

TIMED COLLECTIONS IN THE NASA COSMIC DUST AIRCRAFT COLLECTED PARTICLE COLLECTION INCLUDING PREVIOUS COLLECTORS M. Fries¹, R. Bastien², K. McBride², M. Rodriguez²,
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Introduction: The NASA Cosmic Dust Collections includes a collection of interplanetary particles gathered using high-altitude aircraft (the Aircraft Collected Particle collection, or ACP). These particles include cosmic-origin particles as well as particles of terrestrial origin such as volcanic ash, solid rocket motor effluent, and terrestrial dust. The cosmic-origin dust comes from two principal sources - material originating from the diffuse interplanetary background which are uncoupled from the orbits of larger bodies, and cometary-origin particles which are dynamically coupled with the orbits of their parent bodies to form dust streams. These dust stream particles generate short-lived, annual meteor showers and are important because, if they can be identified as originating from a given dust stream, they can be studied in the laboratory as samples of a specific comet. Collecting these particles requires dedicated ACP flights which are timed to coincide with a specific meteor shower. These “timed collections” hold the promise of providing samples from a suite of comets including those never visited by spacecraft [1-3]. This abstract describes a recent (Dec 2020) timed collection attempt, lists previous timed collections with collected particles available for request from the NASA Cosmic Dust Collections, as well as listing ACP collectors which were collected when no meteor showers were active for potential use as control samples.

Description: The NASA Cosmic Dust Collections is dedicated to supporting timed collection research by the community. The following improvements have been implemented in this pursuit:

2020 Geminids Timed Collection: A pair of WB-57 flights dedicated to attempted collection of particles from the Geminids meteor shower (Figure 1) were flown in 2020. Four small collectors (W7320-23) were exposed for five hours each soon after peak flux for the shower. The Geminids originate from parent body 3200 Phaethon, a “rocky comet” that is the principal science target for the upcoming JAXA Destiny+ mission. The short exposure time (5 hours) produced a small number of particles that will be announced as available for request in the spring 2022 ExMAG mission. The infall speed of this shower is high (35 km/s) so survival chances are reduced, but the potential science value of supporting Destiny+ merits a collection attempt.

Figures Illustrating Exposure Times of Collectors: Currently, the Cosmic Dust public database does not include detailed descriptions of the collectors, focusing instead on the particles. This will be remedied, and new



Figure 1: Long-exposure composite photo of the 2020 Geminids meteor shower as seen near Uvalde, TX. This shower was the target of a new timed collection attempt. Photo Credit: Linda Welzenbach

figures (Figure 2) comparing the exposure period of Aircraft Collected Particle (ACP) collectors with known meteor showers will be included in the database. The new figures are adapted from Moorhead et al (2019) with permission and show infall flux in low Earth orbit (LEO) compared to the period a collector was exposed. The user can see the active flux at the time of collection in terms of particle mass, and whether a given meteor shower was active. These figures are intended for illustrative purposes only, and do not guarantee that particles from a given meteor shower are present on the collector. Also, settling times must be considered and may limit capture of particles from a given shower.

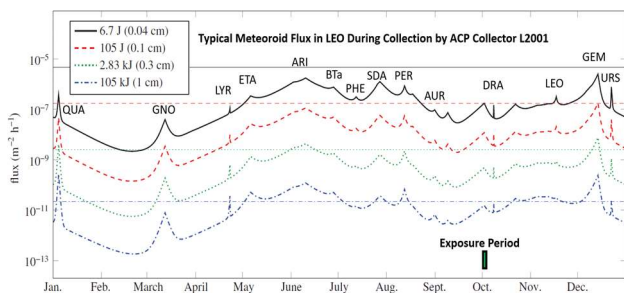


Figure 2: Example figure using collector L2001, showing flux active at the time L2001 was exposed. Flux repeats annually and is shown as colored lines representing particle sizes. The exposure period for L2001 is shown as a bar near the bottom, for a short period in early October. Comparing the bar position and width to the flux lines reveals infall during exposure.

Meteor Shower	Flag	Start Date	End Date	Hours Exposed
Quadrantids (QUA, Early January)	L2021-23	1/7/1994	2/8/1994	35.8
	U2071-72	1/7/1994	2/8/1994	UNK
Gamma-Normids (GNO, mid-March)	W7234-39	3/7/2001	4/19/2001	35
Lyrids (LYR, late April), Pi Puppids (PPU, late April)	W7034-40	4/1/1982	5/1/1982	13
	W7118-21	4/1/1992	5/1/1992	20
	W7246-51	4/4/2002	5/15/2002	49
Eta-Aquariids (ETA, early May)	L2064-65	5/5/2007	5/15/2007	28
	L2083-85	5/6/2010	5/23/2010	32
	L2090-93	5/7/2012	6/14/2012	8
	U2045	5/1/1987	6/1/1987	28.1
Daytime Arietids (ARI, early June), Daytime Delta-Taurids (BTA, end of June)	L2009-12	6/1/1991	7/1/1991	36
	L2033-36	6/7/1994	7/5/1994	26
	U2023	6/1/1984	7/1/1984	40.55
	U2050	6/1/1991	7/1/1991	60
Southern Delta Aquariids (SDA, late July)	U2007-08	7/1/1982	8/1/1982	50.6
	U2135-36	7/28/2006	8/14/2006	39.25
	U2138-39	7/6/2007	7/30/2007	39.3
	U2162-63	7/10/2014	8/1/2014	40
	W7295-98	7/22/2010	8/22/2010	69
Perseids (PER, mid-August)	L2056-59	8/13/2004	8/20/2004	23.5
	U2130	8/13/2004	8/13/2004	3.6
	U2172-73	8/20/2018	8/20/2018	4
Draconids (DRA, early October)	L2094-95, U2153-54	10/15/2012	10/17/2012	23.2
	L2096-97, U2155-60	10/15/2012	10/16/2012	15.1
Leonids (LEO, mid-November)	L2017-20	11/1/1992	12/1/1992	47.5
	W7066-73	11/1/1983	12/1/1983	33
Geminids (GEM, early December)	L2046-49	12/6/1999	12/8/1999	6.5
	U2035-39	12/1/1985	12/1/1985	19
	U2040-43	12/1/1985	12/1/1985	3.5
	W7320-23	12/14/2020	12/14/2020	5
Controls - Flights with no Major Showers	U2051-52	2/1/1992	2/1/1992	3
	U2053-54	2/1/1992	3/1/1992	40.7
	U2089-90	2/2/1997	2/13/1997	28.2
	W7115	2/1/1992	2/1/1992	4
	W7228-33	2/1/2001	3/6/2001	29

Figure 3: Table of previously flown ACP collectors which coincide with known meteor showers. See text for discussion.

Compilation of Potential Timed Collections for all ACP Collectors: Timed collections have been performed since 1994 but collectors in the NASA collection date back to 1981 [4], affording the possibility that timed collections can be found in previous collectors. The table on this page is a selection of collectors (or “flags”) which may contain particles from the meteor shower listed in the left-hand column. This list is intended to nucleate discussion and is provided based on collection timing only. It does not consider infall geometry, infall velocity, meteor flux, or other factors. For a more

detailed list and/or a list of all collectors, talk to or email the Curator (address in the title bar).

References: [1] Warren, J.L. and Zolensky, M.E., 1994, July. In AIP Conference proceedings (Vol. 310, No. 1, pp. 245-254). American Institute of Physics. [2] Dermott, S.F. and Liou, J.C., 1994, July. In *AIP Conference Proceedings* (Vol. 310, No. 1, pp. 13-21). American Institute of Physics. [3] Messenger, S., 2002. *Meteoritics & Planetary Science*, 37(11), pp.1491-1505. [4] Zolensky, M.E., 2016. *Elements*, pp.159-160.