Why can't the hubble telescope show us the landing site on the moon and left behind equipment?

Answer

The Hubble Space Telescope (HST) is not well-suited for observing the Moon's surface or human-made objects on it for several reasons:

1. **Resolution Limitations:**
   - Hubble's best resolution is about 0.05 arcseconds. While this is exceptional for observing distant galaxies or stars, it translates to roughly 100 meters per pixel at the distance of the Moon. This means that the small-scale features like the Apollo landing sites, which are less than 100 meters in scale, would not be resolved well enough to be distinguishable from the surrounding lunar terrain.
2. **Proximity of the Moon:**
   - The Moon is relatively close to Earth compared to the vast distances Hubble typically observes. Hubble is designed to look at objects far beyond our solar system, where its resolution is more effectively utilized. Objects that are too close risk "Earth glare" or other light interference, which can make observing them difficult.
3. **Field of View and Exposure:**
   - Even if Hubble could resolve details on the Moon, the field of view it captures in a single image is not optimized for such close objects. To image the Moon, you would need to take many small images and stitch them together, which isn't practical for Hubble's observational strategy.
4. **Contrast and Brightness:**
   - The Moon is very bright compared to the deep space objects Hubble is designed to observe. This brightness can saturate Hubble's sensors, making it hard to get useful data from the surface. Also, the contrast between the bright lunar surface and any artifacts left by humans would be challenging to capture clearly.
5. **Purpose of Hubble:**
   - Hubble was designed to study the universe beyond our solar system, not to look at planetary surfaces or nearby celestial bodies. Its instruments are optimized for different wavelengths and sensitivities than what would be needed to observe small objects on the Moon.

For observing the Apollo landing sites or other lunar surface features:

- **Lunar Reconnaissance Orbiter (LRO):** NASA's LRO, launched in 2009, has been specifically tasked with mapping the Moon. Its camera, the Lunar Reconnaissance Orbiter Camera (LROC), can take images with resolutions down to 50 cm/pixel, far better than Hubble can achieve from Earth orbit. LRO has indeed imaged the Apollo landing sites, showing the descent stages of the lunar modules, tracks made by the astronauts, and even some of the equipment they left behind.
- **Other Spacecraft:** Missions like Japan's SELENE (Kaguya) have also observed the lunar surface in detail, although not specifically to look at the Apollo sites.
- **Future Missions:** Upcoming missions might include even more advanced imaging technology, potentially providing even clearer views of human artifacts on the Moon.

While Hubble has revolutionized our understanding of the universe, its capabilities are not aligned with detailed lunar surface imaging, especially not for small, human-made objects like the Apollo landing sites.

Why can't earth telescopes show us the langing sites?

Answer

Observing the Apollo landing sites from Earth-based telescopes faces several challenges:

1. **Resolution Limitations:**
   - Even the largest ground-based telescopes do not have the resolution necessary to clearly image small objects like the Apollo landing sites on the Moon. The angular resolution of these telescopes is limited by atmospheric turbulence (seeing), diffraction limits, and the size of the telescope's mirror or lens. The best resolution you can achieve from Earth is roughly 0.5 arcseconds under perfect conditions, which at the Moon's distance translates to about 1 kilometer per pixel. The Apollo sites, being much smaller, cannot be resolved.
2. **Atmospheric Distortion:**
   - The Earth's atmosphere causes images to blur due to turbulence. This phenomenon, known as "seeing," limits the clarity with which we can observe celestial objects from the ground. Even with adaptive optics, which can correct for some atmospheric distortion, the resolution isn't sufficient for seeing small features on the lunar surface.
3. **Brightness and Contrast:**
   - The Moon's surface is very bright, especially when viewed from Earth. The contrast between the natural lunar terrain and small, human-made objects is very low. This makes it difficult to distinguish the Apollo landing sites from the surrounding landscape.
4. **Technical Challenges:**
   - Earth-based telescopes optimized for planetary observation (like those used for Mars or Jupiter's moons) are more about capturing broad features rather than pinpointing small objects. The Apollo sites are too small to be seen as anything other than a speck even if you could get the resolution.
5. **Field of View:**
   - To capture an image of the Moon, you would need a very wide field of view, but to resolve small features, you need to zoom in significantly. Balancing these requirements is technically challenging, and no ground-based telescope has been designed with the aim of observing such tiny details on the Moon.
6. **Light Pollution:**
   - Especially near urban areas, light pollution can interfere with observations, although this is less of an issue for the Moon compared to faint deep-sky objects.

To overcome these limitations:

- **Lunar Reconnaissance Orbiter (LRO):** As mentioned earlier, spacecraft in lunar orbit like LRO can take high-resolution images of the lunar surface. The LRO has provided images of the Apollo landing sites, showing details like footprints and equipment.
- **Space Telescopes for Lunar Observation:** While Hubble isn't suited for this, future space telescopes might be designed or repurposed for such tasks, though none have been specifically planned for this purpose as of now.
- **Advances in Ground-Based Telescopes:**
  - **Giant Segmented Mirror Telescopes:** Future telescopes like the Extremely Large Telescope (ELT) or the Giant Magellan Telescope (GMT) might offer better resolution, but even they would struggle with such small features due to the reasons listed.
  - **Interferometry:** Techniques like optical interferometry, where the light from multiple telescopes is combined to achieve higher resolution, might

theoretically allow for better imaging of lunar features, but practically, this is challenging for such small objects.

- **Lunar Missions:** Sending more missions to the Moon equipped with high-resolution cameras is the most effective way to study these sites in detail.

In summary, the combination of astronomical distances, Earth's atmospheric effects, and the small size of the targets makes imaging the Apollo landing sites from Earth-based telescopes currently impossible. Instead, we rely on spacecraft specifically designed for lunar exploration.



Spy agencies can read a postage stamp from space with their equipment, why can't they resolve the landing site which is much bigger?

Answer

...



I'll try again . . . Spy agencies can read a postage stamp from space with their equipment, why can't they resolve the landing site which is much bigger?

Answer

The claim that spy agencies can read a postage stamp from space is often an exaggeration or a simplified way of describing the capabilities of high-resolution satellite imagery. Here's why such claims need clarification in context with observing lunar landing sites:

1. **Satellite Imagery vs. Lunar Observation:**
   - **Earth Orbit:** Spy satellites are in Earth orbit, which means they are much closer to their targets than any telescope or satellite would be to the Moon. The Moon is, on average, about 384,400 kilometers away from Earth, far beyond the capabilities of even the most advanced Earth-orbiting reconnaissance satellites.
   - **Resolution:** While spy satellites can indeed achieve very high resolutions (sometimes sub-meter resolution, meaning they can resolve objects less than a meter in size), this capability is within the context of being relatively close to Earth. The resolution required to see small objects on the Moon from Earth would need to be orders of magnitude better than what's currently possible with space-based observation technology due to the vast distance.
2. **Physics of Resolution:**
   - **Diffraction Limit:** The resolution of an imaging system is limited by the wavelength of light used and the size of the aperture (diameter of the lens or mirror). Even with a very large aperture, the resolution needed to see something the size of the Apollo landing sites from Earth would require an impossibly large telescope given the Moon's distance.
   - **Light Travel:** Light spreads out as it travels, so the image becomes less sharp over distance. The Moon is far enough away that even the best adaptive optics can't compensate for the spread of light over such a distance to resolve such small features.
3. **Lunar Conditions:**
   - **Contrast:** On the Moon, the contrast between the bright lunar surface and dark shadows or small objects like equipment is not as pronounced as one might expect, especially when viewed from a great distance. The reflective properties of lunar dust and the lack of atmosphere make it challenging.
   - **Lighting:** The angle and intensity of sunlight on the Moon can either overexpose areas or cast deep shadows, obscuring details.
4. **Technological Limitations:**

- **Current Technology:** Even with advanced imaging technology, the actual resolution needed to see the Apollo sites from Earth is beyond what current space-based or ground-based telescopes can achieve. The technology to image small objects on the Moon from Earth would require a significant leap in imaging technology, much beyond what's currently available even for sensitive military or intelligence applications.

5. **Purpose and Design:**
   - **Spy Satellites:** These are designed to monitor Earth for military, intelligence, or other purposes. They are not designed or positioned to observe the Moon.
   - **Astrophotography:** Telescopes aimed at celestial bodies like the Moon are built for different purposes, focusing on broad astronomical phenomena rather than pinpointing small, detailed features.

If spy agencies or space agencies were to observe the Moon with the intent to see human-made objects, they would use spacecraft in lunar orbit, like the Lunar Reconnaissance Orbiter (LRO), which can provide the necessary resolution due to its proximity to the Moon's surface.

In summary, while spy satellites can achieve high resolution for Earth observation, the physics of imaging, the distance to the Moon, and the design of current observational technology mean that seeing the Apollo landing sites from Earth remains beyond our capabilities