

LSST capabilities for GW follow-up

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Gravitational Wave EM Counterpart Discovery





- Occasionally interrupt LSST survey for target of opportunity "ToO" short program
- Leverage known sky
- Fast survey of GW event area
- Competes with all other special survey programs for ~3% of the observing time



False positives background in 8h





Estimate follow-up capability 2025

- Assume GW source localization of 100 sq. deg.
- LSST 24 mag limit per visit.

Issues:

- Speed of LSST coverage
- Transient + moving object background
- Classification accuracy-completeness trade

Requirements

- Survey the GW alert area rapidly (< 1 night)
- Cover a range of spectral signatures
 Well sampled light curves, grizy
- Distinguish from "normal" optical transients!
- Good photometry: moderate airmass
 [Likely 2-5 hrs usable for random GW position]
- False alarm rate < few per night
- ML classifier

Proposed strategy

- Cover 16 fields with hex packed single visits in yirzgiy sequence (1.5 hours, inc filter changes + slews)
- Repeat 2-3 times
- 4-6 point light curve in *iy*, plus some grz info
- In the first *yir* pass, there will be "only" 320 new unclassified variables

Proposed strategy

- Thus we need a classifier false positive rate < 0.01
- Also need efficiency > 80%
- This may be possible for some transients in the background
- Rely on 2 hour revisit to exclude asteroids
- If we can get the false positives down to a few per night then the hand-off to Gemini etc is efficient

Summary

- Unclassified new transient background challenge
- 90% < 100 deg² ToO follow-up is possible
- Overall optical survey efficiency ~5% due to fraction of sky covered, 5/24hrs, Galaxy, weather
- Joint GW+LSST efficiency few %
- Need to optimize ToO strategy in a mix with main survey and mini surveys weekly coverage
- If five GW ToO per year, this is a 2% survey
- LSST is oversubscribed in mini surveys

How will we arrive at a plan?

- LSST will formally engage the community through its Science Advisory Committee
- The Project Science Team will evaluate the trades
- The Telescope and Site team has responsibility for development and implementation, and must respond to programmatic constraints plus guidance from the PST