Patrick's plans for O3

Gravity Exploration Institute – Away
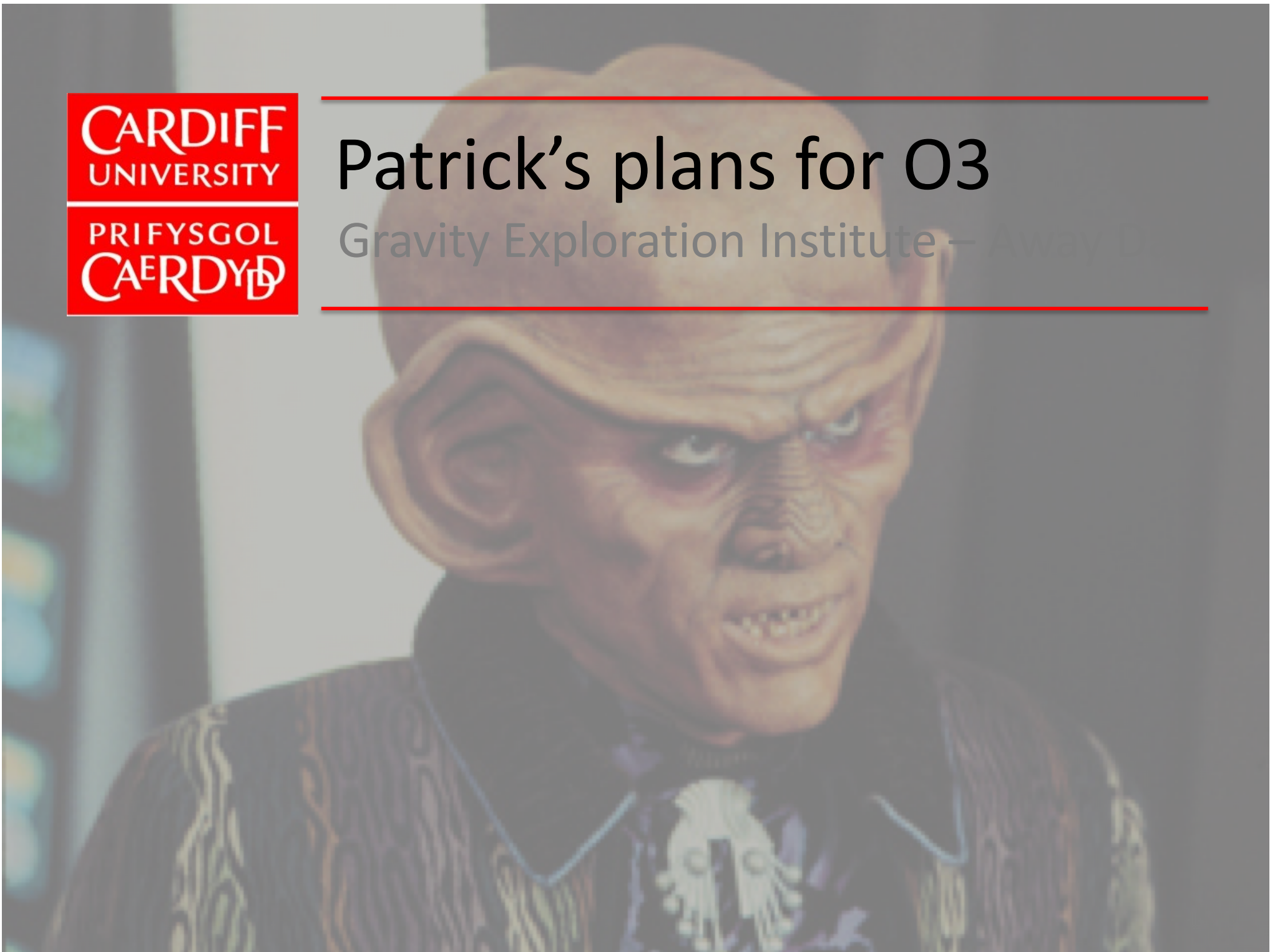
The Burst Group

The Burst Group

All-sky search (short & long duration)
IMBH Search
Cosmic strings
Isolated neutron star transients
Core-collapse supernovae
EOS with pre/post-merger GWs
Gamma-Ray Bursts (incl. FRBs)
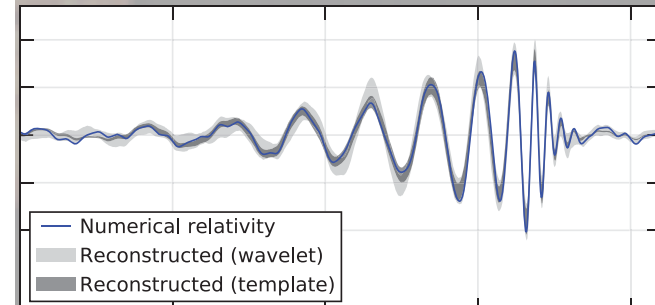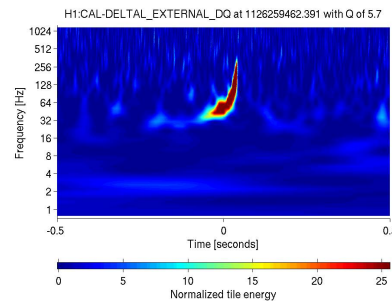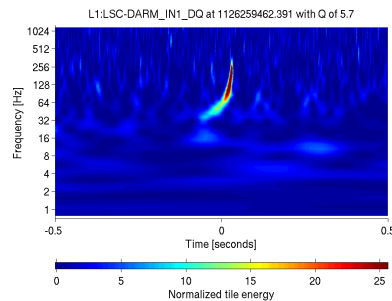High Energy Neutrinos

Bursts Landscape

(MY SUBJECTIVE OPINION)

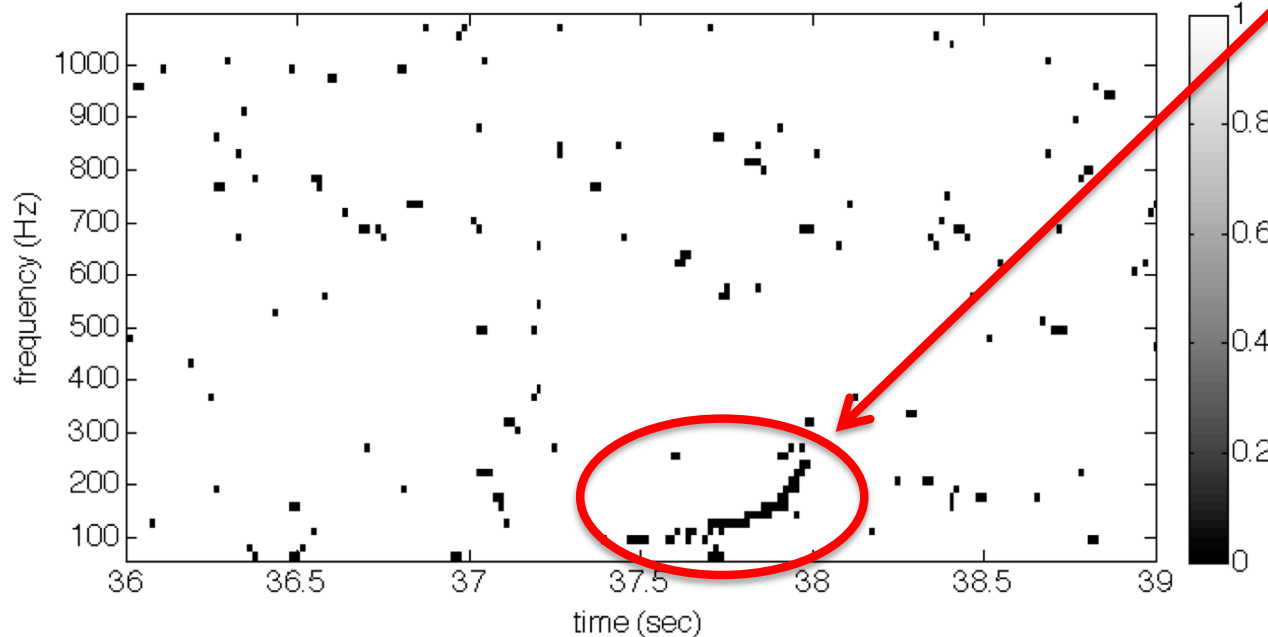| pipeline	Fast?	Good?	Who	Comment
cWB	Yes	Yes	Florida, Trento	800lb gorilla of bursts
oLIB	Yes	No	MIT	2cd all-sky pipeline
BayesWave	No	Yes	Montana, Alabama	waveform reconstruction
STAMP-AS	No	Yes	Stochastic	long-duration transients
X-Pipeline	No	Yes	Cardiff, Sheffield	external triggers

X in a Nutshell

- Read h(t) data for a network of detectors.

- Whiten, FFT.

- Sum FFTed data over detectors to make time-frequency maps of various energy measures.
  - detectors weighted by F+, Fx, S(f) in sums

- Threshold on map energy values; loud pixels are clustered together to form "events".
  - Each event characterised by peak time, duration, bandwidth, significance (w.r.t Gaussian noise), various energy measures.
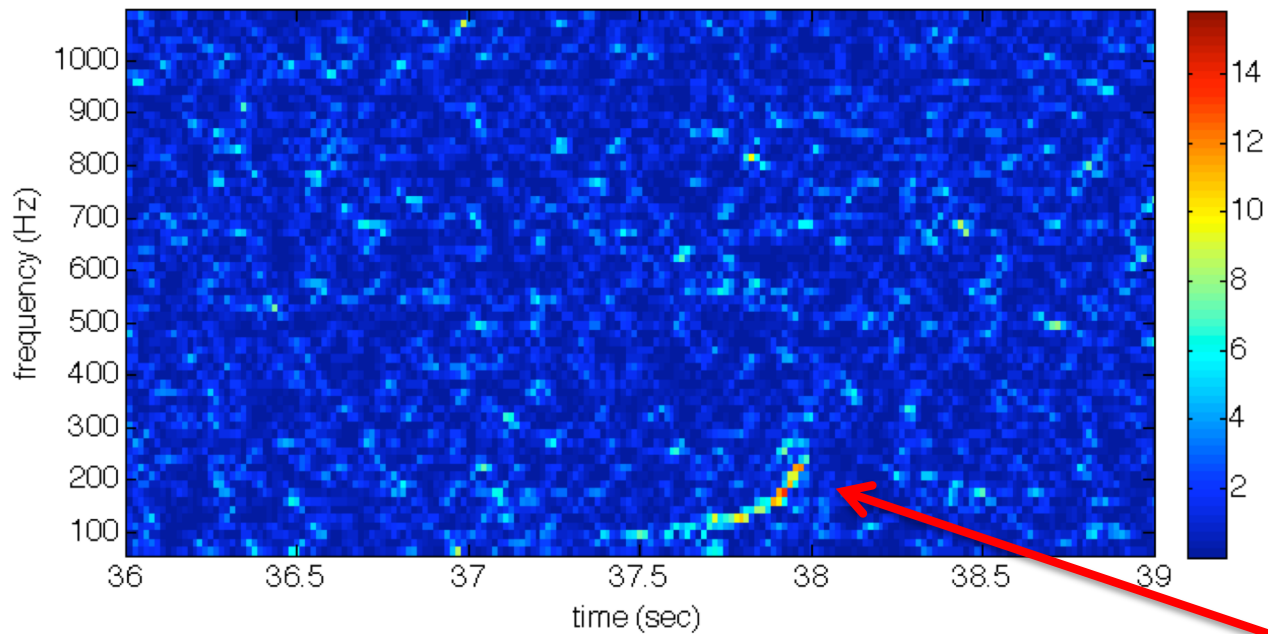
example
detection
statistic

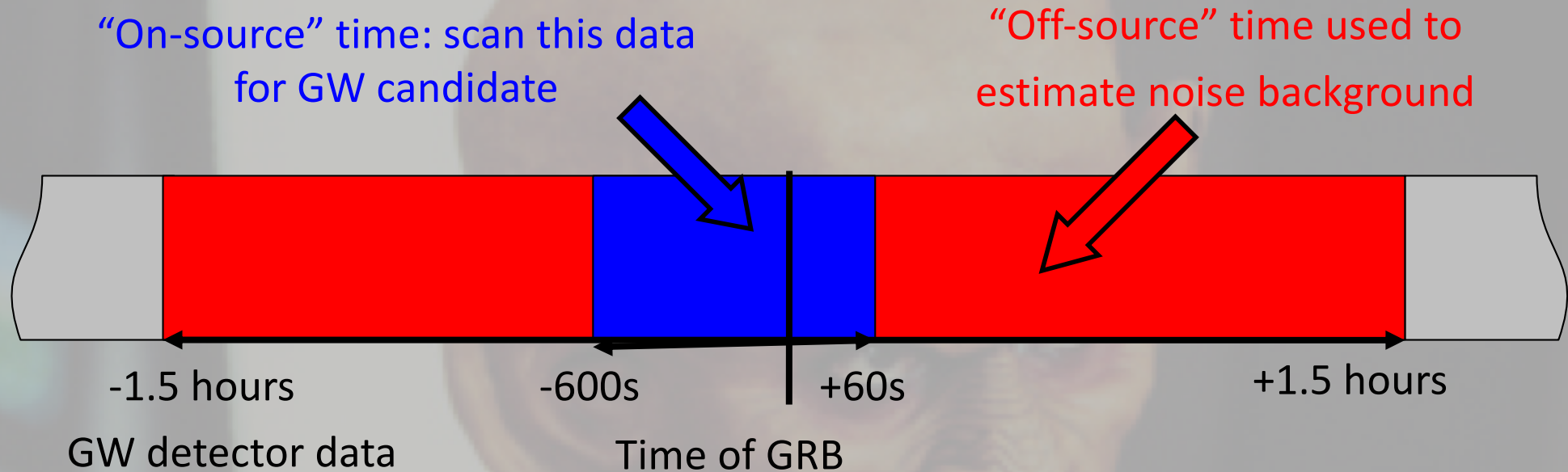map of estimated
$|h_+(f)|^2 + |h_x(f)|^2$
"maximum likelihood"

inspiral injection
in H1, H2 data

Events

(loudest 1% of pixels)

A GRB-triggered search

"On-source" time: scan this data for GW candidate

"Off-source" time used to estimate noise background

-1.5 hours

GW detector data

-600s

Time of GRB

+60s

+1.5 hours

- Estimate significance of on-source events by comparing to off-source.
  - Possible GW detection := significant event

- Estimate minimum detectable GW amplitude by adding simulated GWs to the on-source data and re-analysing.
  - Upper limit := signal amplitude/energy at which 90% of simulated GWs are louder than the loudest on-source event.
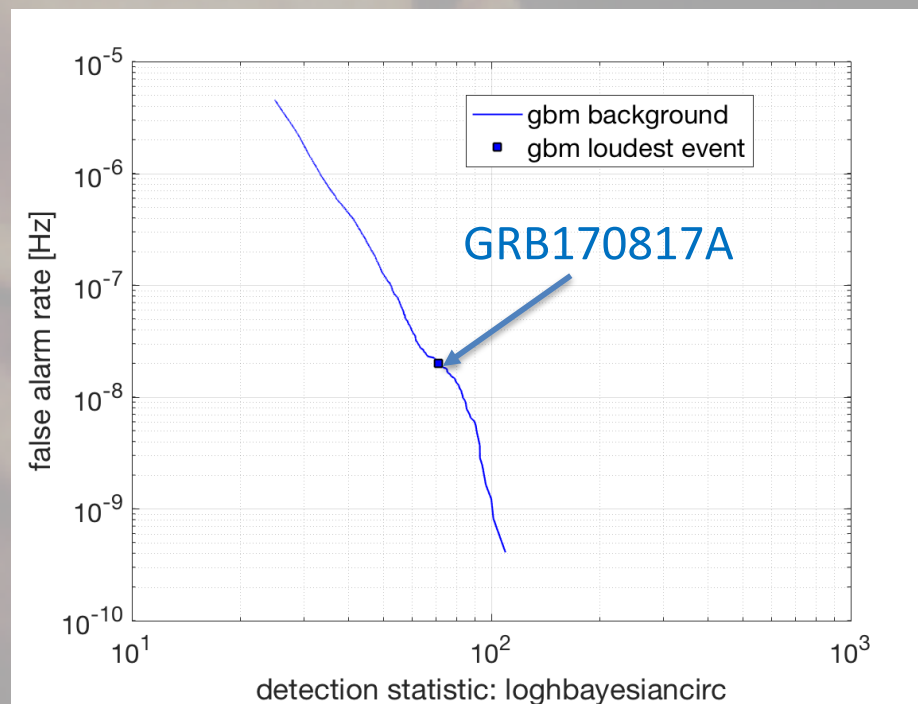
Background rejection

- Apply cuts to energies that measure correlation between detectors.
  - Cut thresholds determined automatically for each GRB by comparing background and simulation events.
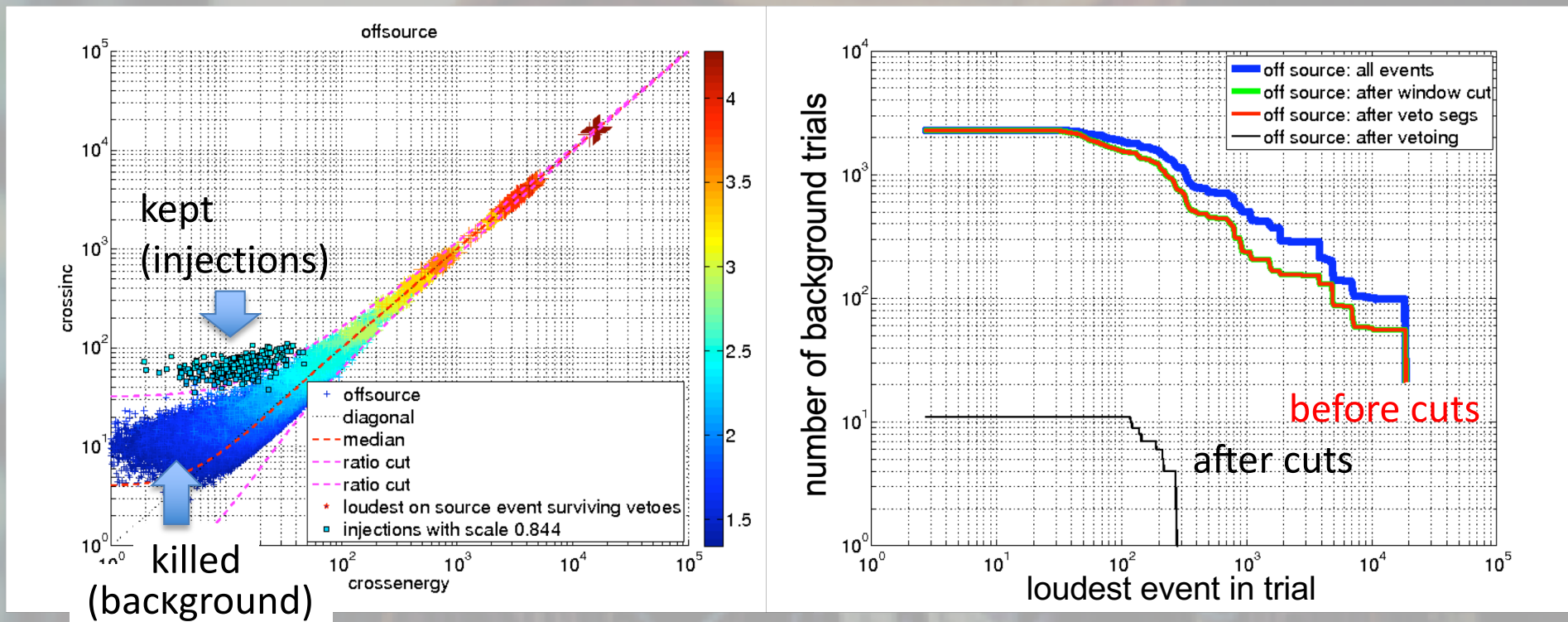
These techniques work
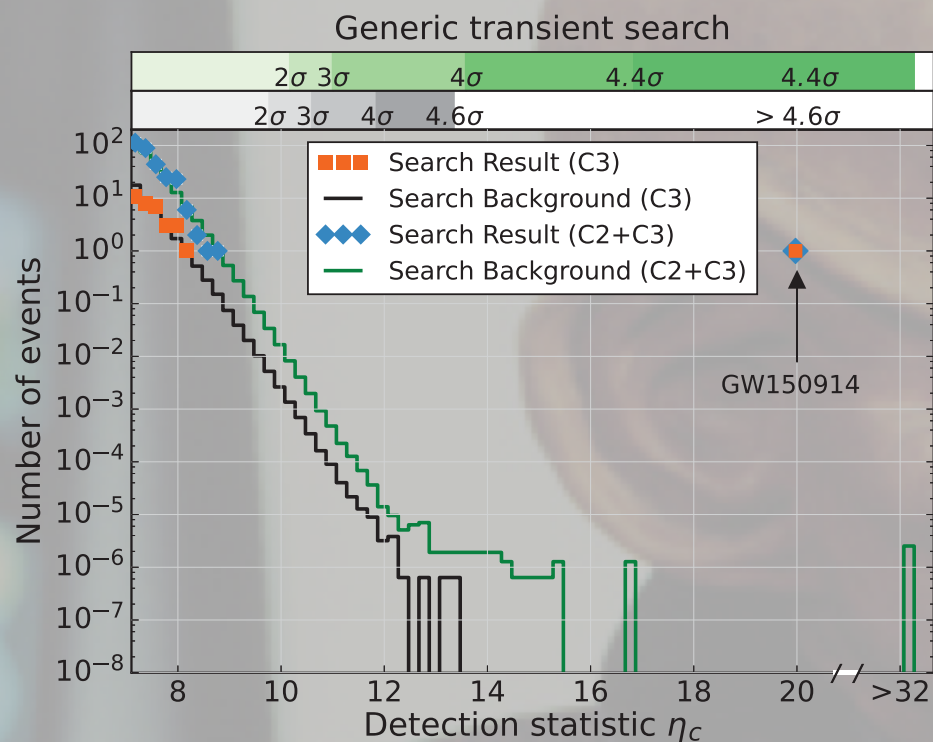
cWB on GW150914


X-Pipeline on GRB170817A

Cardiff burst activities

- **Vassilis:** Deep Neural Networks for burst detection

- **Scotty:** SNEWS triggered supernova search (X-Pipeline), also GravitySpy

- **Ronaldas**: burst signal interpretation & burst GRBs (X-Pipeline)

- **Iain:** multi-variate analysis (X-Pipeline), also CBC GRBs

- **Patrick:** X-Pipeline development, general ranting

X-Pipeline developments (me)

- Support for triggered searches (GRBs) and all-sky search (Sheffield)
  - Code improvements to post processing for speed, robustness, ease of development
  - More efficient use of injections (fewer)
- **Goals:** reduce latency time
  - GRB searches from ~1 day to a few hours
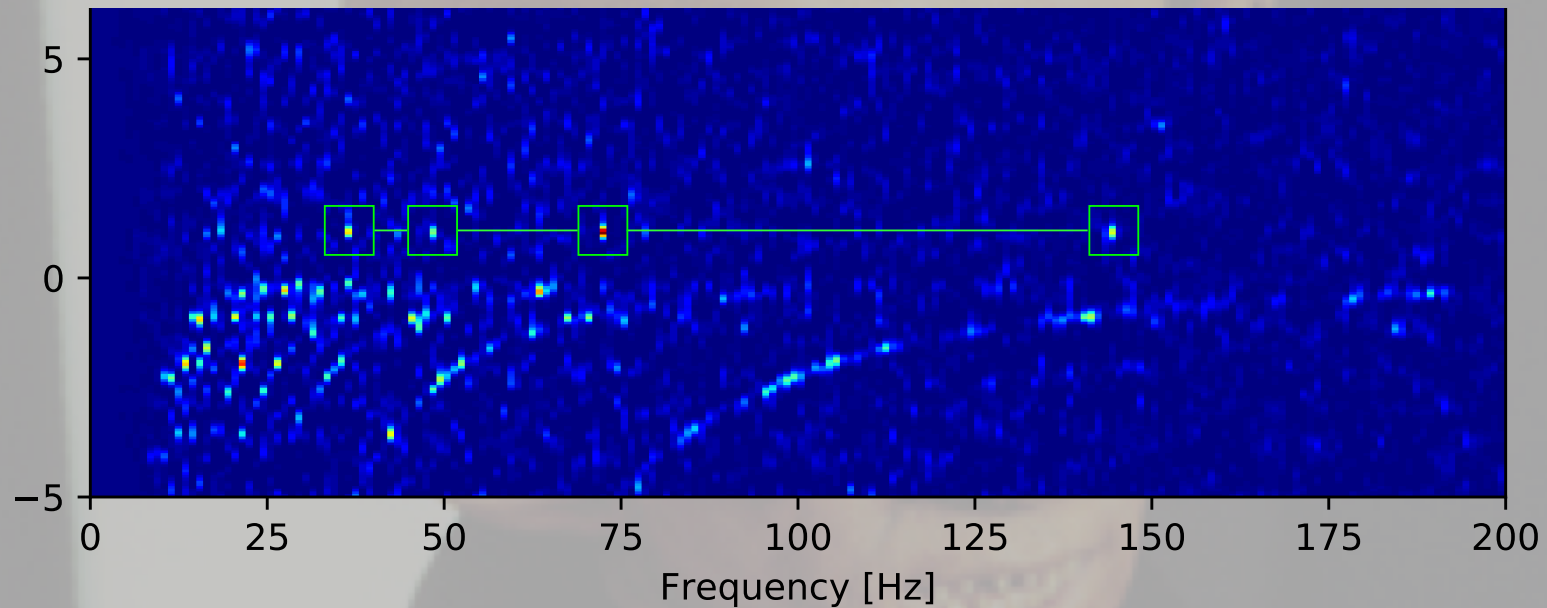 - SNEWS: aim for ~ 1 hour turn around

All-sky Neural Network Search (Vassilis)

- Use existing NN packages
- Train on HLV data ("colour images").
- **Goal:** day latency all-sky burst search.
  - Use existing X infrastructure for data finding, conditioning, etc.
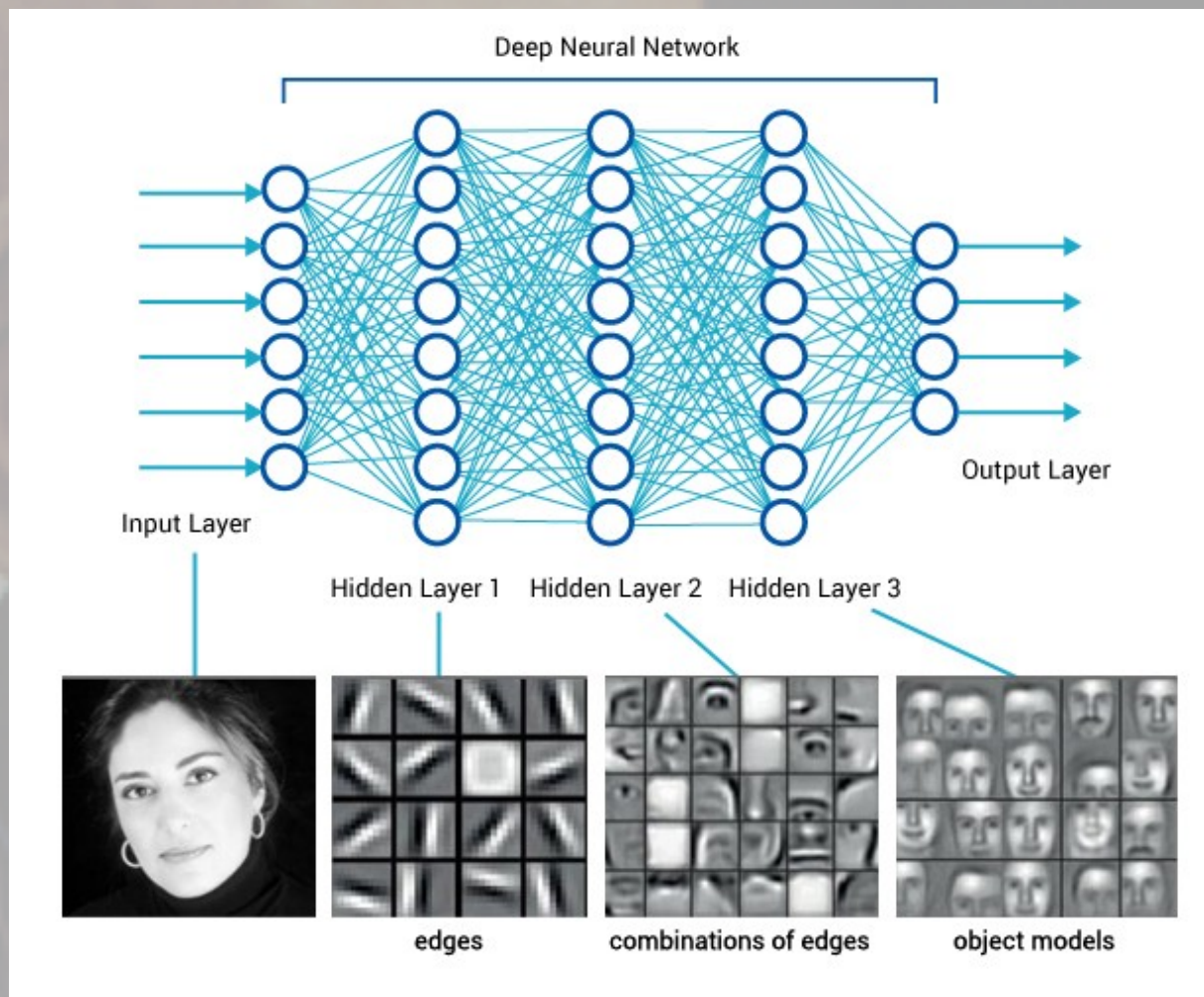
Echoes

- Look for post-merger echoes from BNS / NS-BH detections.

- Analysis simple & fast (~ CPU-day).
- **Now:** finish & publish GW170817 follow-up on pubic data.

- **O3 goals:** Repeat (quickly) for any further BNS / NS-BH detections.
- Low cost, speculative.