DETECTION EFFICIENCY AND NOISE RATES IN THE
STARDUST@HOME INSTRUMENT. A.J. Westphal1, D.
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>26,000 Stardust@home dusters3 1Space Sciences Laboratory,
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Introduction: In 2006, the Stardust spacecraft returned the
first samples from a known comet and the first samples of con-
temporary interstellar dust. The cometary dust collection con-
sists of thousands of particles captured in aerogel and aluminum
foil. Many of these particles are >10µm in size and so are rela-
tively straightforward to analyze. The interstellar dust collection
is orders of magnitude more challenging than the cometary col-
lection for two reasons: the dust particles are less than a thou-
sandth the mass of the typical cometary dust samples; and there
are far fewer, probably only a few dozen in the entire 1000 cm²
collector. We developed the Stardust@home project to solve a
challenging problem: before any analyses of these tiny particles
can be done, it is obviously first necessary to identify them. A
search ~10⁶ microscope fields of view is required. We enlisted
the help of volunteer collaborators in the search for interstellar
dust.

Instrument: We adapted an automated microscope for col-
lecting digital imagery of the collector with ~0.5µm resolution.
This microscope has collected three-dimensional image data on
~30% of the collector. We developed a web-based virtual micro-
scope which enables the image data to be efficiently searched by
eye. These are the essential components of Stardust@home.
>26,000 volunteers have gone through the online training and
testing required to register as Stardust@home “dusters”.

Search tool: The ensemble of Stardust@home dusters can be
thought of as a multi-channel instrument consisting of thousands
of individual detectors. Here we took a quantitative approach.
We calibrate the dusters using calibration images (known blanks
and images dubbed with the image of a track produced by a sub-
micron particle using a dust accelerator). The calibrations are
randomly inserted into the data stream. The dusters do not know
which images are calibrations. Using these calibrations we
measure the individual noise rate and detection efficiencies as a
function of track size. Using responses to 1.2x10⁷ viewings of
dubbed calibration fields of view (among ~5x10⁷ searches), we
found that for tracks >5µm diameter, the detector sensitivity is
>90%. Because each image is viewed many times (~300), multi-
ple coincidence is used to increase the instrumental detection
efficiency to ~100% for features that match the calibration im-
ages. The median response rate in response to all data is ~1.2%;
since >>99% of fields of view are blank, the median specificity is
~99%. This demonstrates that this unusual approach is effective
in identifying candidate features that closely match calibrations.

Discovery tool: A question remains regarding the flexibility
of the dusters in identifying features that do not closely match the
 calibration images. We evaluate this by considering 27 “off-
normal” tracks that have been discovered through Star-
dust@home. These are tracks of slow secondary particles gener-
ated by impacts on the spacecraft solar panels by micrometeorite
impacts. The tracks look very different from the calibration im-
ages. About one-third of these off-normal tracks could be found
in this dataset by reviewing the candidates down to a response
level of 20%, which is about 1% of the entire dataset. This is a
demonstration that this “distributed thinking” approach may be
used as a discovery tool as well as a search tool.