



Universiteit  
Leiden  
The Netherlands

## The chemistry of planet-forming disks: a story from inner to outer disk

Temmink, M.

### Citation

Temmink, M. (2026, June 5). *The chemistry of planet-forming disks: a story from inner to outer disk*. Retrieved from <https://hdl.handle.net/1887/4304669>

Version: Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/4304669>

**Note:** To cite this publication please use the final published version (if applicable).

---

# Bibliography

---

- Abgrall, H., Le Bourlot, J., Pineau Des Forets, G., et al. 1992, *A&A*, 253, 525
- Aikawa, Y., van Zadelhoff, G. J., van Dishoeck, E. F., & Herbst, E. 2002, *A&A*, 386, 622
- Akiyama, E., Vorobyov, E. I., Liu, H. B., et al. 2019, *AJ*, 157, 165
- Alexander, R. D., Clarke, C. J., & Pringle, J. E. 2006a, *MNRAS*, 369, 216
- Alexander, R. D., Clarke, C. J., & Pringle, J. E. 2006b, *MNRAS*, 369, 229
- ALMA Partnership, Brogan, C. L., Pérez, L. M., et al. 2015, *ApJ*, 808, L3
- Andrews, S. M. 2020, *ARA&A*, 58, 483
- Andrews, S. M., Huang, J., Pérez, L. M., et al. 2018, *ApJ*, 869, L41
- Ansdell, M., Williams, J. P., van der Marel, N., et al. 2016, *ApJ*, 828, 46
- Arabhavi, A. M., Kamp, I., Henning, T., et al. 2024, *Science*, 384, 1086
- Ardila, D. R., Basri, G., Walter, F. M., Valenti, J. A., & Johns-Krull, C. M. 2002, *ApJ*, 567, 1013
- Argyriou, I., Glasse, A., Law, D. R., et al. 2023, *A&A*, 675, A111
- Armitage, P. J. 2015, arXiv e-prints, arXiv:1509.06382
- Arulanantham, N., McClure, M. K., Pontoppidan, K., et al. 2024, *ApJ*, 965, L13
- Arun, R., Mathew, B., Manoj, P., et al. 2019, *AJ*, 157, 159
- Aspin, C., Reipurth, B., Herczeg, G. J., & Capak, P. 2010, *ApJ*, 719, L50
- Astropy Collaboration, Price-Whelan, A. M., Lim, P. L., et al. 2022, *ApJ*, 935, 167
- Astropy Collaboration, Price-Whelan, A. M., Sipőcz, B. M., et al. 2018, *AJ*, 156, 123

- Astropy Collaboration, Robitaille, T. P., Tollerud, E. J., et al. 2013, *A&A*, 558, A33
- Ataiee, S., Baruteau, C., Alibert, Y., & Benz, W. 2018, *A&A*, 615, A110
- Atkinson, R., Baulch, D. L., Cox, R. A., et al. 2006, *Atmospheric Chemistry & Physics*, 6, 3625
- Avenhaus, H., Quanz, S. P., Schmid, H. M., et al. 2014, *ApJ*, 781, 87
- Avni, Y. 1976, *ApJ*, 210, 642
- Bae, J., Hartmann, L., & Zhu, Z. 2015, *ApJ*, 805, 15
- Bae, J., Isella, A., Zhu, Z., et al. 2023, in *Astronomical Society of the Pacific Conference Series*, Vol. 534, *Protostars and Planets VII*, ed. S. Inutsuka, Y. Aikawa, T. Muto, K. Tomida, & M. Tamura, 423
- Bae, J. & Zhu, Z. 2018, *ApJ*, 859, 118
- Bae, J., Zhu, Z., & Hartmann, L. 2017, *ApJ*, 850, 201
- Balança, C., Spielfiedel, A., & Feautrier, N. 2016, *MNRAS*, 460, 3766
- Balmer, W. O., Follette, K. B., Close, L. M., et al. 2022, *AJ*, 164, 29
- Banzatti, A., Abernathy, K. M., Brittain, S., et al. 2022, *AJ*, 163, 174
- Banzatti, A., Ballering, N., Gasman, D., et al. 2025a, in *PRIMA General Observer Science Book Volume 2*, ed. A. Moullet, D. Burgarella, T. Kataria, H. Beuther, C. Battersby, M. Cheng, T. Essinger-Hileman, H. Inami, E. Mills, T. Nagao, & S. Unwin, Vol. 2, 314–318
- Banzatti, A., Meyer, M. R., Bruderer, S., et al. 2012, *ApJ*, 745, 90
- Banzatti, A., Pascucci, I., Bosman, A. D., et al. 2020, *ApJ*, 903, 124
- Banzatti, A., Pascucci, I., Edwards, S., et al. 2019, *ApJ*, 870, 76
- Banzatti, A. & Pontoppidan, K. M. 2015, *ApJ*, 809, 167
- Banzatti, A., Pontoppidan, K. M., Carr, J. S., et al. 2023a, *ApJ*, 957, L22
- Banzatti, A., Pontoppidan, K. M., Péré Chávez, J., et al. 2023b, *AJ*, 165, 72
- Banzatti, A., Pontoppidan, K. M., Salyk, C., et al. 2017, *ApJ*, 834, 152
- Banzatti, A., Salyk, C., Pontoppidan, K. M., et al. 2025b, *AJ*, 169, 165
- Barvainis, R. 1987, *ApJ*, 320, 537
- Bast, J. E., Brown, J. M., Herczeg, G. J., van Dishoeck, E. F., & Pontoppidan, K. M. 2011, *A&A*, 527, A119

- Benisty, M., Dominik, C., Follette, K., et al. 2023, in *Astronomical Society of the Pacific Conference Series*, Vol. 534, *Protostars and Planets VII*, ed. S. Inutsuka, Y. Aikawa, T. Muto, K. Tomida, & M. Tamura, 605
- Benisty, M., Juhász, A., Facchini, S., et al. 2018, *A&A*, 619, A171
- Bergin, E. A., Aikawa, Y., Blake, G. A., & van Dishoeck, E. F. 2007, in *Protostars and Planets V*, ed. B. Reipurth, D. Jewitt, & K. Keil, 751
- Bergin, E. A., Cleeves, L. I., Gorti, U., et al. 2013, *Nature*, 493, 644
- Bergin, E. A., Du, F., Cleeves, L. I., et al. 2016, *ApJ*, 831, 101
- Bergin, E. A. & Tafalla, M. 2007, *ARA&A*, 45, 339
- Bergin, E. A. & Williams, J. P. 2017, in *Astrophysics and Space Science Library*, Vol. 445, *Formation, Evolution, and Dynamics of Young Solar Systems*, ed. M. Pessah & O. Gressel, 1
- Bergner, J. B., Guzmán, V. G., Öberg, K. I., Loomis, R. A., & Pegues, J. 2018, *ApJ*, 857, 69
- Béthune, W., Lesur, G., & Ferreira, J. 2017, *A&A*, 600, A75
- Biller, B., Lacour, S., Juhász, A., et al. 2012, *ApJ*, 753, L38
- Birnstiel, T. 2024, *ARA&A*, 62, 157
- Birnstiel, T., Dullemond, C. P., & Brauer, F. 2010, *A&A*, 513, A79
- Bisschop, S. E., Fraser, H. J., Öberg, K. I., van Dishoeck, E. F., & Schlemmer, S. 2006, *A&A*, 449, 1297
- Bitsch, B., Morbidelli, A., Johansen, A., et al. 2018, *A&A*, 612, A30
- Blandford, R. D. & Payne, D. G. 1982, *MNRAS*, 199, 883
- Blevins, S. M., Pontoppidan, K. M., Banzatti, A., et al. 2016, *ApJ*, 818, 22
- Blum, J. & Wurm, G. 2008, *ARA&A*, 46, 21
- Boehler, Y., Ménard, F., Robert, C. M. T., et al. 2021, *A&A*, 650, A59
- Boehler, Y., Weaver, E., Isella, A., et al. 2017, *ApJ*, 840, 60
- Bohn, A. J., Benisty, M., Perraut, K., et al. 2022, *A&A*, 658, A183
- Boogert, A. C. A., Gerakines, P. A., & Whittet, D. C. B. 2015, *ARA&A*, 53, 541
- Booth, A. S., Calahan, J., Temmink, M., et al. 2026, *AJ*, 171, 128
- Booth, A. S., Ilee, J. D., Walsh, C., et al. 2023, *A&A*, 669, A53
- Booth, A. S., Leemker, M., van Dishoeck, E. F., et al. 2024a, *AJ*, 167, 164

- Booth, A. S., Temmink, M., van Dishoeck, E. F., et al. 2024b, *AJ*, 167, 165
- Booth, A. S., van der Marel, N., Leemker, M., van Dishoeck, E. F., & Ohashi, S. 2021a, *A&A*, 651, L6
- Booth, A. S., Walsh, C., Terwisscha van Scheltinga, J., et al. 2021b, *Nature Astronomy*, 5, 684
- Booth, A. S., Wölfer, L., Temmink, M., et al. 2025, *ApJ*, 986, L9
- Bosman, A. D. & Bergin, E. A. 2021, *ApJ*, 918, L10
- Bosman, A. D., Bergin, E. A., Calahan, J., & Duval, S. E. 2022a, *ApJ*, 930, L26
- Bosman, A. D., Bergin, E. A., Calahan, J. K., & Duval, S. E. 2022b, *ApJ*, 933, L40
- Bosman, A. D., Bergin, E. A., Loomis, R. A., et al. 2021, *ApJS*, 257, 15
- Bosman, A. D., Bruderer, S., & van Dishoeck, E. F. 2017, *A&A*, 601, A36
- Bosman, A. D., Tielens, A. G. G. M., & van Dishoeck, E. F. 2018, *A&A*, 611, A80
- Bouwman, J., Meeus, G., de Koter, A., et al. 2001, *A&A*, 375, 950
- Brandl, B., Bettonvil, F., van Boekel, R., et al. 2021, *The Messenger*, 182, 22
- Brauer, F., Dullemond, C. P., & Henning, T. 2008, *A&A*, 480, 859
- Braun, T. A. M., Yen, H.-W., Koch, P. M., et al. 2021, *ApJ*, 908, 46
- Brittain, S. D., Kamp, I., Meeus, G., Oudmaijer, R. D., & Waters, L. B. F. M. 2023, *Space Sci. Rev.*, 219, 7
- Brittain, S. D., Najita, J. R., & Carr, J. S. 2009, *ApJ*, 702, 85
- Brittain, S. D., Simon, T., Najita, J. R., & Rettig, T. W. 2007, *ApJ*, 659, 685
- Brown, J. M., Herczeg, G. J., Pontoppidan, K. M., & van Dishoeck, E. F. 2012, *ApJ*, 744, 116
- Brown, J. M., Pontoppidan, K. M., van Dishoeck, E. F., et al. 2013, *ApJ*, 770, 94
- Brown, W. A. & Bolina, A. S. 2007, *MNRAS*, 374, 1006
- Bruderer, S. 2013, *A&A*, 559, A46
- Bruderer, S., Harsono, D., & van Dishoeck, E. F. 2015, *A&A*, 575, A94
- Bruderer, S., van der Marel, N., van Dishoeck, E. F., & van Kempen, T. A. 2014, *A&A*, 562, A26
- Bruderer, S., van Dishoeck, E. F., Doty, S. D., & Herczeg, G. J. 2012, *A&A*, 541, A91

- Brunken, N. G. C., Booth, A. S., Leemker, M., et al. 2022, *A&A*, 659, A29
- Bushouse, H., Eisenhamer, J., Dencheva, N., et al. 2023a, JWST Calibration Pipeline, Zenodo
- Bushouse, H., Eisenhamer, J., Dencheva, N., et al. 2023b, JWST Calibration Pipeline
- Bushouse, H., Eisenhamer, J., Dencheva, N., et al. 2024, JWST Calibration Pipeline
- Calahan, J. K., Bergin, E., Zhang, K., et al. 2021, *ApJ*, 908, 8
- Calahan, J. K., Bergin, E. A., & Bosman, A. D. 2022, *ApJ*, 934, L14
- Calahan, J. K., Bergin, E. A., van't Hoff, M., et al. 2024, *ApJ*, 975, 170
- Carnall, A. C. 2017, arXiv e-prints, arXiv:1705.05165
- Carney, M. T., Fedele, D., Hogerheijde, M. R., et al. 2018, *A&A*, 614, A106
- Carney, M. T., Hogerheijde, M. R., Guzmán, V. V., et al. 2019, *A&A*, 623, A124
- Carney, M. T., Hogerheijde, M. R., Loomis, R. A., et al. 2017, *A&A*, 605, A21
- Carpenter, J., Brogan, C., Iono, D., & Mroczkowski, T. 2023, in *Physics and Chemistry of Star Formation: The Dynamical ISM Across Time and Spatial Scales*, ed. V. Ossenkopf-Okada, R. Schaaf, I. Breloy, & J. Stutzki, 304
- Carr, J. S. & Najita, J. R. 2011, *ApJ*, 733, 102
- Carr, J. S. & Najita, J. R. 2014, *ApJ*, 788, 66
- CASA Team, Bean, B., Bhatnagar, S., et al. 2022, *PASP*, 134, 114501
- Casassus, S., Christiaens, V., Cárcamo, M., et al. 2021, *MNRAS*, 507, 3789
- Casassus, S., van der Plas, G. M., Perez, S., et al. 2013, *Nature*, 493, 191
- Cassen, P. & Moosman, A. 1981, *ICARUS*, 48, 353
- Cazzoletti, P., van Dishoeck, E. F., Visser, R., Facchini, S., & Bruderer, S. 2018, *A&A*, 609, A93
- Charnley, S. B. 1997, *ApJ*, 481, 396
- Chiang, E. I. & Goldreich, P. 1997, *ApJ*, 490, 368
- Christiaens, V., Casassus, S., Perez, S., van der Plas, G., & Ménard, F. 2014, *ApJ*, 785, L12
- Christiaens, V., Gonzalez, C., Farkas, R., et al. 2023, *The Journal of Open Source Software*, 8, 4774

- Claes, R. A. B., Manara, C. F., Garcia-Lopez, R., et al. 2022, *A&A*, 664, L7
- Clarke, C. J., Tazzari, M., Juhasz, A., et al. 2018, *ApJ*, 866, L6
- Cleeves, L. I., Bergin, E. A., Qi, C., Adams, F. C., & Öberg, K. I. 2015, *ApJ*, 799, 204
- Cleeves, L. I., Loomis, R. A., Teague, R., et al. 2021, *ApJ*, 911, 29
- Cleeves, L. I., Öberg, K. I., Wilner, D. J., et al. 2018, *ApJ*, 865, 155
- Colangeli, L., Henning, T., Brucato, J. R., et al. 2003, *A&A Rev.*, 11, 97
- Collings, M. P., Anderson, M. A., Chen, R., et al. 2004, *MNRAS*, 354, 1133
- Colmenares, M. J., Bergin, E. A., Salyk, C., et al. 2024, *ApJ*, 977, 173
- Cossins, P., Lodato, G., & Clarke, C. J. 2009, *MNRAS*, 393, 1157
- Crnkovic-Rubsamen, I., Zhu, Z., & Stone, J. M. 2015, *MNRAS*, 450, 4285
- Cuppen, H. M., Linnartz, H., & Ioppolo, S. 2024, *ARA&A*, 62, 243
- Cutri, R. M., Wright, E. L., Conrow, T., et al. 2013, Explanatory Supplement to the AllWISE Data Release Products, Explanatory Supplement to the AllWISE Data Release Products, by R. M. Cutri et al.
- Cuzzi, J. N. & Zahnle, K. J. 2004, *ApJ*, 614, 490
- Czekala, I., Loomis, R. A., Teague, R., et al. 2021, *ApJS*, 257, 2
- D'Alessio, P., Cantö, J., Calvet, N., & Lizano, S. 1998, *ApJ*, 500, 411
- Dartois, E., Dutrey, A., & Guilloteau, S. 2003, *A&A*, 399, 773
- Dawson, R. I. & Johnson, J. A. 2018, *ARA&A*, 56, 175
- Dong, R., Li, S., Chiang, E., & Li, H. 2017, *ApJ*, 843, 127
- Dong, R., Zhu, Z., Rafikov, R. R., & Stone, J. M. 2015, *ApJ*, 809, L5
- Dorn, R. J., Anglada-Escude, G., Baade, D., et al. 2014, *The Messenger*, 156, 7
- Dorn, R. J., Bristow, P., Smoker, J. V., et al. 2023, *A&A*, 671, A24
- Draine, B. T. 2003, *ARA&A*, 41, 241
- Drażkowska, J., Alibert, Y., & Moore, B. 2016, *A&A*, 594, A105
- Drażkowska, J., Bitsch, B., Lambrechts, M., et al. 2023, in *Astronomical Society of the Pacific Conference Series*, Vol. 534, Protostars and Planets VII, ed. S. Inutsuka, Y. Aikawa, T. Muto, K. Tomida, & M. Tamura, 717
- Dubrulle, B., Morfill, G., & Sterzik, M. 1995, *ICARUS*, 114, 237

- Duchêne, G., Ménard, F., Stapelfeldt, K., & Duvert, G. 2003, *A&A*, 400, 559
- Dullemond, C. P. & Dominik, C. 2004, *A&A*, 417, 159
- Dullemond, C. P., Dominik, C., & Natta, A. 2001, *ApJ*, 560, 957
- Easterwood, W., Kalyaan, A., & Banzatti, A. 2024, *ApJ*, 977, 21
- Ehrenfreund, P., Boogert, A. C. A., Gerakines, P. A., Tielens, A. G. G. M., & van Dishoeck, E. F. 1997, *A&A*, 328, 649
- Eistrup, C., Walsh, C., & van Dishoeck, E. F. 2016, *A&A*, 595, A83
- Erb, D. 2022, pybaselines: A Python library of algorithms for the baseline correction of experimental data, Zenodo
- Ercolano, B. & Pascucci, I. 2017, *Royal Society Open Science*, 4, 170114
- Espaillet, C., Muzerolle, J., Najita, J., et al. 2014, in *Protostars and Planets VI*, ed. H. Beuther, R. S. Klessen, C. P. Dullemond, & T. Henning, 497–520
- Fabian, D., Jäger, C., Henning, T., Dorschner, J., & Mutschke, H. 2000, *A&A*, 364, 282
- Facchini, S., Birnstiel, T., Bruderer, S., & van Dishoeck, E. F. 2017, *A&A*, 605, A16
- Facchini, S., Teague, R., Bae, J., et al. 2021, *AJ*, 162, 99
- Facchini, S., van Dishoeck, E. F., Manara, C. F., et al. 2019, *A&A*, 626, L2
- Fairlamb, J. R., Oudmaijer, R. D., Mendigutía, I., Ilee, J. D., & van den Ancker, M. E. 2015, *MNRAS*, 453, 976
- Fang, M., Pascucci, I., Edwards, S., et al. 2018, *ApJ*, 868, 28
- Fedele, D. & Favre, C. 2020, *A&A*, 638, A110
- Fischer, W. J., Hillenbrand, L. A., Herczeg, G. J., et al. 2023, in *Astronomical Society of the Pacific Conference Series*, Vol. 534, *Protostars and Planets VII*, ed. S. Inutsuka, Y. Aikawa, T. Muto, K. Tomida, & M. Tamura, 355
- Flaherty, K., Hughes, A. M., Simon, J. B., et al. 2020, *ApJ*, 895, 109
- Flaherty, K., Hughes, A. M., Simon, J. B., et al. 2024, *MNRAS*, 532, 363
- Flaherty, K. M., Hughes, A. M., Rose, S. C., et al. 2017, *ApJ*, 843, 150
- Flaherty, K. M., Hughes, A. M., Rosenfeld, K. A., et al. 2015, *ApJ*, 813, 99
- Flock, M., Nelson, R. P., Turner, N. J., et al. 2017, *ApJ*, 850, 131
- Flock, M., Turner, N. J., Nelson, R. P., et al. 2020, *ApJ*, 897, 155

- Fockenberg, C. & Preses, J. M. 2002, *Journal of Physical Chemistry A*, 106, 2924
- Foreman-Mackey, D., Hogg, D. W., Lang, D., & Goodman, J. 2013, *PASP*, 125, 306
- Francis, L. & van der Marel, N. 2020, *ApJ*, 892, 111
- Francis, L., van Gelder, M. L., van Dishoeck, E. F., et al. 2024, arXiv e-prints, arXiv:2401.06880
- Fraser, H. J., Collings, M. P., McCoustra, M. R. S., & Williams, D. A. 2001, *MNRAS*, 327, 1165
- Fuchs, G. W., Cuppen, H. M., Ioppolo, S., et al. 2009, *A&A*, 505, 629
- Fujiwara, H., Honda, M., Kataza, H., et al. 2006, *ApJ*, 644, L133
- Fukagawa, M., Tamura, M., Itoh, Y., et al. 2006, *ApJ*, 636, L153
- Fukagawa, M., Tsukagoshi, T., Momose, M., et al. 2013, *PASJ*, 65, L14
- Furuya, K. 2024, arXiv e-prints, arXiv:2408.02958
- Furuya, K., Tsukagoshi, T., Qi, C., et al. 2022, *ApJ*, 926, 148
- Gaia Collaboration, Brown, A. G. A., Vallenari, A., et al. 2018, *A&A*, 616, A1
- Gaia Collaboration, Vallenari, A., Brown, A. G. A., et al. 2023, *A&A*, 674, A1
- Gammie, C. F. 1996, *ApJ*, 457, 355
- Gangi, M., Antonucci, S., Biazzo, K., et al. 2022, *A&A*, 667, A124
- Garg, H., Pinte, C., Christiaens, V., et al. 2021, *MNRAS*, 504, 782
- Garufi, A., Podio, L., Codella, C., et al. 2022, *A&A*, 658, A104
- Garufi, A., Podio, L., Kamp, I., et al. 2014, *A&A*, 567, A141
- Gasman, D., Temmink, M., van Dishoeck, E. F., et al. 2025, *A&A*, 694, A147
- Gasman, D., van Dishoeck, E. F., Grant, S. L., et al. 2023, *A&A*, 679, A117
- Gerakines, P. A., Whittet, D. C. B., Ehrenfreund, P., et al. 1999, *ApJ*, 522, 357
- Ginski, C., Facchini, S., Huang, J., et al. 2021, *ApJ*, 908, L25
- Glass, I. S. 1999, *Handbook of Infrared Astronomy*
- Glassgold, A. E., Najita, J., & Igea, J. 1997, *ApJ*, 480, 344
- Glenn, J., Meixner, M., Bradford, C. M., et al. 2025, *Journal of Astronomical Telescopes, Instruments, and Systems*, 11, 031628
- Godon, P. & Livio, M. 1999, *ApJ*, 523, 350

- Goldsmith, P. F. & Langer, W. D. 1999, *ApJ*, 517, 209
- Gomez Gonzalez, C. A., Wertz, O., Absil, O., et al. 2017, *AJ*, 154, 7
- Gordon, I. E., Rothman, L. S., Hargreaves, R. J., et al. 2022, *J. Quant. Spectr. Rad. Transf.*, 277, 107949
- Gould, R. J. & Salpeter, E. E. 1963, *ApJ*, 138, 393
- Grant, S. L., Bettoni, G., Banzatti, A., et al. 2023a, *arXiv e-prints*, arXiv:2309.03888
- Grant, S. L., Temmink, M., van Dishoeck, E. F., et al. 2025, *A&A*, 702, A126
- Grant, S. L., van Dishoeck, E. F., Tabone, B., et al. 2023b, *ApJ*, 947, L6
- GRAVITY Collaboration, Perraut, K., Labadie, L., et al. 2021, *A&A*, 655, A73
- Greenwood, A. J., Kamp, I., Waters, L. B. F. M., Woitke, P., & Thi, W. F. 2019, *A&A*, 626, A6
- Guidi, G., Isella, A., Testi, L., et al. 2022, *A&A*, 664, A137
- Guillot, T., Ida, S., & Ormel, C. W. 2014, *A&A*, 572, A72
- Guzmán, V. V., Öberg, K. I., Carpenter, J., et al. 2018, *ApJ*, 864, 170
- Haffert, S. Y., Bohn, A. J., de Boer, J., et al. 2019, *Nature Astronomy*, 3, 749
- Hammer, M., Kratter, K. M., & Lin, M.-K. 2017, *MNRAS*, 466, 3533
- Hammer, M. & Lin, M.-K. 2023, *MNRAS*, 525, 123
- Hammer, M., Lin, M.-K., Kratter, K. M., & Pinilla, P. 2021, *MNRAS*, 504, 3963
- Hammer, M., Pinilla, P., Kratter, K. M., & Lin, M.-K. 2019, *MNRAS*, 482, 3609
- Harris, C. R., Millman, K. J., van der Walt, S. J., et al. 2020, *Nature*, 585, 357
- Harsono, D., Bjerkeli, P., van der Wiel, M. H. D., et al. 2018, *Nature Astronomy*, 2, 646
- Harsono, D., Bruderer, S., & van Dishoeck, E. F. 2015, *A&A*, 582, A41
- Hartmann, L., Calvet, N., Gullbring, E., & D'Alessio, P. 1998, *ApJ*, 495, 385
- Hasegawa, T. I., Herbst, E., & Leung, C. M. 1992, *ApJS*, 82, 167
- Hawley, J. F. 2001, *ApJ*, 554, 534
- Heays, A. N., Bosman, A. D., & van Dishoeck, E. F. 2017, *A&A*, 602, A105
- Henning, T. 2010, *ARA&A*, 48, 21
- Henning, T., Kamp, I., Samland, M., et al. 2024, *PASP*, 136, 054302

- Herbig, G. H. 1960, *ApJS*, 4, 337
- Herbst, E. & Klemperer, W. 1973, *ApJ*, 185, 505
- Herbst, E. & van Dishoeck, E. F. 2009, *ARA&A*, 47, 427
- Herczeg, G. J., Brown, J. M., van Dishoeck, E. F., & Pontoppidan, K. M. 2011, *A&A*, 533, A112
- Herczeg, G. J. & Hillenbrand, L. A. 2014, *ApJ*, 786, 97
- Hernández-Vera, C., Guzmán, V. V., Artur de la Villarmois, E., et al. 2024, *ApJ*, 967, 68
- Ho, P. T. P., Moran, J. M., & Lo, K. Y. 2004, *ApJ*, 616, L1
- Hollenbach, D., Johnstone, D., Lizano, S., & Shu, F. 1994, *ApJ*, 428, 654
- Honda, M., Inoue, A. K., Fukagawa, M., et al. 2009, *ApJ*, 690, L110
- Houck, J. R., Roellig, T. L., van Cleve, J., et al. 2004, *ApJS*, 154, 18
- Houge, A., Krijt, S., Banzatti, A., et al. 2025, *MNRAS*, 537, 691
- Huang, J., Andrews, S. M., Pérez, L. M., et al. 2018a, *ApJ*, 869, L43
- Huang, J., Bergin, E. A., Öberg, K. I., et al. 2021, *ApJS*, 257, 19
- Huang, P., Isella, A., Li, H., Li, S., & Ji, J. 2018b, *ApJ*, 867, 3
- Hunter, J. D. 2007, *Computing in Science & Engineering*, 9, 90
- Hunziker, S., Schmid, H. M., Ma, J., et al. 2021, *A&A*, 648, A110
- Ikoma, M. & Kobayashi, H. 2025, *ARA&A*, 63, 217
- Ilee, J. D., Forgan, D. H., Evans, M. G., et al. 2017, *MNRAS*, 472, 189
- Ilee, J. D., Walsh, C., Booth, A. S., et al. 2021, *ApJS*, 257, 9
- Ilee, J. D., Walsh, C., & Calahan, J. K. 2026, *AJ*, 171, 3
- Isella, A., Huang, J., Andrews, S. M., et al. 2018, *ApJ*, 869, L49
- Itoh, Y., Oasa, Y., Kudo, T., et al. 2014, *Research in Astronomy and Astrophysics*, 14, 1438
- Izquierdo, A. F., Facchini, S., Rosotti, G. P., van Dishoeck, E. F., & Testi, L. 2022, *ApJ*, 928, 2
- Jakobsen, P., Ferruit, P., Alves de Oliveira, C., et al. 2022, *A&A*, 661, A80
- Jang, H., Waters, R., Kaeufer, T., et al. 2024, *A&A*, 691, A148

- Jansen, D. J., Spaans, M., Hogerheijde, M. R., & van Dishoeck, E. F. 1995, *A&A*, 303, 541
- Jennings, J., Booth, R. A., Tazzari, M., Clarke, C. J., & Rosotti, G. P. 2022a, *MNRAS*, 509, 2780
- Jennings, J., Booth, R. A., Tazzari, M., Rosotti, G. P., & Clarke, C. J. 2020, *MNRAS*, 495, 3209
- Jennings, J., Tazzari, M., Clarke, C. J., Booth, R. A., & Rosotti, G. P. 2022b, *MNRAS*, 514, 6053
- Johansen, A. & Lacerda, P. 2010, *MNRAS*, 404, 475
- Johansen, A. & Lambrechts, M. 2017, *Annual Review of Earth and Planetary Sciences*, 45, 359
- Johansen, A., Youdin, A., & Klahr, H. 2009, *ApJ*, 697, 1269
- Johnstone, D., Boonman, A. M. S., & van Dishoeck, E. F. 2003, *A&A*, 412, 157
- Juhász, A., Bouwman, J., Henning, T., et al. 2010, *ApJ*, 721, 431
- Kaeufer, T., Min, M., Woitke, P., Kamp, I., & Arabhavi, A. M. 2024, *A&A*, 687, A209
- Kaeufl, H.-U., Ballester, P., Biereichel, P., et al. 2004, in *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, Vol. 5492, *Ground-based Instrumentation for Astronomy*, ed. A. F. M. Moorwood & M. Iye, 1218–1227
- Kalyaan, A., Pinilla, P., Krijt, S., et al. 2023, *ApJ*, 954, 66
- Kalyaan, A., Pinilla, P., Krijt, S., Mulders, G. D., & Banzatti, A. 2021, *ApJ*, 921, 84
- Kama, M., Bruderer, S., van Dishoeck, E. F., et al. 2016, *A&A*, 592, A83
- Kama, M., Trapman, L., Fedele, D., et al. 2020, *A&A*, 634, A88
- Kamp, I., Henning, T., Arabhavi, A. M., et al. 2023, *Faraday Discussions*, 245, 112
- Kamp, I., Thi, W. F., Meeus, G., et al. 2013, *A&A*, 559, A24
- Kastner, J. H., Qi, C., Dickson-Vandervelde, D. A., et al. 2018, *ApJ*, 863, 106
- Kastner, J. H., Zuckerman, B., Weintraub, D. A., & Forveille, T. 1997, *Science*, 277, 67
- Kayanuma, M., Shoji, M., Furuya, K., et al. 2019, *Chemical Physics Letters*, 714, 137
- Kenyon, S. J., Dobrzycka, D., & Hartmann, L. 1994, *AJ*, 108, 1872

- Keppler, M., Benisty, M., Müller, A., et al. 2018, *A&A*, 617, A44
- Keppler, M., Penzlin, A., Benisty, M., et al. 2020, *A&A*, 639, A62
- Kessler, M. F., Steinz, J. A., Anderegg, M. E., et al. 1996, *A&A*, 315, L27
- Kley, W. 1999, *MNRAS*, 303, 696
- Kluyver, T., Ragan-Kelley, B., Pérez, F., et al. 2016, in *Positioning and Power in Academic Publishing: Players, Agents and Agendas*, ed. F. Loizides & B. Schmidt, IOS Press, 87 – 90
- Kokubo, E. & Ida, S. 1996, *ICARUS*, 123, 180
- Kokubo, E. & Ida, S. 2002, *ApJ*, 581, 666
- Kóspál, Á., Ábrahám, P., Diehl, L., et al. 2023, *ApJ*, 945, L7
- Kraus, S., Kreplin, A., Fukugawa, M., et al. 2017, *ApJ*, 848, L11
- Krist, J. E., Stapelfeldt, K. R., & Watson, A. M. 2002, *ApJ*, 570, 785
- Krolikowski, D. M., Kraus, A. L., & Rizzuto, A. C. 2021, *AJ*, 162, 110
- Kuznetsova, A., Bae, J., Hartmann, L., & Mac Low, M.-M. 2022, *ApJ*, 928, 92
- Labiano, A., Argyriou, I., Álvarez-Márquez, J., et al. 2021, *A&A*, 656, A57
- Lacour, S., Biller, B., Cheetham, A., et al. 2016, *A&A*, 590, A90
- Lacy, J. H., Sneden, C., Kim, H., & Jaffe, D. T. 2017, *ApJ*, 838, 66
- Lambrechts, M. & Johansen, A. 2012, *A&A*, 544, A32
- Lambrechts, M., Johansen, A., & Morbidelli, A. 2014, *A&A*, 572, A35
- Law, C. J., Alarcón, F., Cleeves, L. I., Öberg, K. I., & Paneque-Carreño, T. 2023a, *ApJ*, 959, L27
- Law, C. J., Benisty, M., Facchini, S., et al. 2024, *ApJ*, 964, 190
- Law, C. J., Teague, R., Loomis, R. A., et al. 2021, *ApJS*, 257, 4
- Law, C. J., Teague, R., Öberg, K. I., et al. 2023b, *ApJ*, 948, 60
- Le Gal, R., Öberg, K. I., Loomis, R. A., Pegues, J., & Bergner, J. B. 2019, *ApJ*, 876, 72
- Le Gal, R., Öberg, K. I., Teague, R., et al. 2021, *ApJS*, 257, 12
- Lee, J.-E., Lee, S., Baek, G., et al. 2019, *Nature Astronomy*, 3, 314
- Leemker, M., Booth, A. S., van Dishoeck, E. F., et al. 2022, *A&A*, 663, A23
- Leemker, M., Booth, A. S., van Dishoeck, E. F., et al. 2023, *A&A*, 673, A7

- Leemker, M., Tobin, J. J., Facchini, S., et al. 2025, *Nature Astronomy*, 9, 1486
- Leemker, M., van't Hoff, M. L. R., Trapman, L., et al. 2021, *A&A*, 646, A3
- Lesur, G., Ferreira, J., & Ogilvie, G. I. 2013, *A&A*, 550, A61
- Lesur, G., Flock, M., Ercolano, B., et al. 2023, in *Astronomical Society of the Pacific Conference Series*, Vol. 534, *Protostars and Planets VII*, ed. S. Inutsuka, Y. Aikawa, T. Muto, K. Tomida, & M. Tamura, 465
- Lesur, G., Hennebelle, P., & Fromang, S. 2015, *A&A*, 582, L9
- Li, H., Finn, J. M., Lovelace, R. V. E., & Colgate, S. A. 2000, *ApJ*, 533, 1023
- Lienert, J. L., Bitsch, B., & Henning, T. 2024, *A&A*, 691, A72
- Lissauer, J. J. 1993, *ARA&A*, 31, 129
- Long, F., Andrews, S. M., Zhang, S., et al. 2022, *ApJ*, 937, L1
- Long, F., Herczeg, G. J., Harsono, D., et al. 2019, *ApJ*, 882, 49
- Long, F., Pinilla, P., Herczeg, G. J., et al. 2018, *ApJ*, 869, 17
- Loomis, R. A., Cleeves, L. I., Öberg, K. I., et al. 2018, *ApJ*, 859, 131
- Loomis, R. A., Cleeves, L. I., Öberg, K. I., Guzman, V. V., & Andrews, S. M. 2015, *ApJ*, 809, L25
- Loomis, R. A., Facchini, S., Benisty, M., et al. 2025, *ApJ*, 984, L7
- Lovelace, R. V. E. & Hohlfield, R. G. 2013, *MNRAS*, 429, 529
- Lovelace, R. V. E., Li, H., Colgate, S. A., & Nelson, A. F. 1999, *ApJ*, 513, 805
- Lovelace, R. V. E. & Romanova, M. M. 2014, *Fluid Dynamics Research*, 46, 041401
- Luhman, K. L. 2012, *ARA&A*, 50, 65
- Luhman, K. L. 2023, *AJ*, 165, 37
- Lynden-Bell, D. & Pringle, J. E. 1974, *MNRAS*, 168, 603
- Lyra, W., Johansen, A., Zsom, A., Klahr, H., & Piskunov, N. 2009, *A&A*, 497, 869
- Mah, J., Bitsch, B., Pascucci, I., & Henning, T. 2023, *A&A*, 677, L7
- Mah, J., Savvidou, S., & Bitsch, B. 2024, *A&A*, 686, L17
- Malfait, K., Waelkens, C., Waters, L. B. F. M., et al. 1998, *A&A*, 332, L25
- Mallaney, P., Banzatti, A., Salyk, C., et al. 2026, *arXiv e-prints*, arXiv:2601.02344

- Mamajek, E. E. 2009, in American Institute of Physics Conference Series, Vol. 1158, *Exoplanets and Disks: Their Formation and Diversity*, ed. T. Usuda, M. Tamura, & M. Ishii (AIP), 3–10
- Manara, C. F., Ansdell, M., Rosotti, G. P., et al. 2023, in *Astronomical Society of the Pacific Conference Series*, Vol. 534, *Protostars and Planets VII*, ed. S. Inutsuka, Y. Aikawa, T. Muto, K. Tomida, & M. Tamura, 539
- Manara, C. F., Fedele, D., Herczeg, G. J., & Teixeira, P. S. 2016, *A&A*, 585, A136
- Mandell, A. M., Bast, J., van Dishoeck, E. F., et al. 2012, *ApJ*, 747, 92
- Marino, S., Casassus, S., Perez, S., et al. 2015a, *ApJ*, 813, 76
- Marino, S., Perez, S., & Casassus, S. 2015b, *ApJ*, 798, L44
- Mayama, S., Pérez, S., Kusakabe, N., et al. 2020, *AJ*, 159, 12
- McClure, M. K., Bergin, E. A., Cleeves, L. I., et al. 2016, *ApJ*, 831, 167
- McGuire, B. A. 2022, *ApJS*, 259, 30
- McKee, C. F. & Ostriker, E. C. 2007, *ARA&A*, 45, 565
- McLean, I. S., Becklin, E. E., Bendiksen, O., et al. 1998, in *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, Vol. 3354, *Infrared Astronomical Instrumentation*, ed. A. M. Fowler, 566–578
- McMullin, J. P., Waters, B., Schiebel, D., Young, W., & Golap, K. 2007, in *Astronomical Society of the Pacific Conference Series*, Vol. 376, *Astronomical Data Analysis Software and Systems XVI*, ed. R. A. Shaw, F. Hill, & D. J. Bell, 127
- Meheut, H., Lovelace, R. V. E., & Lai, D. 2013, *MNRAS*, 430, 1988
- Meheut, H., Meliani, Z., Varniere, P., & Benz, W. 2012a, *A&A*, 545, A134
- Meheut, H., Yu, C., & Lai, D. 2012b, *MNRAS*, 422, 2399
- Meijerink, R., Pontoppidan, K. M., Blake, G. A., Poelman, D. R., & Dullemond, C. P. 2009, *ApJ*, 704, 1471
- Ménard, F., Cuello, N., Ginski, C., et al. 2020, *A&A*, 639, L1
- Milam, S. N., Savage, C., Brewster, M. A., Ziurys, L. M., & Wyckoff, S. 2005, *ApJ*, 634, 1126
- Millar, T. J. & Nejad, L. A. M. 1985, *MNRAS*, 217, 507
- Millar, T. J., Walsh, C., Cordiner, M. A., Ní Chuimín, R., & Herbst, E. 2007, *ApJ*, 662, L87
- Min, M., Bouwman, J., Dominik, C., et al. 2016, *A&A*, 593, A11

- Minissale, M., Aikawa, Y., Bergin, E., et al. 2022, *ACS Earth and Space Chemistry*, 6, 597
- Miotello, A., Facchini, S., van Dishoeck, E. F., et al. 2019, *A&A*, 631, A69
- Miotello, A., Kamp, I., Birnstiel, T., Cleeves, L. C., & Kataoka, A. 2023, in *Astronomical Society of the Pacific Conference Series*, Vol. 534, *Protostars and Planets VII*, ed. S. Inutsuka, Y. Aikawa, T. Muto, K. Tomida, & M. Tamura, 501
- Mollière, P., Molyarova, T., Bitsch, B., et al. 2022, *ApJ*, 934, 74
- Montesinos, M., Perez, S., Casassus, S., et al. 2016, *ApJ*, 823, L8
- Morbidelli, A., Lunine, J. I., O’Brien, D. P., Raymond, S. N., & Walsh, K. J. 2012, *Annual Review of Earth and Planetary Sciences*, 40, 251
- Mulders, G. D., Ciesla, F. J., Min, M., & Pascucci, I. 2015, *ApJ*, 807, 9
- Müller, A., Keppler, M., Henning, T., et al. 2018, *A&A*, 617, L2
- Müller, H. S. P., Schlöder, F., Stutzki, J., & Winnewisser, G. 2005, *Journal of Molecular Structure*, 742, 215
- Müller, H. S. P., Thorwirth, S., Roth, D. A., & Winnewisser, G. 2001, *A&A*, 370, L49
- Najita, J. R., Carr, J. S., Salyk, C., et al. 2018, *ApJ*, 862, 122
- Najita, J. R., Carr, J. S., Strom, S. E., et al. 2010, *ApJ*, 712, 274
- Najita, J. R., Strom, S. E., & Muzerolle, J. 2007, *MNRAS*, 378, 369
- Nazari, P., Tabone, B., & Rosotti, G. P. 2023, *A&A*, 671, A107
- Newville, M., Stensitzki, T., Allen, D. B., & Ingargiola, A. 2014, *LMFIT: Non-Linear Least-Square Minimization and Curve-Fitting for Python*
- Nguyen, D. C., Brandeker, A., van Kerkwijk, M. H., & Jayawardhana, R. 2012, *ApJ*, 745, 119
- Noble, J. A., Theule, P., Mispelaer, F., et al. 2012, *A&A*, 543, A5
- Öberg, K. I. & Bergin, E. A. 2021, *Phys. Rep.*, 893, 1
- Öberg, K. I., Facchini, S., & Anderson, D. E. 2023, *ARA&A*, 61, 287
- Öberg, K. I., Furuya, K., Loomis, R., et al. 2015, *ApJ*, 810, 112
- Öberg, K. I., Guzmán, V. V., Walsh, C., et al. 2021, *ApJS*, 257, 1
- Öberg, K. I., Qi, C., Fogel, J. K. J., et al. 2010, *ApJ*, 720, 480
- Öberg, K. I., Qi, C., Wilner, D. J., & Andrews, S. M. 2011, *ApJ*, 743, 152

- Ohashi, N. 2008, *AP&SS*, 313, 101
- Ohashi, S., Kataoka, A., van der Marel, N., et al. 2020, *ApJ*, 900, 81
- Olofsson, J., Augereau, J.-C., van Dishoeck, E. F., et al. 2009, *A&A*, 507, 327
- Ormel, C. W. & Klahr, H. H. 2010, *A&A*, 520, A43
- Owen, J. E. & Kollmeier, J. A. 2017, *MNRAS*, 467, 3379
- pandas development team, T. 2020, *pandas-dev/pandas*: Pandas
- Paneque-Carreño, T., Izquierdo, A. F., Teague, R., et al. 2024, *A&A*, 684, A174
- Paneque-Carreño, T., Miotello, A., van Dishoeck, E. F., et al. 2023, *A&A*, 669, A126
- Pascucci, I., Apai, D., Hardegree-Ullman, E. E., et al. 2008, *ApJ*, 673, 477
- Pascucci, I., Cabrit, S., Edwards, S., et al. 2023, in *Astronomical Society of the Pacific Conference Series*, Vol. 534, *Protostars and Planets VII*, ed. S. Inutsuka, Y. Aikawa, T. Muto, K. Tomida, & M. Tamura, 567
- Pearson, T. J. 1999, in *Astronomical Society of the Pacific Conference Series*, Vol. 180, *Synthesis Imaging in Radio Astronomy II*, ed. G. B. Taylor, C. L. Carilli, & R. A. Perley, 335
- Pegues, J., Öberg, K. I., Bergner, J. B., et al. 2020, *ApJ*, 890, 142
- Penteado, E. M., Walsh, C., & Cuppen, H. M. 2017, *ApJ*, 844, 71
- Pérez, F. & Granger, B. E. 2007, *Computing in Science and Engineering*, 9, 21
- Pérez, L. M., Isella, A., Carpenter, J. M., & Chandler, C. J. 2014, *ApJ*, 783, L13
- Perez, S., Dunhill, A., Casassus, S., et al. 2015, *ApJ*, 811, L5
- Perotti, G., Christiaens, V., Henning, T., et al. 2023, *Nature*, 620, 516
- Perrero, J., Enrique-Romero, J., Ferrero, S., et al. 2022, *ApJ*, 938, 158
- Pilbratt, G. L., Riedinger, J. R., Passvogel, T., et al. 2010, *A&A*, 518, L1
- Pinilla, P. 2022, *European Physical Journal Plus*, 137, 1206
- Pinilla, P., Benisty, M., & Birnstiel, T. 2012a, *A&A*, 545, A81
- Pinilla, P., Benisty, M., de Boer, J., et al. 2018, *ApJ*, 868, 85
- Pinilla, P., Benisty, M., Waters, R., Bae, J., & Facchini, S. 2024, *A&A*, 686, A135
- Pinilla, P., Birnstiel, T., Ricci, L., et al. 2012b, *A&A*, 538, A114
- Pinte, C., van der Plas, G., Ménard, F., et al. 2019, *Nature Astronomy*, 3, 1109

- Pollack, J. B., Hubickyj, O., Bodenheimer, P., et al. 1996, *ICARUS*, 124, 62
- Pontoppidan, K., Battersby, C., Kataria, T., et al. 2025, in *American Astronomical Society Meeting Abstracts*, Vol. 245, American Astronomical Society Meeting Abstracts #245, 209.07
- Pontoppidan, K. M., Blake, G. A., & Smette, A. 2011, *ApJ*, 733, 84
- Pontoppidan, K. M., Blake, G. A., van Dishoeck, E. F., et al. 2008a, *ApJ*, 684, 1323
- Pontoppidan, K. M., Boogert, A. C. A., Fraser, H. J., et al. 2008b, *ApJ*, 678, 1005
- Pontoppidan, K. M., Salyk, C., Banzatti, A., et al. 2024, *ApJ*, 963, 158
- Pontoppidan, K. M., Salyk, C., Bergin, E. A., et al. 2014, in *Protostars and Planets VI*, ed. H. Beuther, R. S. Klessen, C. P. Dullemond, & T. Henning, 363–385
- Pontoppidan, K. M., Salyk, C., Blake, G. A., et al. 2010, *ApJ*, 720, 887
- Press, W. H., Teukolsky, S. A., Vetterling, W. T., & Flannery, B. P. 1992, *Numerical recipes in C. The art of scientific computing*
- Price, D. J., Cuello, N., Pinte, C., et al. 2018, *MNRAS*, 477, 1270
- Pringle, J. E. 1981, *ARA&A*, 19, 137
- Qi, C., Öberg, K. I., & Wilner, D. J. 2013, *ApJ*, 765, 34
- Rab, C., Kamp, I., Dominik, C., et al. 2020, *A&A*, 642, A165
- Rabli, D. & Flower, D. R. 2010, *MNRAS*, 406, 95
- Raettig, N., Lyra, W., & Klahr, H. 2021, *ApJ*, 913, 92
- Rampinelli, L., Facchini, S., Leemker, M., et al. 2024, *A&A*, 689, A65
- Rayner, J., Tokunaga, A., Jaffe, D., et al. 2022, *PASP*, 134, 015002
- Rayner, J., Tokunaga, A., Jaffe, D., et al. 2016, in *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, Vol. 9908, *Ground-based and Airborne Instrumentation for Astronomy VI*, ed. C. J. Evans, L. Simard, & H. Takami, 990884
- Regály, Z., Juhász, A., Sándor, Z., & Dullemond, C. P. 2012, *MNRAS*, 419, 1701
- Regály, Z., Kadam, K., & Dullemond, C. P. 2021, *MNRAS*, 506, 2685
- Rice, W. K. M., Lodato, G., Pringle, J. E., Armitage, P. J., & Bonnell, I. A. 2004, *MNRAS*, 355, 543
- Rich, E. A., Wisniewski, J. P., Currie, T., et al. 2019, *ApJ*, 875, 38
- Rieke, G. H., Wright, G. S., Böker, T., et al. 2015, *PASP*, 127, 584

- Rigby, J., Perrin, M., McElwain, M., et al. 2023, *PASP*, 135, 048001
- Roccatagliata, V., Franciosini, E., Sacco, G. G., Randich, S., & Sicilia-Aguilar, A. 2020, *A&A*, 638, A85
- Romero-Mirza, C. E., Banzatti, A., Öberg, K. I., et al. 2024a, *ApJ*, 975, 78
- Romero-Mirza, C. E., Öberg, K. I., Banzatti, A., et al. 2024b, *ApJ*, 964, 36
- Romero-Mirza, C. E., Öberg, K. I., Law, C. J., et al. 2023, *ApJ*, 943, 35
- Rometsch, T., Ziampras, A., Kley, W., & Béthune, W. 2021, *A&A*, 656, A130
- Rosotti, G. P., Benisty, M., Juhász, A., et al. 2020, *MNRAS*, 491, 1335
- Rosotti, G. P., Ilee, J. D., Facchini, S., et al. 2021, *MNRAS*, 501, 3427
- Rota, A. A., Meijerhof, J. D., van der Marel, N., et al. 2024, *A&A*, 684, A134
- Salinas, V. N., Hogerheijde, M. R., Mathews, G. S., et al. 2017, *A&A*, 606, A125
- Salyk, C., Blake, G. A., Boogert, A. C. A., & Brown, J. M. 2009, *ApJ*, 699, 330
- Salyk, C., Blake, G. A., Boogert, A. C. A., & Brown, J. M. 2011a, *ApJ*, 743, 112
- Salyk, C. & Gasman, D. 2025, in *PRIMA General Observer Science Book Volume 2*, ed. A. Moullet, D. Burgarella, T. Kataria, H. Beuther, C. Battersby, M. Cheng, T. Essinger-Hileman, H. Inami, E. Mills, T. Nagao, & S. Unwin, Vol. 2, 476–480
- Salyk, C., Lacy, J., Richter, M., et al. 2019, *ApJ*, 874, 24
- Salyk, C., Pontoppidan, K. M., Banzatti, A., et al. 2025, *AJ*, 169, 184
- Salyk, C., Pontoppidan, K. M., Blake, G. A., et al. 2008, *ApJ*, 676, L49
- Salyk, C., Pontoppidan, K. M., Blake, G. A., Najita, J. R., & Carr, J. S. 2011b, *ApJ*, 731, 130
- Santos, J. C., Chuang, K.-J., Lamberts, T., et al. 2022, *ApJ*, 931, L33
- Savitzky, A. & Golay, M. J. E. 1964, *Analytical Chemistry*, 36, 1627
- Schöier, F. L., van der Tak, F. F. S., van Dishoeck, E. F., & Black, J. H. 2005, *A&A*, 432, 369
- Schwarz, K. R., Henning, T., Christiaens, V., et al. 2024, *ApJ*, 962, 8
- Schwarz, K. R., Samland, M., Olofsson, G., et al. 2025, *ApJ*, 980, 148
- Sellek, A. D., Vlasblom, M., & van Dishoeck, E. F. 2025, *A&A*, 694, A79
- Semenov, D., Favre, C., Fedele, D., et al. 2018, *A&A*, 617, A28
- Semenov, D., Wiebe, D., & Henning, T. 2006, *ApJ*, 647, L57

- Shakura, N. I. & Sunyaev, R. A. 1973, *A&A*, 24, 337
- Shu, F. H., Adams, F. C., & Lizano, S. 1987, *ARA&A*, 25, 23
- Simon, M., Guilloteau, S., Di Folco, E., et al. 2017, *ApJ*, 844, 158
- Skrutskie, M. F., Dutkevitch, D., Strom, S. E., et al. 1990, *AJ*, 99, 1187
- Smith, S. A., Romero-Mirza, C. E., Banzatti, A., et al. 2025, *ApJ*, 984, L51
- Speedie, J., Dong, R., Hall, C., et al. 2024, *Nature*, 633, 58
- Speedie, J., Dong, R., Teague, R., et al. 2025, *ApJ*, 981, L30
- Stacey, G. & POEMM Science Team. 2025, in *American Astronomical Society Meeting Abstracts*, Vol. 245, *American Astronomical Society Meeting Abstracts #245*, 441.05
- Stadler, J., Benisty, M., Zagaria, F., et al. 2026, arXiv e-prints, arXiv:2601.15262
- Stapper, L. M., Hogerheijde, M. R., van Dishoeck, E. F., et al. 2024, *A&A*, 682, A149
- Stapper, L. M., Hogerheijde, M. R., van Dishoeck, E. F., & Mentel, R. 2022, *A&A*, 658, A112
- Stecher, T. P. & Williams, D. A. 1967, *ApJ*, 149, L29
- Sternberg, A. & Dalgarno, A. 1995, *ApJS*, 99, 565
- Stevenson, D. J. & Lunine, J. I. 1988, *ICARUS*, 75, 146
- Stolker, T., Kammerer, J., Benisty, M., et al. 2024, *A&A*, 682, A101
- Strom, K. M., Strom, S. E., Edwards, S., Cabrit, S., & Skrutskie, M. F. 1989, *AJ*, 97, 1451
- Sturm, J. A., McClure, M. K., Beck, T. L., et al. 2023a, *A&A*, 679, A138
- Sturm, J. A., McClure, M. K., Bergner, J. B., et al. 2023b, *A&A*, 677, A18
- Sturm, J. A., McClure, M. K., Law, C. J., et al. 2023c, *A&A*, 677, A17
- Su, Z. & Bai, X.-N. 2024, *ApJ*, 975, 126
- Tabone, B., Bettoni, G., van Dishoeck, E. F., et al. 2023, *Nature Astronomy*, 7, 805
- Tabone, B., Rosotti, G. P., Lodato, G., et al. 2022, *MNRAS*, 512, L74
- Tabone, B., van Dishoeck, E. F., & Black, J. H. 2024, *A&A*, 691, A11
- Tabone, B., van Hemert, M. C., van Dishoeck, E. F., & Black, J. H. 2021, *A&A*, 650, A192

- Taniguchi, K., Pineda, J. E., Caselli, P., et al. 2024, *ApJ*, 965, 162
- Tanious, M., Le Gal, R., Faure, A., et al. 2025, *A&A*, 703, A244
- Tanious, M., Le Gal, R., Neri, R., et al. 2024, *A&A*, 687, A92
- Tazaki, R., Murakawa, K., Muto, T., Honda, M., & Inoue, A. K. 2021, *ApJ*, 921, 173
- Tazzari, M., Testi, L., Ercolano, B., et al. 2016, *A&A*, 588, A53
- Tazzari, M., Testi, L., Natta, A., et al. 2017, *A&A*, 606, A88
- Teague, R. 2019a, *The Journal of Open Source Software*, 4, 1220
- Teague, R. 2019b, *The Journal of Open Source Software*, 4, 1632
- Teague, R. 2020, *richteague/keplerian\_mask*: Initial Release
- Teague, R., Bae, J., Aikawa, Y., et al. 2021, *ApJS*, 257, 18
- Teague, R., Bae, J., Huang, J., & Bergin, E. A. 2019, *ApJ*, 884, L56
- Teague, R. & Foreman-Mackey, D. 2018, *Research Notes of the American Astronomical Society*, 2, 173
- Temmink, M., Booth, A. S., Leemker, M., et al. 2025a, *A&A*, 693, A101
- Temmink, M., Booth, A. S., van der Marel, N., & van Dishoeck, E. F. 2023, *A&A*, 675, A131
- Temmink, M., Sellek, A. D., Gasman, D., et al. 2025b, *A&A*, 699, A134
- Temmink, M., van Dishoeck, E. F., Gasman, D., et al. 2024a, *A&A*, 689, A330
- Temmink, M., van Dishoeck, E. F., Grant, S. L., et al. 2024b, *A&A*, 686, A117
- Tennyson, J. 2019, *Astronomical Spectroscopy. An Introduction to the Atomic and Molecular Physics of Astronomical Spectroscopy*
- Terwisscha van Scheltinga, J., Hogerheijde, M. R., Cleves, L. I., et al. 2021, *ApJ*, 906, 111
- Terwisscha van Scheltinga, J., Ligterink, N. F. W., Bosman, A. D., Hogerheijde, M. R., & Linnartz, H. 2022, *A&A*, 666, A35
- Thi, W. F., Kamp, I., Woitke, P., et al. 2013, *A&A*, 551, A49
- Thi, W. F., van Dishoeck, E. F., Blake, G. A., et al. 2001, *ApJ*, 561, 1074
- Thi, W. F., van Zadelhoff, G. J., & van Dishoeck, E. F. 2004, *A&A*, 425, 955
- Tielens, A. 2021, *Molecular Astrophysics*
- Tielens, A. G. G. M. 2013, *Reviews of Modern Physics*, 85, 1021

- Tielens, A. G. G. M. & Allamandola, L. J. 1987, in *Interstellar Processes*, ed. D. J. Hollenbach & J. Thronson, *Harley A.*, Vol. 134, 397
- Tielens, A. G. G. M. & Hagen, W. 1982, *A&A*, 114, 245
- Tielens, A. G. G. M. & Hollenbach, D. 1985, *ApJ*, 291, 747
- Tobin, J. J. & Sheehan, P. D. 2024, *ARA&A*, 62, 203
- Tobin, J. J., van't Hoff, M. L. R., Leemker, M., et al. 2023, *Nature*, 615, 227
- Trapman, L., Facchini, S., Hogerheijde, M. R., van Dishoeck, E. F., & Bruderer, S. 2019, *A&A*, 629, A79
- Trapman, L., Miotello, A., Kama, M., van Dishoeck, E. F., & Bruderer, S. 2017, *A&A*, 605, A69
- Trapman, L., Rosotti, G., Bosman, A. D., Hogerheijde, M. R., & van Dishoeck, E. F. 2020, *A&A*, 640, A5
- Trapman, L., Tabone, B., Rosotti, G., & Zhang, K. 2022a, *ApJ*, 926, 61
- Trapman, L., Zhang, K., van't Hoff, M. L. R., Hogerheijde, M. R., & Bergin, E. A. 2022b, *ApJ*, 926, L2
- Tychoniec, Ł., Manara, C. F., Rosotti, G. P., et al. 2020, *A&A*, 640, A19
- Tychoniec, Ł., van Gelder, M. L., van Dishoeck, E. F., et al. 2024, *A&A*, 687, A36
- Urbina, F., Miley, J., Kama, M., & Keyte, L. 2024, *A&A*, 686, A120
- Urpin, V. & Brandenburg, A. 1998, *MNRAS*, 294, 399
- Valenti, J. A., Johns-Krull, C. M., & Linsky, J. L. 2000, *ApJS*, 129, 399
- van Capelleveen, R. F., Ginski, C., Kenworthy, M. A., et al. 2025, *ApJ*, 990, L8
- van der Marel, N. 2023, *European Physical Journal Plus*, 138, 225
- van der Marel, N., Booth, A. S., Leemker, M., van Dishoeck, E. F., & Ohashi, S. 2021a, *A&A*, 651, L5
- van der Marel, N., Bosman, A. D., Krijt, S., Mulders, G. D., & Bergner, J. B. 2021b, *A&A*, 653, L9
- van der Marel, N., Cazzoletti, P., Pinilla, P., & Garufi, A. 2016a, *ApJ*, 832, 178
- van der Marel, N. & Pinilla, P. 2023, *arXiv e-prints*, arXiv:2310.09077
- van der Marel, N., van Dishoeck, E. F., Bruderer, S., et al. 2016b, *A&A*, 585, A58
- van der Marel, N., van Dishoeck, E. F., Bruderer, S., et al. 2013, *Science*, 340, 1199

- van der Marel, N., van Dishoeck, E. F., Bruderer, S., & van Kempen, T. A. 2014, *A&A*, 563, A113
- van der Plas, G., Casassus, S., Ménard, F., et al. 2014, *ApJ*, 792, L25
- van der Plas, G., van den Ancker, M. E., Waters, L. B. F. M., & Dominik, C. 2015, *A&A*, 574, A75
- van der Tak, F. F. S., Black, J. H., Schöier, F. L., Jansen, D. J., & van Dishoeck, E. F. 2007, *A&A*, 468, 627
- van Dishoeck, E. F. 2006, *Proceedings of the National Academy of Science*, 103, 12249
- van Dishoeck, E. F. 2014, *Faraday Discussions*, 168, 9
- van Dishoeck, E. F. & Black, J. H. 1988, *ApJ*, 334, 771
- van Dishoeck, E. F., Herbst, E., & Neufeld, D. A. 2013, *Chemical Reviews*, 113, 9043
- van Dishoeck, E. F., Kristensen, L. E., Mottram, J. C., et al. 2021, *A&A*, 648, A24
- van Gelder, M. L., Ressler, M. E., van Dishoeck, E. F., et al. 2024, *A&A*, 682, A78
- van Gelder, M. L., Tabone, B., van Dishoeck, E. F., & Godard, B. 2021, *A&A*, 653, A159
- van 't Hoff, M. L. R., Tobin, J. J., Trapman, L., et al. 2018, *ApJ*, 864, L23
- van 't Hoff, M. L. R., Walsh, C., Kama, M., Facchini, S., & van Dishoeck, E. F. 2017, *A&A*, 599, A101
- van Terwisga, S. E., van Dishoeck, E. F., Ansdell, M., et al. 2018, *A&A*, 616, A88
- van Zadelhoff, G. J., Aikawa, Y., Hogerheijde, M. R., & van Dishoeck, E. F. 2003, *A&A*, 397, 789
- van Zadelhoff, G. J., van Dishoeck, E. F., Thi, W. F., & Blake, G. A. 2001, *A&A*, 377, 566
- van't Hoff, M. L. R. & Bergner, J. B. 2026, in *Encyclopedia of Astrophysics*, Vol. 1, 210–232
- Verhoeff, A. P., Min, M., Pantin, E., et al. 2011, *A&A*, 528, A91
- Vidal, T. H. G., Loison, J.-C., Jaziri, A. Y., et al. 2017, *MNRAS*, 469, 435
- Villenave, M., Ménard, F., Dent, W. R. F., et al. 2020, *A&A*, 642, A164
- Vioque, M., Booth, R. A., Ragusa, E., et al. 2026, *A&A*, 705, A238
- Virtanen, P., Gommers, R., Oliphant, T. E., et al. 2020, *Nature Methods*, 17, 261

- Visser, R., van Dishoeck, E. F., Doty, S. D., & Dullemond, C. P. 2009, *A&A*, 495, 881
- Vlasblom, M., Temmink, M., Grant, S. L., et al. 2025a, *A&A*, 693, A278
- Vlasblom, M., Temmink, M., Sellek, A. D., & van Dishoeck, E. F. 2025b, *A&A*, 703, A52
- Vlasblom, M., van Dishoeck, E. F., Tabone, B., & Bruderer, S. 2024, *A&A*, 682, A91
- Waelkens, C., Waters, L. B. F. M., de Graauw, M. S., et al. 1996, *A&A*, 315, L245
- Wafflard-Fernandez, G. & Baruteau, C. 2020, *MNRAS*, 493, 5892
- Waggoner, A. R. & Cleeves, L. I. 2022, *ApJ*, 928, 46
- Waggoner, A. R., Cleeves, L. I., Loomis, R. A., et al. 2023, *ApJ*, 956, 103
- Wakelam, V., Bron, E., Cazaux, S., et al. 2017, *Molecular Astrophysics*, 9, 1
- Wakelam, V., Herbst, E., Loison, J.-C., et al. 2012, *ApJS*, 199, 21
- Walsh, C., Loomis, R. A., Öberg, K. I., et al. 2016, *ApJ*, 823, L10
- Walsh, C., Millar, T. J., & Nomura, H. 2010, *ApJ*, 722, 1607
- Walsh, C., Nomura, H., Millar, T. J., & Aikawa, Y. 2012, *ApJ*, 747, 114
- Walsh, C., Nomura, H., & van Dishoeck, E. 2015, *A&A*, 582, A88
- Watanabe, N. & Kouchi, A. 2002, *ApJ*, 571, L173
- Watson, D. M., Leisenring, J. M., Furlan, E., et al. 2009, *ApJS*, 180, 84
- Watson, W. D. 1976, *Reviews of Modern Physics*, 48, 513
- Weaver, E., Isella, A., & Boehler, Y. 2018, *ApJ*, 853, 113
- Wells, M., Pel, J. W., Glasse, A., et al. 2015, *PASP*, 127, 646
- Werner, M. W., Roellig, T. L., Low, F. J., et al. 2004, *ApJS*, 154, 1
- Wetherill, G. W. & Stewart, G. R. 1989, *ICARUS*, 77, 330
- Wheeler, C. H., Hinkel, N. R., & Banzatti, A. 2024, *PASP*, 136, 113002
- Wiesenfeld, L. & Faure, A. 2013, *MNRAS*, 432, 2573
- Williams, J. P. & Cieza, L. A. 2011, *ARA&A*, 49, 67
- Wilson, T. L. 1999, *Reports on Progress in Physics*, 62, 143
- Woitke, P., Kamp, I., Antonellini, S., et al. 2019, *PASP*, 131, 064301

- Woitke, P., Kamp, I., & Thi, W. F. 2009, *A&A*, 501, 383
- Woitke, P., Min, M., Thi, W. F., et al. 2018, *A&A*, 618, A57
- Woitke, P., Thi, W. F., Arabhavi, A. M., et al. 2024, *A&A*, 683, A219
- Wölfer, L., Facchini, S., Kurtovic, N. T., et al. 2021, *A&A*, 648, A19
- Wölfer, L., Facchini, S., van der Marel, N., et al. 2023, *A&A*, 670, A154
- Wootten, A. & Thompson, A. R. 2009, *IEEE Proceedings*, 97, 1463
- Wright, E. L., Eisenhardt, P. R. M., Mainzer, A. K., et al. 2010, *AJ*, 140, 1868
- Wright, G. S., Rieke, G. H., Glasse, A., et al. 2023, *PASP*, 135, 048003
- Wright, G. S., Wright, D., Goodson, G. B., et al. 2015, *PASP*, 127, 595
- Wyatt, M. C. 2018, in *Handbook of Exoplanets*, ed. H. J. Deeg & J. A. Belmonte, 146
- Xie, T., Allen, M., & Langer, W. D. 1995, *ApJ*, 440, 674
- Yamato, Y., Aikawa, Y., Guzmán, V. V., et al. 2024a, *ApJ*, 974, 83
- Yamato, Y., Notsu, S., Aikawa, Y., et al. 2024b, *AJ*, 167, 66
- Yang, H., Fernández-López, M., Li, Z.-Y., et al. 2023, *ApJ*, 948, L2
- Yang, H., Fernández-López, M., Li, Z.-Y., et al. 2024, *ApJ*, 963, 134
- Yen, H.-W., Koch, P. M., Liu, H. B., et al. 2016, *ApJ*, 832, 204
- Youdin, A. N. & Goodman, J. 2005, *ApJ*, 620, 459
- Youdin, A. N. & Lithwick, Y. 2007, *ICARUS*, 192, 588
- Young, A. K., Alexander, R., Walsh, C., et al. 2021, *MNRAS*, 505, 4821
- Yu, S.-Y., Ho, L. C., & Zhu, Z. 2019, *ApJ*, 877, 100
- Zagaria, F., Jiang, H., Cataldi, G., et al. 2025, *ApJ*, 989, 30
- Zannese, M., Tabone, B., Habart, E., et al. 2024, *Nature Astronomy* [[arXiv:2312.14056](#)]
- Zhang, K., Bergin, E. A., Blake, G. A., et al. 2016, *ApJ*, 818, L16
- Zhang, K., Booth, A. S., Law, C. J., et al. 2021, *ApJS*, 257, 5
- Zhang, K., Pontoppidan, K. M., Salyk, C., & Blake, G. A. 2013, *ApJ*, 766, 82
- Zhang, S., Kalscheur, M., Long, F., et al. 2023, *ApJ*, 952, 108
- Zhang, S., Zhu, Z., & Fairbairn, C. W. 2025, *ApJ*, 995, L33
- Zhu, Z., Dong, R., Stone, J. M., & Rafikov, R. R. 2015, *ApJ*, 813, 88
- Zhu, Z. & Stone, J. M. 2018, *ApJ*, 857, 34