METEOROID ORBITS AVAILABLE FROM THE
IAU METEOR DATA CENTER

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Abstract. Since it was founded early in the 1980's, the IAU Meteor Data Center
(IAU MDC) has accumulated a large number of the meteoroid orbits measured world­
wide so as to make these freely available to all interested researchers. The total number
of orbits available is about 68,000, of which about 6,000 were determined using optical
techniques (photographic or TV), the bulk having been detected using decameter radars.
The observation sites range from various locations in the U.S.A., Canada, Australia, and
in the former Soviet Union and Czechoslovakia; radar orbits from the Soviet Equatorial
Expedition to Somalia are also archived. About 39,000 of the 62,000 radar orbits are
derived from the Harvard Radar Meteor Project. Most of these programs were carried
out during the 1960's and 1970's, but still represent our best knowledge of the orbital
distribution of interplanetary particles in the size range from 100 \( \mu \)m to 1 meter. A new
survey currently in progress in New Zealand has so far rendered over 350,000 orbits, and it
is anticipated that these will soon become available through the IAU MDC. Presently the
68,000 orbits archived in the IAU MDC are only available on magnetic recording media,
but it is planned that they will shortly be made accessible via anonymous ftp.

1. The IAU Meteor Data Center

Starting in the 1930’s it became possible to determine the orbits of individual
particles observed as meteors using photographic techniques, so that at least the
nighttime meteor showers could be investigated and definitively linked to specific
comets. The development of suitable (decameter) radars in the 1940’s meant that
by the 1950’s the daytime showers were also amenable to study, and the smaller
particles (fainter meteors) detectable with such radars also led to a much enhanced
detection rate. During the 1950’s the various researchers at the Jodrell Bank station
of the University of Manchester (England) developed a set-up which could render
meteoroid orbits by determining the atmospheric speed from Fresnel oscillations
in the echo amplitude, and using the time of closest approach to each of a series
of receiver stations separated by several kilometers to deduce the meteor radiant.
With the time of detection known the heliocentric orbit could then be found. The
Jodrell Bank team determined over 2,500 orbits in this way, comprising the largest
repository of small particle orbits available in the late 1950’s for investigations of the
origin and evolution of such bodies. Some hundreds of orbits of larger meteoroids had also been measured using photographic methods, in particular by the team at Harvard led by F.L. Whipple.

These pioneering Jodrell Bank orbits have unfortunately been lost over the years, and so are no longer available to researchers wanting to investigate their orbital distribution, nor indeed historians of astronomy. With the realization that such epoch-making data are of importance, and should not be lost since they are still of scientific value, the first author of this paper established the IAU Meteor Data Center with a view to ensuring that all subsequent meteoroid orbit data be archived for use by new researchers. Five immediate justifications for such a data center spring to mind: (i) Such meteor research programs are ephemeral, so that unless a central repository exists, as a program terminates and the researchers disperse the data are often mislaid or deliberately discarded; (ii) Although several programs were carried out during the years 1960–75, since that time there has been very little activity in this area, making the old data the only available data; (iii) Some millions of dollars and roubles were spent in obtaining the data initially, so that it would not be sensible to let them be lost for the sake of a few thousand units of the same currencies, which is all that was required to assure their security; (iv) New techniques (and new minds) have made alternative types of analysis possible, in particular with the huge improvement in the computing power which has become available; (v) Newly-discovered comets and asteroids present themselves as possible parent objects for previously-observed meteoroids, the original orbits being needed for testing of such genetic relationships.

In fact the decision to collect all meteoroid orbits together was made only just in time. For example, well over 50% of the orbits now archived come from the Harvard Radar Meteor Project observation campaigns of 1961–65 and 1968–69, and the only source for these available was two computer tapes which had been stored in Z. Sekanina’s attic in Pasadena, California, for some years. Thankfully those tapes were successfully read by C.D. Murray and S.F. Dermott, and the data saved. Similarly the orbits from the Adelaide radar surveys of 1960–61 and 1968–69, the only such data collected from the southern hemisphere until very recently, were rescued from racks of dusty and decaying cards in an old data store which was cleared out soon thereafter.

Despite some close escapes most of the known orbits have been collected together, with Lindblad basing the IAU MDC at the Lund Observatory in Sweden (Lindblad, 1991a). Its foundation results from a proposal to the IAU at the General Assembly of 1976 from Commission 22, confirmed at the GA in 1982.

2. Meteoroid orbits available

The meteoroid orbits available from the IAU MDC in machine-readable form are listed in Table 1. These have been divided here into two separate groups, according to whether the meteors were observed optically (i.e. nighttime meteors only) or with radars (both night- and day-time observations). The survey names are given here only for the purposes of easy identification. A complete description of the observing techniques, sites, references to original publications on each, etc., is available from the IAU MDC (see below).