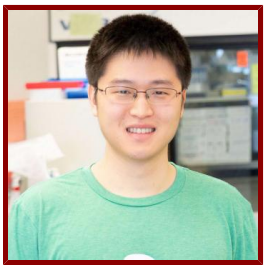
Stanford



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

2025-26

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

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Pujuan Deng, Hyunbin Lee

Doctoral Dissertation Advisor (AC)

Collin Chiu, 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

- **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