The Moon as an Astronomical Platform

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Many astronomical events show different signatures in different regions of the electromagnetic spectrum, so it is highly desirable to have data from all wavelengths. Unfortunately, this is not possible from Earth-based instruments, as Earth's atmosphere absorbs most of the incoming radiation. To have access to the whole spectrum we must go away from the Earth's atmosphere and magnetic shield. This can be done from orbital platforms as well as from the surface of the Moon. We discuss the advantadges and drawbacks of observing from Earth, satellites and the Moon in a comparative study. The Earth's atmosphere absorbs most of the radiation and also introduces turbulence and aberrations in our observations. The main advantadge is immediate access to technical personnel and available technology. From satellites we have access to the whole spectrum, but there's a stability problem. A satellite platform also has a very short operational lifetime and cannot be supported by technicians in a continuous manner. From the surface of the Moon we can study the same as from satellites, but with much more stability and a longer lifetime. We can do astronomy from gamma to long radio waves. On the Moon we can implement an interferometric array not limited to the radio range. As there's no atmosphere, the resolution we can achieve is limited only by manufacturing and theoretical restrictions. The low lunar gravity also allows to make larger structures. For radio astronomy, it is important to note that the far side of the Moon is the cleanest place in the solar system, as the Moon itself blocks all interferences from Earth. All of this allows a very substantial enhancement of the observing power of our telescopes. For example, in the optical a lunar-based Keck-like telescope could achieve a resolution of about 10 milliarcseconds, almost a hundred times better than the best Earth-based instruments and comparable to the VLA resolution with radio interferometry. The Moon seismic stability also allows the establishment of an interferometric network in the infrared and perhaps also in the optical range, able to resolve protoplanetary disks and extrasolar planets. An astronomical observatory on the surface of the Moon has access to all wavelengths. Unique and interesting astrophysical phenomena like supernovae explosions and Gamma Ray Bursts may then be studied simultaneously in different ranges. For instance, supernovae studies could focus on the comparative evolution of brightness vs. optical, IR, X, gamma and radio wavelengths. Observations in the X and gamma bands allows the identification of chemical elements and processes occurring in the supernova shells. IR observations provide information on the kinematics and dynamics of the shell, and comparison of IR and X data permits the study of the dust heating mechanism. Meanwhile, the radio region can be used to study the evolution of magnetic fields.