Gemma Cheng

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Introduction

I am a final-year astronomy PhD student at the University of Hertfordshire, embarking on a project entitled "the exoplanet brown dwarf connection - ultracool companions to *Gaia* stars". I have also worked with the GUCDS team, using IRTF SpeX spectra to classify the spectral types and determine characteristics of and ultracool dwarfs. My research is centred around brown dwarfs: both the discovery of and characterising of some of the coolest objects in space.

Research Projects

- **The *Gaia* Ultracool Dwarf Sample**
  Surveys & Instruments: Gaia, IRTF SpeX, Blanco ARCoIRIS
  Published in: Cheng et al., 2025, MNRAS, 538, 4, 3144
  - Obtained spectra of 51 ultracool dwarfs using IRTF SpeX and Blanco ARCoIRIS
  - Reduced the spectral data to extract spectra from observation images
  - Classified spectroscopic spectral types of each ultracool dwarf
  - Determined key characteristics of objects in the sample (e.g. radial velocity, youth, binarity
- **T-Dwarf Companions to *Gaia*-Detected Primaries**
  Surveys & Instruments: VHS, DES, Gaia, CatWISE2020, CTiO FourStar, CTiO FIRE
  - Find candidate T-dwarfs using VHS and DES data
  - Identify candidates close in space to *Gaia*-detected stars and with common proper motions
  - Spectroscopically confirm spectral types of candidates with FIRE spectra
  - Derive properties of T-dwarfs from their primaries by assuming co-evolution
- **Y-Dwarfs From Deep WISE Shift-and-Stack Images**
  Surveys & Instruments: WISE
  - Create deep stacked images from WISE data, shifting to account for stellar proper motions
  - Identify sources which have common proper motions with WISE stars
  - Source identification at low signal-to-noise thresholds
  - Select Y-dwarf candidates to further investigate with photometric criteria (i.e. colour and magnitude cuts)
- **Halo T-Dwarf Candidates in VHS and DES**
  Surveys & Instruments: VHS, DES, CTiO FIRE
  - Developed a novel method to identify high proper motion objects in deep DES *z*-band stacks
  - Use colour and magnitude cuts to find candidate T-dwarfs: 30 candidates, including 10 halo
  - Follow up by obtaining FIRE spectra of the candidates to confirm spectral type classifications
  - Use kinematics to confirm ages and origins of candidates

Publications and Conferences

- **Cheng, G.** (2024). *Finding T-Dwarf Companions to* Gaia *Primary Stars.* The 22nd Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun, 24–28 June 2024, San Diego. DOI: 10.5281/zenodo.13120981.
- Baig, S., Smart, R.L., Jones, H.R.A., Gagné, J., Pinfield, D.J., **Cheng, G.**, Moranta, L. (2024). 'The *Gaia* ultracool dwarf sample – V: the ultracool dwarf companion catalogue', MNRAS, 533(4), pp. 3784–3810. DOI: 10.1093/mnras/stae2005.
- **Cheng, G.**, Jones, H.R.A, Smart, R.L., Marocco, F., Cooper, W.J., Burgasser, A., Beamin, J.C., Pinfield, D.J., Gagné, J., Moranta, L. (2025), 'The *Gaia* ultracool dwarf sample – VI. Spectral types and properties of 51 ultracool dwarfs', MNRAS, 538(4), pp. 3144–3176. DOI: 10.1093/mnras/staf432.

- Baig, S., Smart, R.L., Jones, H.R.A., Pinna, E., Sozzetti, A., **Cheng, G.**, Cusano, F., Rossi, F., Plantet, C., Agapito, G. (2025). 'J1250+0455AB an ultracool binary in a hierarchical triple system', MNRAS, 542(1), pp. 310–321. DOI: 10.1093/mnras/staf1234.
- Zhang, Z.H., Navarete, F., Gálvez-Ortiz, M.C., Jones, H.R.A., Burgasser, A.J., Cruz, P., Marocco, F., Lodieu, N., Shan, Y., Gauza, B., Raddi, R., Huang, M.R., Smart, R.L., Baig, S., **Cheng, G.**, Pinfield, D.J. (2025). 'Benchmark brown dwarfs – I. A blue M2 + T5 wide binary and a probable young [M4 + M4] + [T7 + T8] hierarchical quadruple', MNRAS, 542(2), pp. 656–668. DOI: 10.1093/mnras/staf895.
- **Cheng, G.**, Pinfield, D.J., Kurtev, R., Guo, Z. (in prep). '10 New T-Dwarf Wide Companions to *Gaia*-Detected Primary Stars', *to be submitted to MNRAS*.

Skills

- **Research Skills:** *Near-infrared observations, Data reduction, Spectral analysis*
- **Specialized Areas:** *Brown dwarfs, Ultracool dwarfs*
- **Data Analysis:** *Spectral type classification, Near-infrared spectral analysis, Astrometry*
- **Data Reduction:** *IRTF SpeX (prism and SXD), Blanco ARCoIRIS, Magellan FIRE (prism), Magellan FourStar*
- **Programming Languages:** *Python, LaTeX, IDL basics, HTML basics*
- **Languages:** *English (Native), German (Limited working proficiency), Chinese (Mandarin, Elementary)*
- **Other Skills:** *Time management, Resilience, Teamwork, Organisation*

Employment History

- **Visiting Lecturer** — *Hatfield, UK*
  University of Hertfordshire — 2022 – present
  - ◦ Marking of undergraduate lab reports and exams
  - ◦ Assessing Masters-level data science assignments
  - ◦ Teaching observation-based astronomy practicals at Bayfordbury Observatory

Education

- **University of Hertfordshire** — *Hatfield, UK*
  PhD Astronomy — 2022 – present
  ***MPhys (Hons) Astrophysics**: First class honours* — 2017 – 2022
- **Oklahoma State University** — *Stillwater, USA*
  ***Study Abroad Year**: 3.8 GPA* — 2019 – 2020
- **Sir Henry Floyd Grammar School** — *Aylesbury, UK*
  ***International Baccalaureate Diploma**: 37 points* — 2015 – 2017
  ***GCSE**: 12 A*–B, including mathematics and English* — 2013 – 2015

Honors and Awards

- **Gold Go Herts Award**
  ***University of Hertfordshire**: For outstanding engagement in extracurricular and personal development activities* — 2022
- **Dean's Honor Roll**
  ***Oklahoma State University**: For having a GPA of 3.50 or higher with no grade below a C* — 2020

Professional Memberships

- **Royal Astronomical Society** *Membership ID: 11256* — 2022 – present
- **European Astronomical Society** *Membership ID: 6680* — 2023 – present