bias

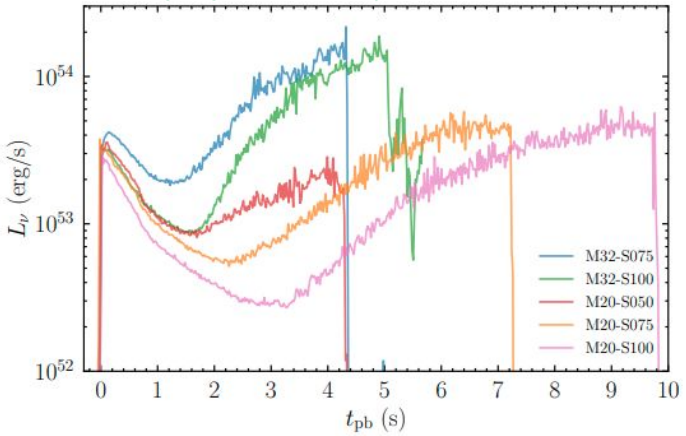


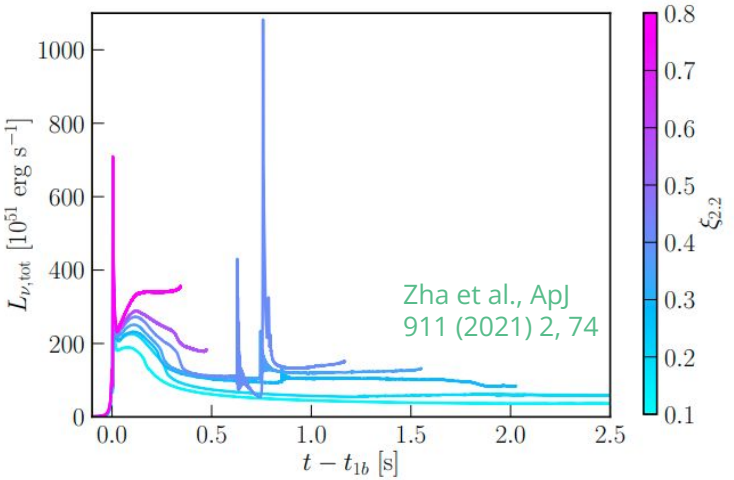
5ms bias in KL:
~10^{o} in RA and DEC

Other calculations to do

- Incorporate direction information from individual experiments
  - Expect these to arrive via alarm updates
- Distance estimate: parameters for more detectors
- Fourier transforms: SASI, Earth-matter effects (?), cross-correlations
  - What frequency range?
- Confidence levels for features
  - Cut-off, e.g., black hole
  - Secondary bursts
  - Other features to look for?
  - Are results better together or separate?

Fujibayashi et al., ApJ 919 (2021) 2, 80





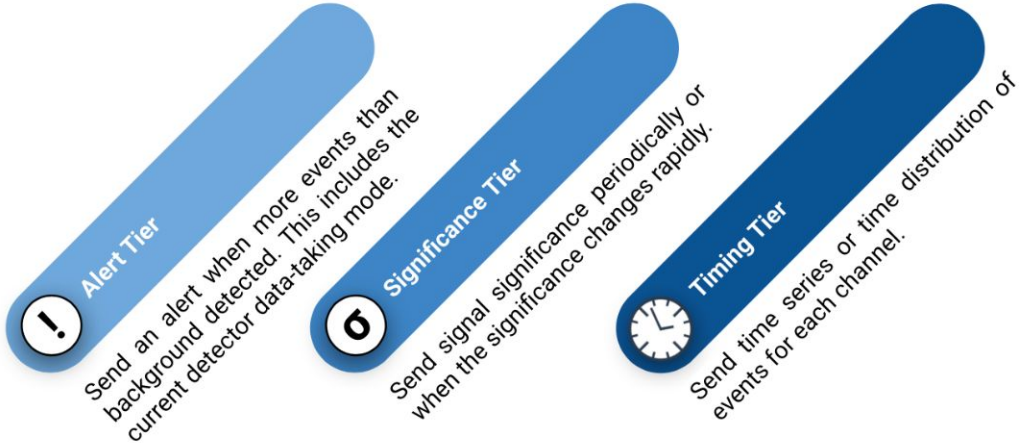
Interaction with SNEWS server

- We seem to be assuming snewpdag will run as a separate process on the SNEWS server, or one very close by
  - Subscribe to SNEWS server messages
  - Returning results to SNEWS server:
    - Via message: most likely direction, distance, feature likelihoods, URL's
    - Skymaps (FITS files), payloads, workbooks, other data in static store
    - Some data will be public, others internal to SNEWS
  - We haven't specified message contents yet
  - Can snewpdag occupy multiple processes, or remain single-threaded?
- Assume that first step involves validating and then converting experiment payload into internal payload formats and objects
  - We can hope this is mostly pass-through, but it shouldn't surprise us if experiments interpret our recommendations differently

Robustness

- How do we ensure snewpdag doesn't crash when it's really needed?
  - Fire drills
  - Unit tests
  - Keep plugins simple, doing as little as possible
    - Fewer execution branches to test
    - Generally favor using DAG (directed acyclic graph) to handle different conditions, rather than branches within plugins
- This entails code reviews and rewrites
  - We haven't been too rigorous about this yet because of development phase
  - Necessary step to "production" code, as we build up the production DAG

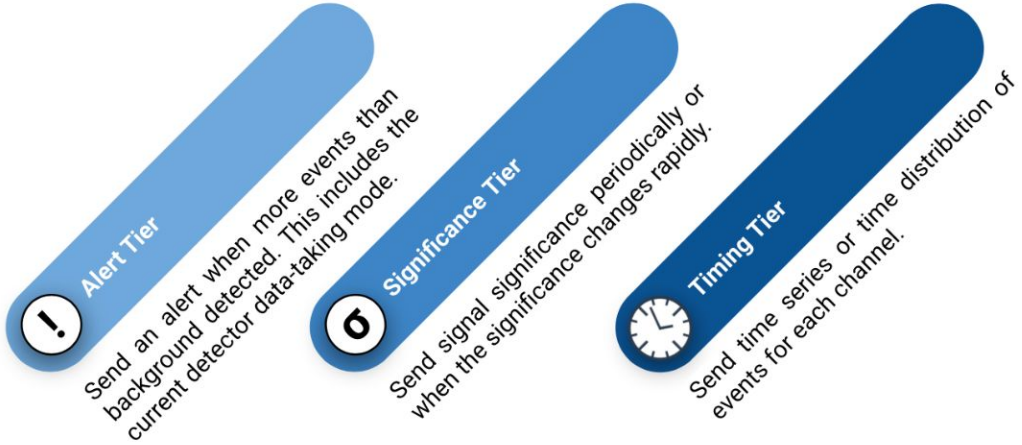
Recommendations for experiments (proposals)



- Clock drift requirements
  - Monitor with heartbeats, but "timing tier" experiments likely need to participate in more active tests, e.g., round-trip timing
- Common t_0 definition
  - *Alert/significance tiers* could remain ambiguous, like SNEWS1. Only need 10s coincidence.
  - "*Timing tier 1*" could include specific definition for t_0 calculation
- *Timing tier 2*:
  - Experiments to separate events into classes (~ channels, e.g., IBD)
  - Experiments to send expected background rate, or at least 1s of data before t0
  - Time histograms bin width approx 0.1ms, such that each bin has the same expected background rate (i.e., no weird binning effects)

Aims for paper(s)

- Top-down triangulation method
  - Comparing compatible experiments/channels
- Burst time method
  - For comparing experiments with different channels
  - Interplay with mass ordering
- Overall: what more can we do if experiments share more data with SNEWS?



Steps to fire drills, readiness

1. Pipeline for triangulation using t_0's can be used for tests
   a. For imminent fire drills, assume the t_0's have a common meaning
   b. Sort out how snewpdag will run in relation to SNEWS server
2. Recipe for t_0
3. Top-down triangulation
   a. Can start using neutrino light curves along with t_0's
4. Complete distance estimate calculations
5. Set up process for production code
6. Experiment recommendations (and papers?)
7. Feature detection, FFT's, etc, can be added incrementally, along with further optimization of direction and distance calculations