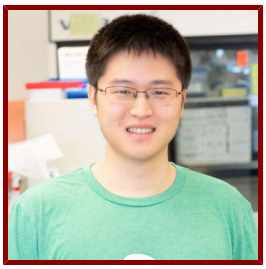
Stanford



Alex Gao

Assistant Professor of Biochemistry and of Microbiology and Immunology

Bio

ACADEMIC APPOINTMENTS

- Assistant Professor, Biochemistry
- Assistant Professor, Microbiology and Immunology
- Member, Bio-X

HONORS AND AWARDS

- Esther Ehrman Lazard Faculty Scholar, Stanford University

PROFESSIONAL EDUCATION

- Junior Fellow, Harvard Society of Fellows (2022)
- PhD, Massachusetts Institute of Technology , Biological Engineering (2020)
- MS, Stanford University , Electrical Engineering (2014)
- BS, Stanford University , Chemistry (2013)

LINKS

- Gao Lab: http://gaolab.bio

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

We integrate computational genome mining with high-throughput experimental approaches and structural biology to harness the rich diversity of genes from microbes, with the goal of developing new antibiotic strategies and molecular biotechnology. A major area of current interest is uncovering novel molecular functions involved in anti-phage defense and bacteria–phage interactions, which are a major driver of molecular innovation in nature.

Teaching

COURSES

2026-27

- Foundations of Medicine I: INDE 243 (Aut)
- Molecular, Cellular, and Genetic Medicine: BIOC 205, GENE 202 (Aut)

2025-26

- Molecular, Cellular, and Genetic Medicine: BIOC 205, GENE 202 (Aut)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Angel Madero Rincon

Postdoctoral Faculty Sponsor

Pujuan Deng, Hyunbin Lee

Doctoral Dissertation Advisor (AC)

Hannah Barsouk, Simone Evans, Yu Tin Lin, Sofia Luengo-Woods

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biochemistry (PhD Program)
- Biophysics (PhD Program)
- Microbiology and Immunology (PhD Program)

Publications

PUBLICATIONS

- **Phage terminase recognition by the bacterial immune sensors Avs2 and Upx.** *Nature communications*
  Evans, S. A., Chiu, C., Wilkinson, M. E., Li, D. B., Biswal, M., Strecker, J., Pleiner, T., Zhang, F., Gao, A.
  2026; 17 (1)
- **Diverse bacterial pattern recognition receptors sense the core phage proteome.** *Nature*
  Lee, H., Luengo-Woods, S., Zhang, J., Makarova, K. S., Wolf, Y. I., Chiu, C., Evans, S. A., Chen, J., Xiao, H., Feng, L., Koonin, E. V., Gao, A.
  2026
- **Protein-templated synthesis of dinucleotide repeat DNA by an antiphage reverse transcriptase.** *Science (New York, N.Y.)*
  Deng, P., Lee, H., Armijo, C., Wang, H., Gao, A.
  2026: eaed1656
- **Naturally ornate RNA-only complexes revealed by cryo-EM.** *Nature*
  Kretsch, R. C., Wu, Y., Shabalina, S. A., Lee, H., Nye, G., Koonin, E. V., Gao, A., Chiu, W., Das, R.
  2025
- **Phage-triggered reverse transcription assembles a toxic repetitive gene from a noncoding RNA.** *Science (New York, N.Y.)*
  Wilkinson, M. E., Li, D., Gao, A., Macrae, R. K., Zhang, F.
  2024: eadq3977
- **Prokaryotic innate immunity through pattern recognition of conserved viral proteins** *SCIENCE*
  Gao, L., Wilkinson, M. E., Strecker, J., Makarova, K. S., Macrae, R. K., Koonin, E., Zhang, F.
  2022; 377 (6607): 726-+
- **UG/Abi: a highly diverse family of prokaryotic reverse transcriptases associated with defense functions** *NUCLEIC ACIDS RESEARCH*
  Rodriguez Mestre, M., Alex Gao, L., Shah, S. A., Lopez-Beltran, A., Gonzalez-Delgado, A., Martinez-Abarca, F., Iranzo, J., Redrejo-Rodriguez, M., Zhang, F., Toro, N.
  2022; 50 (11): 6084-6101
- **A highly homogeneous polymer composed of tetrahedron-like monomers for high-isotropy expansion microscopy** *NATURE NANOTECHNOLOGY*
  Gao, R., Yu, C., Gao, L., Piatkevich, K. D., Neve, R. L., Munro, J. B., Upadhyayula, S., Boyden, E. S.
  2021; 16 (6): 698-+
- **Diverse enzymatic activities mediate antiviral immunity in prokaryotes** *SCIENCE*
  Gao, L., Altae-Tran, H., Bohning, F., Makarova, K. S., Segel, M., Schmid-Burgk, J. L., Koob, J., Wolf, Y. I., Koonin, E. V., Zhang, F.

2020; 369 (6507): 1077-+

- **Highly Parallel Profiling of Cas9 Variant Specificity** *MOLECULAR CELL*
  Schmid-Burgk, J. L., Gao, L., Li, D., Gardner, Z., Strecker, J., Lash, B., Zhang, F.
  2020; 78 (4): 794-+
- **Computational identification of repeat-containing proteins and systems** *QRB DISCOVERY*
  Altae-Tran, H., Gao, L., Strecker, J., Macrae, R. K., Zhang, F.
  2020; 1: e10
- **Unexpected connections between type VI-B CRISPR-Cas systems, bacterial natural competence, ubiquitin signaling network and DNA modification through a distinct family of membrane proteins** *FEMS MICROBIOLOGY LETTERS*
  Makarova, K. S., Gao, L., Zhang, F., Koonin, E.
  2019; 366 (8)
- **Engineering of CRISPR-Cas12b for human genome editing** *NATURE COMMUNICATIONS*
  Strecker, J., Jones, S., Koopal, B., Schmid-Burgk, J., Zetsche, B., Gao, L., Makarova, K. S., Koonin, E. V., Zhang, F.
  2019; 10: 212
- **Engineered CRISPR-Cas9 nuclease with expanded targeting space** *SCIENCE*
  Nishimasu, H., Shi, X., Ishiguro, S., Gao, L., Hirano, S., Okazaki, S., Noda, T., Abudayyeh, O. O., Gootenberg, J. S., Mori, H., Oura, S., Holmes, B., Tanaka, et al
  2018; 361 (6408): 1259-1262
- **Effects of 3D culturing conditions on the transcriptomic profile of stem-cell-derived neurons** *NATURE BIOMEDICAL ENGINEERING*
  Tekin, H., Simmons, S., Cummings, B., Gao, L., Adiconis, X., Hession, C. C., Ghoshal, A., Dionne, D., Choudhury, S. R., Yesilyurt, V., Sanjana, N. E., Shi, X., Lu, et al
  2018; 2 (7): 540-554
- **Engineered Cpf1 variants with altered PAM specificities** *NATURE BIOTECHNOLOGY*
  Gao, L., Cox, D. B. T., Yan, W. X., Manteiga, J. C., Schneider, M. W., Yamano, T., Nishimasu, H., Nureki, O., Crosetto, N., Zhang, F.
  2017; 35 (8): 789-792
- **Structural Basis for the Altered PAM Recognition by Engineered CRISPR-Cpf1** *MOLECULAR CELL*
  Nishimasu, H., Yamano, T., Gao, L., Zhang, F., Ishitani, R., Nureki, O.
  2017; 67 (1): 139-+
- **BLISS is a versatile and quantitative method for genome-wide profiling of DNA double-strand breaks** *NATURE COMMUNICATIONS*
  Yan, W. X., Mirzazadeh, R., Garnerone, S., Scott, D., Schneider, M. W., Kallas, T., Custodio, J., Wernersson, E., Li, Y., Gao, L., Federova, Y., Zetsche, B., Zhang, et al
  2017; 8: 15058
- **Protein-retention expansion microscopy of cells and tissues labeled using standard fluorescent proteins and antibodies** *NATURE BIOTECHNOLOGY*
  Tillberg, P. W., Chen, F., Piatkevich, K. D., Zhao, Y., Yu, C., English, B. P., Gao, L., Martorell, A., Suk, H., Yoshida, F., DeGennaro, E. M., Roossien, D. H., Gong, et al
  2016; 34 (9): 987-+
- **Rationally engineered Cas9 nucleases with improved specificity** *SCIENCE*
  Slaymaker, I. M., Gao, L., Zetsche, B., Scott, D. A., Yan, W. X., Zhang, F.
  2016; 351 (6268): 84-88