



**STScI** | SPACE TELESCOPE  
SCIENCE INSTITUTE

EXPANDING THE FRONTIERS OF SPACE ASTRONOMY

# Exploring New Rapid Response Capabilities

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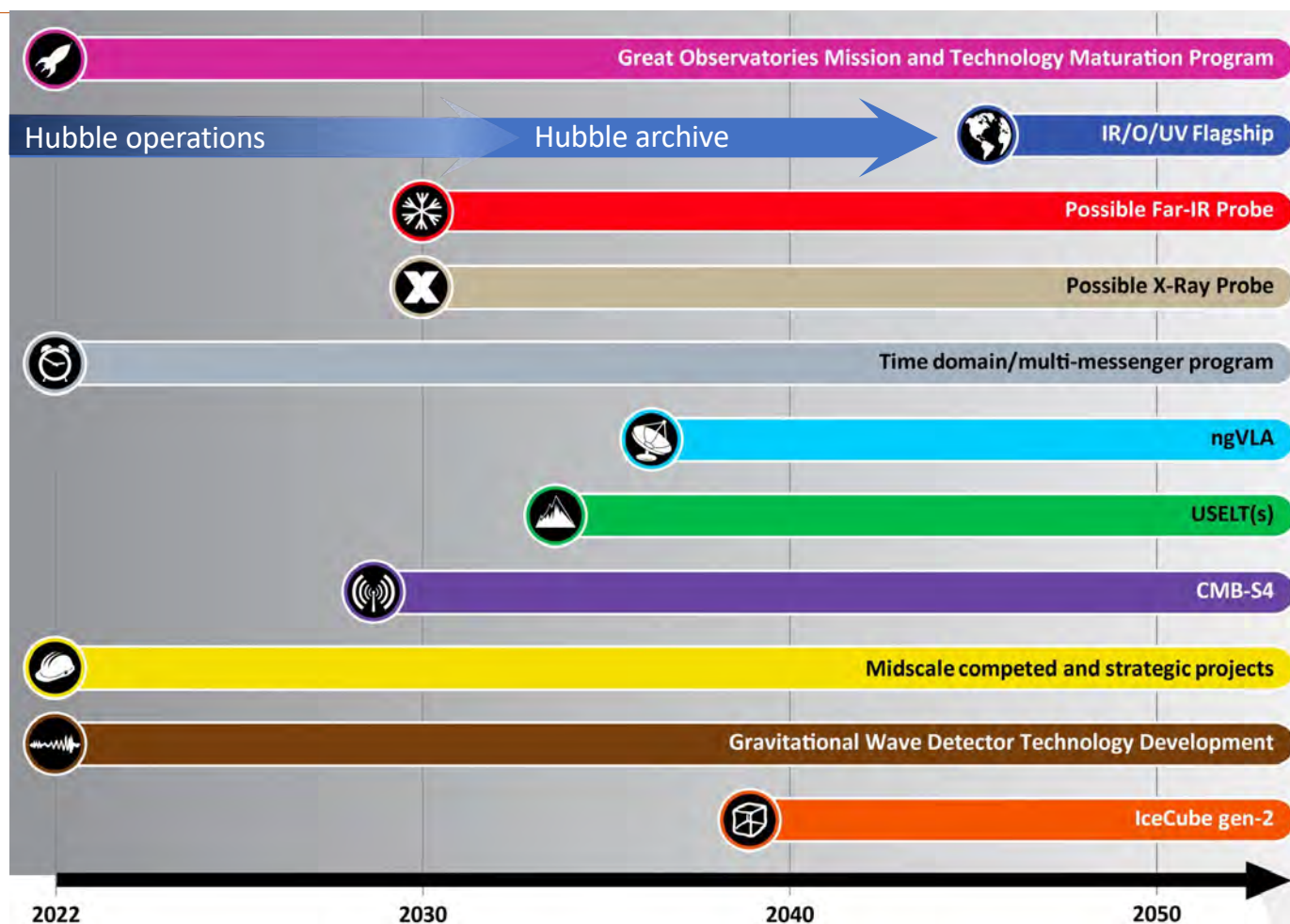


## Hubble Looking Forward

Hubble will continue to be a crucial asset in the context of 2020 facilities

- Unique physical insights (e.g., temperature & chemistry) from UV/O with high spatial & spectral resolution
- AstroSat & Swift do not provide comparable capabilities
- Spektr-UV & Xuntian uncertain
- Hubble's independent discoveries will continue
- Every facility in operation will drive demand for Hubble data that confirm, complement, and extend their discoveries

Astro 2020 timeline







## Tensions Arising from Time Domain Science

### Hubble and all-sky + multi-messenger surveys

- Increasing excitement & pressure from discoveries of transient phenomena
  - All-sky O/IR surveys (e.g., Rubin, Roman, Zwicky Transit Facility)
  - Gravitational wave experiments (e.g., LIGO, Kamioka, Virgo, LISA)
  - Neutrino observatories (e.g., IceCube Gen2, Super Kamiokande, Hyper Kamiokande)
- Scheduling tension between exciting science programs
  - Exoplanet & Solar System support programs require tight timing constraints, as do observations coordinated with other facilities
  - Transient phenomena often require rapid response
- We are exploring ways to maximize scientific return while accommodating competing pressures
  - Hubble can provide crucial context but not necessarily on shortest timescale





## Current Target of Opportunity Policy

### Cycle 30 Call for Proposals

- HST Observation Types
  - Target of Opportunity (ToO) Observations

*“The turn-around time for a ToO observation is defined as the time between STScI receiving a ToO activation and the execution of the observations. **The HST observing schedule is updated weekly, and construction of each weekly calendar starts approximately eleven days in advance of the first observations on that calendar. Thus, in the normal course of events, almost three weeks can elapse between Phase II submission of a ToO and execution of the observations.** Any short-notice interruptions to the schedule place extra demands on the scheduling system, and may lead to a decrease in overall efficiency of the observatory.”*





## Current Target of Opportunity Policy

### Turn-around time

- Time between STScI receiving activation (and Phase II) and observations

### Disruptive

- Less than 3 weeks
- Minimum 2-5 days
- Limited to 8 activations since C26

### Non-disruptive

- More than 3 weeks
- No limit on activations in C30

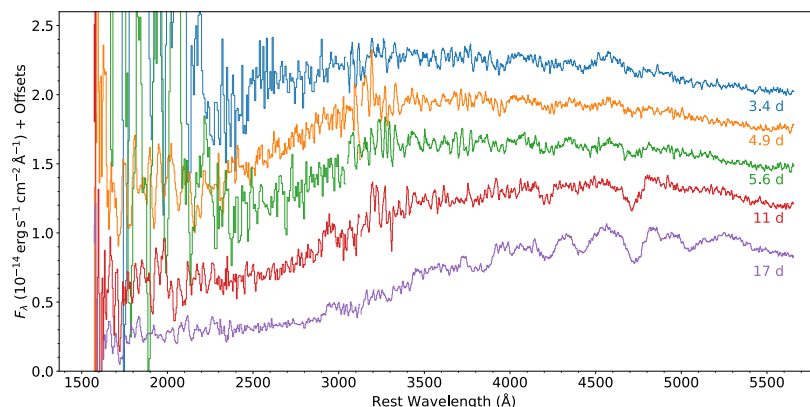


### Ultra-disruptive

- 36 – 48 hours
- None will be awarded in C30

### In 2020 and 2021

- 14 disruptive activations
- 9 on Fri/Sat
- 12 on Thu/Fri/Sat
- Maximizes disruption of the HST ops staff by falling outside of the normal work week



## What's Next?

Increasing frequency of transients offers a challenge & opportunity

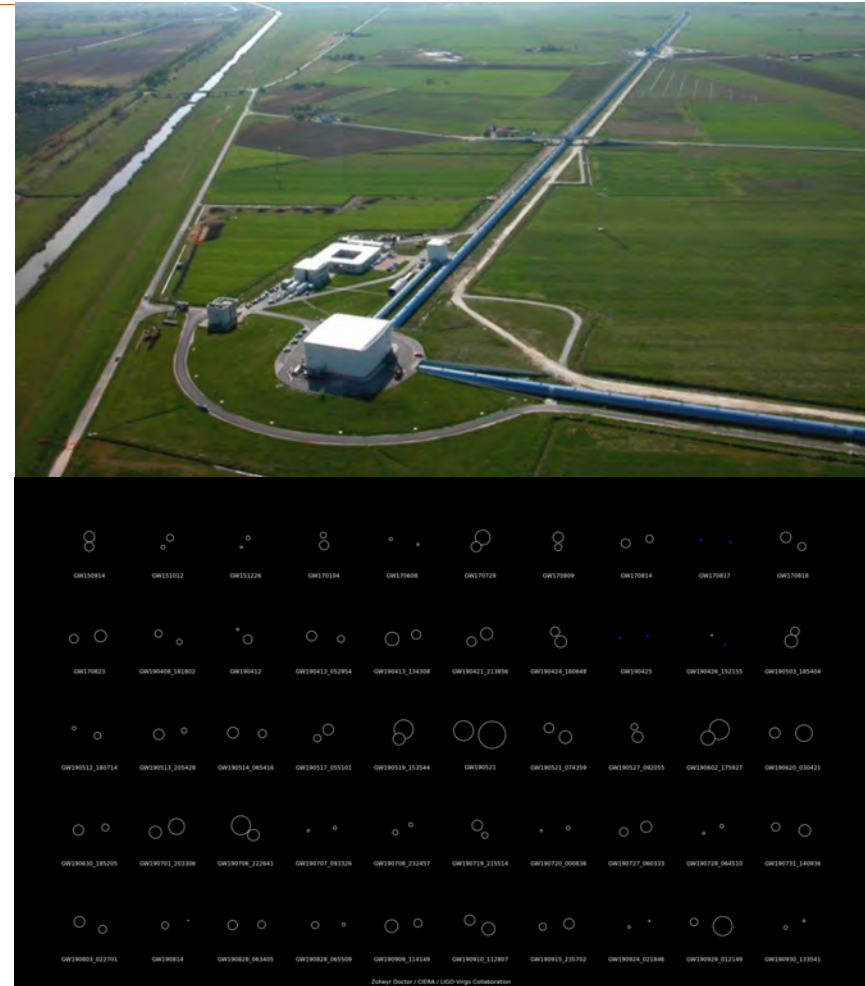
Targets can be selected using:

- Scientific criteria (maximize scientific impact)
- Scheduling criteria (minimize disruption of other science)

GO programs awarded through TAC and annual call are the appropriate avenue for large sample of unpredictable transients (as opposed to one-off DD proposals chasing individual transients)

Make an intentional choice to modify the observatory science program in a predictable manner

- Accommodate these ToOs in the science program allocated annually
- Mitigate disruption of non-transient science
- Advance preparation for observations

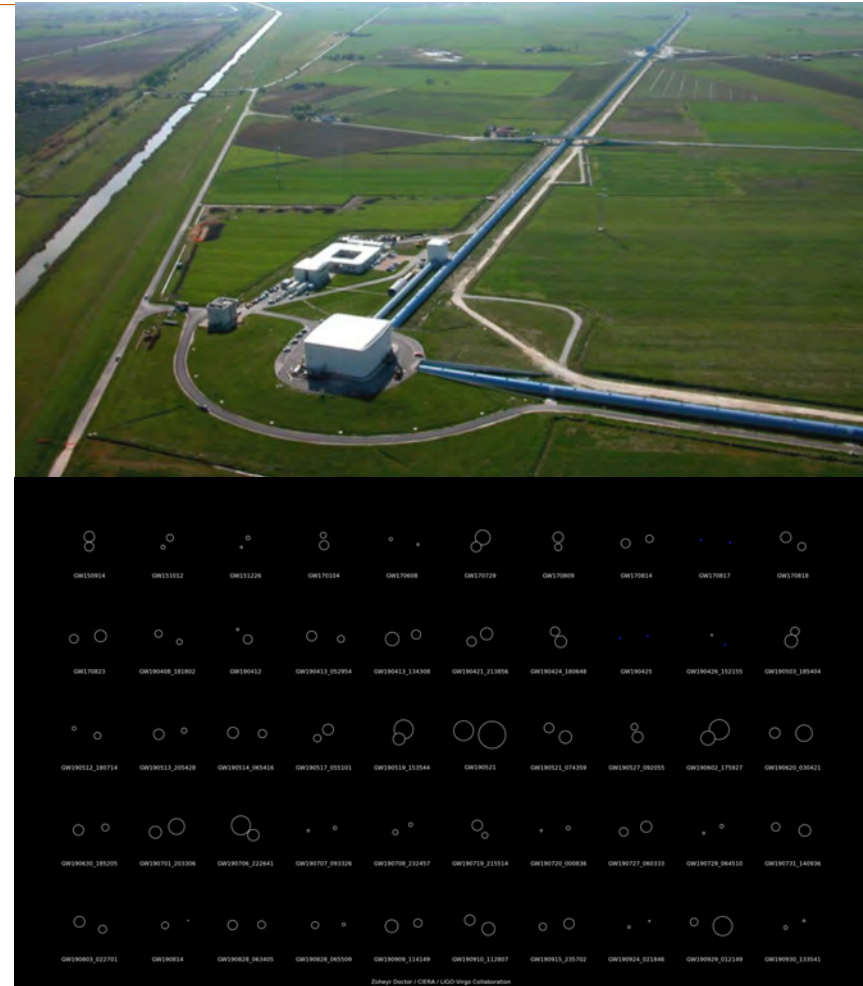






## A New Category of Disruptive ToO – Streamlined ToOs

- This would be a new GO ToO category (not DD)
- Will schedule on short side of current disruptive category: 2 to 5 days
- Assumes statistically significant sample of transients from which to draw activations
- Strictly enforced rules to minimize disruption to the rest of the Hubble science program
- Given the Hubble calendar build process, observations occur on designated Thursdays (e.g., one constraint-free Thursday per month)
- This “constraint-free Thursday” could accommodate multiple activations in this new category, or perhaps one such activation and a DD program that was approved and ready to go
- Requires accepting ~50-100 orbits of material in the annual call that can be used on constraint-free Thursday in the event activation is not triggered (e.g., SNAPshot programs, super-snaps)
- More broadly, the entire science program must be consistent with this constraint-free Thursday, but that should not be a problem





## Streamlined ToO Assumptions

- Activation (w/P2) required by Tuesday 6AM EST
- Schedulability 100%
- Executes on constraint-free Thursday
- No timing/orient constraints
  - Although specific cadence or spacing within the bounds of designated Thursday might be possible
- Single visit without follow-up visits
- No MAMAs or BOP checks
- Maximum of 5 SAA-free orbits
- No iteration on Phase II beyond activation
- Absolutely strict enforcement of ground rules

