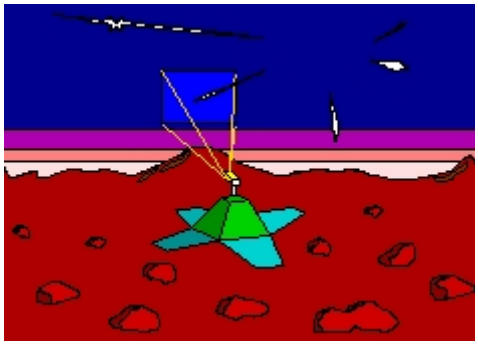
Martian meteor showers



Introduction.

Meteors are more than just pretty lights in the sky. Since the majority of meteor-producing meteoroids originate from comets, they contain invaluable information about these objects not otherwise obtainable.

In the first place, the activity profiles of annually recurring showers provide us with information about the conditions at the point and time of origin ie the parent comet. These annual showers as well as episodic events such as meteor outbursts continually teach us how meteoroid streams can evolve over time.

Observations of the characteristics of individual meteors can serve as a proxy for their physical structure and chemical composition and, in consequence, the relevant properties of their parent body. As such meteors serve as a kind of ``poor man's comet probe'' such as the upcoming ROSETTA mission with the advantage that instead of just studying just one object, one is able to engage in comparative studies of different parent comets through their respective meteor showers.

In that respect our window to the meteoroid complex in the solar system is quite limited in that one can detect meteoroid steams which intersect the orbit of the Earth. Judging from the number of known periodic comets the meteoroid stream complex should be significantly richer than what we can presently detect from the Earth.

Meteor brightness at Mars.

For this reason, one needs to consider using the atmospheres of other planets for meteor detection and more sophisticated survey work. One such possibility is the planet Mars. A 1996 paper in the journal Icarus by Adolfsson, Gustafson and Murray has pointed out that, although the atmospheric pressure at the surface is less than one percent the respective value at the Earth, the larger mean scale height of the atmosphere means that at an altitude of ~120km where meteoroids begin to ablate, atmospheric densities are comparable. As a result, meteors of the same mass and atmospheric entry speed at the atmospheres would be of similar magnitude . Taking into account the slower average speed of incoming material at the heliocentric distance of

Mars from the Sun, a meteoroid of the same mass entering the martian atmosphere at 30km/sec would produce a meteor +0.5 mag fainter than at Earth.

Possible martian meteor showers.

Judging from the relative orientation of the respective orbits in space as well as their minimum distance, a search can be performed for known comets which may produce observable annual enhancements of meteor activity in the martian atmosphere. As a result of such a search, Christou and Beurle (1999) concluded that a number of objects may be considered as good candidate parent bodies for such showers at specific times of the Martian year. This includes comet 1P/Halley (whose return to the inner solar system in 1986 made it the target of in situ scrutiny by no less than five spacecraft), Halley-type comet 13P/Olbers and the mystery object (5335) Damocles.

Detection Methods.

If meteors associated with these and other bodies do occur, observing them in the martian atmosphere presents some unique challenges. Automated imaging of meteors from landers is a possibility, although there are obvious bandwidth and power contraints which do not usually plague Earth-based video and camera networks. Perhaps the most appealing prospect in the short term is detection of meteors by instruments pointed downwards from orbit. As far as camera searches are concerned, meteors have already been observed in this manner from space. In addition, a camera with a given field of view can usually cover much more atmospheric surface area from orbit than from the surface, the tradeoff being that a given meteor in the latter case will appear brighter as it is closer to the observer.

Radar can also be brought to bear in the search for martian meteors, with currently planned subsurface sounding instruments to fly in the 2003 and 2005 opportunities operating in the few-MHz range, suitable for meteor detection.