



Universiteit
Leiden
The Netherlands

The infrared spectrum of massive protostars: circumstellar disks and high mass star formation

Barr, A.G.

Citation

Barr, A. G. (2022, April 12). *The infrared spectrum of massive protostars: circumstellar disks and high mass star formation*. Retrieved from <https://hdl.handle.net/1887/3283538>

Version: Publisher's Version

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

License: <https://hdl.handle.net/1887/3283538>

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

Bibliography

- Adams, S. C., Ádámkovics, M., Carr, J. S., Najita, J., & Brittain, S. D. 2019, ApJ, 871, 173
- Agúndez, M., Cernicharo, J & Goicoechea, J. R. 2008, A&A, 483, 831
- Agúndez, M., Roueff, E., LePetit, F & Le Bourlot, J. 2018, A&A, 616, A19
- ALMA Partnership et al. 2015, ApJ, 808, L3
- André, P., Di Francesco, J., Ward-Thompson, D., et al. 2014, in Protostars and Planets VI, ed. H. Beuther, R. S. Klessen, C. P. Dullemond, & T. Henning, 27
- Andrews, S. M. 2020, ARA&A, 58, 483
- Asplund, M., Grevesse, N., Sauval, A. J., & Scott, P. 2009, ARA&A, 47, 481
- Bally, J., Lada, C. J. 1983, ApJ, 265, 824
- Banzatti, A., Pontoppidan, K. M., Salyk, C., et al. 2017, ApJ, 834, 152
- Barentine, J & Lacy, J. 2012, ApJ, 757, 111
- Barger, C. J., & Garrod, R. T. 2020, ApJ, 888, 38
- Bast, J. E., Brown, J. M., Herczeg, G. J., van Dishoeck, E. F., & Pontoppidan, K. M. 2011, A&A, 527, A119
- Bast, J. E., Lahuis, F., van Dishoeck, E. F., & Tielens, A. G. G. M. 2013, A&A, 551, A118
- Beltrán M. T., Cesaroni R., Neri R., Codella C. 2004, ApJ, 601, L187
- Beltrán, M. T., Cesaroni, R., Neri, R., Codella, C., et al. 2005, A&A, 435, 901
- Beltrán, M. T., & de Wit, W. J. 2016, A&A Rev., 24, 6
- Beltrán, M. T., Cesaroni, R., Rivilla, V. M., et al. 2018, A&A, 615, A141
- Benz, A. O., Staüber, P., Bourke, T. L., van der Tak, F. F. S., et al. 2007, A&A, 475, 549
- Bertoldi, F., McKee, C. F. 1992, ApJ, 395, 140
- Beuther, H., Schilke, P., Sridharan, T. K., et al. 2002, A&A, 383, 892
- Beuther, H. 2006, Triggered Star Formation in a Turbulent ISM Proceedings IAU Symposium, ed. Elmegreen B. G., & Palous, J, 237
- Beuther, H., Churchwell, E. B., McKee, C. F., & Tan, C. J. 2007, Protostars and Planets V, ed. Reipurth, Bo., Jewitt, David., & Keil, Klaus, University of Arizona Press, Tucson, 951
- Beuther, H., Shepherd, D. S. 2005, In Cores to Clusters: Star Formation with Next Generation Telescopes, ed. MS Nanda Kumar, M Tafalla, P Caselli. Astrophys. Space Sci. Libr. 324, 105
- Bik, A., & Thi, W. 2004, A&A, 427, L13
- Bik, A., Kaper, L., & Waters, L. B. F. M. 2006, A&A, 455, 561
- Black, J. H., van Dishoeck, E. F., Wilner, S. P., & Woods, R. C. 1990, ApJ, 358, 459
- Blake, G. A., Sutton, E. C., Masson, C. R., & Phillips, T. G. 1987, ApJ, 315, 621
- Blake, G. A., & Boogert, A. C. A. 2004, ApJ, 606, L73
- Boley, P. A., Linz, H., van Boekel, R., et al. 2013, A&A, 558, A24

- Bonnell, I. A., Bate, M. R., Clarke, C. J., & Pringle, J. E. 1997, MNRAS, 285, 201
- Bonnell, I. A., Bate, M. R., Zinnecker, H. 1998, MNRAS, 298, 93
- Bonnell, I. A., & Bates, M. R. 2006, MNRAS, 270, 588
- Boogert, A. C. A, Blake, G. A., & Öberg, K. I. 2004, ApJ, 615, 344
- Boogert, A. C. A., Gerakines, P. A., & Whittet, C. B. 2015, ARA&A, 53, 541
- Boonman, A. M.S., van Dishoeck, E. F., Luhuis, F., et al. 2000, ISO Beyond the Peaks: The 2nd ISO Workshop on Analytical Spectroscopy, ed. Salama, A., Kessler, M. F., Leech, K. & Schulz, B., ESA Special Publication, 456, 67
- Boonman, A. M. S., Stark, R., van der Tak, F. F. S., et al. 2001, ApJ, 553, L63
- Boonman,A. M. S., Doty, S. D., van Dishoeck, E. F., et al. 2003, A&A, 406, 937
- Boonman, A. M. S., van Dishoeck, E. F., Luhuis, F., & Doty, S. D. 2003, A&A, 399, 1063
- Boonman, A. M.S., van Dishoeck, E. F. 2003, A&A, 403, 1003
- Bottinelli, S., Ceccarelli, C., Lefloch, B., Williams, J.P., et al. 2004, ApJ, 615, 354
- Bruderer, S., Benz, A. O., Bourke, T. L., & Doty, S. D. 2009, A&A, 503, L13
- Carey, S. J., Clark, F. O., Egan, M. P., et al. 1998, ApJ, 508, 721
- Carr, J. S., Evans, N. J., Lacy, J. H., & Zhou, S. 1995, ApJ, 450, 667
- Carr, J. S., & Najita, J. R. 2008, Science, 319, 1504
- Carr, J. S., Najita, J.R. 2011, ApJ, 733, 102
- Cassen, P., & Summers, A. 1983, Icarus, 53, 26
- Cazaux, S., Tielens, A. G. G. M., Ceccarelli, C., Castets, A., et al. 2003, ApJ, 593, L51
- Ceccarelli, C. 2008, Organic Matter in Space Proceedings IAU Symposium, No. 251, 2008, S. Kwok & S. Sandford, eds.
- Cernicharo, J., Lim, T., Cox, P., et al. 1997, A&A, 323, L25
- Cernicharo, J., & Crovisier, J. 2005, Space Sci. Rev., 119, 29
- Cesaroni, R. 2005, Ap&SS, 295, 5
- Cesaroni, R. 2005, in IAU Symp. 227, Massive Star Birth: A Crossroads of Astrophysics, ed. R. Cesaroni, M. Felli, E. Churchwell, & M. Walmsley (Cambridge: Cambridge Univ. Press), 59
- Cesaroni, R., Galli, D., Lodato, G., Walmsley, C. M. & Zhang, Q. 2007, Protostars and Planets V, ed. Reipurth, Bo., Jewitt, David., & Keil, Klaus, University of Arizona Press, Tucson, 197
- Charnley, S. B. 1997, ApJ, 481, 396
- Choi, Y., van der Tak, F. F. S., van Dishoeck, E. F., Herpin, F., & Wyrowski, F. 2015, A&A, 576, A85
- Clarke, C. J., Gendrin, A., Sotomayor, M. 2001, MNRAS, 328, 485
- Clarke, M., Vacca, W. D., & Shuping, R. Y. 2015, Astronomical Society of the Pacific Conference Series, Vol. 495, Astronomical Data Analysis Software anSystems XXIV (ADASS XXIV), ed. A. R. Taylor & E. Rosolowsky, 355
- Collins, G. W. 2003, The Fundamentals of Stellar Astrophysics, (Web Edition; pg 345)
- Cooper, H. D. B., Lumsden, S. L., Oudmaijer, R. D., et al. 2013 MNRAS, 430, 1125
- Cushing, M. C., Vacca, W. D., & Rayner, J. T. 2004, PASP, 116, 362
- D'Alessio, P., Cantó, J., Calvet, N., & Lizano, S. 1998, ApJ, 500, 411
- Davies, B., Lumsden, S. L., Hoare, M. G., et al. 2010, MNRAS, 402, 1504
- de Wit, W. J., Hoare, M. G., Oudmaijer, R. D., et al. 2011, A&A, 526, L5
- Doty, S. D., van Dishoeck, E. F., van der Tak, F. F. S., & Boonman, A. M. S. 2002, A&A, 389, 446
- Draine, B. T./ 2003, ARA&A, 41, 241

- Dullemond, C. P., Hollenbach, D., Kamp, I., & D'Alessio, P. 2007, Protostars and Planets V, ed. Reipurth, Bo., Jewitt, David., & Keil, Klaus, University of Arizona Press, Tucson, 555
- Dullemond, C. P., & Monnier, J. D. 2010, ARA&A, 48, 205
- Dungee, R., Boogert, A., DeWitt, C. N., Montiel, E., et al. 2018, ApJ, 868, L10
- Egan, M. P., Shipman, R. F., Price, S. D., et al. 1998, ApJ, 494, L199
- Eislöffel, J., Mundt, R., Ray, T. P., & Rodriguez, L. F. 2000, in Protostars and Planets IV, ed. V. Mannings, A. P. Boss, & S. S. Russel (Tucson: University of Arizona Press), 815
- Elitzur, M., Hollenbach, D. J., & McKee, C. F. 1989, ApJ, 346, 983
- Esplugues, G. B., Viti, S., Goicoechea, J. R., & Cernicharo, J. 2014, A&A, 567, A95
- Evans, N. J., Lacy, J. H., & Carr, J. S. 1991, ApJ, 383, 674
- Faure, A., Hily-Blant, P., Le Galm R., et al. 2013, ApJ, 770, l2
- Favre, C., Fedele, D., Semenov, D., et al. 1018, ApJ, 862, L2
- Fedele, D., Pascucci, I., Brittain, S., et al. 2011, ApJ732, 106
- Fedele, D., Bruderer, S., van Dishoeck, E. F., et al. 2012, A&A, 544, L9
- Fedele, D., Bruderer, S., van Dishoeck, E. F., et al. 2013, A&A, 559, A77
- Fedriani, R., Caratti o Garatti, A., Koutoulaki, M., et al. 2020, A&A, 633, A128
- Feng, S., Beuther, H., Henning, Th., et al. 2015, A&A, 581, A71
- Feuchtgruber, H., Helmich, F. P., van Dishoeck, E. F., & Wright, C. M. 2000, ApJ, 535, L111
- Frost, A. J., Oudmaijer, R. D., de Wit W. J., & Lumsden, S. L. 2021, A&A, 648, A62
- Fuente, A., Treviño-Morales, S. P., Alonso-Albi, T., et al. 2021, MNRAS, 507, 1886
- Gibb, E. L., Whittet, D. C. B., Boogert, A. C.. A., & Tielens, A. G. G. M. 2004, ApJS, 151, 35
- Gibb, E. L., Van Brunt, K. A., Brittain, S. D., & Rettig, T. W. 2007, ApJ, 660, 1572
- Gibb, K. L., & Horne, D. 2013, ApJ, 776, L28
- Gieser, C., Semenov, D., Beuther, H., et al. 2019, A&A, A&A, 631, A142
- Goddi, C., Ginsburg, A., Maud, L. T., Zhang, Q., & Zapata, L. A. 2020, ApJ, 905, 25
- González-Alfonso, E., Cernicharo, J., van Dishoeck, E. F., et al. 1998, ApJ, 502, L169
- Gordon, I. .E., Rothman, L. S., Hill, C. et al. 2017, JQSRT, 203, 3
- Goto, M., Usuda, T., Takato, N., et al. 2003, ApJ, 598, 1038
- Goto, M., Geballe, T. R., Harju, J., et al. 2019, A&A, 632, A29
- Grunblatt, S. K., Huber, D., Gaidos, E., et al. 2019, AJ, 158, 227
- Hatchell, J., Thompson, M. A., Millar, T. J., et al. 2009, A&A, 504, 853
- Helmich, F. P., van Dishoeck, E. F., Black, J. H., et al. 1996, A&A, 315, L173
- Hennemann, M., Motte, F., Schneider, N., Didelon, P., et al. 2012, A&A, 543, L3
- Henning, Th., Chini, R., & Pfau, W. 1992, A&A, 263, 285
- Henning, T., Feldt, M., & Stecklum, B. 2002, Hot Star Workshop III: The Earliest Phases of Massive Star Birth, ed. Paul A. Crowther, ASP Conference Series, Vol 267
- Hall, D. N. B., Ridgway, S. T., Gillet, F. C., & Kleinmann, S. G. 1978, ApJ, 223, L47
- Herbst, W., & Racine, R. 1976, AJ, 81, 840
- Herbst, E., van Dishoeck, E. F. 2009, ARA&A, 47, 427
- Hernández, J., Hartmann, L., Megeath, T., Gutermuth, R., Muzerolle, J., Calvet, et al. 2007, ApJ, 662, 1067
- Hernández Vera, M., Lique, F., Dumouchel, F., Hily-Blant, P., Faure, A. 2017, MNRAS, 468, 1084
- Hill, T., Motte, F., Didelon, P., et al. 2011, A&A, 533, A94

- Hofner, P., Peterson, S., & Cesaroni, R. 1999, ApJ, 514, 899
- Hollands, M., Tremblay, P. E., Gänsicke, B. T., et al. 2021, Nature, 5, 451
- Hollenbach, D., Elitzur, M., & McKee, C. 2013, ApJ, 773, 70
- Hunter C. 1977, ApJ, 218, 834
- Ilee, J. D., Wheelwright, H. E., Oudmaijer, R. D. 2013, MNRAS, 429, 2960
- Ilee, J. D., Cyganowski, C. J., Nazari, P., et al. 2016, MNRAS, 462, 4386
- Indriolo, N., Neufeld, D. A., Seifahrt, A., & Richter, M. J. 2013, ApJ, 776, 8
- Indriolo, N., Neufeld, D. A., DeWitt, C. N., Richter, M. J., et al. 2015, ApJ, 802: L14
- Indriolo, N., Neufeld, D. A., Gerin, M., Schilke, P., et al. 2015, 800, 40
- Indriolo, N., Neufeld, D. A., Barr, A. G., et al. 2020, ApJ, 894, 107
- Jijina, J., & Adams, F. C. 1996, ApJ, 462, 874
- Jiménez-Serra, I., Zhang, Q., Viti, S., Martín-Pintado, J., & De-Wit, W. -J. 2012, ApJ, 753, 34
- Jiménez-Serra, I., Alejandro, B., Martín-Pintado, J., et al. 2020, ApJ, 897, L33
- Johnston, K. G., Shepherd, D. S., Robitaille, T. P., & Wood, K. 2013, A&A, 551, A43
- Johnston, K. G., Robitaille, T. P., Beuther, H., et al. 2015, ApJ, 813, L19
- Jørgensen, J. K., Belloche, A., & Garrod, R. T. 2020, ARA&A, 58, 1
- Kaźmierczak-Barthel, M., van der Tak, F. F. S., Helmich, F. P., et al. 2014, A&A, 567, A53
- Keane, J. V., Boonman, A. M. S., Tielens, A. G. G. M., & van Dishoeck, E. F. 2001, A&A, 376, L5
- Keto, E. 2007, ApJ, 666, 976
- Knez, C., Lacy, J. H., Evans, N. J., van Dishoeck, E. F., & Richter, M. J. 2013, ApJ, 696, 471
- Kraus, S., Hofmann, K. H., Menten, K. M., et al. 2010, Nature, 466, 339
- Kress, M., Tielens, A. G. G. M., & Frenklach, M. 2008, 5th Spitzer Conference. New Light on Young Stars: Spitzer's View of Circumstellar Disks, poster 31
- Krumholz, M. R., Klein, K. R., & McKee, C. F. 2005, in Massive Star Birth: A Crossroads of Astrophysics, Proceedings IAU Symposium, ed. R. Cesaroni, M. Felli, E. Churchwell & C. M. Walmsley, 227
- Krumholz, M. R., Matzner, C. D., McKee, C. F. 2006, ApJ, 653, 361
- Kuiper, R., Klahr, H., Beuther, H., & Henning, T. 2010, ApJ, 722, 1556
- Kuiper, R., Turner, N. J., & Yorke, H. W. 2016, ApJ, 832, 40
- Kurtz, S., Cesaroni, R., Churchwell, E., Hofner, P., & Walmsley, C. M. 2000, in Protostars and Planets IV, ed. V. Mannings, A. P. Boss, & S. S. Russell (Tucson, AZ: Univ. Arizona Press), 299
- Kwon, J., Tamura, M., Hough J. H., Nagata, T., & Kusakabe, N. 2016, ApJ, 152, 67
- Lacy, J. H., Evans, N. J., Achtermann, J. M., et al. 1989, ApJ, 342, L43
- Lacy, J. H., Carr, J. S., Evans, N. J., et al. 1991, ApJ, 376, 556
- Lacy, J. H., Knacke, R., Geballe, T. R., Tokunaga, A. T. 1994, ApJ, 428, L69
- Lacy, J. H., Richter, M. J., Greathouse, T. K., Jaffe, D. T., & Zhu, Q. 2002, PASP, 114, 153
- Lacy, J. H., Richter, M. J., Greathouse, T., et al. 2003, Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series, 4841, 1572
- Lacy, J. H. 2013, ApJ, 765, 130
- Lada, C. J., & Lada, E. A. 2003, ARA&A, 41, 57
- Lahuis, F., van Dishoeck, E. F. 2000, A&A, 355, 699
- Lahuis, F., van Dishoeck, E. F., Boogert, A. C. A., Pontoppidan, K. M., et al. 2006, ApJ, 636, L145

- Li, J., Wang, J., Zhu, Q., Zhang, J., & Li, D. 2015, ApJ, 802, 40
- Lique, F., Spielfiedel, A., Cernicharo, J. 2006, A&A, 451, 1125
- Liu, H. B., Galván-Madrid, R., Jiménez-Serra, I., et al. 2015, ApJ, 804, 37
- Lord, S. D. 1992, NASA Technical Memorandum 103957
- Lumsden, S. L., Hoare, M. G., Urquhart, J. S., et al. 2013, ApJS, 208, 11
- Lynden-Bell, D., & Pringle, J. E. 1974, MNRAS, 168, 603
- Mandell, A. M., Bast, J., van Dishoeck, E. F., Blake, G. A., et al. 2012, ApJ, 747, 92
- Markwick, A., Ilgner, M., Millar, T. J., & Henning, Th. 2002, A&A, 385, 632
- Maud, L. T., Hoare, M. G., Galván-Madrid, R., et al. 2017, MNRAS, 467, L120
- Maud, L. T., Cesaroni, R., Kumar, M. S. N., van der Tak, F. F. S., et al. 2018, A&A, 620, A31
- Maud, L. T., Cesaroni, R., Kumar, M. S. N., Rivilla, V. M., et al. 2019, A&A, A&A, 627, L6
- May, P. W., Pineau des Forets, G., Flower, D. R., et al. 2000, MNRAS, 318, 809
- McKee, C. F., & Ostriker, E. C. 2007, ARA&A, 45, 565
- Melnick, G. J., Tolls, V., Neufeld, D. A., et al. 2010, A&A, 521, L27
- Menten, K. M., & van der Tak, F. F. S. 2004, A&A, 414, 289
- Mihalas, D. 1978, Stellar Atmospheres, (2nd Edition; W. H. Freeman; pg 211-213)
- Mitchell, G. F., Curry, C., Maillard, J., & Allen, M. 1989, ApJ, 341, 1020
- Mitchell, G. F., Maillard, J., Allen, M. 1990, ApJ, 363, 554
- Mitchell, G. F., Maillard, J., & Hasewaga, T. I. 1991, ApJ, 371, 342
- Monnier, J. D., Tuthill, P. G., Ireland, M., et al. 2009, ApJ, 700, 491
- Moreno, R., Lellouch, E., Luisa, L. M., et al. 2012, Icarus, 221, 753
- Moscadelli, L., & Goddi, C. 2014, A&A, 566, A150
- Moscadelli, L., Sanna, A., Cesaroni, R., et al. 2019, A&A, 622, A206
- Murakawa, K., Preibisch, T., Krau, S., & Weigelt, G. / 2008, A&A, 490, 673
- Murukawa, K., Lumsden, S. L., Oudmaijer, R. D., et al. 2013, MNRAS, 436, 511
- Najita, J., Carr, J. S., & Mathieu, R. D. 2003, ApJ, 589, 931
- Najita, J. R., Carr, J. S., Brittain, S. D., Lacy, J. H., et al. 2021, ApJ, 908, 171
- Nakano, T., Hasegawa, T., & Norman, C. 1995, ApJ, 450, 183
- Nakano, T. 1989, ApJ, 345, 464
- Neufeld, D. A., & Melnick, G. J. 1991, ApJ, 368, 215
- Neufeld, D. A., González-Alfonso, E., Melnick, G. J., et al. 2011, ApJ, 727, L28
- Neufeld, D. A., DeWitt, C., Lesaffre, P., et al. 2019, ApJ, 878, L18
- Nielbock, M., Chini, R., Hoffmeister, V. H., Scheyda, C. M., et al. 2007, ApJ, 656, L81
- Öberg, K. I., Boogert, A. C. A., Pontoppidan, K. M., et al. 2008, ApJ, 678, 1032
- Öberg, K. I., Guzmán, V. V., Furuya, K., et al. 2015, Nature, 520, 198
- Öberg, K. I. 2016, Chem. Rev, 116, 17, 9631
- Olmi L., Cesaroni R., Hofner P., Kurtz S., et al. 2003, A&A, 407, 225
- Ormel, C. W., Min, M., Tielens, A. G. G. M., et al. 2011, A&A, 532, A43
- Osorio, M., Anglada, G., Lizano, S., & D'Alessio, P. 2009, ApJ, 694, 29
- Padovani, M., Hennebelle, P., Marcowith, A., & Ferrière, K. 2015, A&A, 582, L13
- Padovani, M., Hennebelle, P., Marcowith, A., & Ferrière, K. 2016, A&A, 590, A8
- Palmeirim, P., André, P., Kirk, J., et al. 2013, A&A, 550, A38
- Papousek, D. 1982, Molecular Vibrational-Rotational Spectra: Theory and Applications of High Resolution Infrared, Microwave, and Raman Spectroscopy of Polyatomic Molecules,

- (1st Edition; Elsevier Science Pub Co)
- Pascucci, I., Apai, D., Luhman, K., et al. 2009, *ApJ*, 696, 143
- Patel, N. A., Curiel, S., Sridharan, T. K., et al. 2005, *Nature*, 437, 576
- Peimbert, M., Luridiana, V., & Peimbert, A. 2007, *ApJ*, 666, 636
- Pineda, J., Goodman, A., Arce, H., et al. 2010, *ApJ*, 712, L116
- Plambeck, R. L., & Wright, M. C. H. 1987, *ApJ*, 317, L101
- Pomohaci, R., Oudmaijer, R. D., Lumsden, S. L., et al. 2017, *MNRAS*, 472, 3624
- Pontoppidan, K. M., Salyk, C., Blake, G. A., et al. 2010, *ApJ*, 720, 887
- Pontoppidan, K. M., Blake, G. A., & Smette, A. 2011, *ApJ*, 733, 84
- Pontoppidan, K. M., Salyk, C., Bergin, E. A., et al. 2014, *Protostars and Planets VI*, 363
- Pontoppidan, K. M., Salyk, C., Banzatti, A., et al. 2019, *ApJ*, 874, 92
- Preibisch, T., Balega, Y. Y., Schertl, D., & Weigelt, G. 2002, *A&A*, 392, 945
- Preibisch, T., Balega, Y. Y., Schertl, D., & Weigelt, G. 2003, *A&A*, 412, 735
- Rangwala, N., Colgan, S. W. J., Le Gal, R., Acharyya, K., et al. 2018, *ApJ*, 856, 9
- Rathborne, J. M., Jackson, J. M., & Simon, R. 2006, *ApJ*, 641, 389
- J. T. Rayner, A. Tokunaga, D. Jaffe, M. Bonnet, G. Ching, M. Connelley, D. Kokubun, C. Lockhart, & E. Warmbier. 2016, SPIE, 9908E, 84R
- Reffert, S., Bergmann, C., Quirrenbach, A., Trifonov, T., Künstler, A. 2015, *A&A*, 574, A116
- Richter, M. J., Ennico, K. A., McKelvey, M. E., & Seifahrt, A. 2010, in Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series, Vol. 7735
- Richter, M. et al. 2018, *Journal of Astronomical Instrumentation*, 7,4
- Rothman, L. S., Gordon, I. E., Babikov, Y., et al. 2013, *J. Quant. Spec. Radiat. Transf.*, 130, 4
- Rygl K. L. J. et al. 2012, *A&A*, 539, 79
- Sakamoto, K., Okumura, S. K., Ishizuki, S., Scoville, N. Z. 1999, *ApJS*, 124, 403
- Salyk, C., Blake, G. A., Boogert, A. C. A., & Brown, J. M. 2009, *ApJ*, 699, 330
- Salyk, C., Pontoppidan, K. M., Blake, G. A., et al. 2011, *ApJ*, 731, 130
- Sandell, G., Wright, M., Forster, J. R. 2003, *ApJ*, 590 L45
- Sanna, A., Reid, M. J., Carrasco-González, C., et al. 2012, *ApJ*, 745, 191
- Schneider, N., Csengeri, T., Hennemann, M., et al. 2012, *A&A*, 540, L11
- Schlake, P., Groesbeck, T. D., Blake, G. A., & Phillips, T. G. 1997, *ApJS*, 108, 301
- Schwarz, K. R., & Bergin, E. A. 2014, *ApJ*, 797, 113
- Scoville, N., Klienmann, S. G., Hall, D. N. B., & Ridgway, S. T. 1983, *ApJ*, 275, 201
- Segura-Cox, D. M., Schmiedeke, A., Pineda, J. E., et al. 2020, *Nature*, 586, 228
- Setterholm, B. R., Monnier, J. D., Davies, C. L., Kreplin, A., et al. 2019, *ApJ*, 869, 164
- Shakura, N. I., & Sunyaev, R. A. 1973, *A&A*, 24, 337
- Sheehan, P. D., Tobin, J. J., Federman, S., et al. 2020, *ApJ*, 902, 141
- Shepherd, D. S., Churchwell, E. 1996a, *ApJ*. 472, 225
- Shepherd, D. S., Churchwell, E. 1996b, *ApJ*, 457, 267
- Shu, F. H. 1977, *ApJ*, 214, 488
- Shu, F. H., Adams, F. C., & Lizano, S. 1987, *ARA&A*, 25, 23
- Šimečková, M., Jacquemart, D., Rothman, L. S., et al. 2006, *Journal of Quantitative Spectroscopy & Radiative Transfer* 98, 130
- Smith, R. G. 1991, *MNRAS*, 249, 172
- Smith, M. D. 1993, *ApJ*, 406, 520
- Smith, R. L., Gudipati, M. S., Boogert, A. C. A., & Blake, G. A. 2020, *Lunar and Planetary*

- Science Conference, 1239
- Sollins P. K., Zhang Q., Keto E., and Ho P. T. P. 2005, 631, 399
- Spoon H. W. W., Farrah D., Lebouteiller V., González-Alfonso E., et al. 2013, ApJ, 775, 127
- Stahler, S. W., & Palla, F. 2005, *The Formation of Stars*, John Wiley & Sons, Ltd, 865
- Tamura, M., & Yamashita, T. 1992, ApJ, 391, 710
- Tan, J. C. 2008, *Massive Star Formation: Observations Confront Theory*, eds. Beuther, Linz, & Henning, ASP, Vol. 387
- Tan, J. C. 2017, Astrochemistry VII, Proceedings IAU Symposium No. 322
- Tan, J. C., & McKee, C. F. 2003, IAU Symp. 221, *Star Formation at High Angular Resolution*, eds. Burton, Jayawardhana, & Bourke, ASP, 221 (astro-ph/0309139)
- Tanaka, K. E. I., Tan, J. C., & Zhang, Y. 2016, ApJ, 8181, 52
- Tanaka, K. E. E., Tan, J. C., Staff, J. E., & Zhang, Y. 2017, ApJ, 849, 133
- Tercero, B., Cernicharo, J., Pardo, & J. R., Goioechea, J. R. 2010, A&A, 517, A96
- Tieftrunk, A., Pineau Des Forets, G., Schilke, P., et al. 1994, A&A, 289, 579
- Tielens, A. G. G. M., & Hollenbach, D. 1985, ApJ, 291, 722
- Tielens, A. G. G. M. 2005, *The Physics and Chemistry of the Interstellar Medium* (Cambridge University Press)
- Tielens, A.G .G .M. 2021, *Molecular Astrophysics*, (1st Edition; Cambridge University Press pg 132
- Timmermann, R. 1998, ApJ, 498, 246
- Theulé, P., Duvernay, F., Danger, G., et al. 2013. Adv. Space Res, 52, 1567
- Torrelles, J. M., Trinidad, M. A., Curiel, S., et al. 2014, MNRAS, 437, 3803
- Trinidad, M. A., Curiel, S., Cantó, J., et al. 2003, ApJ, 589, 386
- Turner, B. E., Chan, K., Green, S., & Lubowich, D. A. 1992, ApJ, 399, 114
- Turner, N., Fromang, S., Gammie, C., Klahr, H., et al. 2014, Protostars Planets VI, 411
- Urquhart, J. S., Hoare, M. G., Lumsden, S. L., et al. 2012, MNRAS, 420, 1656
- Urquhart, J. S., Figura, C. C., Moore, T. J. T., et al. 2014, MNRAS, 437, 1791
- van der Tak, F. F S., van Dishoeck, E. F., Evans, N. J., & Bakker, E. J. 1999, ApJ, 522, 991
- van der Tak, F. F. S., & van Dishoeck, E. F. 2000, A&A, 358, L79
- van der Tak, F. F. S. 2003, *Star Formation at High Angular Resolution* ASP Conference Series, ed. Jayawardhana, R., Burton, M. G., & Bourke, T. L, 221
- van der Tak, F. F. S., Walmsley, C. M., Herpin, F., & Ceccarelli, C. 2006, A&A, 447, 1011
- van der Tak, F. F. S., Boonman A. M. S., Braakman, R., & van Dishoeck, E. F. 2003, A&A, 412, 133
- van der Tak, F. F. .S., & Menten, K. M. 2005, A&A, 437, 947
- van der Tak, F. F. S., Chavarria, L., Herpin, F., et al. 2013, A&A, 554, A83
- van Dishoeck, E. F., & Black, J., H. 1988, ApJ, 334, 771
- van Dishoeck, E. F. 1998, in *Chemistry and Physics of Molecules and Grains in Space*, Faraday Discussions, 109, 31
- van Dishoeck, E. F., & Blake, G. A. 1998, ARA&A, 36, 317
- van Dishoeck, E. F., & Helmich, F. P. 1996, A&A, 315, L177
- van Dishoeck, E. F., Herbst, E., & Neufeld, D. 2013, Chem. Rev., 113, 9043
- van Dishoeck, E. F., Kristensen, L. E., Mottram, J. C., et al. 2021, A&A, 648, A24
- Veras, D., Tremblay, P. E., Hermes, J. J., McDonald, C. H., et al. 2020, MNRAS, 493, 765
- Villanueva, G. L., Smith, M. D., Protopapa, S., Faggi, S., & Mandell, A. M. 2018, J. Quant. Spec. Radiat. Transf., 217, 86

- Visser, R., van Dishoeck, E. F., Doty, S. D. & Dullemond, C. P. 2009, A&A, 495, 881
- Viti, S., Collings, M. P., Dever, J. W., McCoustra, M. R. S., & Williams, D. A. 2004, MNRAS, 354, 1141
- Vogel, S. N., Kulkarni, S. R., Scoville, N. Z. 1988, Nature, 334, 402
- Walsh, C., Millar, T. J., & Nomura, H. 2010, ApJ, 722, 1607
- Walsh, C., Nomura, H., & van Dishoeck, E. F. 2015, A&A, 582, A88
- Walsh, C., Loomis, R. A., Öberg, K. I., et al. 2016, ApJ, 823, L10
- Wang, K. S., van der Tak, F. F. .S., & Hogerheijde, M. R. 2012, A&A, 543 A22
- Willacy, K., & Woods, P. M. 2009, ApJ, 703, 479
- Williams, J. P., & Cieza, L. A. 2011, ARA&A, 49, 67
- Wilson, T. L., & Rood, R. T. 1994, ARA&A, 32, 191
- Wolfire, M. G., & Cassinelli, J. P. 1986, ApJ, 310, 207
- Wright, C. M., van Dishoeck, E. F., Black, J. H., et al. 2000, A&A, 358, 689
- Wu, Y., Zhang, Q., Chen, H., et al. 2005, AJ, 129, 330
- Yang, B. ., Stancil, P. C., Balakrishnan, N., & Forrey, R. C. 2010, ApJ, 718, 1062
- Yao, Y., Hirata, N., Ishii, M., et al. 1997, ApJ, 490, 281
- Yorke, H. W., & Bodenheimer, P. 1999, ApJ, 525, 330
- Yorke, H. W., & Sonnhalter, C. 2002, ApJ, 569, 846
- Young, E. T., Becklin, E. E., Marcum, P. M., et al. 2012, ApJ, 749, L17
- Zapata, L. A., Garay, G., Palau, A. 2019, ApJ, 872, 176
- Zinnecker, H., & Yorke H. W. 2007, ARA&A, 45, 481