Stardust Allocation Subcommittee report

CAPTEM Mar 19, 2016

Andrew Westphal, Berkeley, Chair
Andy Davis, Chicago
Philipp Heck, Field Museum
Scott Sandford, NASA/ARC
George Flynn, SUNY Plattsburgh
Rhonda Stroud, Naval Research Lab

Requests and allocations summary
Stardust: publication of results
Stardust Workshop
Stardust White Paper

Request summary through 19 Mar 16

Westphal+ *Rare sample request (organics in track 191 "Jezebel")*

Westphal+ *Rare sample request (fine-grained material associated with track 191 "Andromeda")*

#167 Floss+ *TEM analysis of interstellar collector craters*

#168 Floss+ *Auger analysis of interstellar collector craters*

#169 Stroud+ *Multi-Instrument analysis of interstellar collector craters*

Compendium maintained on a shared Papers collection

142 refereed publications

Ryan C Ogliore et al.	Oxygen isotopic comp...	Geochimica et...	2015	
Frans J M Rietmeijer	The smallest comet 81...	Meteorit Planet...	2015	
Zack Gainsforth et al.	Constraints on the for...	Meteorit Planet...	2015	
Gerardo Dominguez et al.	Nanoscale infrared sp...	Nature Commu...	2014	
David R Frank et al.	Olivine in terminal par...	Geochimica et...	2014	
Frank E Brenker et al.	Stardust Interstellar P...	Meteorit Planet...	2014	
Anna L Butterworth et al.	Stardust Interstellar P...	Meteorit Planet...	2014	
George J Flynn et al.	Stardust Interstellar P...	Meteorit Planet...	2014	
F Postberg et al.	Stardust Interstellar P...	Meteorit Planet...	2014	
Alexandre S Simionovici et al.	Stardust Interstellar P...	Meteorit Planet...	2014	
Veerle J Sterken et al.	Stardust Interstellar P...	Meteorit Planet...	2014	
Andrew J Westphal et al.	Final reports of the St...	Meteorit Planet...	2014	
Andrew J Westphal et al.	Stardust Interstellar P...	Meteorit Planet...	2014	
Andrew J Westphal et al.	Evidence for interstell...	Science	2014	
Don Brownlee	The Stardust Mission:...	Annual Review...	2014	
A Rotundi et al.	Two refractory Wild 2...	Meteorit Planet...	2014	
Julien Stodolna et al.	Characterization of pr...	Earth and Plan...	2014	
Julien Stodolna et al.	Iron valence state of fi...	Geochimica et...	2013	
N F Foster et al.	Identification by Rama...	Geochimica et...	2013	
Hugues Leroux and Damien Jacob	Fine-grained material...	Meteorit Planet...	2013	
G Matrajt et al.	The Origin of the 3.4 μ...	The Astrophysi...	2013	
Christine Floss et al.	The Abundance of Pre...	The Astrophysi...	2013	
Hans A Bechtel et al.	Stardust Interstellar P...	Meteorit Planet...	2013	
Z Gainsforth et al.	Stardust Interstellar P...	Meteorit Planet...	2013	
Zack Gainsforth et al.	Stardust Interstellar P...	Meteorit Planet...	2013	
Rhonda M Stroud et al.	Stardust Interstellar P...	Meteorit Planet...	2013	
Daisuke Nakashima et al.	Oxygen isotopes in cr...	Earth and Plan...	2012	
Hans A Bechtel et al.	Surface modifications...	Meteorit Planet...	2012	

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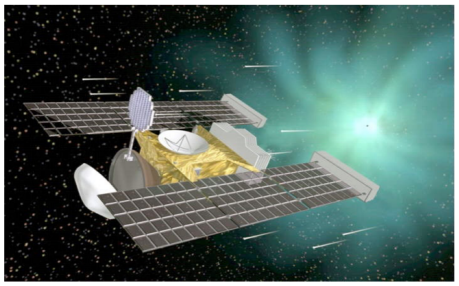
https://online.papersapp.com/collections/78f7e539-718c-4111-81b7-15e5ad62ee7e/share



Pre-MetSoc Workshop on results from the Stardust Mission

July 24-25, 2015
Berkeley

Generously supported by a grant from NASA, and sponsored by CAPTEM.

Publication Plan:

White paper
focused on Unsolved Problems in Planetary Science that can be addressed by analyses of Stardust samples, with emphasis on instrumentation and sample preparation development
(In parallel with similar paper for Genesis)

Book or special issue of MAPS
working group has 21 members

Pre-MetSoc Stardust Workshop

24-25 July 2015

Hillside Club, Berkeley, CA

Generously supported by a grant from NASA, and sponsored by CAPTEM.

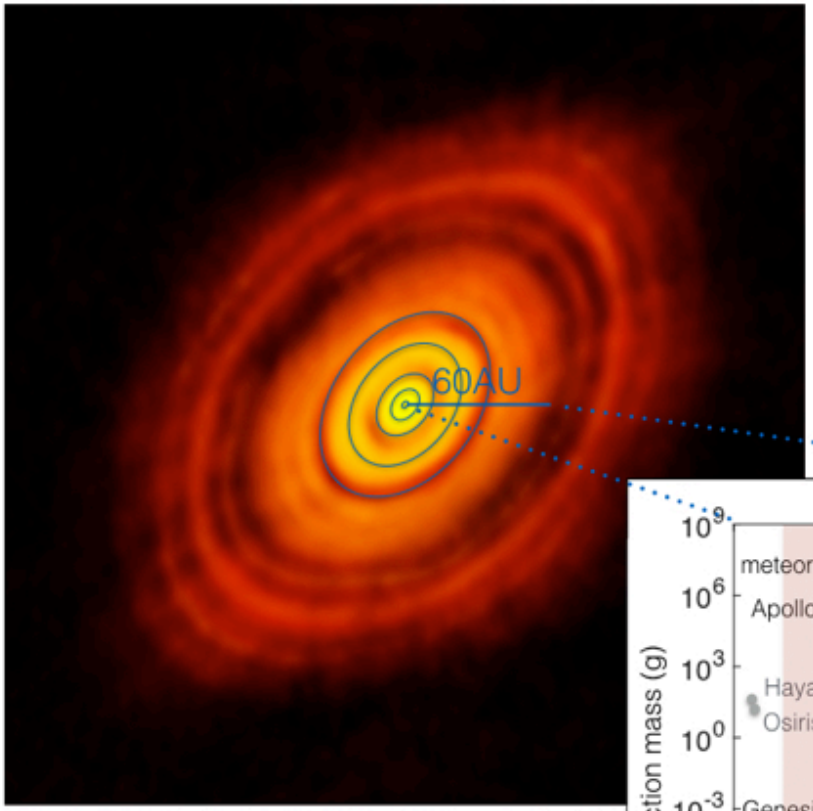
Participants

Hans Bechtel
Eve Berger
John Bridges
Donald Brownlee
Don Burnett
Anna Butterworth
Hitesh Changela
Simon Clemett
Kevin Croat
Andrew Davis
Elena Dobrica
Brad de Gregorio
Imke de Pater
Céline Defouilloy
Gerardo Dominguez
Denton Ebel
Christine Floss
George Flynn
Zack Gainsforth
Daniel Glavin
Monica Grady
Jeff Grossman
Brendan Haas
Pierre Haenecour
Philipp Heck
Torsten Henkel
Hugh Hill
Zhengwei Hu
Munir Humayun
Gary Huss
Hope Ishii
Peter Jenniskens
David Joswiak
Lindsay Keller
Mike Kelley
Noriko Kita
Jan Leitner
Laurence Lemelle
Casey Lisse
Ian Lyon
Glenn Macpherson
Matthew Marcus
Kuljeet Marhas
Rich Mathies
Kevin McKeegan
Scott Messenger
Hiroko Nagahara
Keiko Nakamura-Messenger
Ann Nguyen
Larry Nittler
Ryan Ogliore
Russ Palma
Frans Rietmeijer
Scott Sandford
Alexandre Simionovici
Christopher Snead
Thomas Stephan
Rhonda Stroud
Mario Trieloff
Andrew Westphal
Amanda White
Sue Wirick
Diane Wooden
Hikaru Yabuta
Michael Zolensky

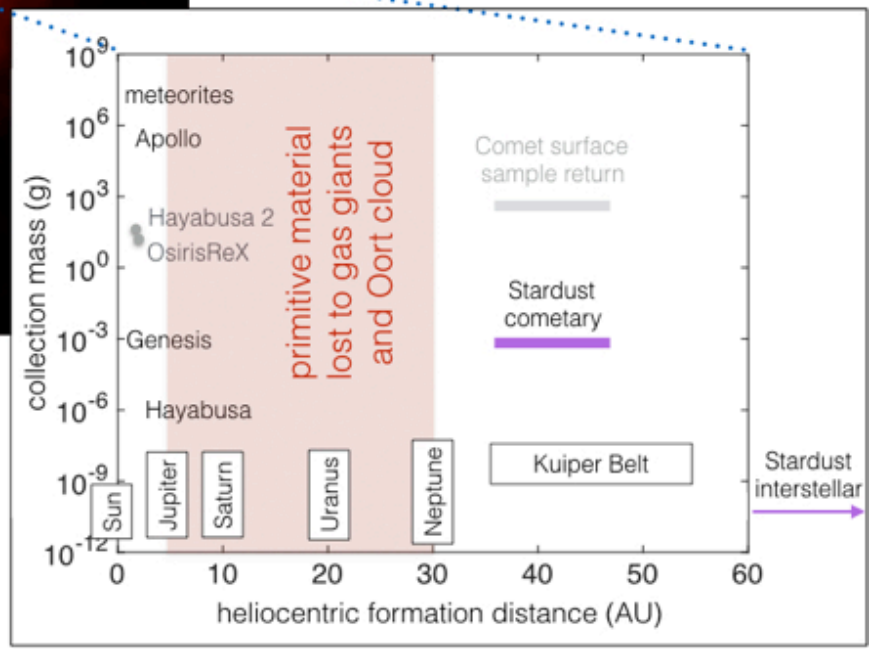
32 talks, 5 posters

The Future of Stardust Science
A Special Report to NASA
Feb 29, 2016

A. J. Westphal[1], J. C. Bridges[2], D. E. Brownlee[3], A. L. Butterworth[1], B. T. De Gregorio[4], G. Dominguez[5], Z. Gainsforth[1], G. J. Flynn[6], H. A. Ishii[7], D. Joswiak[3], L. R. Nittler[8], R. C. Ogliore[9], R. O. Pepin[10], R. Palma[10], T. Stephan[11], M. E. Zolensky[12]



Comets are undersampled with respect to asteroids by ~10^{13}.

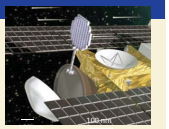


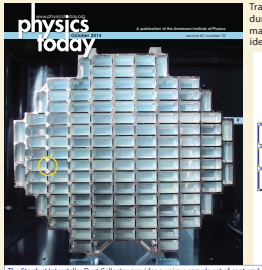
foils@home

crowd-sourced impact identification in Stardust Interstellar foil collectors

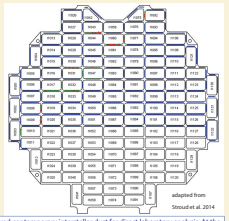
IDENTIFICATION OF CANDIDATE INTERSTELLAR DUST IMPACT FEATURES ON STARDUST FOIL I1020W,1

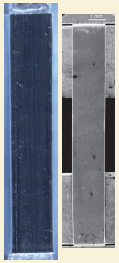
R. M. Stroud[1], B. T. De Gregorio[1], N. D. Bassim[1], A. J. Westphal[2], A. L. Butterworth[2], R. Lettieri[2], W. Marchant[2], D. Zevin[2], 90 stardust@home "dusters"[3]
[1]Naval Research Laboratory, Code 6366, 4555 Overlook Ave. SW, Washington, DC 20375, USA
[2]Space Sciences Laboratory, University of California at Berkeley, Berkeley, CA 94720, USA
[3]worldwide





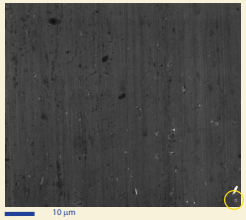
Tray schematic showing locations of foils mapped during preliminary examination (green) and newly mapped I1020W (cyan). Approximate locations of identified impact features are shown (red).

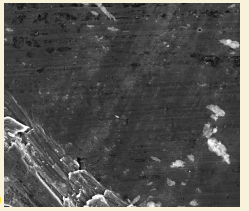




(far left) Level II optical documentation image of Foil I1020W on tray (near left) SEM image of foil I1020W,1 mounted on archival stretcher. The foil is ~2 mm * 10 mm.

Side view of example stretcher



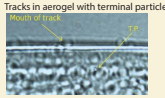


The Stardust Interstellar Dust Collector provides a unique sample set of captured contemporary interstellar dust for direct laboratory analysis. At the conclusion of Interstellar Preliminary Examination (ISPE) in 2014, 3 particles caputred in aerogel and 4 impact craters in the Al foils of probable interstellar origin were reported (Westphal, et al. Science (2014) and accompanying papers in Meteoritics and Planetary Sci.). Approximately 5% of the available foil surface was analyzed during ISPE, leaving the possibility of locating additional candidate interstellar dust impacts. The search for such features by multiple groups is ongoging, e. g., (Floss, 2015). We report here on the identification of new impact features on Foil I1020W,1.

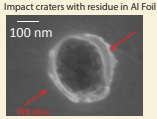
Foils are cut from the tray and mounted on strechers to enable automated SEM imaging. SEM imaging is first performed at low magnification (here, 31.3 nm / px, at 5 mm working distance , 10 kV) to obtain a map of the entire foil. 7,026 individual 1768px × 2048px secondary electron images of I1020W,1 were recorded.

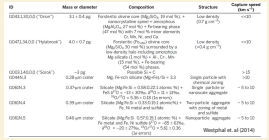
Finding the candidate impact features requires searching through thousands of images per foil. During ISPE, a combination of manual visual inspection and computer algorhytm searching were used to locate candidates. For the tracks in aerogel, an alternate approach of recruiting citizen scientists to participate in the search through an online virtual microscope (Stardust@home) was developed. Based on the success of the Stardust@home program, we've chosen to develop an extension of that effort for foil searching. Details of the Foils@home project are described on the companion poster presented at this meeting by Westphal et al.

Tracks in aerogel with terminal particles

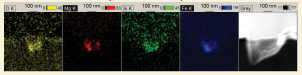


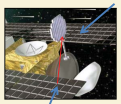
Impact craters with residue in Al Foil





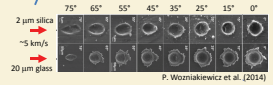
STEM- EDX Net Count Maps of X-Section of probable interstellar dust





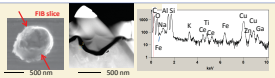
Solar panel secondaries are all off normal, at azimuthal angles (20°,150°), (-20°, -150°)

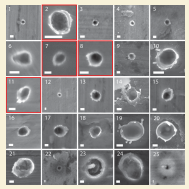
ISD > 0.8 µm primarily from (0°,50°)



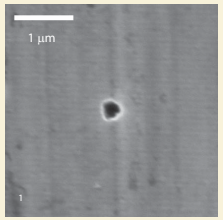
P. Wozniakiewicz et al. (2014)

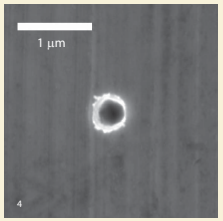
Crater shape can record the incident particle direction in some cases. Many of the shallow craters observed during ISPEwere due to secondary impact from the solar cell array. These have distinct elemental compositions rich in Ce, Na, K and Zn.





Features identified during ISPE. The four craters outlined in red contained residue consistent with cosmic origin, 14 others, e.g., #24, showed residues consistent with secondary impacts fromteh solar cell glass. The scale bars shown are 0.25 µm.





To date, dusters using the Foils@ home virtual microscope have identified more than 25 features for further imaging. We reimaged 23 of these features at higher magnification, and identified 6 new candidate impacts. The craters range in size from 0.3 to 0.56 µm equivalent diameter, consistent with those found during ISPE. The next step in the analysis is to determine the elemental composition. Because this foil showed contamination build up when the beam raster size approached the crater size, neither Auger nor SEM-EDS alone is likley to provide definitive composition information. Thus we plan to proceed with FIB extraction of cross-sections of the craters for STEM-EDS analysis, in order to determine which are from cosmic dust,, secondary impacts from either solar cell array or the return capsule lid, or unsual types of defects in the foil. Finally, NanoSIMS measurements of the oxygen isotope composition of any oxide or silicate residues will be performed to provide the most definitive proof of origin in the local interstellar medium. These invasive measurements have been approved by CAPTEM and will be carried out following this meeting.

References:
A. Westphal et al (2014) Evidence for interstellar origin of seven dust particles collected by the Stardust spacecraft, *Science* **345**: 786-791.
A. Westphal et al. (2014) Final reports of the Stardust Interstellar Preliminary Examination, *Meteoritics & Planetary Science* **49**: 1720-1733.
R. M. Stroud et al. (2014) Stardust Interstellar Preliminary Examination XI: Identification and elemental analysis of impact craters on Al foils from the Stardust Interstellar Dust Collector, *Meteoritics & Planetary Science* **49**: 1698-1719.
P. Wozniakiewicz et al. (2014) Micron-scale hypervelocity impact craters: Dependence of crater ellipticity and rim morphology on impact trajectory, projectile size, velocity, and shape, *Meteoritics & Planetary Science* **49**: 1929-1927.
C. Floss (2015) Identification of Impact Craters in Aluminum Foil from the Stardust Interstellar Dust Collector: An Update, *46th LPSC*, Abstract #1005.

Acknowledgements: This work was supported in part by the NASA LARS program and the NRL Institute for Nanoscience.

CAPTEM Informatics Subcommittee

Current membership:

Andrew Westphal (Berkeley)
Tim McCoy (Natural History Museum)
Denton Ebel (American Museum of Natural History)
(Sam Lawrence (ASU), moved to JSC)

Responded to RFI from HQ regarding data management, in consultation and coordination with JSC Curation.

(Immediate) future of Informatics committee

Response to RFI

What role should the PDS play, relative to other archiving alternatives (including scientic journals), in providing the public access to the data that is the product of NASAs funded research and the basis of published scientic studies?

"Use of PDS for Curation data is premature …"

- ~30 types of instruments commonly used in ET sample analyses. Among each type, there are often several different specific instruments. Some are commercial, and some are unique and home-grown by PIs. The result is a bewildering plethora of instruments in the community, and a hodge-podge of (raw) data formats.

- No community consensus on formats for data products

- Without a community consensus, archived data and data products would have to be extensively documented to be of any value to current or future researchers. This documentation would have be written, evaluated, and maintained. In a rapidly changing field, maintenance would be a major challenge. There is currently no support for such activities.

- There is no community consensus on the types of well-documented data or data products that would be of use to current or future researchers. Data analyses are similarly often a work in progress, and there is usually not a clear criterion for deciding which among the various levels of data analysis should be archived. Even if such a consensus could be developed, it would be highly specific to the type of analysis { a generic requirement is probably impossible to write.

Response to RFI

We recognize the need to make data collected on the public dime publicly accessible. …The emerging requirement by journals to include data, data products and analysis procedures or code, and to include these in the review process, is a step forward and addresses many of the issues enumerated above.

Recommendation for future of Informatics committee.

Charter:

The primary responsibilities of the Informatics Subcommittee of CAPTEM are:

- *To develop a prioritized, long-term vision for capabilities of the external interface for JSC curation, in consultation with the PI community and JSC Curation.*
- *To support development of a strategic plan for Informatics, which may include different funding scenarios.*
- *To represent the PI community in the development of external requirements for the JSC databases and catalogs.*
- *To provide ongoing, periodic assessments of external aspects of JSC databases and catalogs.*
- *To provide findings to JSC Curation on the capability and sustainability of current informatics technology as applied to collections.*

We propose to focus on the last three items on the charter in the next two years, in particular on Bullet 4. In this sense, the IC will play a role similar to the CAPTEM Facilities Committee.

Recommendation for future of Informatics committee.

Recruit one representative for each collection (Lunar, Meteorite, CD, Stardust, Genesis, Hayabusa, RSH) to the IC. This might be a past or current Committee member or Chair, or another experienced person from the community. Thus there will be 7 committee members (up from the current three).

For each collection, the responsible member will develop an assessment procedure for the online catalog, in collaboration with the Curator. An example of such a procedure might be:

- obtain a list of samples from the Curator in a spreadsheet
- randomly select a small number (<10) samples from the comprehensive list
- assess the catalog entries for the samples against a checklist of desired information and capability (e.g., discoverability, photodocumentation, allocation history, classification, basic mineralogy, etc.)

Because each collection has unique characteristics, each assessment procedure will be different, and will be compatible with community expectations of the catalog. The assessment procedures will be discussed, approved and documented by the committee, and presented to CAPTEM.

The IC members will carry out this assessment semi-annually, and will report the results at each CAPTEM meeting.