On August 17, 2017 the Laser Interferometer Gravitational-Wave Observatory (LIGO) detected a gravitational wave emitted from a binary neutron star merger, nearly 130 million light years away. The merger caused an explosion known as a kilonova, which ejects tons of neutron-rich material into space at speeds a fraction of the speed of light. It has long been speculated that these kilonova explosions are the cosmological factories that produce heavy elements such as gold, silver and, platinum. The merger caused an explosion known as a kilonova, which ejects tons of neutron-rich material into space at speeds a fraction of the speed of light. It has long been speculated that these kilonova explosions are the cosmological factories that produce heavy elements such as gold, silver and, platinum.

### Observations of Kilonovae

Kilonovae have their peak emission in the near-infrared to mid-infrared part of the spectrum making them difficult to observe. The James Webb Space Telescope (JWST) will be the first satellite to possess instruments designed specifically for these wavelengths.

Targeted configuration strategies can expand the kilonova science by determining reasonable exposure times, helping to maximize the functionality of JWST.

### Goals

- We seek to design observations for JWST that will utilize instruments such as NIRcam and MIRI to effectively study kilonovae.
- Utilize python based program MOSFIT to identify key parameters and model kilonovae events.

### Introduction

On August 17, 2017 the Laser Interferometer Gravitational-Wave Observatory (LIGO) detected a gravitational wave emitted from a binary neutron star merger, nearly 130 million light years away. The merger caused an explosion known as a kilonova, which ejects tons of neutron-rich material into space at speeds a fraction of the speed of light. It has long been speculated that these kilonova explosions are the cosmological factories that produce heavy elements such as gold, silver and, platinum.

### MOSFIT

- **The Modular Open Source Fitter for Transients (MOSFIT)** is python-based program that is used to create models of high-energy events such as kilonovae and supernovae.
- **Models can be run through MOSFIT to produce several outputs such as light curves and SED's**

### Methods

**Design kilonova models using MOSFIT based on parameters of the ejecta (mass, velocity, and opacity).**

**Design host galaxy models using Pandelia based on various properties (redshift, stellar age, star formation rate).**

**Synthesize kilonovae and galaxy models into source scenes for the JWST Exposure Time Calculator**

**Input synthesized scenes into the JWST Exposure Time Calculator**

**Modify viewing configurations to obtain various exposure times and signal-noise ratios (SNR's)**

**Figure I: MIRI band light curve for GW180817 (Villar et. Al 2017)**

**Figure II: Plots for kilonova parameters of GW170817 (v,T, R) changing with time. (Kasliwal et. Al 2017)**

### Results

**Figure 8 (left): MIRI SNR diagrams of host galaxies and kilonovae at redshifts z=0.01 with temperature 5000K, 3500K 1500 K using filter 1280W**

**Figure 9 (right): Plot showing the resulting exposure time across several filters in the near-infrared/mid-infrared bands. Calculated at redshifts z=0.01,0.05,0.1**

**Figure III (left): MIRI SNR diagram of host galaxies and kilonovae at redshifts z=0.01 with temperature 5000K, 3500K 1500 K using filter 1280W**

**Figure IV (right): Plot showing the resulting exposure time across several filters in the near-infrared/mid-infrared bands. Calculated at redshifts z=0.01,0.05,0.1**

### Conclusions

- For the the closest source (z=0.01), MIRI exposure times at all epochs increases as the filter shifts further into the mid-infrared.
- NIRcam exposure times appear to be lower for sources at higher redshifts; MIRI exposure times increase exponentially.
- Further experimenting with configurations will allows us to be more proficient determining effective observing techniques.

### Acknowledgements & Contact

This research was supported by GROWTH, which is funded by the National Science Foundation under its PIRE program via grant 1545949 to California Institute of Technology with subcontract to the University of Maryland.

### References

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### Designing Kilonovae Observations for the James Webb Space Telescope

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