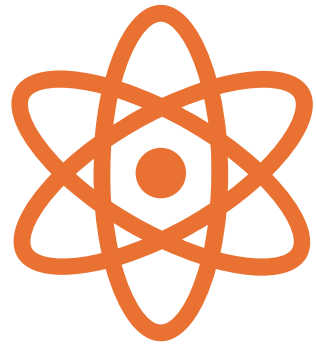


The background is a deep blue with a complex, fluid pattern of concentric, swirling lines that resemble ripples on water or gravitational waves. Scattered throughout the image are numerous small, glowing particles in shades of green and yellow, some appearing as distinct points of light and others as soft, out-of-focus bokeh. The overall effect is one of dynamic energy and cosmic scale.

Gravitational Waves

Justin M. Lewis, O'Brein Carr, Abdullahi Omar

Motivation



Gravitational Wave event
GW150914



Einstein's Theory of General
Relativity

Methods

Open data repository of the
LIGO Hanford detector

Bandpaas and Notch Filters

Amplitude Spectral Density

Strain Extraction from Specified
time range

Results

```
c = 3e8 # Speed of light in m/s
G = 6.674e-11 # Gravitational constant in m^3/kg/s^2
solar_mass = 1.989e30 # Mass of the Sun in kg

# --- GW150914 parameters ---
# Source: https://en.wikipedia.org/wiki/GW150914
total_mass_before = (36 + 29) * solar_mass # Total mass before merger (36 + 29 solar masses)
total_mass_after = 62 * solar_mass # Total mass after merger (62 solar masses)

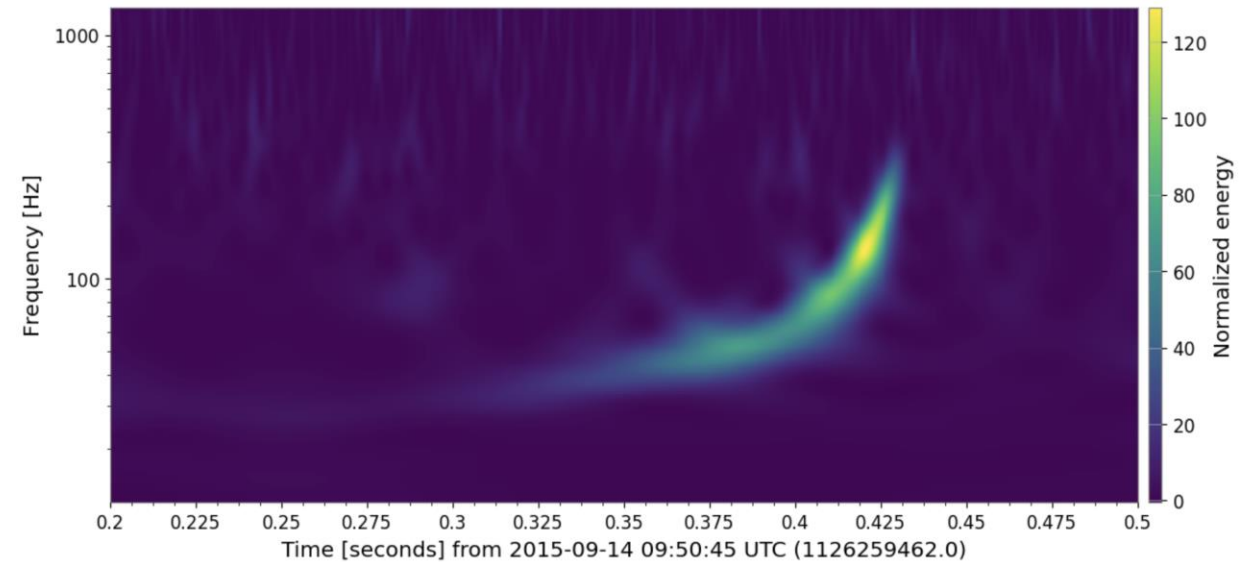
# Calculate the mass lost during the merger
mass_lost = total_mass_before - total_mass_after

# Calculate the energy released using Einstein's mass-energy equivalence (E=mc^2)
energy_released = mass_lost * c**2

# Convert to solar mass equivalent energy
solar_mass_equivalent_energy = energy_released / (solar_mass * c**2)

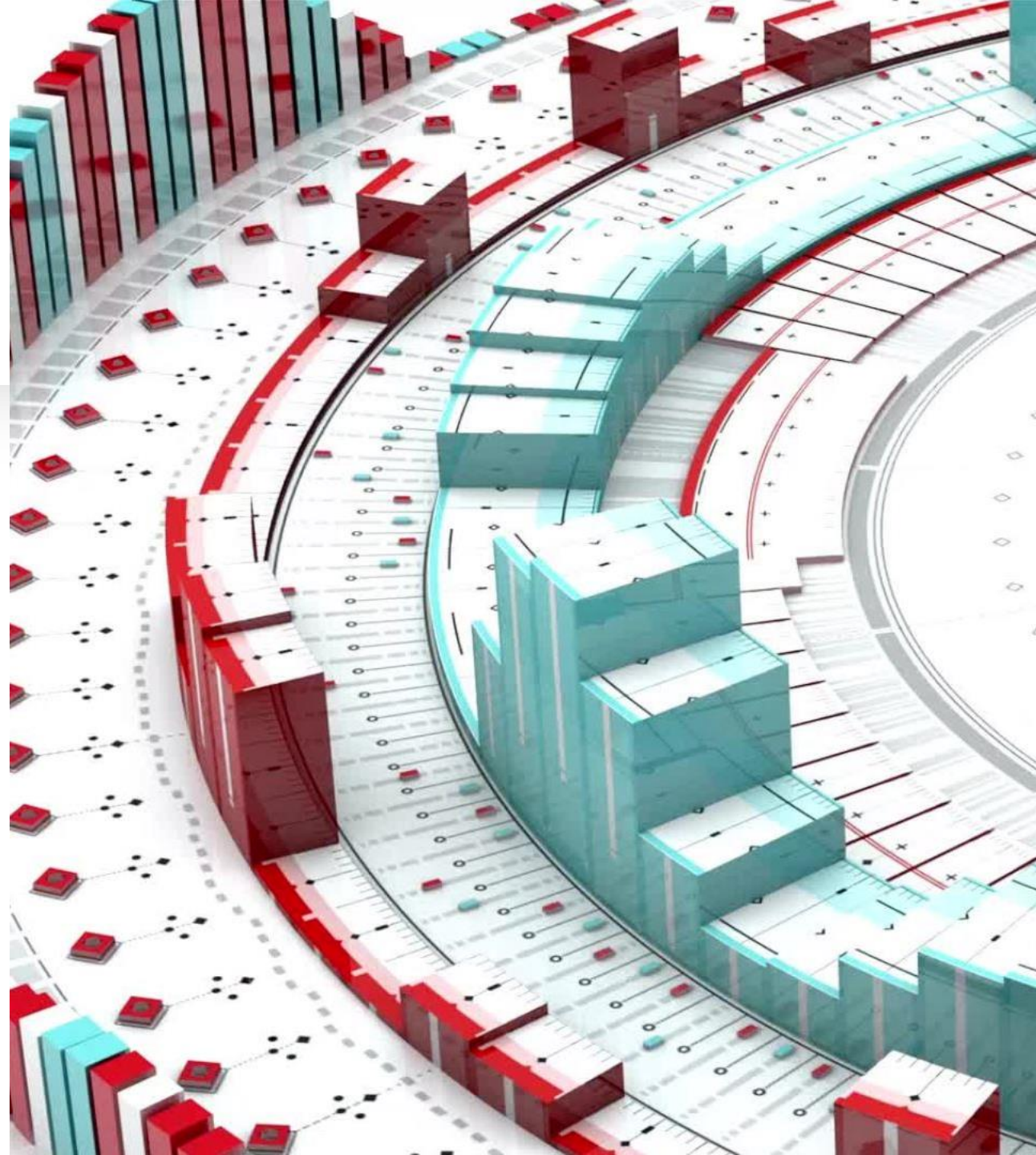
# Print the results
print("Mass lost:", mass_lost, "kg") # Added line to print mass lost in kg
print("Energy released:", energy_released, "Joules")
print("Energy released (solar mass equivalent):", solar_mass_equivalent_energy, "solar masses")

Mass lost: 5.96700000000001e+30 kg
Energy released: 5.3703000000000085e+47 Joules
Energy released (solar mass equivalent): 3.000000000000005 solar masses
```



Conclusion

Our data confirms the feasibility of extracting astrophysical information from strain data. This indicates that gravitational waves can be powerful tools for understanding high-energy astrophysical events.



References/Citations