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Stellar "GPS": Navigation in the Solar System

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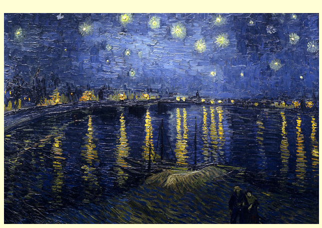
How does one navigate to a planet such as Mars? Will GPS work? Since ancient times sailors have navigated by following a path guided by markers with known locations: bottom sounding, landmarks such as mountain peaks, and of course stars overhead in the sky. In modern times the GPS satellites in the sky are providing the needed markers. However, when our spacecraft travel to the planets they go beyond the reach of GPS signals. What then can the navigator do? Needing markers which are very, very stable in position and very far away, the modern navigator chooses beacons powered by supermassive black holes: quasars!

Yet even super-powerful quasar signals are very diluted by the time they travel billions of light years to Earth. So we need large antennas (~35-meters) and super-cooled electronics (-270 deg C) and averaging over billions of bits of data in order to detect the quasar signals--and even that is not enough. Next we need to link antennas from around the world into a super-antenna we call an "interferometer.” Only then, with these super-antennas and their lever arms the size of the Earth, can we pinpoint the location of the spacecraft to within about the 100 meters accuracy needed to initiate the landing sequence from the top of the Martian atmosphere.

The last part of the trip is the most exciting. First, a parachute slows the lander down enough to fly on auto-pilot (because round trip light time is ~10 minutes) using radar to guide us almost to the ground. Lastly, in the case of MSL, the Curiosity Rover is lowered from a sky crane".

Mission accomplished.



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