Gravitational Waves

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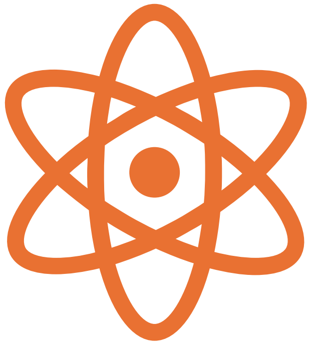
Motivation



Gravitational Wave event GW150914

Einstein's Theory of General Relativity

Methods

Open data repository of the LIGO Hanford detector

Bandpaas and Notch Filters

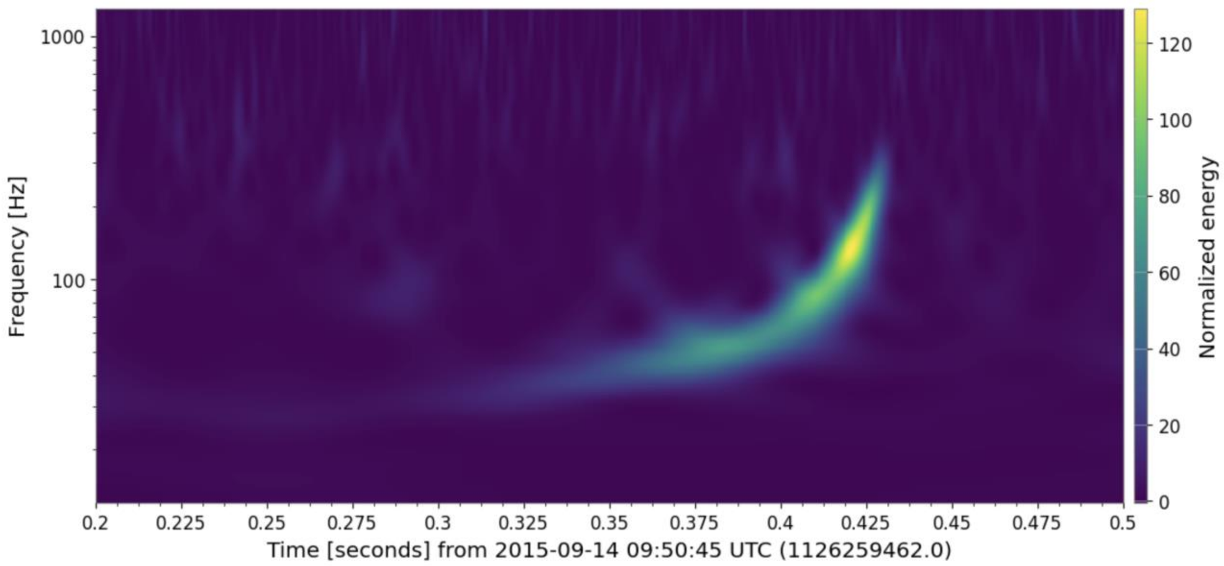
Amplitude Spectral Density

Strain Extraction from Specified time range

Results

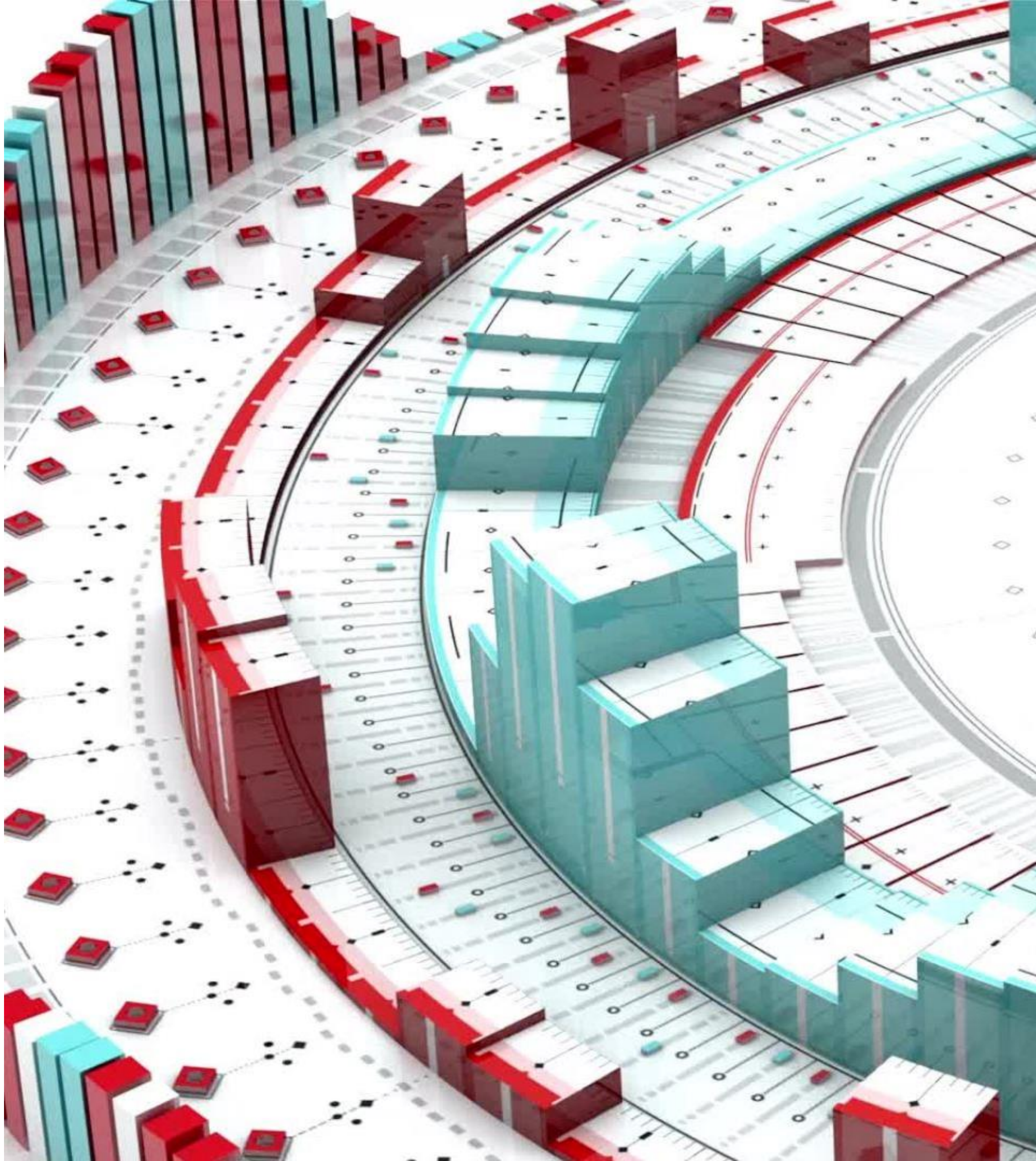
```
c = 3e8  # Speed of light in m/s
G = 6.674e-11  # Gravitational constant in m^3/kg/s^2
solar_mass = 1.989e30  # Mass of the Sun in kg

# --- 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: 5.967000000000001e+30 kg
Energy released: 5.370300000000085e+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