

Caractérisation des données

« DetChar »


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Visite de la délégation CNRS à EGO
August 28, 2018

VIR-0581A-18



Virgo data quality

- **Detector monitoring**
- **Noise characterization**
 - Transient noise
 - Spectral lines
- **Data quality reports** 
 - Commissioning team
 - Data analysis groups
- **Data quality flags and vetoes**
 - Define the ‘good for science’ datasets
 - Help reducing the background for the various search pipelines
- **Vet gravitational-wave candidates**
- **Interface with several other Virgo groups**
 - Noise hunting – see previous talk
 - Online
 - Commissioning, data analysis searches
- + **the LIGO DetChar group**
 - Common tools
 - Similar checks
 - Separate framework

A wide set of tools: a few examples

- **Virgo Interferometer Monitoring**

- Example: 2017/08/17

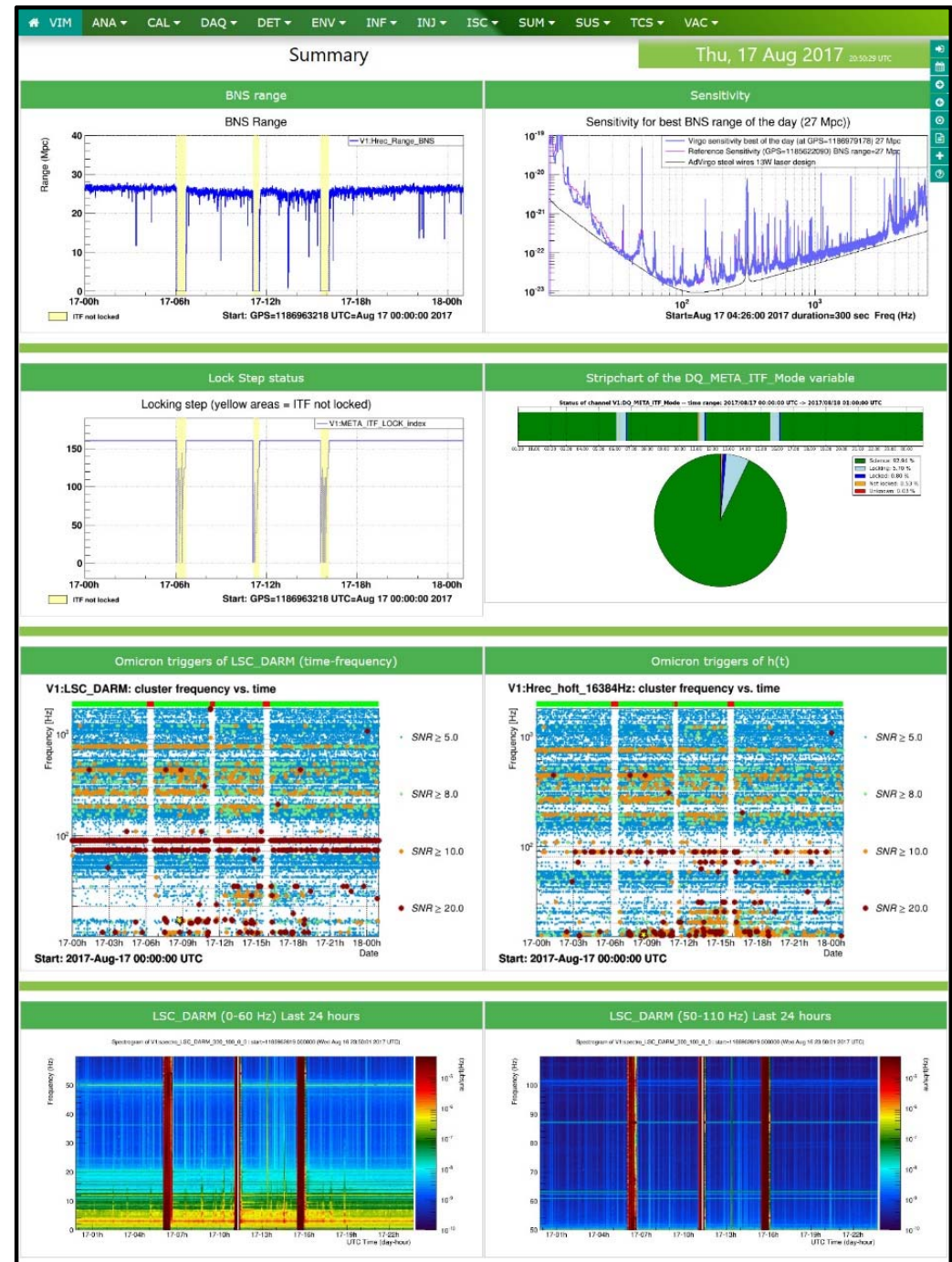
- **Large set of plots**

- Updated every half hour
- Arranged by category
- Archived

→ Subset of these plots public in real time during science runs:

<http://www.virgo-gw.eu/status.html>

- Bookmark URL and browse next year!



A wide set of tools: a few examples

- **Detector Monitoring System**

- Snapshot around GW170817

DMS		ITF Mode: Science (0d 1h 4m 25s)			ITF State: LOW_NOISE_3 (0d 1h 7m 35s)		UTC: 2017-08-17 12:41:02	
Injection	IB_IP	IB_BENCH	IB_BR	IB_Vert	IB_TE	IB_Guard	IB_Electr	
	MC_IP	MC_PAY	MC_BR	MC_Vert	MC_TE	MC_Guard	MC_Electr	
	Laser		LaserAmpli		LaserChiller		SL_TempController	RFC
	MC_Power	PSTAB	IMC_AA	IMC_AA_GALVO	MC_F0_z	BPC	BPC_Electr	
Detection	PD	QPD_B1p	QPD_B2	QPD_B5	QPD_B4	OMC	PicoDisable	
	SDB1_IP	SDB1_LC	SDB1_BR	SDB1_Vert	SDB1_TE	SDB1_Guard	SDB1_Electr	
ISC	B2_8_phi		B4_56_phi		DARM_UGF		SSFS_DigNoise	UNLOCK
	B1p_DC		B4_112MHz_MAG			B7_DC		B8_DC
Suspensions	BS_IP	BS_F7	BS_PAY	BS_BR	BS_Vert	BS_TE	BS_Guard	BS_Electr
	NI_IP	NI_F7	NI_PAY	NI_BR	NI_Vert	NI_TE	NI_Guard	NI_Electr
	NE_IP	NE_F7	NE_PAY	NE_BR	NE_Vert	NE_TE	NE_Guard	NE_Electr
	PR_IP	PR_F7	PR_PAY	PR_BR	PR_Vert	PR_TE	PR_Guard	PR_Electr
	SR_IP	SR_F7	SR_PAY	SR_BR	SR_Vert	SR_TE	SR_Guard	SR_Electr
	WI_IP	WI_F7	WI_PAY	WI_BR	WI_Vert	WI_TE	WI_Guard	WI_Electr
Environment	WE_IP	WE_F7	WE_PAY	WE_BR	WE_Vert	WE_TE	WE_Guard	WE_Electr
	CB_HALL	MC_Hall	TCS_zones	NE_Hall	WE_Hall	WindActivity	Seismon	BRMSMon
Infrastructures	INJ_Area	DET_Area	EERoom	External	DeadChannel	Lights	SeaActivity	
	ACS_CB_Hall	ACS_TB	ACS_DAQ_Room	ACS_EE_Room	ACS_MC	ACS_INJ	ACS_DET	ACS_NE
SBE	UPS_TB	UPS_MC	UPS_NE	UPS_WE	FlatChannel	ExistChannel	ACS_WE	
	SDB2_SBE	SDB2_LC	SNEB_SBE	SNEB_LC	SWEB_SBE	SWEB_LC	SPRB_SBE	SPRB_LC
Vacuum	LargeValves	Clean_Air	TubeServers	TubePumps	TowerServers	MiniTowers	RemDryPMP	
	Pressure	CompressedAir	CryoTrap	O2_Sensors	TankLN2	TurboLinks		
VPM	DetectorSEnvironme	ControlRoom	Minitowers	ISC	Injection	TCS	Suspension	Vacuum
	DetectorMonitoring	DataCollection	Storage	DataAccess	Automation	DetChar		
DAQ-Computing	Latency	Disk	Timing	ADCs_Temperature	Daq_Boxes_Temperatures	NoiseInjection		
ITFOnCall	SoftwareAI		TemperaturesAI		InjectionAI		UpsAI	
Triggers	TripleCoincidences							

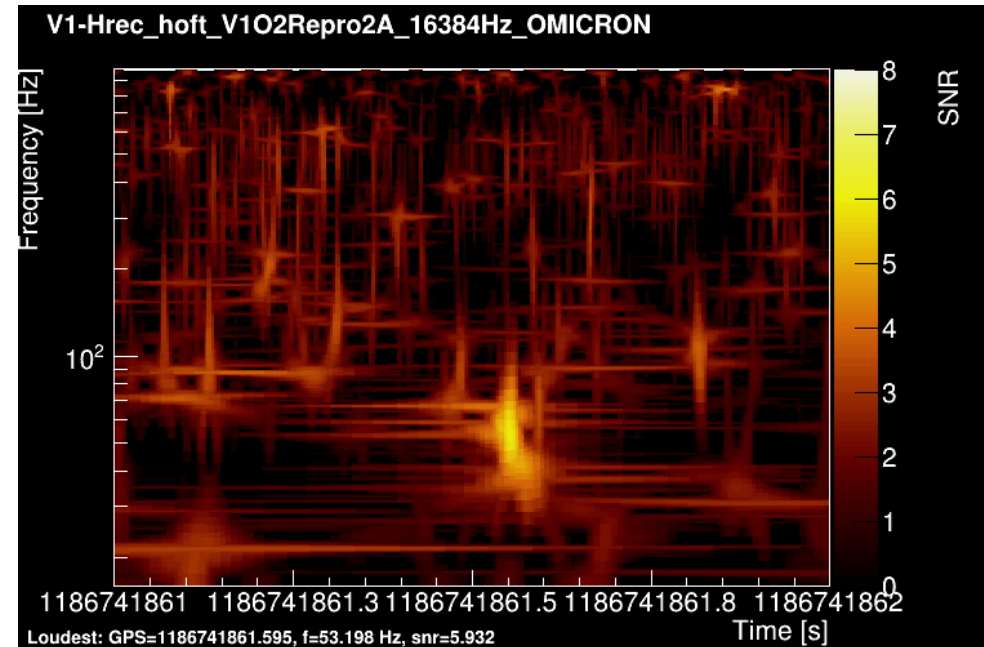
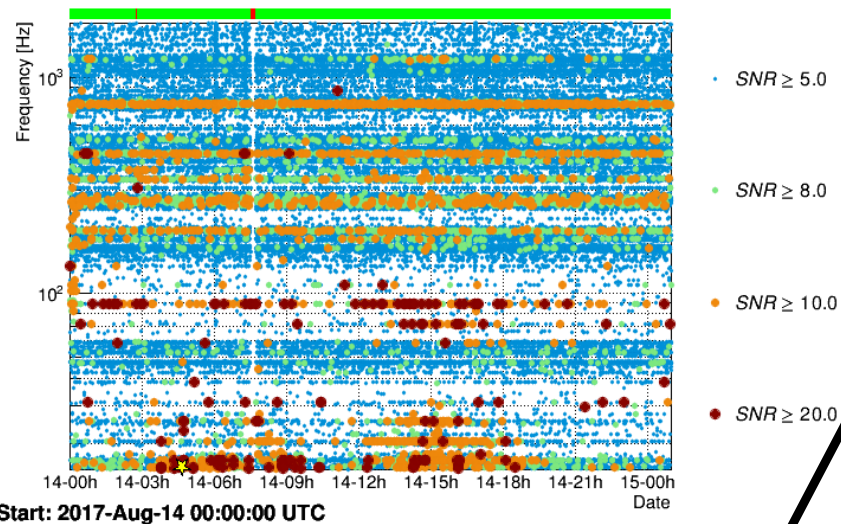
- **Real-time status** of all detector components
- **Hierarchical structure** to find the actual cause of a top-level alarm

- **Archives** accessible in playback mode

A wide set of tools: a few examples

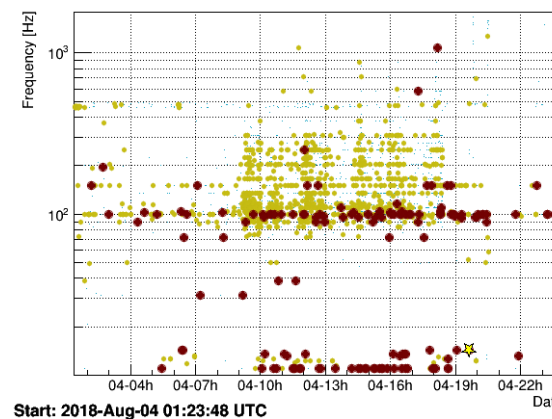
- Glitch monitoring: **Omicron**
 - Analysis of transient bursts of noise in the time-frequency plane
→ Virgo data for GW170814
- **Patterns** visible on hour-long timescale

V1:Hrec_hoft_16384Hz: cluster frequency vs. time

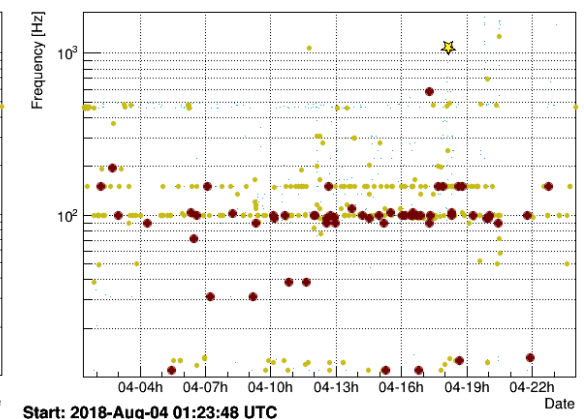


- Scan auxiliary channels
 - Look for glitches in **coincidence**
→ **Veto** recipes
 - Trade-off: **efficiency vs. deadtime**

Before veto

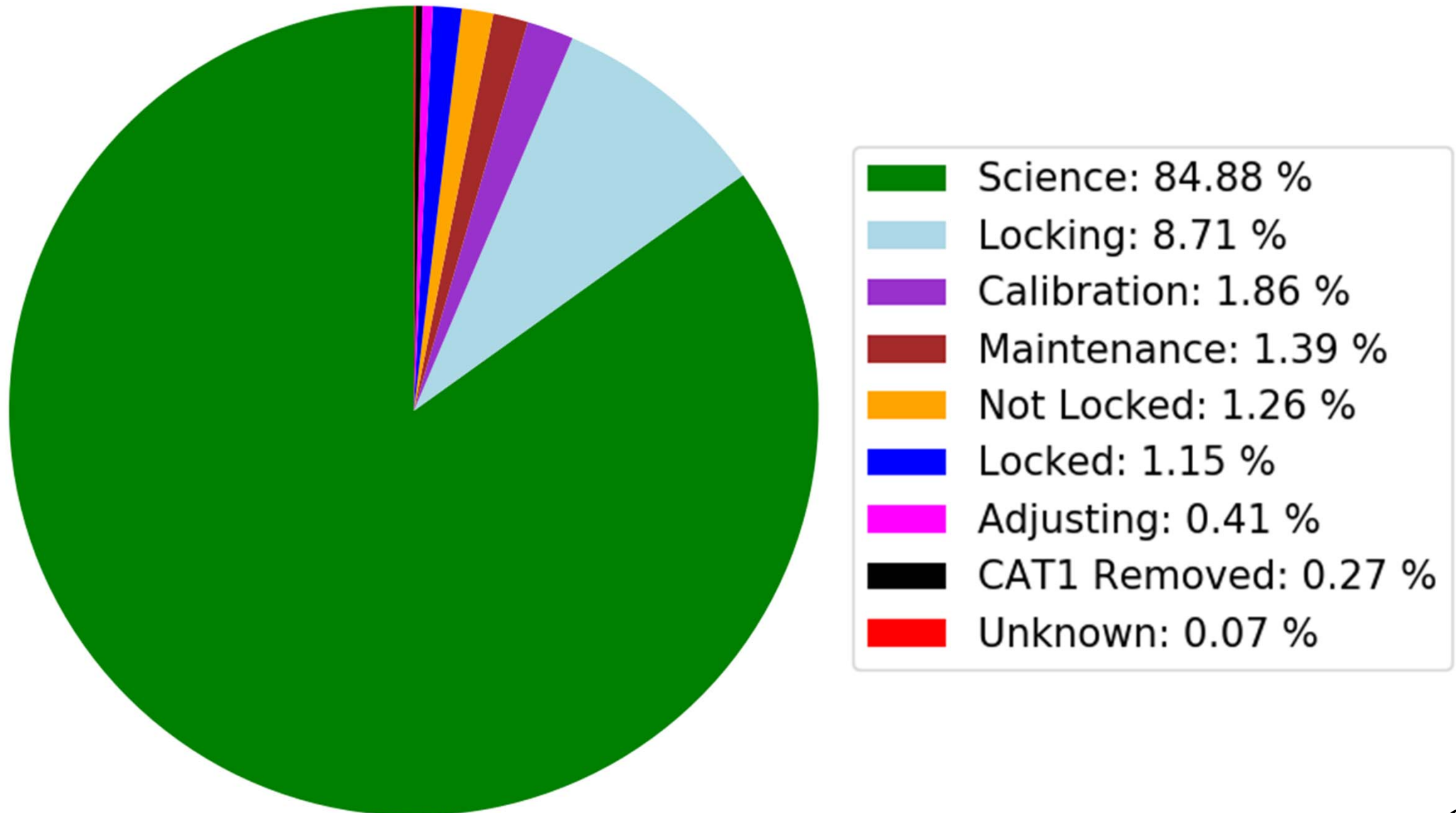


After veto



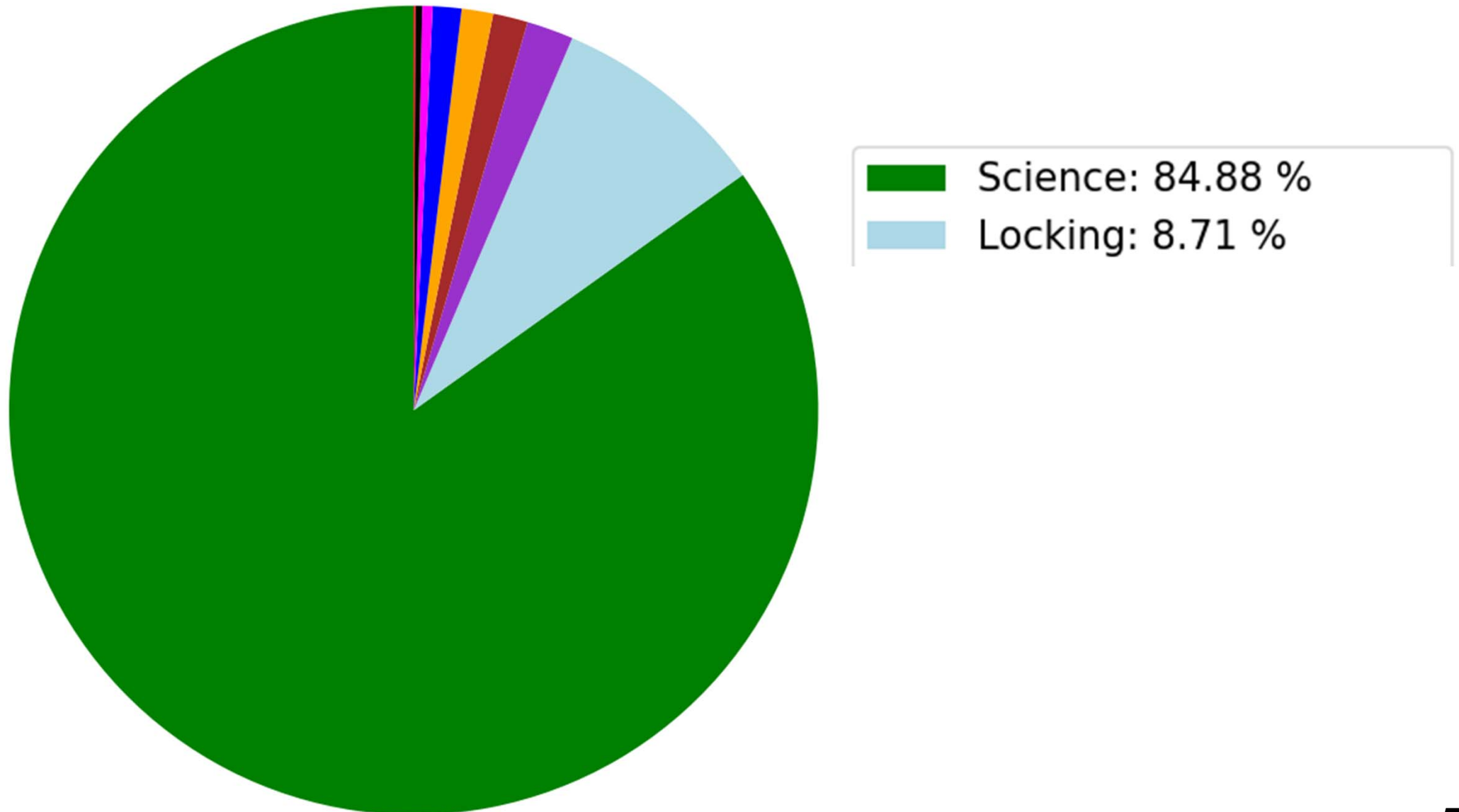
Digest of the Observation Run 2 – ‘O2’

- **Virgo** performance in August 2017



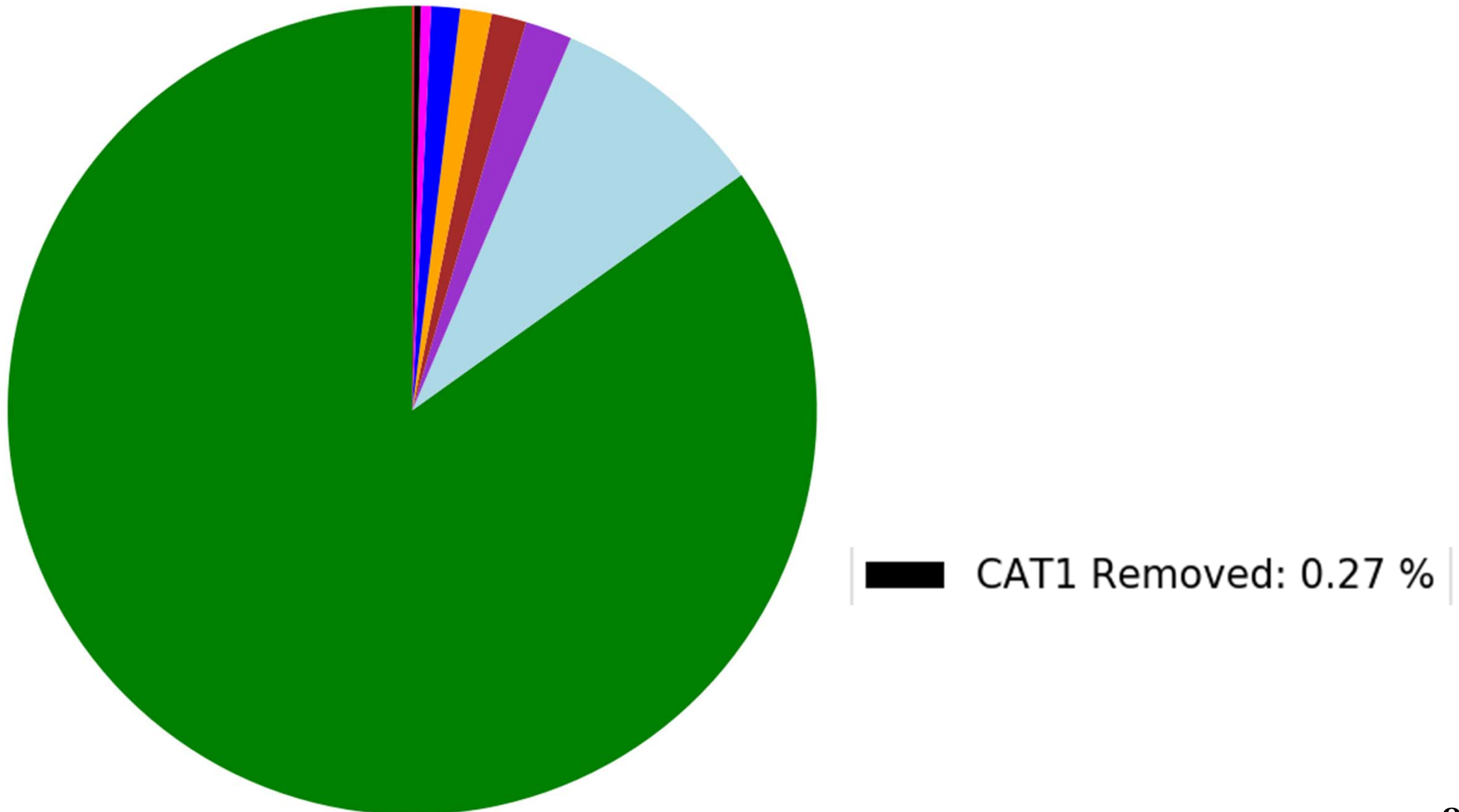
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Digest of the Observation Run 2 – ‘O2’

- **Virgo** performance in August 2017



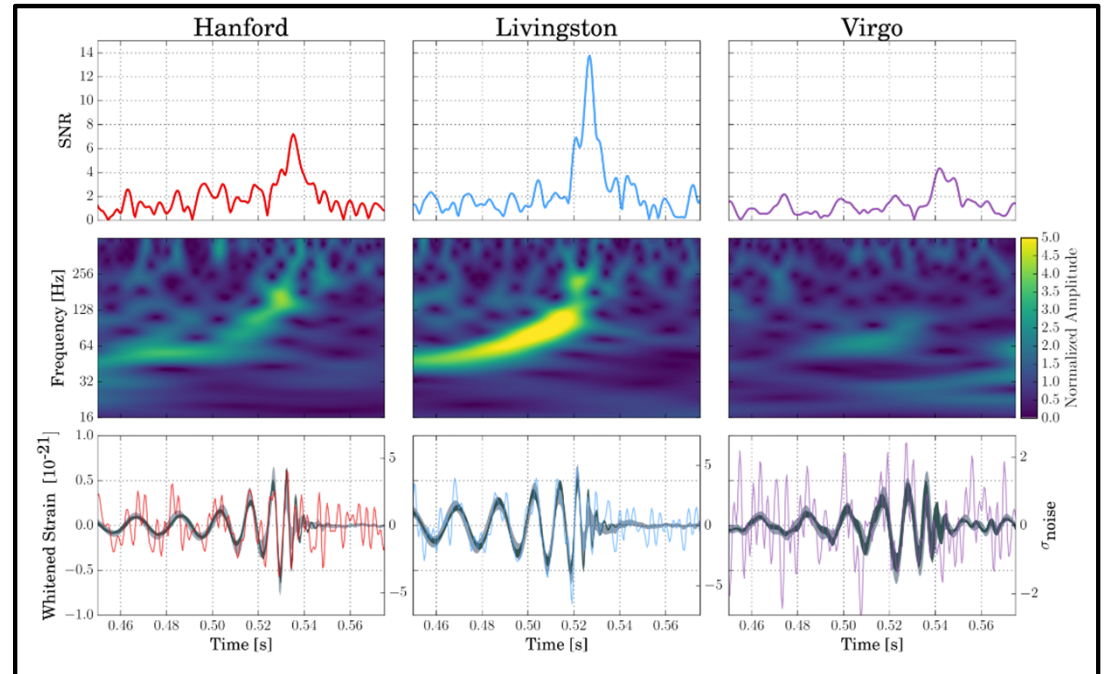
Digest of the Observation Run 2 – ‘O2’

- Detailed studies of the gravitational-wave candidates
 - The GW170814 and GW170817 events

Detection checklist report for GW170814 (G297595)

- ↓ Detection checklist report for GW170814 (G297595)
- ↓ General
- ↓ Preliminary report
- ↓ Detector status
- ↓ Virgo processes status
- ↓ Environment
- ↓ Known noise
 - ↓ Noise budget
 - ↓ Data quality flags
 - ↓ Check for known glitches
- ↓ Transient noise
- ↓ Noise stationarity
 - ↓ Online $h(t)$
 - ↓ Reprocessed $h(t)$ (V1O2Repro1A)
- ↓ Glitchgrams over 4096 s segments
- ↓ CBC plots for detection checklist
- ↓ DQ report

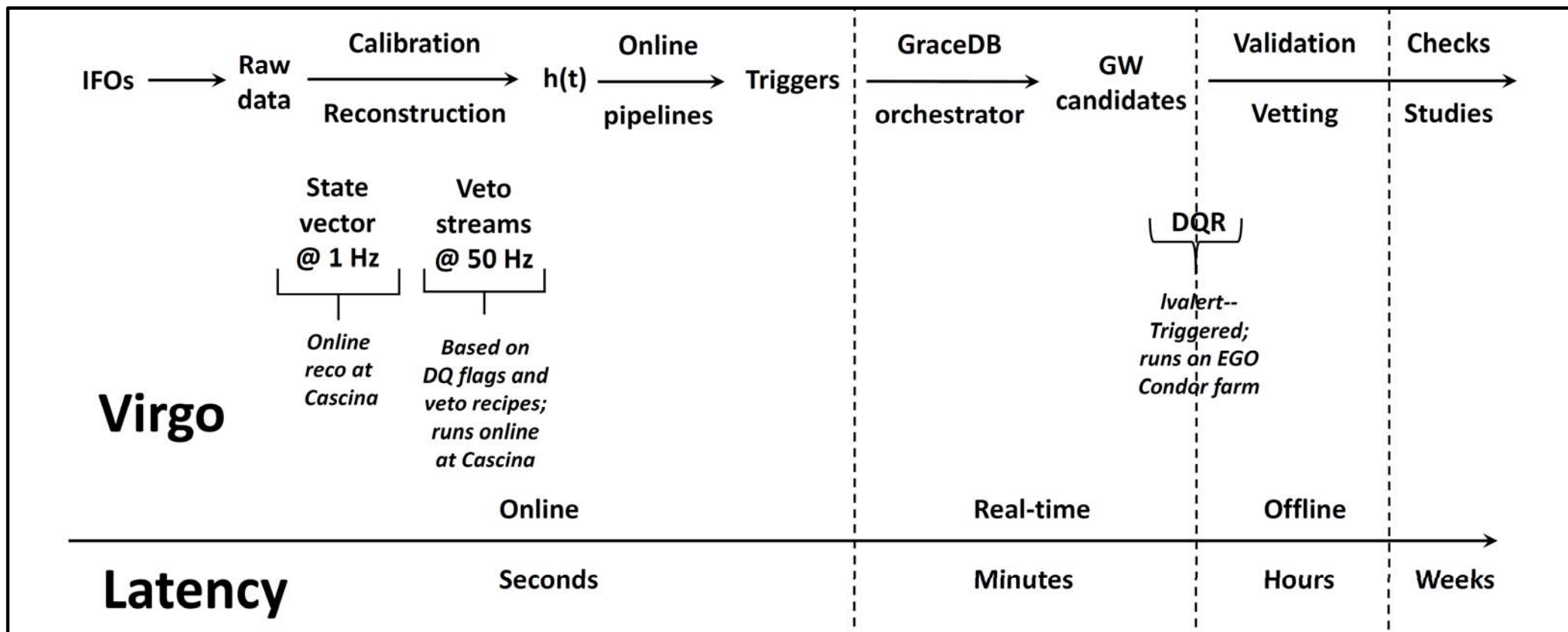
Detection checklist in google/excel form to be used by the detection committee



- Checks done manually; to be automated as much as possible in the future
 - Additional candidates for the final ‘O2 catalog’ to be published soon
- Coordination of a reference O2-Virgo detector journal article
 - Work still in progress: people busy with O2 analysis and/or O3 preparation

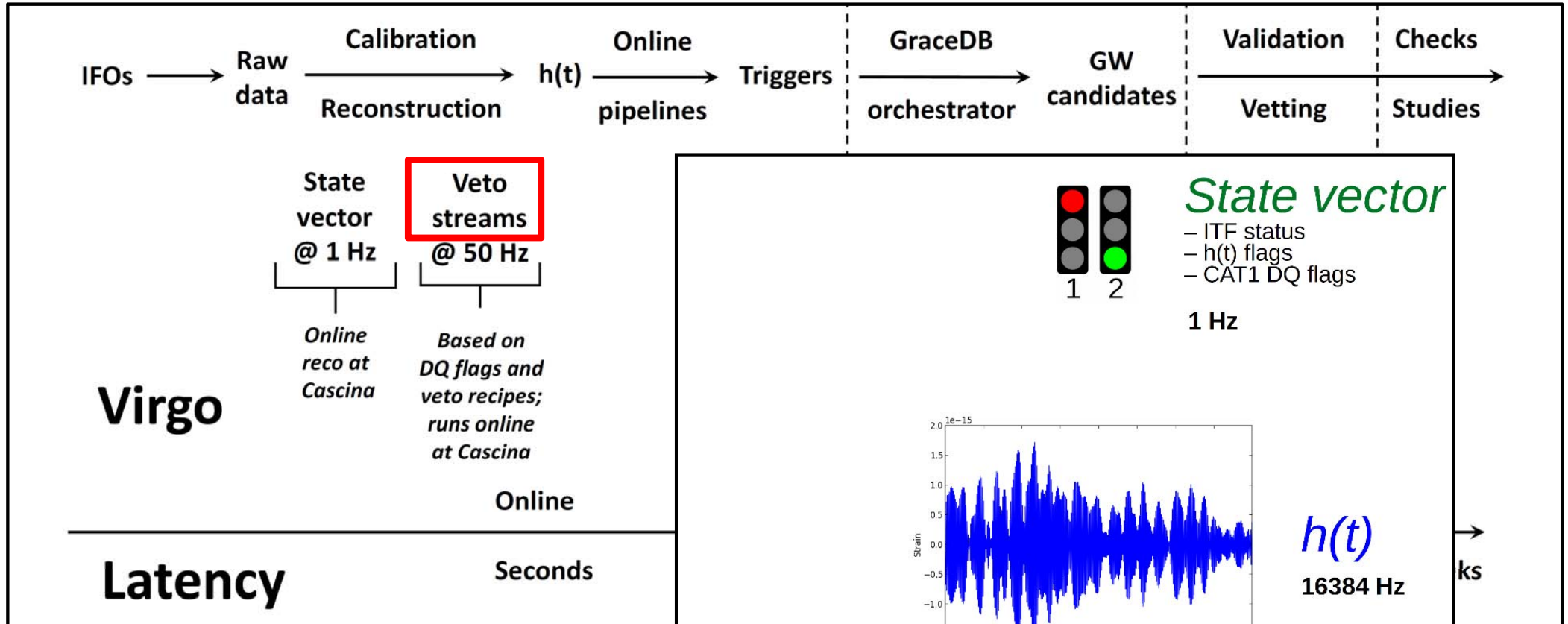
O3 preparation

- Dataflow



O3 preparation

- Dataflow



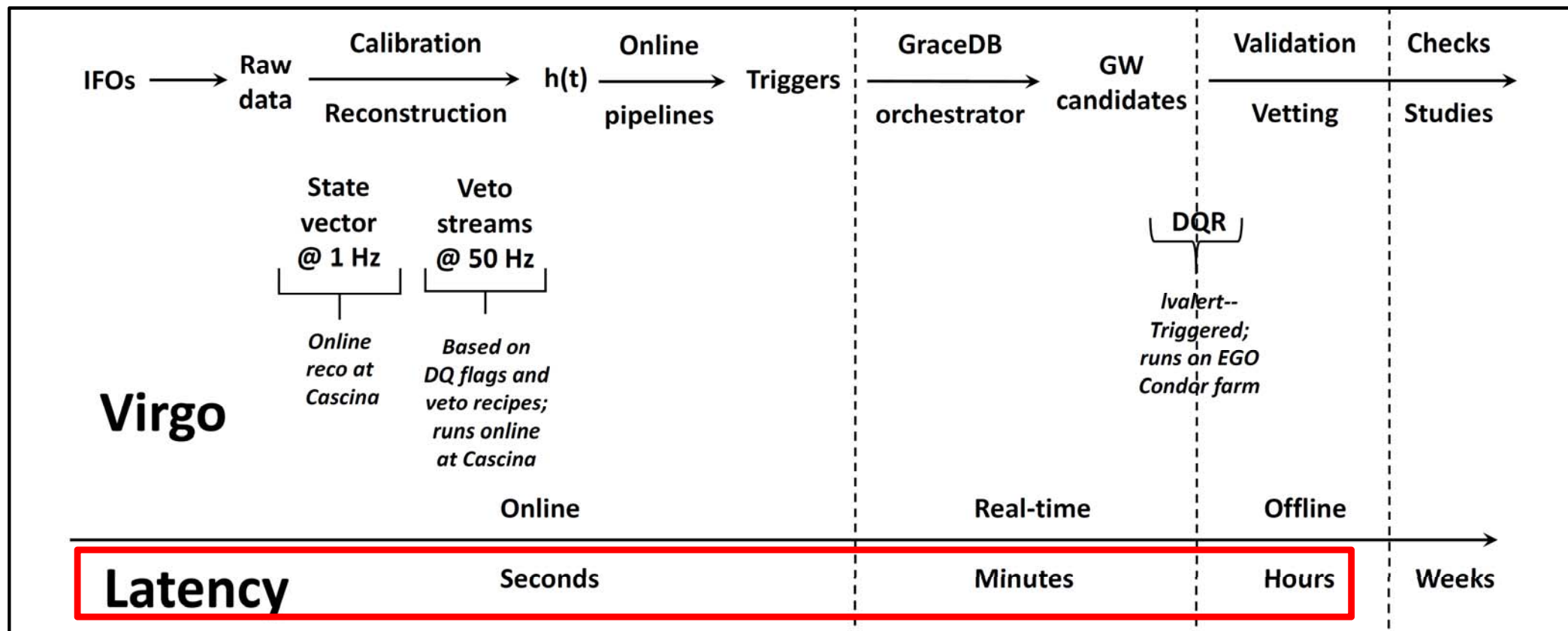
- Challenges

- New data quality products

→ Example: the veto streams

O3 preparation

- Dataflow



- Challenges

- New data quality products
- Low(er) latency
 - Open public alerts era

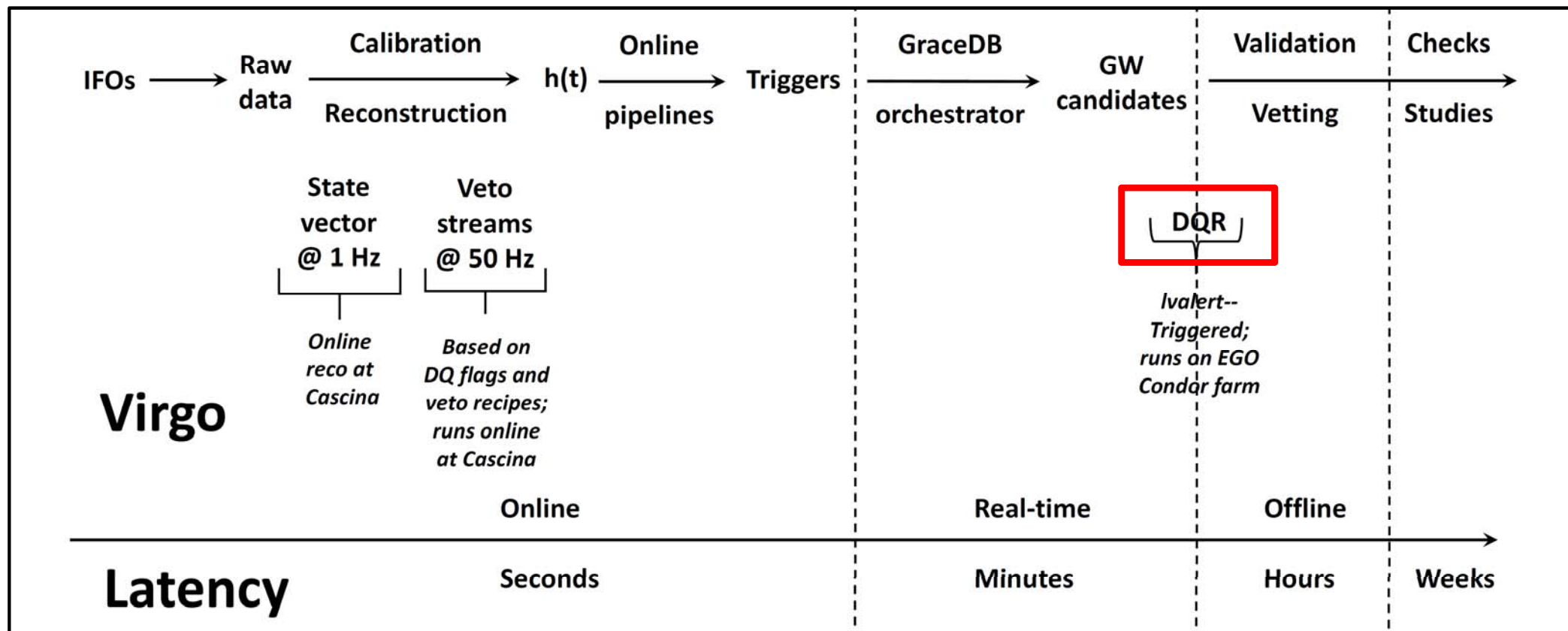
BBH: at least a few per month, maybe more

BNS: 1–10, possibly up to ~1 per month

NSBH: Could detect one or more during O3, but uncertain. We'll see!

O3 preparation

- **Dataflow**



- **Challenges**

- New data quality products
- Low(er) latency
- **Automated data quality reports (DQR)** for the (hopefully numerous) GW candidates
→ **Inputs to ease human decision**

Zoom on the Data Quality Report

- **Webpage** generated for each DQR run
 - Triggered automatically

- A **dozen checks** already implemented
 - Virgo status
 - Data quality flags
 - Various studies of the data quality of the data: from coarse to detailed analysis
 - Scan of the **online process logfiles**
 - Environment checks

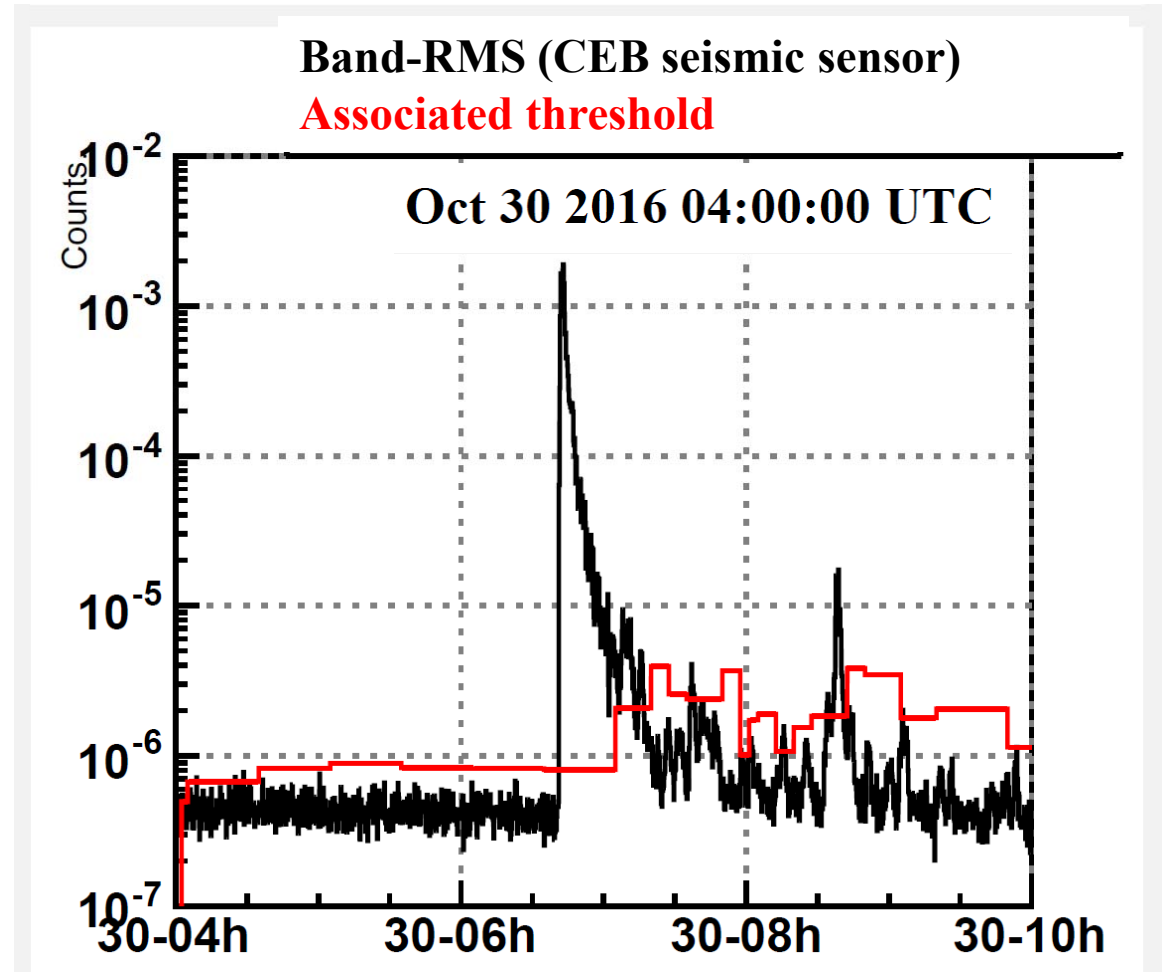
→ **Development still in progress for O3**

A wide set of tools: a few examples

- Environmental monitoring

→ Monitoring of several channels in various frequency bands of interest

- Example: strong earthquake in the center of Italy in Fall 2016, seen by a seismic sensor located in the Virgo central building
 - Adaptive threshold (if relevant)



→ About earthquakes: can use information from various networks (USGS, INGV...) to know in advance that seismic waves from strong and distant earthquakes will hit Virgo

- Few minutes accuracy
- The detector could switch to a particular configuration to ride out the storm

Digest of the Observation Run 2 – ‘O2’

- **LIGO-Virgo Network** performance

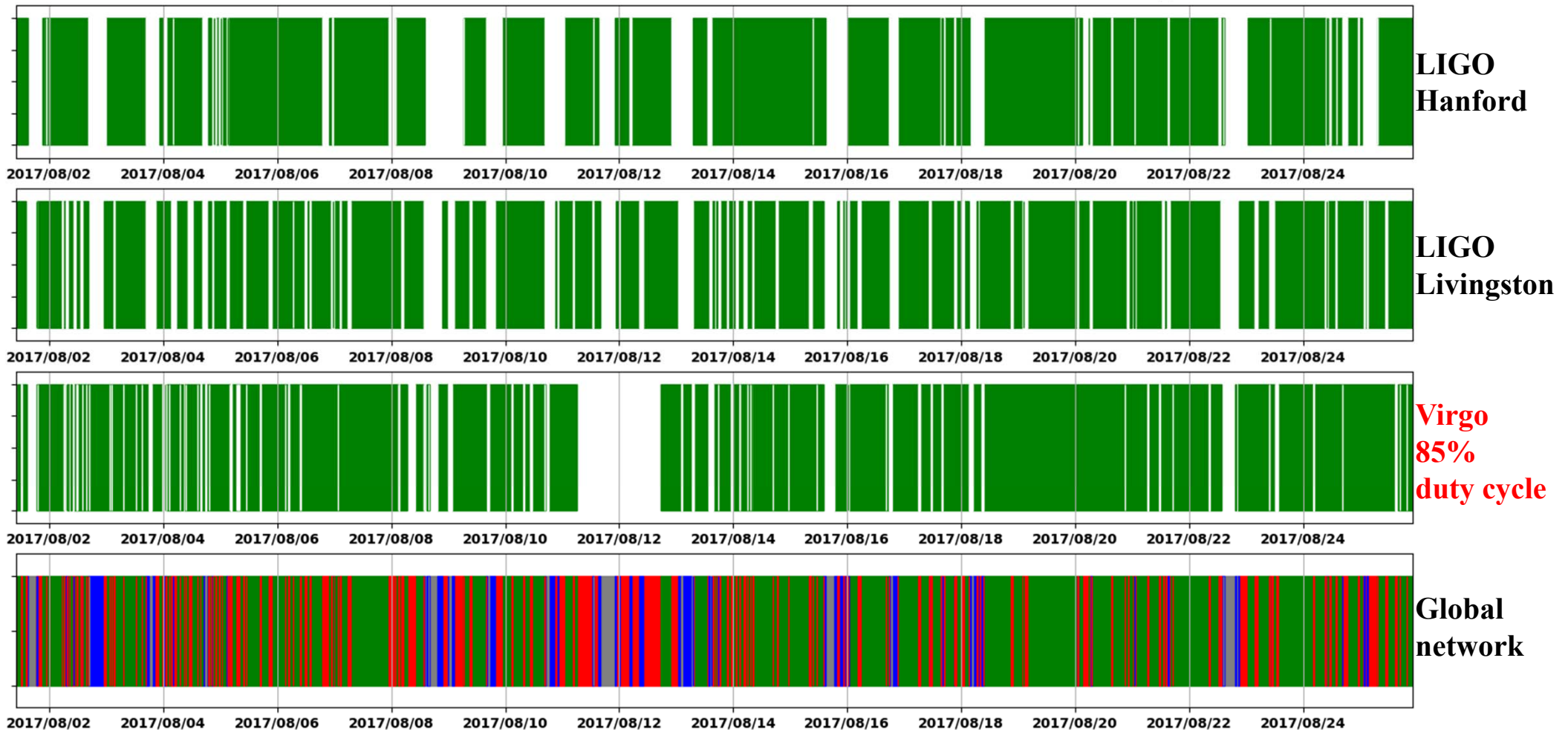
- **Single detectors:**

Green ↔ Good science data

- **Network:**

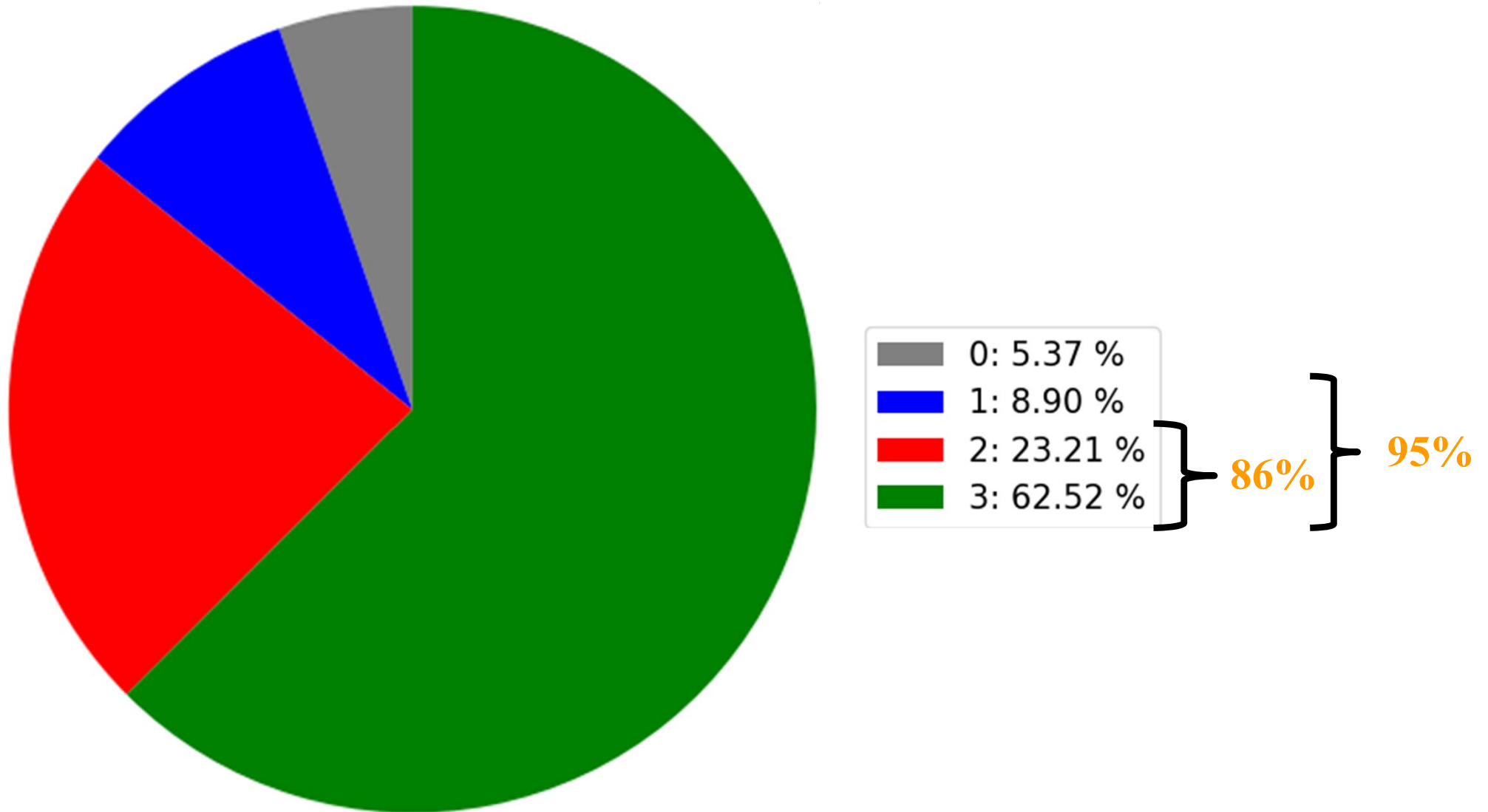


H1-L1-V1 network: 2017-08-01 10:00:00+00:00 UTC -> 2017-08-25 22:00:00+00:00 UTC -- segments: DMT-ANALYSIS_READY (H1-L1), SCIENCE (V1); CAT1 applied



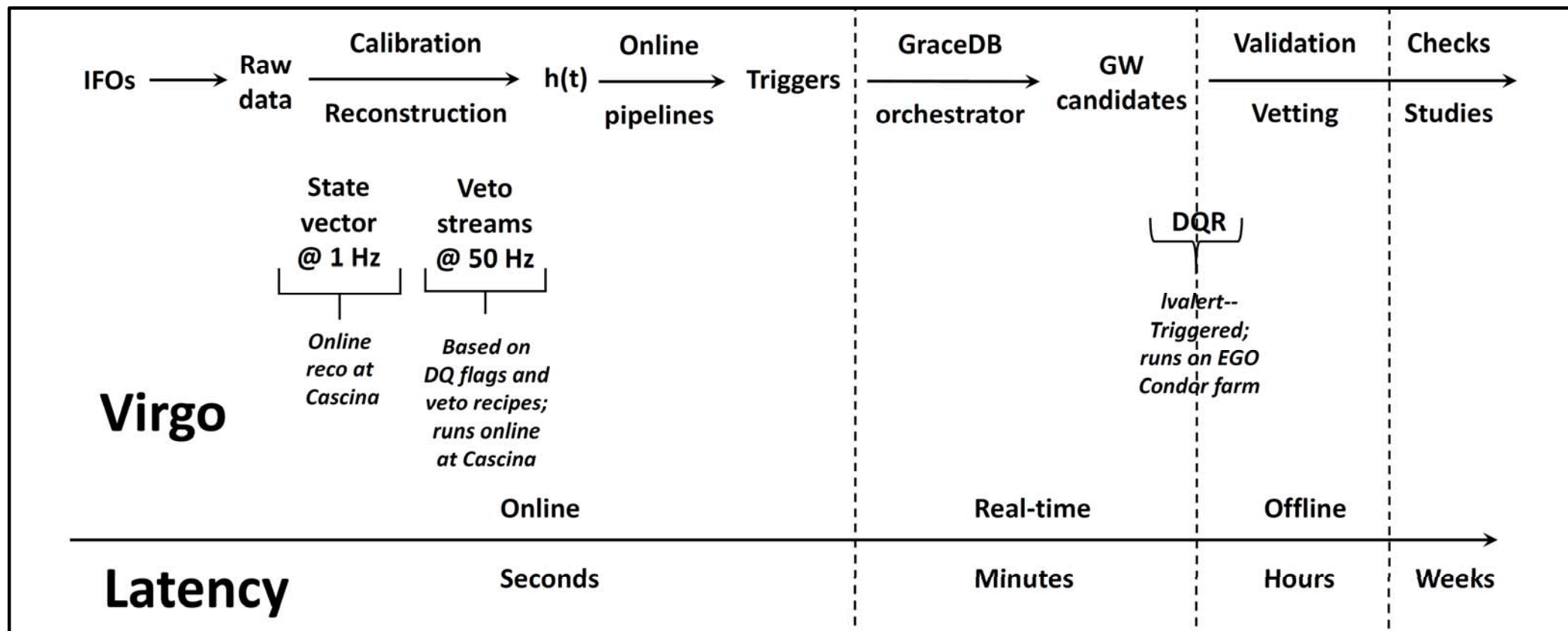
Digest of the Observation Run 2 – ‘O2’

- LIGO-Virgo Network performance



O3 preparation

- **Dataflow**



- **Challenges**

- New data quality products – example: veto streams
- Low(er) latency: open public alert era
- Automated data quality reports (DQR) for the (hopefully numerous) GW candidates
- Organization of **collaboration-wide data quality shifts**