RESOLVING LDEF'S FLUX DISTRIBUTION: ORBITAL (DEBRIS?) AND NATURAL METEOROID POPULATIONS. J.A.M. McDonnell, Unit for Space Sciences, University of Kent at Canterbury, Kent CT2 7NR. UK

A consistent methodology for the collation of data from both penetration and perforation experiments and from data in the Meteoroid and Debris Special Investigator Group (M-D SIG) data-base has led to the derivation of the average impact flux over LDEF's exposure history 1984-1990. Data are first presented for LDEF's N,S,E,W and Space faces ("offset" by 8° and "tilted" by 1° respectively). A model fit is derived for ballistic limits of penetration from 1μm to 1mm of aluminium target, corresponding to impactor masses from $10^{-18}$kg (for $\rho_p=2g/cm^3$) to $10^{-16}$kg (for $\rho_p=1g/cm^3$). A second order harmonic function is fitted to the N,S,E and W fluxes to establish the angular distribution at regular size intervals; this fit is then used to provide "corrected" data corresponding to fluxes applicable to true N,S,E,W and Space directions for a LEO 28.5 degree inclination orbit at a mean altitude of 465 km.

Utilising dynamical modelling techniques [1; 2], the model fluxes are then analysed on the basis of two component flux orbital and meteoroid, model with several parameters allowed to float (e.g. meteoroid velocity and the ratio of orbital to interplanetary flux). Prior to this modelling, note is taken of a space debris component (of some 15%) on the trailing West face which is identified from chemical residues [3; 4].

Parameters deduced are:
1) The meteoroid impact flux from some $10^{-15}$kg to $10^{-7}$kg
2) The average meteoroid velocity at LEO altitudes;
3) The orbital flux (space debris?) incident on the N, S and E directions for impactor masses $10^{-15}$ to $10^{-12}$kg.

It is shown that the meteoroid population is asymmetrical in the mass range $10^{-12}$kg to $10^{-9}$kg regarding the North - South symmetry. This is discussed in the light of likely interplanetary sources; it may demand a small number of prolific cometary sources, rather than a well mixed population.

The orbital flux, which exceeds the natural component by a factor of 4 for micro particle fluxes, is compared with NASA models, the Solar Max Mission [5] and with the results of recent revisions in the Space Debris flux [6].

![Fig.1. Ballistic limit impact data from LDEF's 4 peripheral and Space faces from the MAP experiment [7] and the M-D SIG database. Thick target data is converted using crater depth times 1.5.](https://ntrs.nasa.gov/search.jsp?R=19940011918)
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Fig. 2. Model fluxes for "true" N,S,E,W directions (and Space un-corrected) relative to the orbit vector; they are derived using angular fits to data in Figure X.

Fig. 3. Populations of Orbital and Interplanetary Meteoroids derived from the 2 component modelling [8]. The micro particle orbital component (dominant on the East, South and North) exceeds the natural component on the West and Space faces. At larger dimensions, the debris deduced from chemical data [3] is some 15% of the natural flux.

References