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* Research Article

**Evidence for interstellar origin of seven dust particles collected by the Stardust spacecraft**

1. [Andrew J. Westphal](http://www.sciencemag.org/search?author1=Andrew+J.+Westphal&sortspec=date&submit=Submit)[1](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-1),[\*](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#corresp-1),
2. [Rhonda M. Stroud](http://www.sciencemag.org/search?author1=Rhonda+M.+Stroud&sortspec=date&submit=Submit)[2](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-2),
3. [Hans A. Bechtel](http://www.sciencemag.org/search?author1=Hans+A.+Bechtel&sortspec=date&submit=Submit)[3](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-3),
4. [Frank E. Brenker](http://www.sciencemag.org/search?author1=Frank+E.+Brenker&sortspec=date&submit=Submit)[4](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-4),
5. [Anna L. Butterworth](http://www.sciencemag.org/search?author1=Anna+L.+Butterworth&sortspec=date&submit=Submit)[1](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-1),
6. [George J. Flynn](http://www.sciencemag.org/search?author1=George+J.+Flynn&sortspec=date&submit=Submit)[5](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-5),
7. [David R. Frank](http://www.sciencemag.org/search?author1=David+R.+Frank&sortspec=date&submit=Submit)[6](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-6),
8. [Zack Gainsforth](http://www.sciencemag.org/search?author1=Zack+Gainsforth&sortspec=date&submit=Submit)[1](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-1),
9. [Jon K. Hillier](http://www.sciencemag.org/search?author1=Jon+K.+Hillier&sortspec=date&submit=Submit)[7](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-7),
10. [Frank Postberg](http://www.sciencemag.org/search?author1=Frank+Postberg&sortspec=date&submit=Submit)[7](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-7),
11. [Alexandre S. Simionovici](http://www.sciencemag.org/search?author1=Alexandre+S.+Simionovici&sortspec=date&submit=Submit)[8](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-8),
12. [Veerle J. Sterken](http://www.sciencemag.org/search?author1=Veerle+J.+Sterken&sortspec=date&submit=Submit)[9](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-9),[10](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-10),[11](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-11),[12](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-12),
13. [Larry R. Nittler](http://www.sciencemag.org/search?author1=Larry+R.+Nittler&sortspec=date&submit=Submit)[13](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-13),
14. [Carlton Allen](http://www.sciencemag.org/search?author1=Carlton+Allen&sortspec=date&submit=Submit)[14](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-14),
15. [David Anderson](http://www.sciencemag.org/search?author1=David+Anderson&sortspec=date&submit=Submit)[1](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-1),
16. [Asna Ansari](http://www.sciencemag.org/search?author1=Asna+Ansari&sortspec=date&submit=Submit)[15](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-15),
17. [Saša Bajt](http://www.sciencemag.org/search?author1=Sa%C5%A1a+Bajt&sortspec=date&submit=Submit)[16](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-16),
18. [Ron K. Bastien](http://www.sciencemag.org/search?author1=Ron+K.+Bastien&sortspec=date&submit=Submit)[6](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-6),
19. [Nabil Bassim](http://www.sciencemag.org/search?author1=Nabil+Bassim&sortspec=date&submit=Submit)[2](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-2),
20. [John Bridges](http://www.sciencemag.org/search?author1=John+Bridges&sortspec=date&submit=Submit)[17](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-17),
21. [Donald E. Brownlee](http://www.sciencemag.org/search?author1=Donald+E.+Brownlee&sortspec=date&submit=Submit)[18](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-18),
22. [Mark Burchell](http://www.sciencemag.org/search?author1=Mark+Burchell&sortspec=date&submit=Submit)[19](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-19),
23. [Manfred Burghammer](http://www.sciencemag.org/search?author1=Manfred+Burghammer&sortspec=date&submit=Submit)[20](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-20),
24. [Hitesh Changela](http://www.sciencemag.org/search?author1=Hitesh+Changela&sortspec=date&submit=Submit)[21](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-21),
25. [Peter Cloetens](http://www.sciencemag.org/search?author1=Peter+Cloetens&sortspec=date&submit=Submit)[22](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-22),
26. [Andrew M. Davis](http://www.sciencemag.org/search?author1=Andrew+M.+Davis&sortspec=date&submit=Submit)[23](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-23),
27. [Ryan Doll](http://www.sciencemag.org/search?author1=Ryan+Doll&sortspec=date&submit=Submit)[24](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-24),
28. [Christine Floss](http://www.sciencemag.org/search?author1=Christine+Floss&sortspec=date&submit=Submit)[24](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-24),
29. [Eberhard Grün](http://www.sciencemag.org/search?author1=Eberhard+Gr%C3%BCn&sortspec=date&submit=Submit)[25](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-25),
30. [Philipp R. Heck](http://www.sciencemag.org/search?author1=Philipp+R.+Heck&sortspec=date&submit=Submit)[15](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-12),
31. [Peter Hoppe](http://www.sciencemag.org/search?author1=Peter+Hoppe&sortspec=date&submit=Submit)[26](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-26),
32. [Bruce Hudson](http://www.sciencemag.org/search?author1=Bruce+Hudson&sortspec=date&submit=Submit)[27](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-27),
33. [Joachim Huth](http://www.sciencemag.org/search?author1=Joachim+Huth&sortspec=date&submit=Submit)[26](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-26),
34. [Anton Kearsley](http://www.sciencemag.org/search?author1=Anton+Kearsley&sortspec=date&submit=Submit)[28](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-28),
35. [Ashley J. King](http://www.sciencemag.org/search?author1=Ashley+J.+King&sortspec=date&submit=Submit)[23](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-23),
36. [Barry Lai](http://www.sciencemag.org/search?author1=Barry+Lai&sortspec=date&submit=Submit)[29](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-29),
37. [Jan Leitner](http://www.sciencemag.org/search?author1=Jan+Leitner&sortspec=date&submit=Submit)[26](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-26),
38. [Laurence Lemelle](http://www.sciencemag.org/search?author1=Laurence+Lemelle&sortspec=date&submit=Submit)[30](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-30),
39. [Ariel Leonard](http://www.sciencemag.org/search?author1=Ariel+Leonard&sortspec=date&submit=Submit)[24](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-24),
40. [Hugues Leroux](http://www.sciencemag.org/search?author1=Hugues+Leroux&sortspec=date&submit=Submit)[31](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-31),
41. [Robert Lettieri](http://www.sciencemag.org/search?author1=Robert+Lettieri&sortspec=date&submit=Submit)[1](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-1),
42. [William Marchant](http://www.sciencemag.org/search?author1=William+Marchant&sortspec=date&submit=Submit)[1](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-1),
43. [Ryan Ogliore](http://www.sciencemag.org/search?author1=Ryan+Ogliore&sortspec=date&submit=Submit)[32](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-32),
44. [Wei Jia Ong](http://www.sciencemag.org/search?author1=Wei+Jia+Ong&sortspec=date&submit=Submit)[24](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-24),
45. [Mark C. Price](http://www.sciencemag.org/search?author1=Mark+C.+Price&sortspec=date&submit=Submit)[19](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-19),
46. [Scott A. Sandford](http://www.sciencemag.org/search?author1=Scott+A.+Sandford&sortspec=date&submit=Submit)[33](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-33),
47. [Juan-Angel Sans Tresseras](http://www.sciencemag.org/search?author1=Juan-Angel+Sans+Tresseras&sortspec=date&submit=Submit)[22](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-22),
48. [Sylvia Schmitz](http://www.sciencemag.org/search?author1=Sylvia+Schmitz&sortspec=date&submit=Submit)[4](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-4),
49. [Tom Schoonjans](http://www.sciencemag.org/search?author1=Tom+Schoonjans&sortspec=date&submit=Submit)[20](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-20),
50. [Kate Schreiber](http://www.sciencemag.org/search?author1=Kate+Schreiber&sortspec=date&submit=Submit)[24](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-24),
51. [Geert Silversmit](http://www.sciencemag.org/search?author1=Geert+Silversmit&sortspec=date&submit=Submit)[20](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-20),
52. [Vicente A. Solé](http://www.sciencemag.org/search?author1=Vicente+A.+Sol%C3%A9&sortspec=date&submit=Submit)[22](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-22),
53. [Ralf Srama](http://www.sciencemag.org/search?author1=Ralf+Srama&sortspec=date&submit=Submit)[34](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-34),
54. [Frank Stadermann](http://www.sciencemag.org/search?author1=Frank+Stadermann&sortspec=date&submit=Submit)[24](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-24),[†](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#fn-1),
55. [Thomas Stephan](http://www.sciencemag.org/search?author1=Thomas+Stephan&sortspec=date&submit=Submit)[23](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-23),
56. [Julien Stodolna](http://www.sciencemag.org/search?author1=Julien+Stodolna&sortspec=date&submit=Submit)[1](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-1),
57. [Stephen Sutton](http://www.sciencemag.org/search?author1=Stephen+Sutton&sortspec=date&submit=Submit)[29](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-29),
58. [Mario Trieloff](http://www.sciencemag.org/search?author1=Mario+Trieloff&sortspec=date&submit=Submit)[7](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-7),
59. [Peter Tsou](http://www.sciencemag.org/search?author1=Peter+Tsou&sortspec=date&submit=Submit)[35](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-35),
60. [Tolek Tyliszczak](http://www.sciencemag.org/search?author1=Tolek+Tyliszczak&sortspec=date&submit=Submit)[3](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-3),
61. [Bart Vekemans](http://www.sciencemag.org/search?author1=Bart+Vekemans&sortspec=date&submit=Submit)[20](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-20),
62. [Laszlo Vincze](http://www.sciencemag.org/search?author1=Laszlo+Vincze&sortspec=date&submit=Submit)[20](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-20),
63. [Joshua Von Korff](http://www.sciencemag.org/search?author1=Joshua+Von+Korff&sortspec=date&submit=Submit)[1](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-1),
64. [Naomi Wordsworth](http://www.sciencemag.org/search?author1=Naomi+Wordsworth&sortspec=date&submit=Submit)[36](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-36),
65. [Daniel Zevin](http://www.sciencemag.org/search?author1=Daniel+Zevin&sortspec=date&submit=Submit)[1](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-1),
66. [Michael E. Zolensky](http://www.sciencemag.org/search?author1=Michael+E.+Zolensky&sortspec=date&submit=Submit)[14](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-14),
67. 30714 Stardust@home dusters[37](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#aff-37)

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35. *35Jet Propulsion Laboratory, Pasadena, CA, USA.*
36. *36Wexbury, Farthing Green Lane, Stoke Poges, South Buckinghamshire, UK.*
37. *37Worldwide. List of individual dusters is at* [*http://stardustathome.ssl.berkeley.edu/sciencedusters*](http://stardustathome.ssl.berkeley.edu/sciencedusters)*.*

[+](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018) Author Notes

* [↵](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#xref-fn-1-1)† Deceased.

1. [↵](http://www.sciencemag.org/content/345/6198/786.abstract?sid=0a37c197-35f5-4554-842b-b83a92622018#xref-corresp-1-1)\*Corresponding author. E-mail: [westphal@ssl.berkeley.edu](mailto:westphal@ssl.berkeley.edu)

* [Abstract](http://www.sciencemag.org/content/345/6198/tab-abstract)
* [Editor's Summary](http://www.sciencemag.org/content/345/6198/tab-editor-summary)

Seven particles captured by the Stardust Interstellar Dust Collector and returned to Earth for laboratory analysis have features consistent with an origin in the contemporary interstellar dust stream. More than 50 spacecraft debris particles were also identified. The interstellar dust candidates are readily distinguished from debris impacts on the basis of elemental composition and/or impact trajectory. The seven candidate interstellar particles are diverse in elemental composition, crystal structure, and size. The presence of crystalline grains and multiple iron-bearing phases, including sulfide, in some particles indicates that individual interstellar particles diverge from any one representative model of interstellar dust inferred from astronomical observations and theory.