Proseminar: Astrophysik, Sommersemester 2026

Infos: Robi Banerjee, Hamburger Sternwarte, banerjee@hs.uni-hamburg.de
`hsweb.hs.uni-hamburg.de/projects/star-formation`

- **Vorbesprechung am Dienstag, 14. April, 13:15 Uhr, Jungiusstraße, Hörsaal INF**
- **Blockseminar:** Termine werden in der Vorbesprechung vereinbart.
- Ort: Hamburger Sternwarte, *Sonnenbau*
- Vortrag: 20 Minuten, Vortragsfolien werden als Zusammenfassung/Ausarbeitung gewertet
- + 10 Minuten Diskussion und Nachbesprechung
- Freie Themenauswahl nach Absprache; Vorschläge siehe nächste Seiten
- Vortrag kann auf Deutsch oder Englisch gehalten werden
- Vortragsbesprechung bis 7 Tage vor dem Termin möglich; Terminvereinbarung mindestens 7 Tage vorher
- Lehrbücher
  - Weigert, Wendker & Wisotzki, *Astonomie und Astrophysik*, 2009
  - Unsöld & Baschek, *Der Neue Kosmos*, 2006
  - Shu, *The Physics of Astrophysics, II*, 1992
  - Schulz, *The Formation and Early Evolution of Stars*, 2012
  - Bodenheimer, *Principles of Star Formation*, 2011
  - Ward-Thompson & Whitworth, *An Introduction to Star Formation*, 2011
  - Stahler & Palla, *The Formation of Stars*, 2004
  - Bally & Reipurth, *The Birth of Stars and Planets*, 2006
  - Larson, *The physics of star formation*, Report 2003
  - Armitage, *Astrophysics of Planet Formation*, 2010
  - Klahr & Brandner (Eds.), *Planet Formation*, 2011
  - Binney & Tremaine, *Galactic Dynamics*, 2008
  - Kolb & Turner, *The Early Universe*, 2005
  - Liddle, *Einführung in die moderne Kosmologie*, 2009
  - P. Schneider, *Extragalaktische Astronomie und Kosmologie*, 2007
  - S. Weinberg, *Cosmology*, 2008

- Die Themen sind nach **Absprache** frei wählbar. Themen*vorschläge:*
  - **Instellare Medium (ISM): Zusammensetzung, Dynamik, Geschichtliches** (Weigert et al., 2009; Breitschwerdt, 1998)
  - **Molekülwolken und Turbulenz** (Ballesteros-Paredes et al., 2007; Ballesteros-Paredes, 2004; Blitz et al., 2007)
  - **Enstehung massereicher Sterne** (Zinnecker & Yorke, 2007; Beuther et al., 2007; McKee & Ostriker, 2007)
  - **Suche nach extrasolaren Planeten, Methoden & Techniken** (Dvorak, 2007; Ollivier et al., 2009; Seager, 2011)
  - **Entstehung von Planeten** (Armitage, 2010; Klahr & Brandner, 2011)
  - **Moderne Teleskope und deren Ziele: z.B. ALMA, PLANCK, GAIA, eROSITA, SKA, E-ELT, JWST, TESS, PLATO, EUCLID**
  - **Entstehung der ersten Sterne** (auch einzelne Aspekte, z.B. chemische und thermodynamische Entwicklung, SN-feedback) (Bromm et al., 2009; Abel et al., 2002; Glover, 2005; Greif, 2014)
  - **Kosmische Hintergrundstrahlung (CMBR): Entstehung, Fluktuationen** (Weinberg, 2008; Kolb & Turner, 1994; Schneider, 2006; Durrer, 2008)
  - **Entstehung der ersten Elemente: Big-Bang-Nukleosynthese** (Weinberg, 2008; Kolb & Turner, 1994)
  - **Supernovae–Dunkle-Energie Projekte** (The Supernova Cosmology Project, High-Z SN search Team: Perlmutter, 2003; Perlmutter & Schmidt, 2003; Perlmutter, 2005; Riess, 2000)
  - **Erkenntnisse von** *Dark Energy Spectroscopic Instrument* **(DESI)** (DESI Collaboration, 2024; DESI Collaboration, 2024)
  - **Inter-/Extragalaktische Magnetfelder**(Neronov & Semikoz, 2009; Neronov & Vovk, 2010; Tavecchio et al., 2010; Taylor et al., 2011)
  - **Ergebnisse der GAIA Mission** (z.B. Lindegren et al., 2016; Gaia Collaboration et al., 2016)
  - **Event Horizon Telescope (EHT): Beobachtung Schwarzer Löcher** (EHT Web page, 2022; Event Horizon Telescope Collaboration, 2019, 2022)
  - **Direkter Nachweis von Gravitationswellen** (Abbott et al., 2016a,b; Sathyaprakash & Schutz, 2009)
  - **Gravitationswellen Teleskope: LIGO, eLISA, Einstein Teleskop**
  - **Pulsar Timing Arrays: Gravitationswellen im nano-Hertz Bereich** (Mingarelli et al., 2026)
  - **Gammblitze, *Gamma Ray Bursts*** (Janka, 2011; Janka et al., 2011)
  - **Fast Radio Bursts** (z.B. Keane, 2018; Pen, 2018; Platts et al., 2018)
  - **Astroseismologie** (Aerts et al., 2010; Di Mauro, 2017)

References

Abbott, B. P., Abbott, R., Abbott, T. D., Abernathy, M. R., Acernese, F., Ackley, K., Adams, C., Adams, T., Addesso, P., Adhikari, R. X., & et al., Observation of Gravitational Waves from a Binary Black Hole Merger. 2016a, Physical Review Letters, 116, 061102

—, Tests of General Relativity with GW150914. 2016b, Physical Review Letters, 116, 221101

Abel, T., Bryan, G. L., & Norman, M. L., The Formation of the First Star in the Universe. 2002, Science, 295, 93

Aerts, C., Christensen-Dalsgaard, J., & Kurtz, D. W. 2010, Asteroseismology

Armitage, P. J. 2010, Astrophysics of Planet Formation (Cambridge University Press, 2010.)

Ballesteros-Paredes, J., Turbulent Fragmentation and Star Formation. 2004, Ap&SS, 292, 193

Ballesteros-Paredes, J., Klessen, R. S., Mac Low, M.-M., & Vazquez-Semadeni, E., Molecular Cloud Turbulence and Star Formation. 2007, in Protostars and Planets V, ed. B. Reipurth, D. Jewitt, & K. Keil, 63–80

Beuther, H., Churchwell, E. B., McKee, C. F., & Tan, J. C., The Formation of Massive Stars. 2007, in Protostars and Planets V, ed. B. Reipurth, D. Jewitt, & K. Keil, 165–180

Blitz, L., Fukui, Y., Kawamura, A., Leroy, A., Mizuno, N., & Rosolowsky, E., Giant Molecular Clouds in Local Group Galaxies. 2007, Protostars and Planets V, 81

Breitschwerdt, D., Introductory Lecture: The Local and General Interstellar Medium. 1998, in Lecture Notes in Physics, Berlin Springer Verlag, Vol. 506, IAU Colloq. 166: The Local Bubble and Beyond, ed. D. Breitschwerdt, M. J. Freyberg, & J. Truemper, 5–16

Bromm, V., Yoshida, N., Hernquist, L., & McKee, C. F., The formation of the first stars and galaxies. 2009, Nature, 459, 49

DESI Collaboration, Dark Energy Spectroscopic Instrument. 2024, https://newscenter.lbl.gov/2024/04/04/desi-first-results-make-most-precise-measurement-of-expanding-universe

DESI Collaboration, DESI 2024 VI: Cosmological Constraints from the Measurements of Baryon Acoustic Oscillations. 2024, arXiv e-prints, arXiv:2404.03002

Di Mauro, M. P., A review on Asteroseismology. 2017, ArXiv e-prints

Durrer, R. 2008, The Cosmic Microwave Background (Cambridge Catalogue)

Dvorak, R. 2007, Extrasolar Planets. Formation, Detection and Dynamics (Wiley-VCH, 2007)

EHT Web page, Event Horizon Telescope. 2022, https://eventhorizontelescope.org

Event Horizon Telescope Collaboration, First M87 Event Horizon Telescope Results. I. The Shadow of the Supermassive Black Hole. 2019, ApJ, 875, L1

—, First Sagittarius A* Event Horizon Telescope Results. I. The Shadow of the Supermassive Black Hole in the Center of the Milky Way. 2022, ApJ, 930, L12

Gaia Collaboration, Brown, A. G. A., Vallenari, A., Prusti, T., de Bruijne, J. H. J., Mignard, F., Drimmel, R., Babusiaux, C., Bailer-Jones, C. A. L., Bastian, U., & et al., Gaia Data Release 1. Summary of the astrometric, photometric, and survey properties. 2016, A&A, 595, A2

Glover, S., The Formation Of The First Stars In The Universe. 2005, Space Sci. Rev., 117, 445

Greif, T. H., The numerical frontier of the high-redshift Universe. 2014

Janka, H.-T. 2011, Supernovae und kosmische Gammablitze: Ursachen und Folgen von Sternexplosionen (Spektrum Akademischer Verlag; Auflage: 2011 (11. Januar 2011))

Janka, H.-T., Klose, S., & Röpke, F., Supernovae und kosmische Gammablitze. 2011, Sterne und Weltraum, März+April, 30,44

Keane, E. F., The future of fast radio burst science. 2018, Nature Astronomy, 2, 865

Klahr, H. & Brandner, W. 2011, Planet Formation (Cambridge University Press, 2011)

Kolb, E. W. & Turner, M. S. 1994, The early universe. (Addison-Wesley Publishing Company)

Lindegren, L., Lammers, U., Bastian, U., Hernández, J., Klioner, S., Hobbs, D., Bombrun, A., Michalik, D., Ramos-Lerate, M., Butkevich, A., Comoretto, G., Joliet, E., Holl, B., Hutton, A., Parsons, P., Steidelmüller, H., Abbas, U., Altmann, M., Andrei, A., Anton, S., Bach, N., Barache, C., Becciani, U., Berthier, J., Bianchi, L., Biermann, M., Bouquillon, S., Bourda, G., Brüsemeister, T., Bucciarelli, B., Busonero, D., Carlucci, T., Castañeda, J., Charlot, P., Clotet, M., Crosta, M., Davidson, M., de Felice, F., Drimmel, R., Fabricius, C., Fienga, A., Figueras, F., Fraile, E., Gai, M., Garralda, N., Geyer, R., González-Vidal, J. J., Guerra, R., Hambly, N. C., Hauser, M., Jordan, S., Lattanzi, M. G., Lenhardt, H., Liao, S., Löffler, W., McMillan, P. J., Mignard, F., Mora, A., Morbidelli, R., Portell, J., Riva, A., Sarasso, M., Serraller, I., Siddiqui, H., Smart, R., Spagna, A., Stampa, U., Steele, I., Taris, F., Torra, J., van Reeven, W., Vecchiato, A., Zschocke, S., de Bruijne, J., Gracia, G., Raison, F., Lister, T., Marchant, J., Messineo, R., Soffel, M., Osorio, J., de Torres, A., & O'Mullane, W., Gaia Data Release 1. Astrometry: one billion positions, two million proper motions and parallaxes. 2016, A&A, 595, A4

McKee, C. F. & Ostriker, E. C., Theory of Star Formation. 2007, ARA&A, 45, 565

Mingarelli, C. M. F., Casey-Clyde, J. A., Chang, Y. T., Eisenberg, E., Hutchison, F., Khusid, N., Larsen, B., Moran, A., Semenzato, F., Willson, L., & Zheng, Q., Pulsar timing arrays: the emerging gravitational-wave landscape. 2026, https://arxiv.org/abs/2603.13643

Neronov, A. & Semikoz, D. V., Sensitivity of γ-ray telescopes for detection of magnetic fields in the intergalactic medium. 2009, Phys. Rev. D, 80, 123012

Neronov, A. & Vovk, I., Evidence for Strong Extragalactic Magnetic Fields from Fermi Observations of TeV Blazars. 2010, Science, 328, 73

Ollivier, M., Roques, F., Casoli, F., Encrenaz, T., & Selsis, F. 2009, Planetary Systems (Astronomy And Astrophysics Library. ISBN 978-3-540-75747-4. Springer Berlin Heidelberg, 2009)

Pen, U.-L., The nature of fast radio bursts. 2018, Nature Astronomy, 2, 842

Perlmutter, S., Supernovae, Dark Energy, and the Accelerating Universe. 2003, Physics Today, 56, 040000

—, Studying Dark Energy with Supernovae: Now, Soon, and the Not-Too-Distant Future. 2005, Physica Scripta Volume T, 117, 17

Perlmutter, S. & Schmidt, B. P., Measuring Cosmology with Supernovae. 2003, in Lecture Notes in Physics, Berlin Springer Verlag, Vol. 598, Supernovae and Gamma-Ray Bursters, ed. K. Weiler, 195–217

Platts, E., Weltman, A., Walters, A., Tendulkar, S. P., Gordin, J. E. B., & Kandhai, S., A Living Theory Catalogue for Fast Radio Bursts. 2018, arXiv e-prints

Riess, A. G., The Case for an Accelerating Universe from Supernovae. 2000, PASP, 112, 1284

Sathyaprakash, B. S. & Schutz, B. F., Physics, Astrophysics and Cosmology with Gravitational Waves. 2009, Living Reviews in Relativity, 12, 2

Schneider, P. 2006, Einführung in die extragalaktische Astronomie und Kosmologie (Berlin: Springer)

Seager, S. 2011, Exoplanets (University of Arizona Press, 2011, 526 pp. ISBN 978-0-8165-2945-2.)

Tavecchio, F., Ghisellini, G., Foschini, L., Bonnoli, G., Ghirlanda, G., & Coppi, P., The intergalactic magnetic field constrained by Fermi/Large Area Telescope observations of the TeV blazar 1ES0229+200. 2010, MNRAS, 406, L70

Taylor, A. M., Vovk, I., & Neronov, A., Extragalactic magnetic fields constraints from simultaneous GeV-TeV observations of blazars. 2011, A&A, 529, A144+

Weigert, A., Wendker, H. J., & Wisotzki, L. 2009, Astronomie und Astrophysik (Wiley-VCH 2009)

Weinberg, S. 2008, Cosmology (Oxford University Press)

Zinnecker, H. & Yorke, H. W., Toward Understanding Massive Star Formation. 2007, ARA&A, 45, 481