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IAS VI # 3: Satellites & Telescopes - 01/04/26

Objective: investigate the hidden forces of the universe using NASA Satellites & Telescopes

- Types of Electro Magnetic Waves:
  - ~~Radio waves (10 Hz - 100 GHz)~~
  - Radio Waves: $\geq 10^{-1}$ m
  - Microwaves: 10^{-1} m - 10^{-4} m
  - Infared: 10^{-4} m - 10^{-6} m (1 μm)
  - Visible Light: 10^{-6} m - 10^{-7} m ← Roughly
  - Ultra Violet: 10^{-7} m - 10^{-8} m
  - X-Rays: 10^{-8} m - 10^{-11} m
  - Gamma waves: $\leq 10^{-11}$ m
- Use Cases:
  - ~~James Webb Space Telescope~~
  - Microwaves - Very Large Array
    - Observes shorter end of Radio Spectrum (Microwaves)
    - Captures energy emissions to map out & better understand the cosmos.
  - Infared: Terra Satellite
    - Observes Earth's changing Systems
    - Atmospheres, Land, Ocean, Ice
    - Uses infared to detect heat & energy emitted and creates temperature maps of the Earth
  - Radio waves: Deep Space Network
    - Global System of giant radio antennas
    - Communicates w/ Spacecraft
    - Sends commands & recieves all sorts of data from deployed probes & rovers
    - Radio waves allow communication to occur
  - Visible Light & UV: Hubble Space Telescope
    - Peforms high quality imaging of sections of Space
    - Captures visible light to produce images similar to what we see
    - Captures UV photons from hot, young Stars, nebulae, & galaxies.

- X-Ray: Chandra X-Ray Observatory
  - does high resolution imaging
  - Images hot cosmic environments
- Gamma Rays: Fermi Gamma Ray Telescope
  - Surveys entire sky for high energy light from extreme cosmic events
  - reveals extreme events like black hole jets of Gamma Ray Bursts

- Climate Questions:

1) At what rate are glaciers & ice sheets losing mass?
2) Has cloud coverage changed as a result of climate change?
3) Has climate change affected the Earth's albedo?

- Universe Questions:

1) Is the universe inside of a spinning black hole?
2) Is direct collapse the primary method early supermassive black holes formed?
3) Do primordial black holes exist.

- Final Question:

DO high redshift super massive black holes (z > 7) quasars grow disproportionately faster than their host galaxies in reference to low redshift super massive black hole quasar.

- Data Required:

- Mass of high redshift Black hole
- Mass of its host galaxy
- ULAS J1120+6041 is a good candidate because it has a high predicted mass but has not yet been measured by JWST, which will confirm estimations.
- We understand that the more massive our black hole, the higher the velocity of the things orbiting it
- With that in mind, we can use the JWST Near Infrared Spectograph (NIRSpec)
- We can then employ the Jeans Anisotropic Models (JAM) to test & approximate the mass using stellar kinematics.
- We can also use the NIR Spec Data & some imaging to find the mass distribution & approximate the host galaxies mass
- We can compute the mass of galaxy's percentage quasar mass by dividing the quasars mass by its galaxy's

- Other Data sources:

- In order to measure the proportionality of high redshift quasar mass to its galaxy relative to ours, we need a low redshift quasar
- The Mass of Sagittarius A* & the milky way will serve this purpose fine