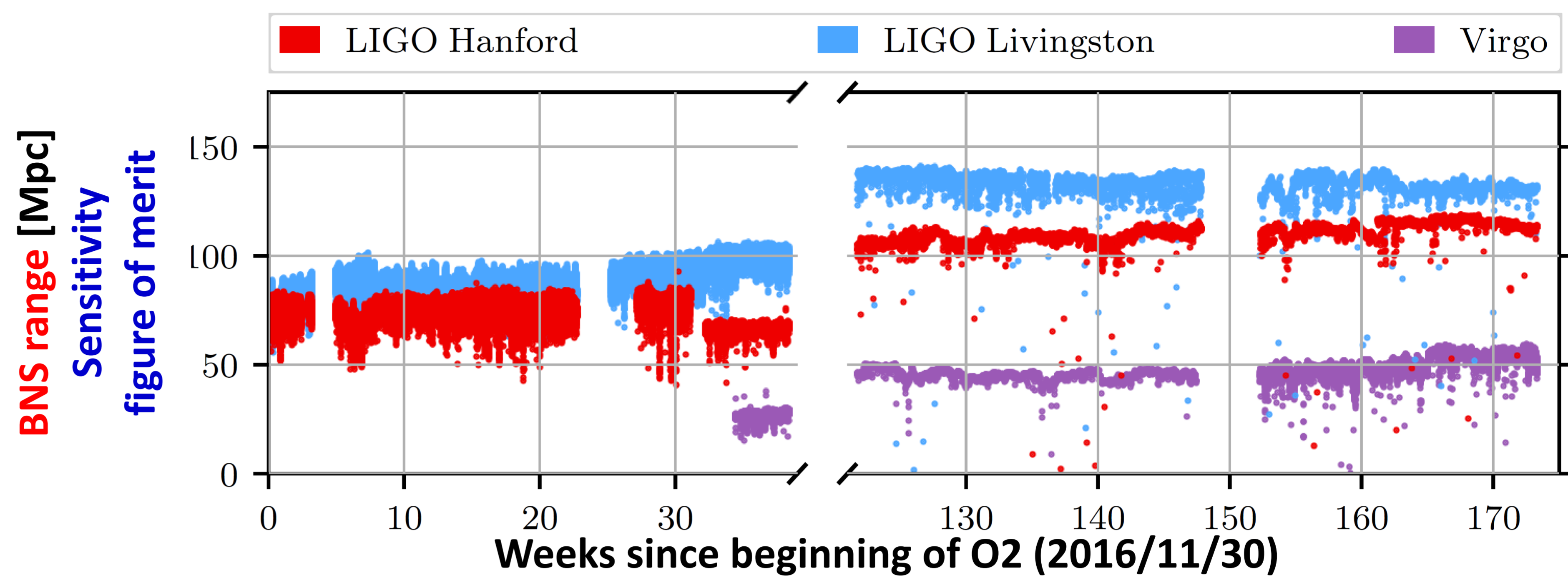# LIGO-Virgo detector characterization and data quality (DetChar): from the O3 performance to the preparation of O4

The LIGO-Virgo O3 run
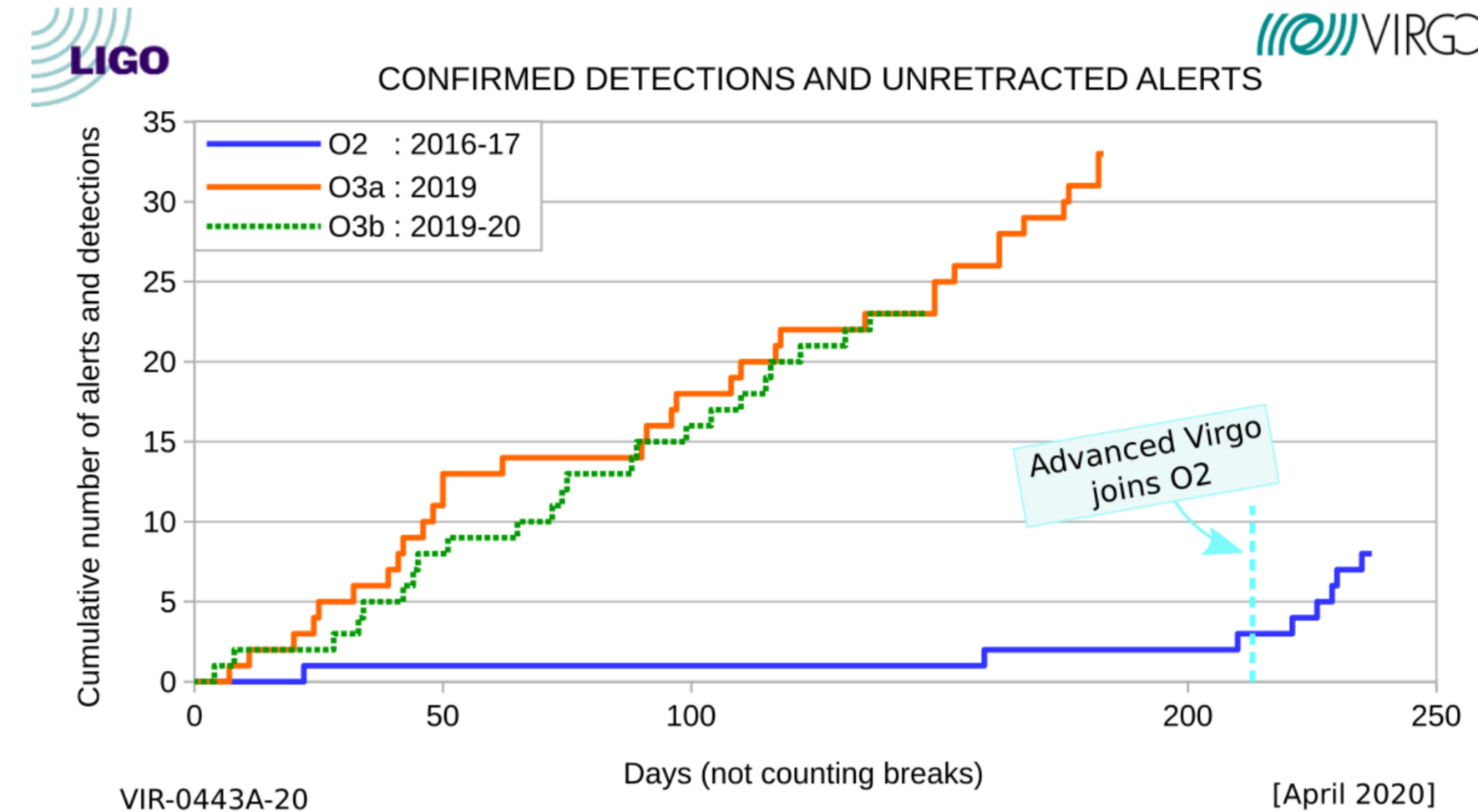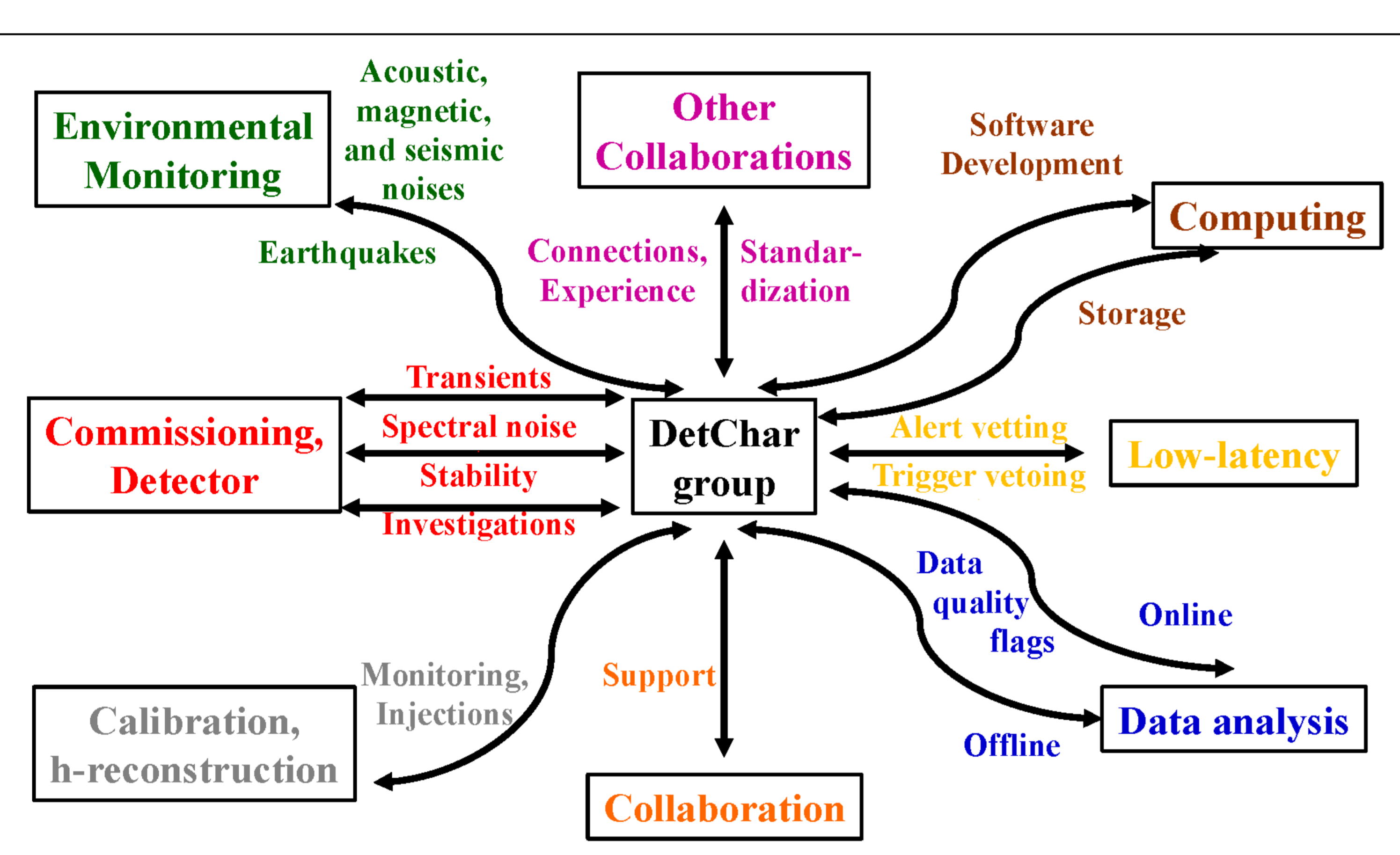
- **3-detector network:**
  LIGO Hanford, LIGO Livingston, Virgo
  → Improved sensitivities
  → Higher duty cycles
- **O3a:** 2019/04/01 → 2019/10/01
- **O3b:** 2019/11/01 → 2020/03/27
  - Early termination due to COVID-19
- **1-month commissioning break** in between O3a and O3b

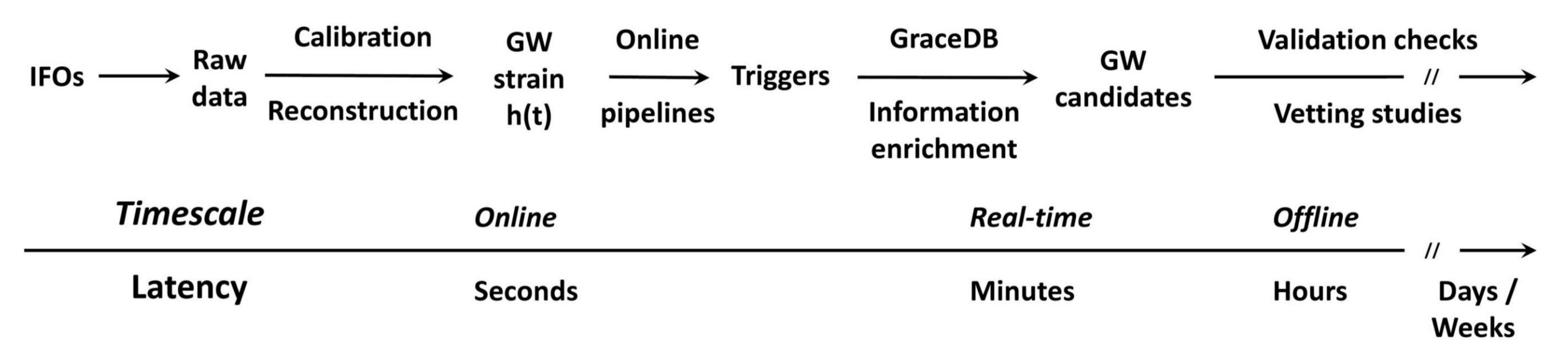| Configuration	3 detectors	At least 2	At least 1	None
O3-averaged duty cycle	47.4%	83.4%	96.7%	3.3%

→ O3a catalog: 39 events including a few "exceptional" ones`-- O3b analysis in progress

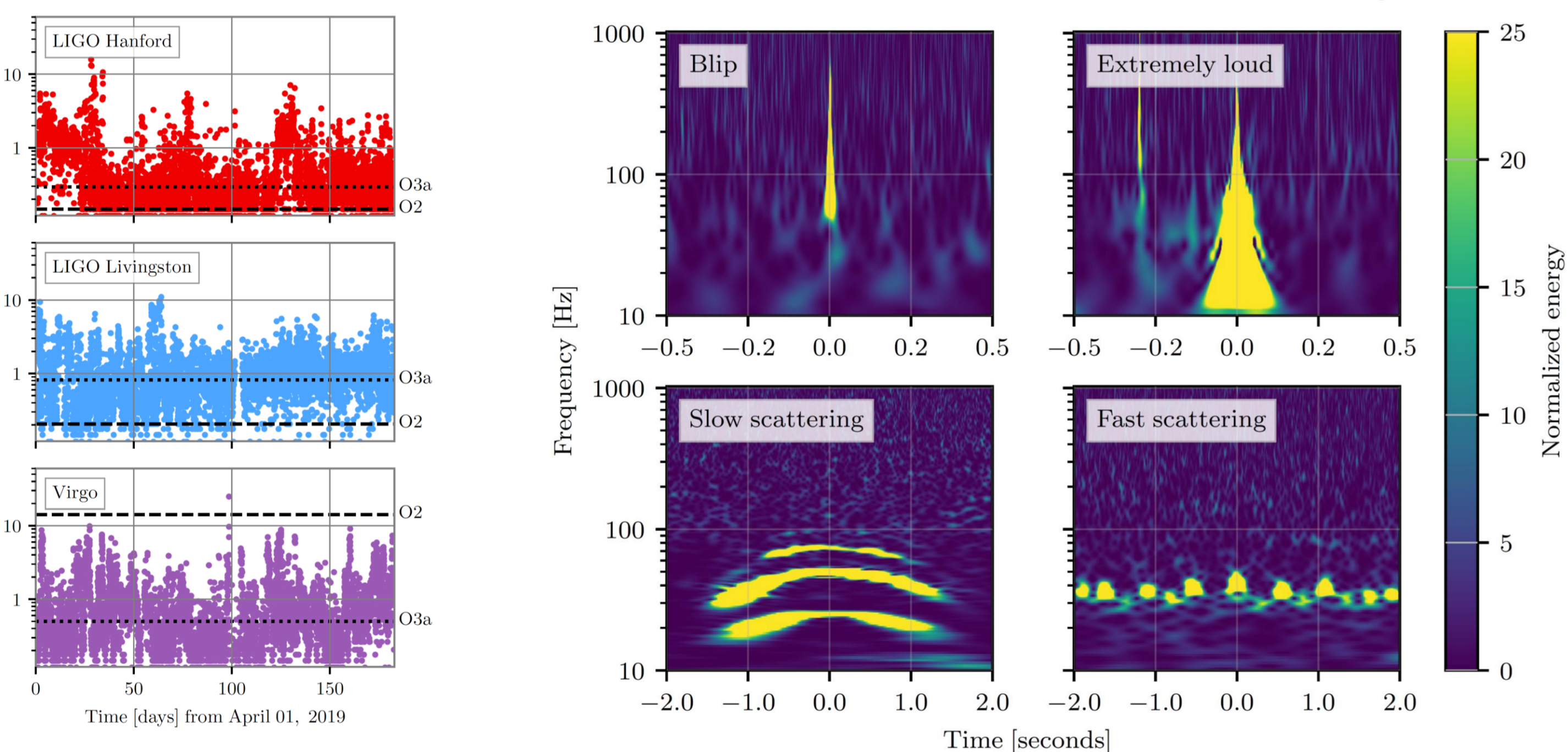## DetChar: a wealth of activities at the interface between instruments and data analysis

O3 public alerts:
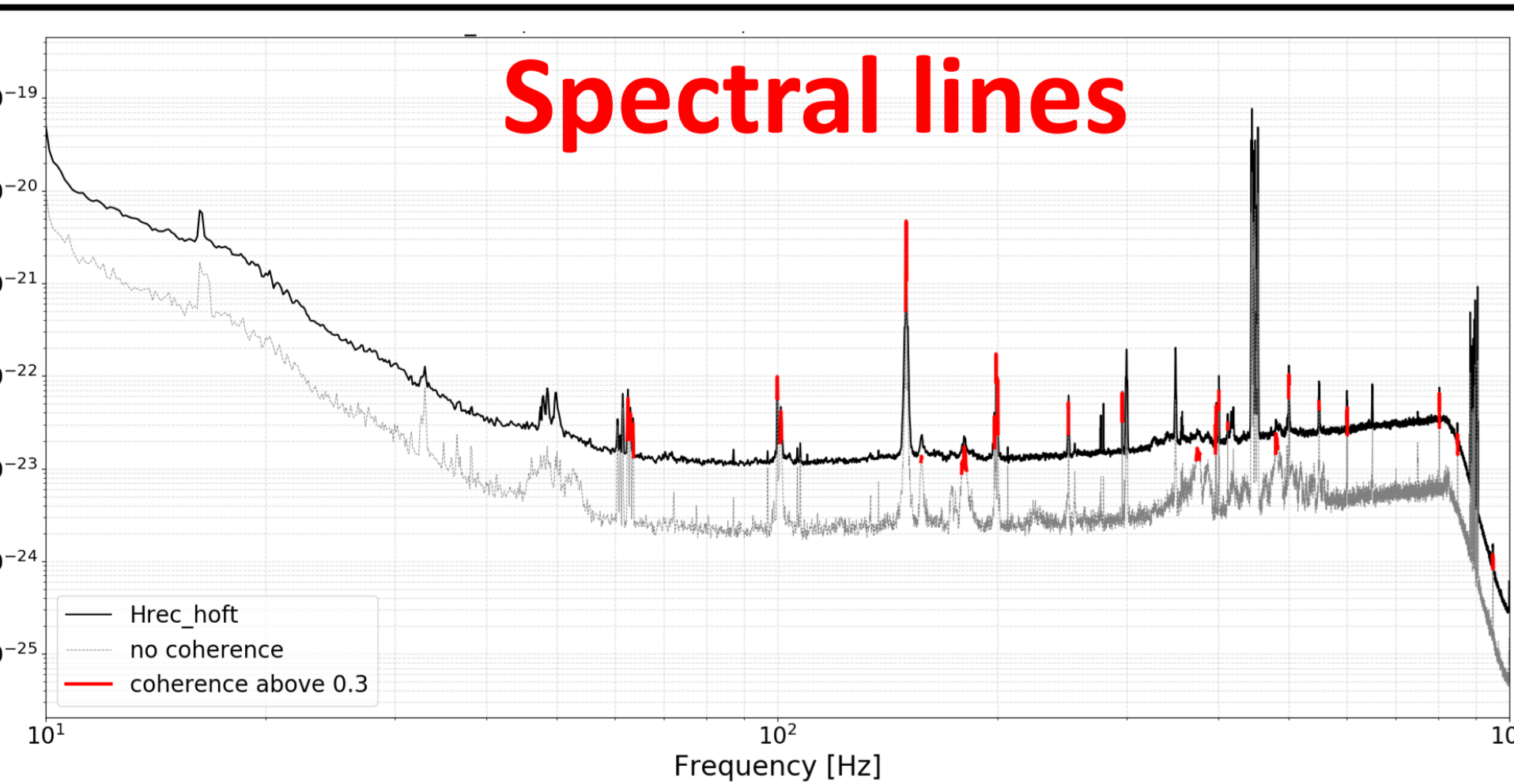- 56 non-retracted
- 24 retracted (8+16)

VIR-0443A-20 [April 2020]

Dataflow timeline: from detectors to detections

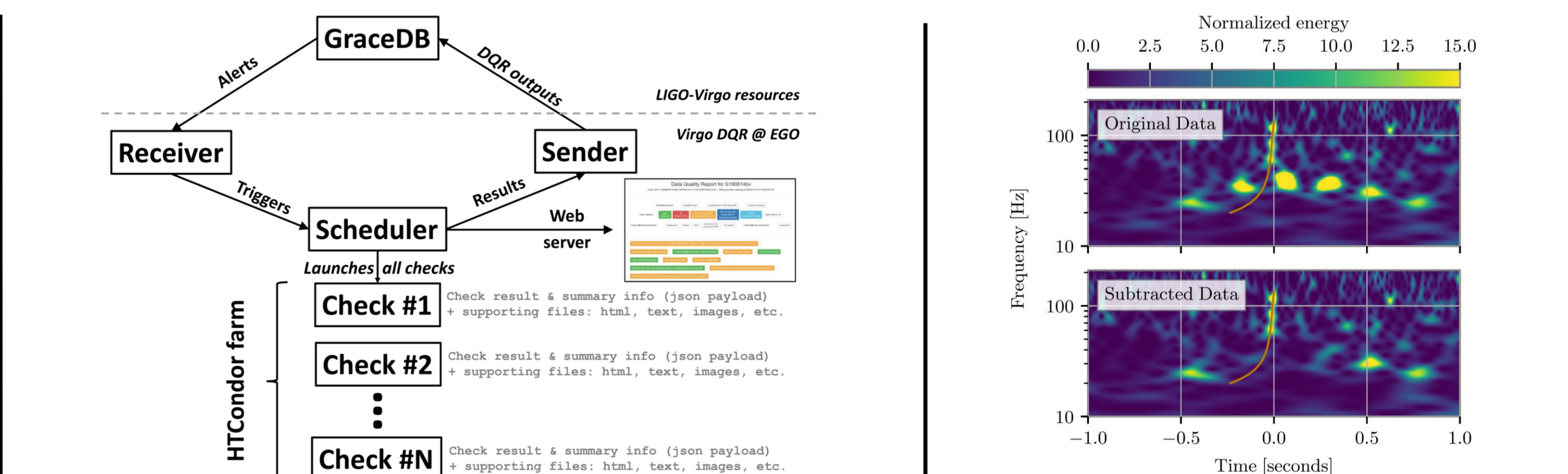### Glitches: noise transients with manifold signatures

Rate depends on control accuracy and environment (seismic, weather)

Classifications (e.g. based on spectrograms) help finding the origin of a family of glitches and thus mitigate their impact – or allow fixing their root cause at the instrument level

Automated frameworks are triggered by online candidates passing significance cuts: data check outputs are vet by a rapid-response team in charge of validating or retracting public alerts

Event validation procedures are used to clean data from glitches or artefacts before using them for source parameters estimation

At most ~1% (and often much less) online data removed by offline data quality checks to make the final dataset
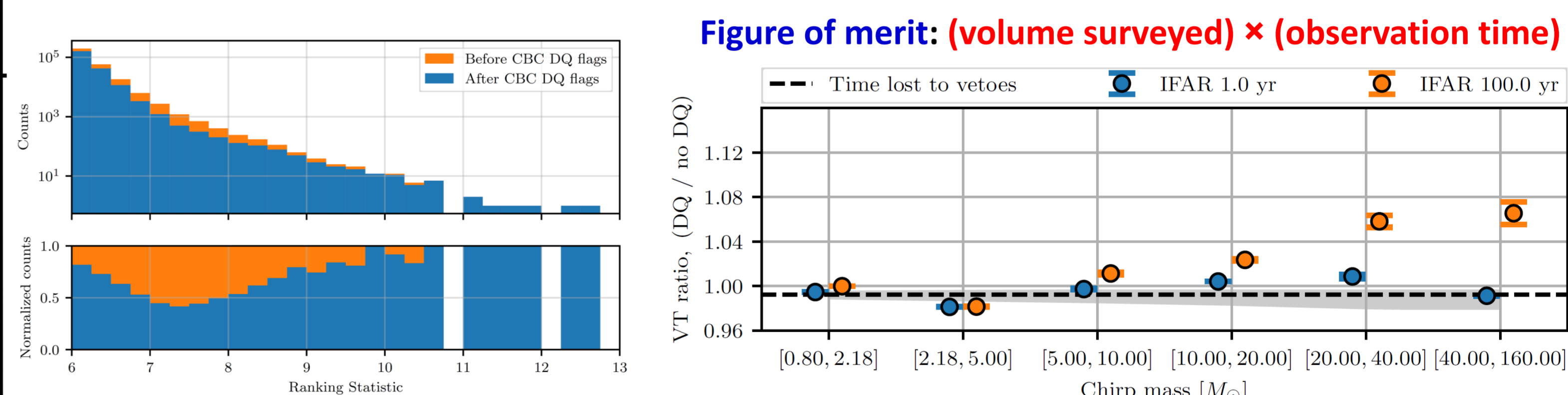
Spectral lines

Besides providing hints about glitch origin, auxiliary channels allow identifying spectral lines (permanent, transient or moving in frequency) in sensitivity

Figure of merit: (volume surveyed) × (observation time)

Analysis-tailored cuts and vetoes allow reducing the trigger rate, thus enhancing the sensitivity of the gravitational-wave searches

O4 run

- Expected start date: Summer 2022 (TBC)
- Duration: 12-18 months
→ Use shutdown time for improvements
  - Detector upgrades

O4 preparation

- Global: joint and coordinated among all groups
  → Operation & data analysis: including DetChar
- Expect a few times more events
  → More automation, lower latency

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On behalf of the LIGO & Virgo DetChar groups

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VIRGO · LSC