

# The Best Case Scenario: Towards Prompt Arcminute Localization of a GW source

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## Want

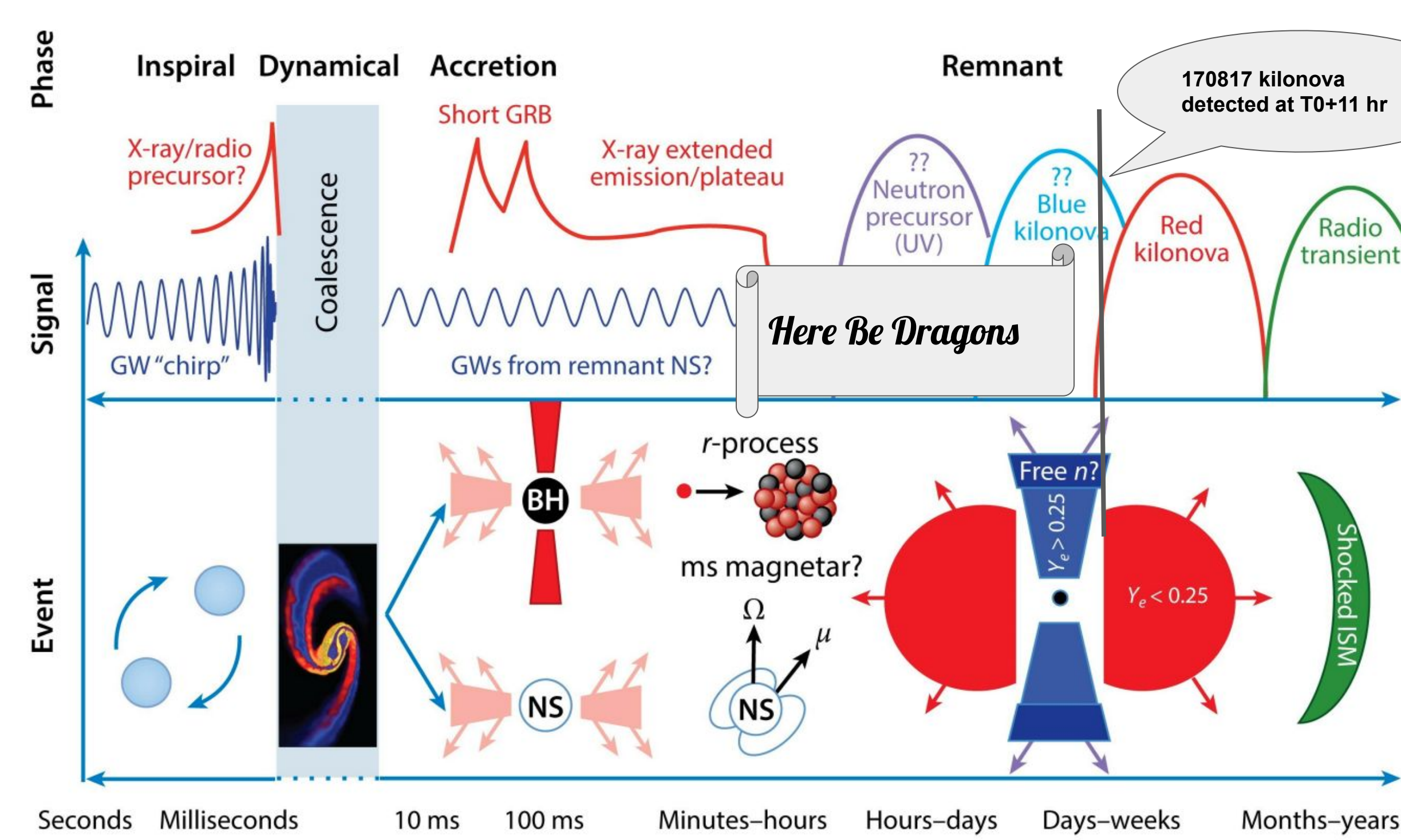
Observational access to early-time post merger environment!

## Problem

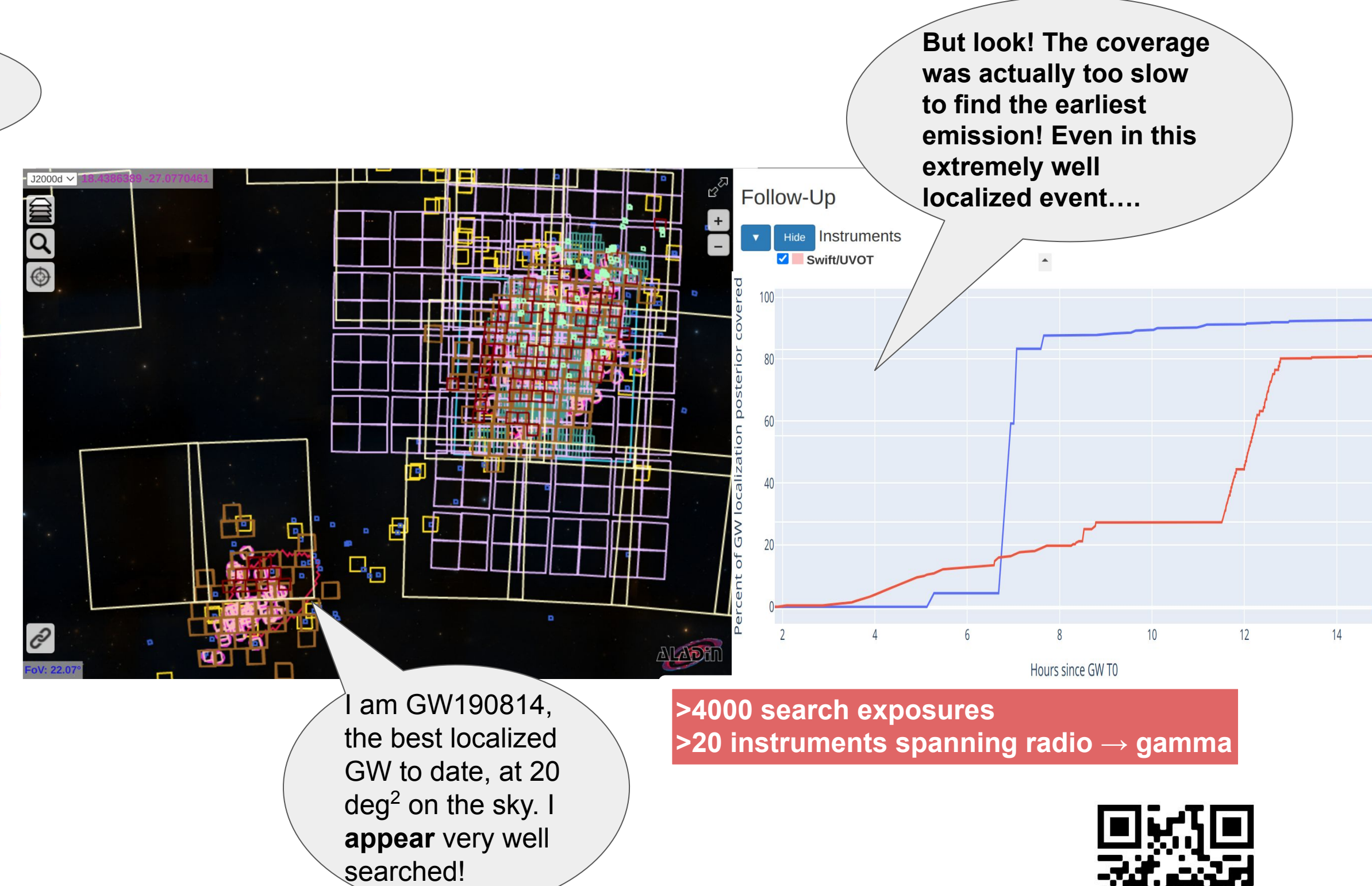
GW localizations **LARGE**, wide-field tiling **SLOW**, optical **DELAYED**

## Solution (?)

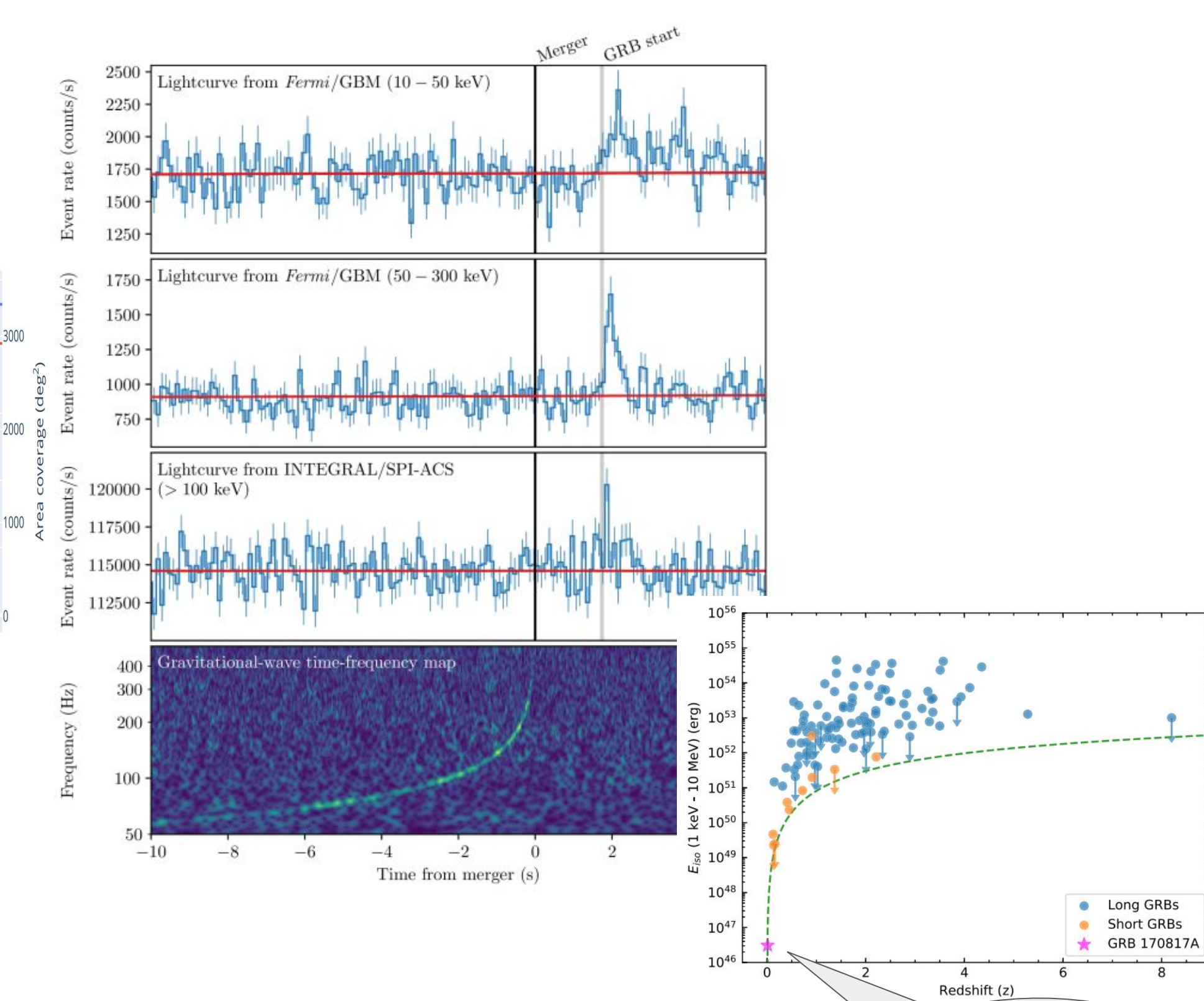
Use the earliest emission (gamma-rays) to localize



Fernandez+Metzger (2017)



GW Treasure Map (Wyatt, Tohuvavohu+ 2020): treasuremap.space

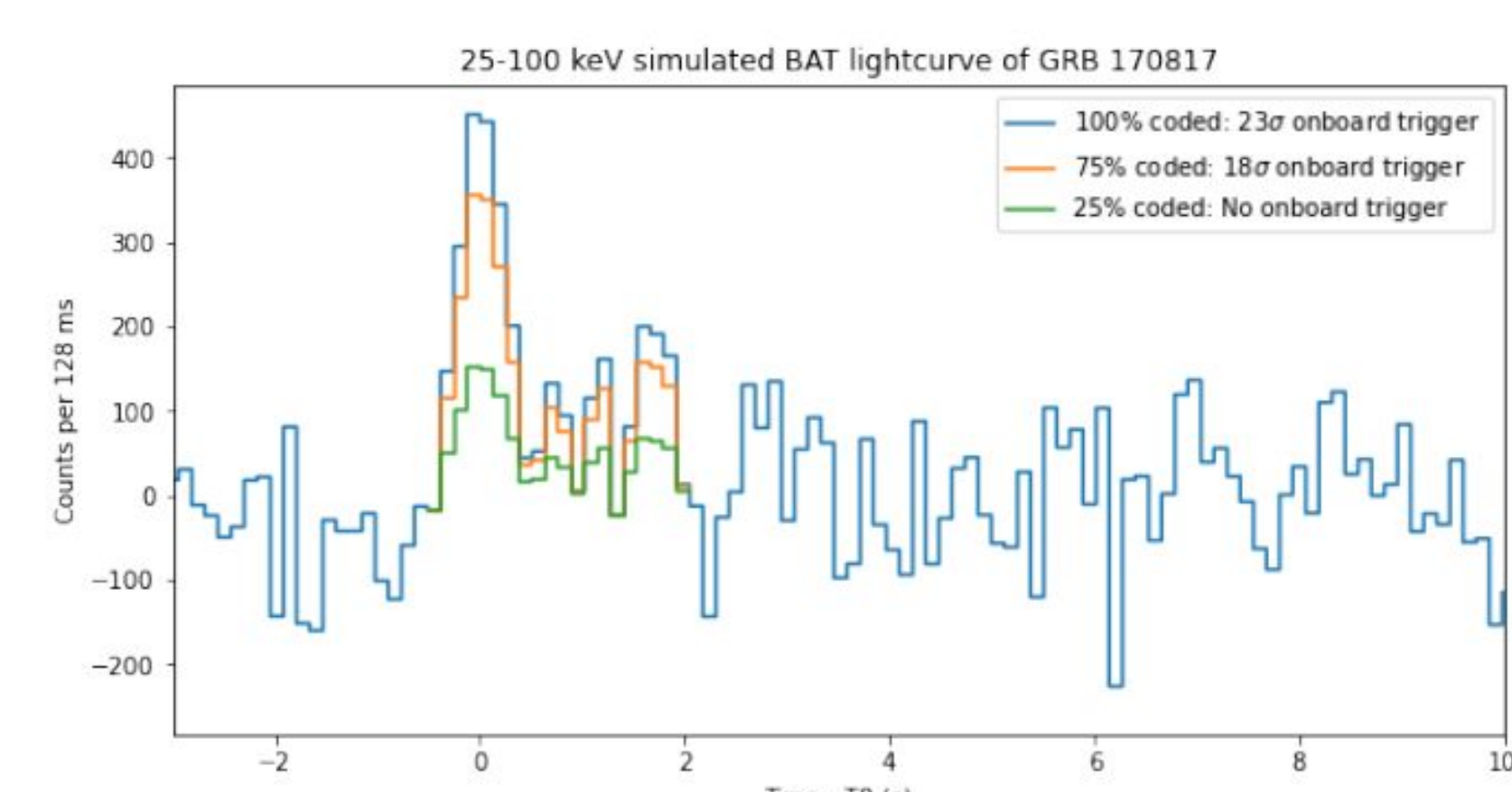


LVC, Fermi/GBM, INTEGRAL (2017).

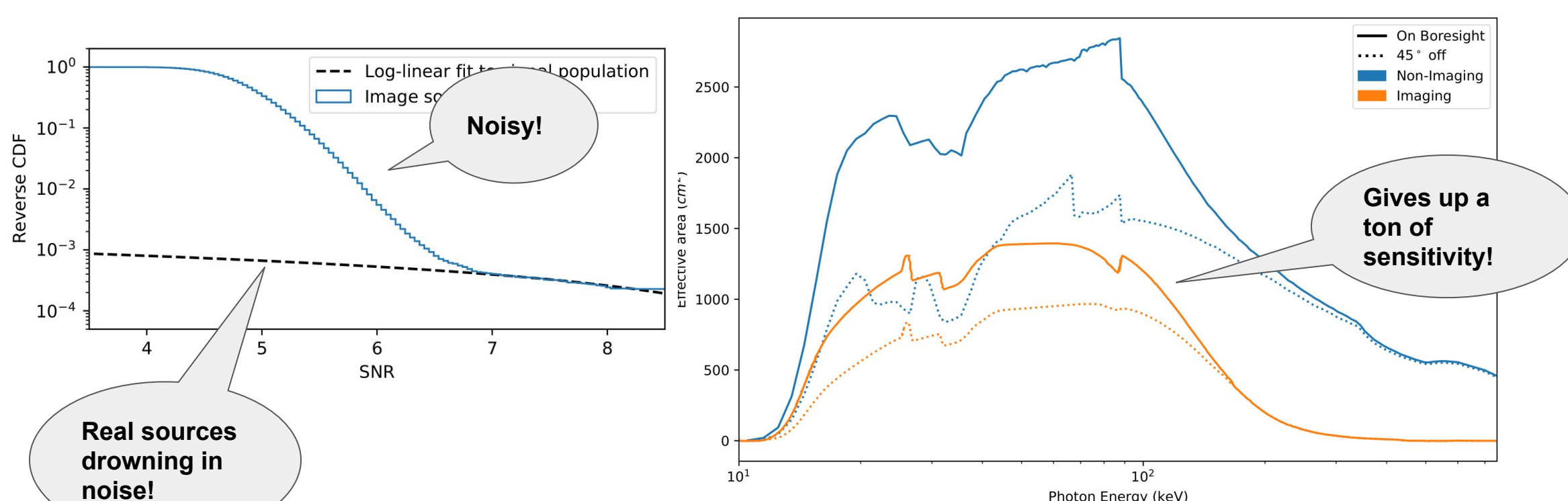
I am very faint, but if you find me, I'll lead you to dragons!

## But the GRB is

## WEAK



Swift/BAT is the most sensitive GRB detector, but Conventional cross-correlation coded aperture imaging is just not good enough:

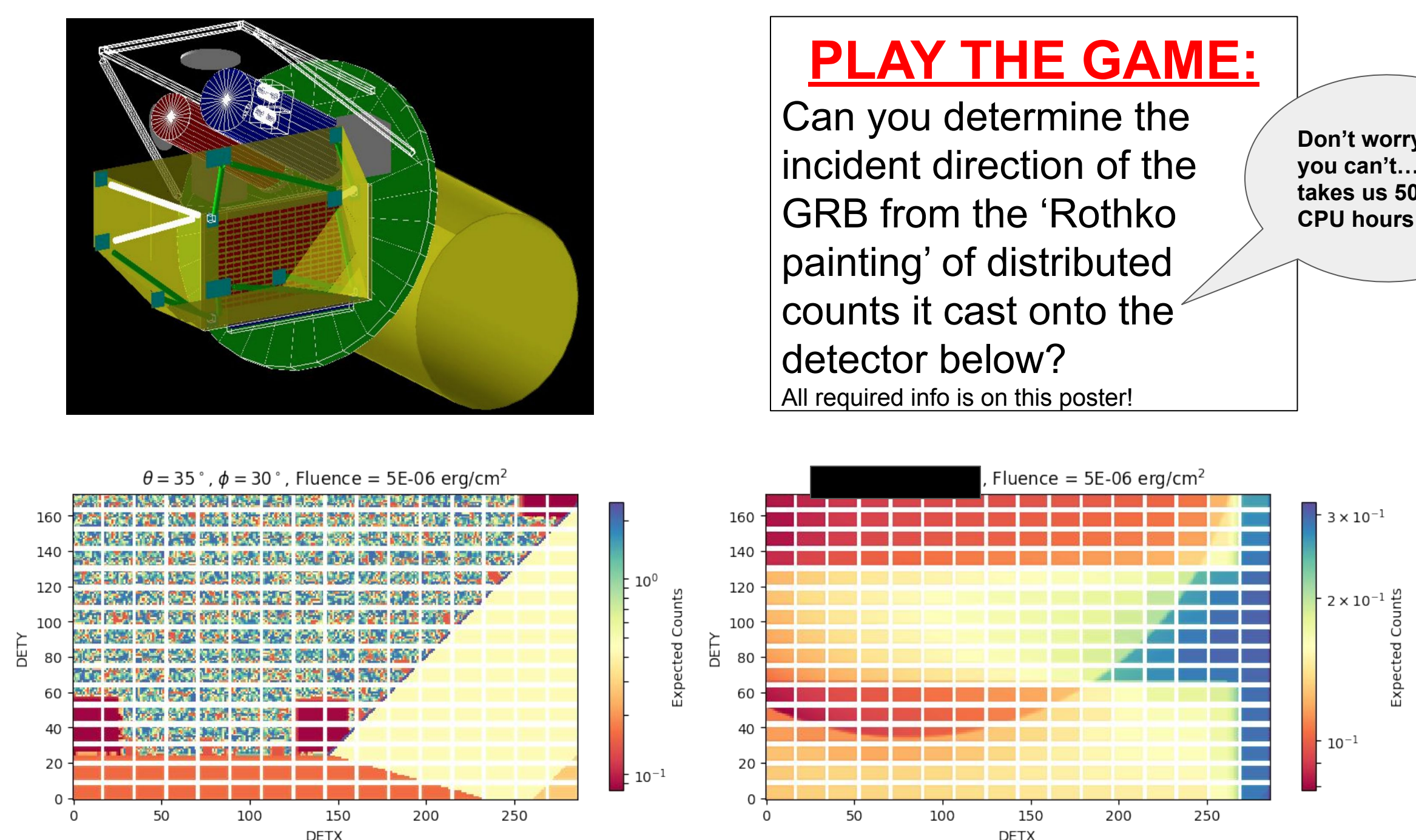


Want a method to retain full intrinsic instrument sensitivity, while also achieving the arcminute localizations imaging provides... Time to do some forward modelling!

### PLAY THE GAME:

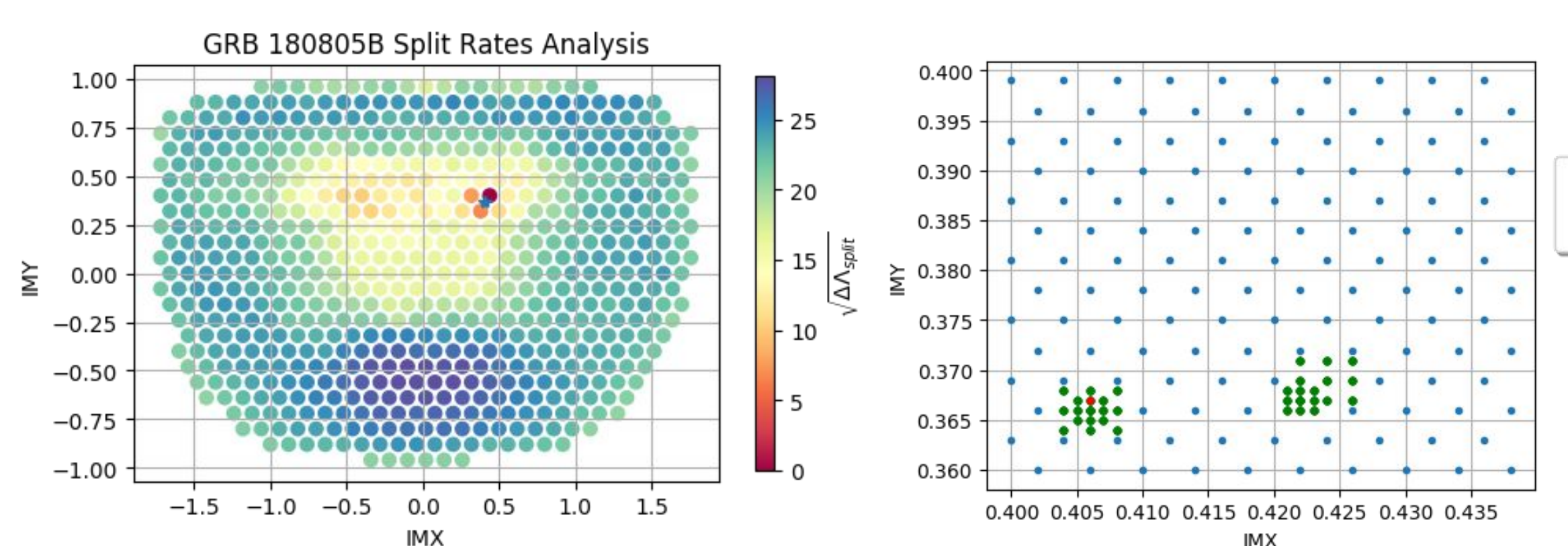
Can you determine the incident direction of the GRB from the 'Rothko painting' of distributed counts it cast onto the detector below? All required info is on this poster!

Don't worry if you can't... It takes us 500 CPU hours!



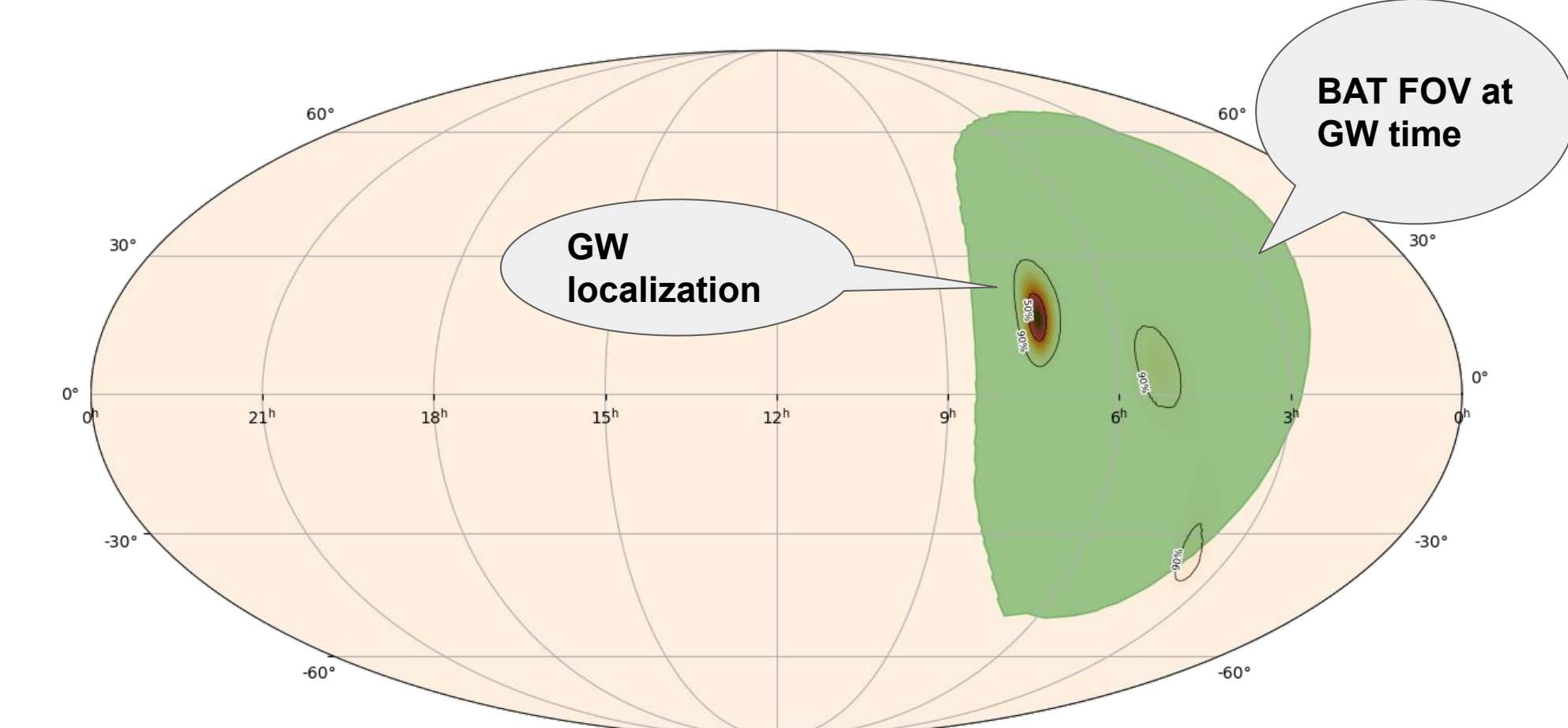
Turn this into a targeted search, by performing forward models over a grid on whole sky+spectral shape, and comparing observed data to simulated with a likelihood test:

**Non-Imaging Transient Reconstruction and Temporal Search (NITRATES)** arXiv:2111.01769  
**27 extra arcmin localized GRBs in 2 years**

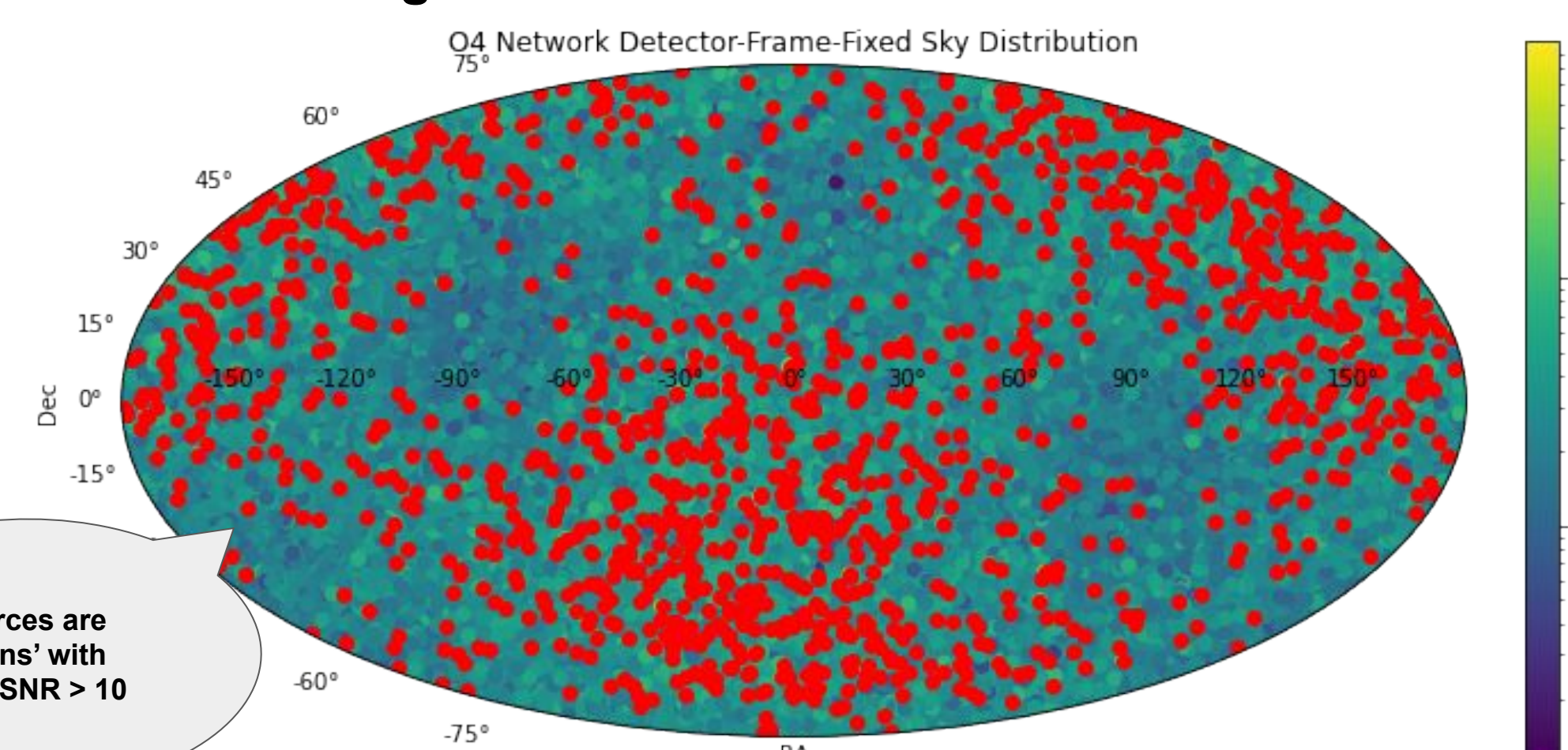


## and sky coverage INCOMPLETE

BAT coded Field-of-View only covers 1/3 sky, but sometimes we get lucky: LVC S200114f

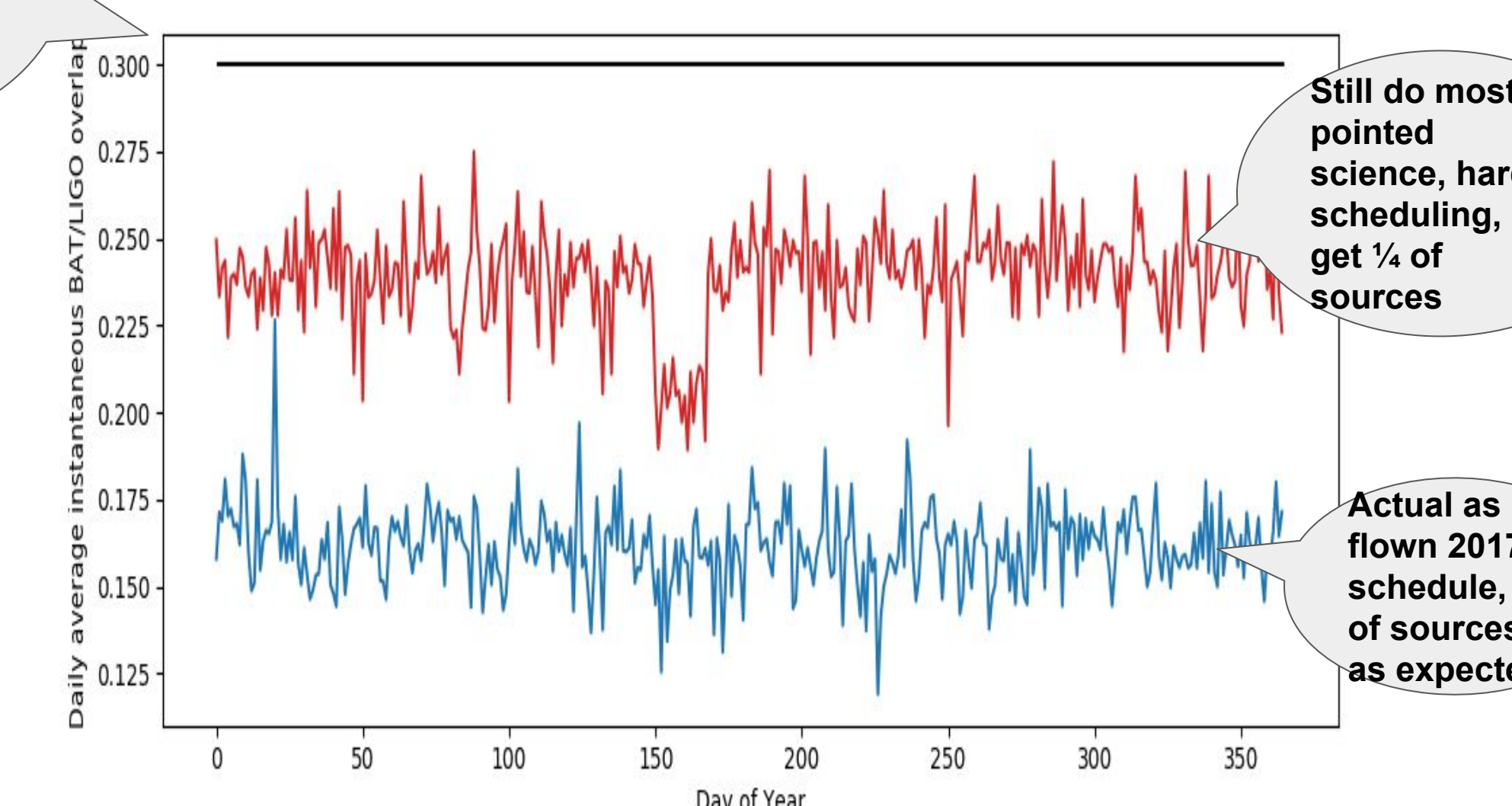


We can 'get lucky' more often by exploiting the structure of the GW network antenna pattern, and biasing the Swift schedule to follow it:



Red sources are 'detections' with network SNR > 10

Fraction of GW-detected sources in BAT FoV per day under different scheduling paradigms



But sometimes you have to be ready to act within seconds:

Come find me! Let's talk about operating space telescopes, building space telescopes, and (not) breaking space telescopes to achieve the Best Case Scenario! Also, data analysis.



GW detectors will soon be able to distribute BNS alerts, with rough localization, 10s of seconds before merger...

