

# Big Island astronomy

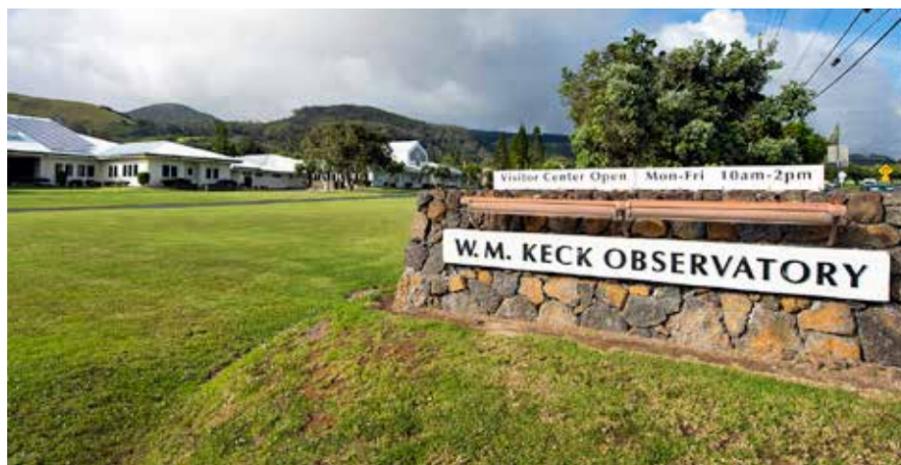
*Snorkeling, sunbathing, and stargazing:  
Hawaii might just be the perfect vacation.*  
by Katherine Kornei

**M**ention the Big Island of Hawaii to most people, and their heads will fill with pictures of palm trees, Sun-drenched beaches, grass skirts, flowery leis, and perhaps the ruddy glow of slowly spreading lava. An astronomer might be more likely to recall the frigid temperatures, treacherous roads, and barren, often snow-covered volcanic rocks, but also the breathtakingly beautiful outlooks of Mauna Kea. This mountain in the heart of Hawaii represents one of the premier observing sites in the world thanks to its dark, clear skies and excellent seeing conditions. The summit is home to 13 world-class telescopes, and astronomy is deeply embedded in the island's economy and culture.

A visit to the 50th state is therefore full of opportunities to geek out on astronomy. From the town of Waimea, home of the W. M. Keck Observatory Headquarters, to the Imiloa Astronomy Center in Hilo, to the peak of Mauna Kea, astronomically relevant locales abound in Hawaii.

## Starting at sea level

The city of Kona on the Big Island's west side — frequently served by interisland and mainland flights — is renowned for its beautiful beaches, rich snorkeling, and touristy shopping strip. A short drive north yields a decidedly different view of Hawaii, however. After turning away from the coast and climbing nearly 3,000 feet (1 kilometer) up the flank of Mauna Kea (“White Mountain”), the breezy, cool town of



The Keck Observatory Headquarters, located well off Mauna Kea in Waimea, serves as home base for visiting astronomers; it also offers tours to the public. STEVE CULLEN



Astronomy opportunities abound on the Big Island. But a visit to the top of Hawaii's central mountain of Mauna Kea, with the 13 telescopes run by organizations from around the globe that call the summit home, will certainly be the peak of your trip. ANDREW HARA

Waimea emerges. The town was once part of, and is now surrounded by, acres of pastureland belonging to Parker Ranch, one of the oldest cattle ranches in the United States. Waimea houses the headquarters of Keck Observatory, which manages the twin 10-meter-diameter Keck telescopes near the summit of Mauna Kea. Keck I and II — as well as their 11 telescope neighbors run by various universities and national astronomy programs — are fewer than 20 miles (30km) away as the crow flies, and some are visible on a clear day from Waimea.

Astronomers from around the world come to Waimea to use the two telescope control rooms at the Keck Observatory Headquarters; researchers are not allowed to conduct Keck observations from the summit due to concerns of altitude sickness.

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During the daytime, the public is welcome to tour the headquarters and explore the building's telescope models and hexagonal patches of lawn representing the distinctive Keck mirrors. Between 10 A.M. and 2 P.M. on weekdays, Keck Observatory docents, called Guide Stars, explain to visitors how the telescopes work and discuss important and recent scientific discoveries. Visitors are additionally invited to attend free evening talks at the nearby Kahilu Theatre given by professional astronomers.

The low-slung white buildings adjacent to the headquarters house the Visiting Scientist Quarters, home away from home for astronomers during their observing runs. Befitting a hotel reserved for nocturnal researchers, the rooms are equipped with sliding wooden panels that cover the windows. An adjacent common room and kitchen serve as a gathering place, and

astronomers store their night snacks in a communal refrigerator bearing a handwritten sign reading “Please label your food.” In the rare event of bad weather on the summit that precludes observing, astronomers can be found enjoying the common room's television and pool table.

## Journey to the top

No self-respecting astronomer or astronomy fan in Hawaii would pass up the opportunity to visit the summit of Mauna Kea. While organized tours of the summit abound, there are also options for exploring the mountaintop yourself, provided that you're feeling adventurous and have a four-wheel-drive vehicle. Check with your rental car company first, however; most companies don't allow their vehicles to be driven on the notoriously twisty, steep, and partially unpaved road leading to the

13,796-foot (4.2km) summit. Stock up on fuel and food before leaving town since the Saddle Road leading to Mauna Kea lacks these amenities.

On the drive from Waimea to the summit, you'll pass through many ecosystems, including tropical dry forest, subalpine grasslands, and alpine deserts. After turning left onto the Mauna Kea Access Road, stop at the Mauna Kea Visitor Information Center at an elevation of 9,200 feet (3km) to acclimatize to the altitude. Short walking trails starting at the visitor center afford good opportunities to stretch your legs and spot the elusive silversword plant, a rosette-shaped bush endemic to the alpine landscape of Mauna Kea. Keep an eye out for nearby cinder cones around small volcanic vents; these structures dot the Mauna Kea landscape as testaments to the past activity of the volcano.



**Parker Ranch — one of the oldest ranches in the United States — still owns much of the land surrounding both Keck headquarters and the observatories on Mauna Kea, and the ranch contributes a substantial piece of the history of the Big Island.** NOAA/JOHN BORTNIAK

The visitor center hosts free stargazing programs each evening, including star tours and a screening of a documentary about the mountain's spiritual and scientific significance. Bring a red flashlight for finding your way from the parking lot, but don't worry about running into one of the area's erstwhile populations of cows. Parker Ranch herds used to wander onto roads at night to enjoy the daytime heat reradiated by the asphalt. Before electric fences were added to the region in 2000, drivers would occasionally collide with the bovines on foggy evenings and then swear they hadn't seen anything in their way. Observatory staff and visitors passed around stories of the so-called "invisible cows." To this day, bumper stickers available in the visitor center proclaim "Beware of Invisible Cows."

Adjacent to the Mauna Kea Visitor Information Center is Hale Pohaku ("House of Stone"), a collection of five buildings containing staff offices, a library, a dining room, and simple yet functional hotel rooms. Some of the observatories on Mauna Kea allow visiting astronomers to conduct observations from the summit of the mountain, and Hale Pohaku is home base for these scientists. The buildings of Hale Pohaku are not open to visitors, though guests are welcome to explore the surrounding area and nearby walking trails. If you happen to be at Hale Pohaku a few hours before sunset, you might notice a flurry of activity as astronomers and telescope operators finish their "breakfast" and begin to drive up the summit for a night of work.

Escorted summit drives are available on weekends from the visitor center, but visitors



**The road up to the summit is challenging, and snow and ice are common sights on the mountain as you climb higher in elevation.** TOM KERR

are also welcome to drive to the summit on their own. The drive up to the top of Mauna Kea is fewer than 9 miles (14km), but there's also nearly 1 mile (2km) of elevation gain. The first 5 miles (8km) of the road is unpaved; watch for large rocks in the roadway and the tight switchbacks. And don't be fooled by Hawaii's tropical reputation: Temperatures on the summit can plummet below freezing, even in summer. Snow is a common sight on the White Mountain in winter; it is indeed possible to ski and surf in Hawaii on the same day. Given the low nighttime temperatures and the fact that astronomers are working on the mountain at night, Mauna Kea rangers suggest limiting summit visits to between a half-hour before sunrise and a half-hour after sunset.

If you're looking for an acclimatization break en route to the summit, there's a hiking trail shortly after the road becomes paved again. Follow the half-mile trail around a large cinder cone to Lake Waiau

("Swirling Water"), the only alpine lake in Hawaii. Lake Waiau, fed by winter snowfall, is spiritually significant to Hawaiians, who often use its waters in ceremonies and leave religious offerings on its banks. Hawaiian royalty and commoners alike have tossed their newborns' umbilical cords into the lake, hoping to ensure strength and health for their young progeny.

### The peak of observing

Upon reaching the summit, take in the sight of some of the most concentrated astronomy facilities in the world. The first large telescope installed on the mountain, the University of Hawaii 2.2-meter telescope, arrived in 1970. Now, 13 telescopes populate the mountain, arranged roughly in a ring. They collect optical, infrared, submillimeter, and radio photons, delivering first-class science across the electromagnetic spectrum.

The next telescope slated to join the Mauna Kea landscape, in 2022, will be the Thirty Meter Telescope (TMT), whose primary mirror will be composed of 492 hexagonal mirror segments. TMT, a collaboration of American, Chinese, Indian, Japanese, and Canadian institutions, will allow astronomers to study the universe with 10 times the spatial resolution of the Hubble Space Telescope. The past year has seen a flurry of controversy over TMT's construction due to cultural and environmental concerns from native Hawaiians, and protests are ongoing. For more on this situation, see p. 15.

The observatories on Mauna Kea are private facilities, although the Subaru Telescope, operated by the National Astronomical Observatory of Japan, offers tours (be aware that you must register in advance), and Keck Observatory provides a small visitor's gallery open to the public. The gallery features exhibits relating to current research and affords views of the Keck I Telescope and its 10-meter mirror. Note that the gallery may be locked after 3:30 P.M. when scientists begin testing the telescopes for their observations that night. And avoid lingering too long at the summit: There's 40 percent less oxygen there than at sea level. In fact, naked-eye stargazing is actually better down at the visitor center; human vision degrades in low-oxygen conditions.

### Back down to Earth

Descending from the summit — in low gear, minding the lack of guardrails — affords excellent views over clouds, cinder



**The silversword plant, endemic to Hawaii, is highly endangered. Efforts are ongoing to reintroduce and repopulate the species.** ROGELIO BERNAL ANDREO



**Cinder cones dot the terrain of Mauna Kea, remnants of the now dormant volcano's more active days.** TOM KERR

cones, and, off in the distance, the Pacific Ocean. Traveling down the Mauna Kea Access Road brings you through Apollo Valley, one of the training grounds of American astronauts in the 1960s and 1970s. Previous volcanic eruptions on the Big Island blanketed the terrain with basalt lava flows, which are chemically and aesthetically similar to the ancient lava flows found in the Sea of Tranquility and elsewhere on the Moon. Therefore, it's not surprising that NASA chose to send some of its Apollo astronauts to Hawaii to train in the lunar-like conditions of what came to be called Apollo Valley. Astronauts sporting sunglasses bounced over the uneven terrain in Moon buggies, collected soil samples using Apollo Lunar Hand Tools, and completed geological surveys similar to those they'd conduct on

the Moon. More recently, Apollo Valley was visited by NASA's Moon and Mars Analog Mission Activities Program to study how rovers could be most effectively used to survey the geology of an extraterrestrial landscape.

A left turn onto the Saddle Road brings you again through myriad ecosystems on your way back to sea level. The journey also affords spectacular close-up views of lava beds, remnants from previous eruptions of Mauna Kea and also Mauna Loa, an active volcano to the south. After approximately half an hour, the city of Hilo appears on the horizon. Hilo, the older, quieter, calmer cousin of Kona, is a place of majestic banyan trees, daily afternoon rain showers, and farmer's markets featuring Hawaiian specialties such as coconut rice wrapped in banana leaves and grilled ahi.

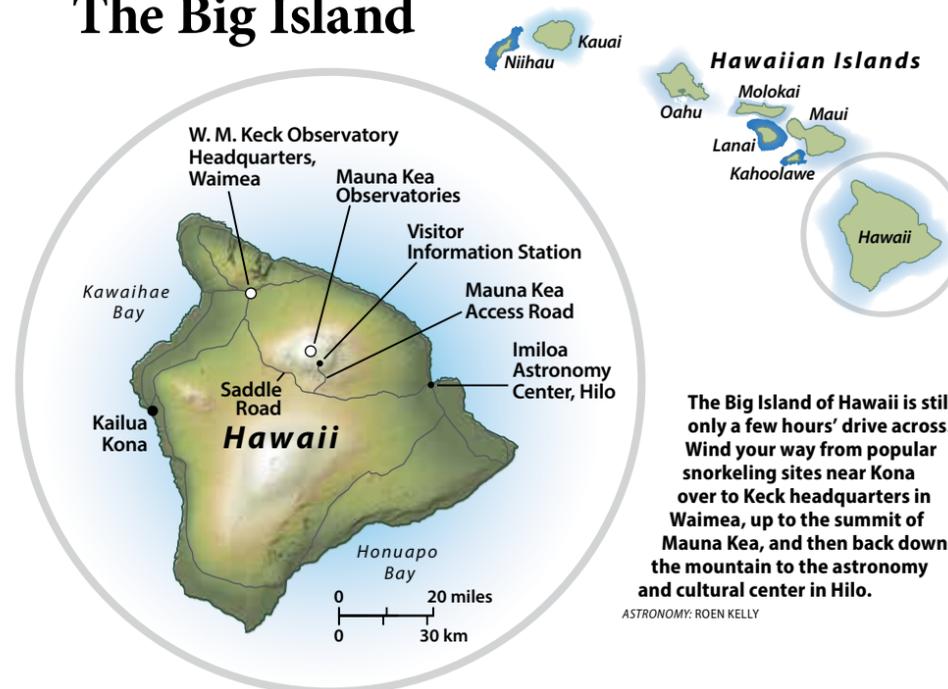


**In 2013, consecutive years of dry conditions had almost depleted Lake Waiau, a Hawaiian environmental and cultural treasure located adjacent to the summit's telescopes. The lake has since made a comeback.** USGS

The University of Hawaii college system maintains a campus in Hilo perched on a hill on the western side of the city. The campus includes a museum dedicated to astronomy, the Imiloa Astronomy Center. This cultural museum, which celebrates the intersection of Hawaiian traditions and astronomy, hosts astronomy lectures in its 120-seat planetarium, in addition to regular planetarium programming. Bilingual English/Hawaiian exhibits highlight both Hawaiian spiritual beliefs about Mauna Kea and the cutting-edge astronomical science being conducted on the summit. The museum furthermore includes the Big Island's only Science on a Sphere installation, which consists of a suspended 6-foot (2m) sphere used for visualizing planetary and space science data.

Astronomical science is clearly celebrated on the Big Island of Hawaii; where else can you find world-class telescopes, astronaut training grounds, and astronomy museums all within a few hours' drive? On your next visit to the 50th state, take a break from the sand and Sun to geek out on astronomy. ☾

## The Big Island



**The Big Island of Hawaii is still only a few hours' drive across. Wind your way from popular snorkeling sites near Kona over to Keck headquarters in Waimea, up to the summit of Mauna Kea, and then back down the mountain to the astronomy and cultural center in Hilo.**

ASTRONOMY: ROEN KELLY