

**Tobias W. Giessen, PhD**  
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## Education

Postdoctoral Fellow	Systems and Synthetic Biology	Harvard Medical School and Wyss Institute for Biologically Inspired Engineering at Harvard	9/14-12/18
Research Fellow	Synthetic Microbiology	Philipps-University Marburg	9/13-8/14
PhD ( <i>summa cum laude</i> )	Biochemistry	Philipps-University Marburg	4/10-8/13
Diploma (equiv. to M.Sc.)	Chemistry	Philipps-University Marburg	6/07-3/10
Erasmus Exchange	Organic Chemistry	Imperial College London	9/08-3/09
Intermediate Diploma	Chemistry	Philipps-University Marburg	5/05-5/07

## Academic Appointments

Assistant Professor	Biological Chemistry	University of Michigan, Ann Arbor	7/19-
Assistant Professor	Biomedical Engineering	University of Michigan, Ann Arbor	1/19-

## Research Interests

- **Protein organelles:** Discovery of novel protein organelles; structure and function of protein organelles; encapsulins; bacterial microcompartments; evolution of protein assemblies; protein organelles in detoxification, stress resistance, nutrient utilization and pathogenesis; human microbiome
- **Synthetic Biology:** Engineered protein compartments; protein engineering; genetic circuits; cell-based theranostics; nanoreactors for biomanufacturing; bionanotechnology; drug delivery; nano- and biomaterials
- **Novel natural products and new enzymology:** Genome-mining of microbial genomes, gene cluster discovery; novel enzymatic transformations; antibiotics discovery

## Honors and Awards

Invited Member	Engineering Biology Research Consortium (ERCB)	7/19
Leopoldina Prize for Young Scientists	German National Academy of Sciences	9/17
Leopoldina Postdoctoral Scholarship	German National Academy of Sciences	6/14
DFG Postdoctoral Scholarship	German Research Foundation (DFG)	4/14
Erasmus Exchange Scholarship	European Union Erasmus Program	9/08
Elected Member	German National Merit Foundation	10/07

## Consulting Positions

Scientific Advisory Board Member	Rilas Technologies, Inc.	6/17-
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## Invited Presentations

University of Michigan, Micro Supergroup Seminar, Ann Arbor, USA	4/30/2019
Boston College, Biology Department, Seminar Series, Boston, USA	2/13/18
Harvard University, Wyss Institute for Biologically Inspired Engineering, Scientific Retreat, Boston, USA	11/17/2017
Technical University Munich, Institute for Advanced Study, Moessbauer Symposium, Munich, Germany	5/8/2017
Harvard Medical School, Department of Systems Biology, Seminar Series, Boston, USA	5/19/2017
Princeton University, Department of Geosciences, Moore MMI seminar, Princeton, USA	12/11/2016
Harvard University, Wyss Institute for Biologically Inspired Engineering, Synthetic Biology Platform Meeting, Boston, USA	10/4/2016
Harvard University, Wyss Institute for Biologically Inspired Engineering, Scientific Retreat, Boston, USA	11/14/2015
Peptide Meeting Kleinwalsertal, Hirschegg, Austria	8/5/2012
NRPS/PKS Meeting, Lake Tahoe, USA	8/2/2010

## Professional Memberships

American Society for Biochemistry and Molecular Biology (ASBMB)  
The Protein Society  
American Chemical Society (ACS)  
American Institute for Chemical Engineers (AIChE)

## Teaching and Mentoring

<b>Simmons College, Center for Excellence in Teaching, Boston, MA</b> Certificate course “Teaching Institute: Theory, Practice & Navigating STEM Higher Ed”	6/2017
<b>Harvard Medical School, Department of Systems Biology, Boston, MA</b> <i>Mentor/Supervisor:</i> Project supervisor for 8 students (2 undergraduate students and 6 graduate students)	2015-2018
<b>Philipps-University Marburg, Department of Chemistry, Marburg</b> <i>Mentor/Supervisor:</i> iGEM advisor for Team Marburg	2014
<i>Mentor/Supervisor:</i> Project supervisor for 8 rotation students (6 undergraduate students and 2 graduate students) in the context of the combined lecture/lab course “The Biochemistry of Energy Metabolism and Expression of Genetic Information” (15 133 00505) and the “Biochemistry Lab Course for Master Students” (15 133 00555)	2010-2014
<i>Lab Course:</i> Organized and taught the lab course “The Biochemistry of Energy Metabolism and Expression of Genetic Information” (15 133 00505)	2012-2013
<i>Lab Course:</i> Organized and taught the “Biochemistry Lab Course for Master Students” (15 133 00555)	2010-2013
<i>Seminar:</i> Organized and taught “Bioanalytics for Graduate Students” (15 133 00540)	2010-2013

## Bibliography

† corresponding author, \* contributed equally

### *Journal Articles:*

1. **Giessen, T. W.**†, Orlando, B. J., Verdegaal, A. A., Chambers, M. G., Gardener, J., Bell, D. C., Birrane, G., Liao, M.†, Silver, P. A.† Large protein organelles form a new iron sequestration system with high storage capacity, ***eLife*, 2019** (accepted).
2. Tscherner, M., **Giessen, T. W.**, Markey, L., Kumamoto, C. A., Silver, P. A.† A synthetic system that senses *Candida albicans* and inhibits virulence factors, ***ACS Synthetic Biology*, 2019**.
3. Lau, YH\*, **Giessen, T. W.**\*, Altenburg, W. J. and Silver, P. A.† Prokaryotic nanocompartments form synthetic organelles in a eukaryote, ***Nature Communications*, 2018**, 9, 1311.
4. Riglar, D. T., **Giessen, T. W.**, Baym, M., Kerns, S. J., Niederhuber, M. J., Bronson, R. T., Kotula, J. W., Gerber, G. K., Way, J. C. and Silver, P. A.† Long-term monitoring of inflammation in the mammalian gut using programmable commensal bacteria, ***Nature Biotechnology*, 2017**, 35, 653-658.
5. **Giessen, T. W.** and Silver, P. A.† Widespread distribution of encapsulin nanocompartments reveals functional diversity, ***Nature Microbiology*, 2017**, 2, 17029.

6. **Giessen, T. W.** and Silver, P. A.† Engineering carbon fixation with artificial protein organelles, ***Current Opinion in Biotechnology***, **2017**, *46*, 42-50.
7. Liu, X., Lopez, P. A., **Giessen, T. W.**, Giles, M., Way, J. C. and Silver, P. A.† Engineering genetically-encoded mineralization and magnetism via directed evolution, ***Scientific Reports***, **2016**, *6*, 38019.
8. **Giessen, T. W.** and Silver, P. A.† A catalytic nanoreactor based on in vivo encapsulation of multiple enzymes in an engineered protein nanocompartment, ***ChemBioChem***, **2016**, *17*, 1931-1935.
9. **Giessen, T. W.** and Silver, P. A.† Converting a natural protein compartment into a nanofactory for the size-constrained synthesis of antimicrobial silver nanoparticles, ***ACS Synthetic Biology***, **2016**, *5*, 1497–1504.
10. **Giessen, T. W.**† Encapsulins: microbial nanocompartments with applications in biomedicine, nanobiotechnology and materials science, ***Current Opinion in Chemical Biology***, **2016**, *34*, 1-10.
11. **Giessen, T. W.**† and Silver, P. A.† Encapsulation as a strategy for the design of biological compartmentalization, ***Journal of Molecular Biology***, **2015**, *428*, 916-927.
12. **Giessen, T. W.**† and Marahiel, M. A. Rational and combinatorial tailoring of bioactive cyclic 9dipeptides, ***Frontiers in. Microbiology***, **2015**, *6*, 785.
13. **Giessen, T. W.**†, Altegoer, F., Nebel, A. J., Steinbach, R. M., Bange, G.† and Marahiel, M. A.† A synthetic adenylation-domain-based tRNA-aminoacylation catalyst, ***Angewandte Chemie International Edition***, **2015**, *54*, 2492-2496.
14. **Giessen, T. W.**† and Marahiel, M. A.† The tRNA-Dependent Biosynthesis of Modified Cyclic Dipeptides, ***International Journal of Molecular Sciences***, **2014**, *15*, 14610-14631.
15. **Giessen, T. W.**, von Tesmar, A. M. and Marahiel, M. A.† A tRNA-dependent two enzyme pathway for the generation of singly and doubly methylated ditryptophan 2,5-diketopiperazines, ***Biochemistry***, **2013**, *52*, 4274-4283.
16. Flühe, L., Burghaus, O., Wieckowski, B. M., **Giessen, T. W.**, Linne, U. and Marahiel, M. A.† Two [4Fe-4S] cluster containing radical SAM enzyme SkfB catalyze thioether bond formation during the maturation of the sporulation killing factor, ***Journal of the American Chemical Society***, **2013**, *135*, 959-962.
17. **Giessen, T. W.**, von Tesmar, A. M. and Marahiel, M. A.† Insights into the generation of structural diversity in a tRNA-dependent pathway for highly modified bioactive cyclic dipeptides, ***Chemistry & Biology***, **2013**, *20*, 828-838.
18. Bosello, M., Mielcarek, A., **Giessen, T. W.** and Marahiel, M. A.† An enzymatic pathway for the biosynthesis of the formylhydroxyornithine required for rhodochelin iron coordination, ***Biochemistry***, **2012**, *14*, 3059-3066.
19. **Giessen, T. W.** and Marahiel, M. A.† Ribosome-independent biosynthesis of biologically active peptides: Application of synthetic biology to generate structural diversity, ***FEBS Letters***, **2012**, *586*, 2065-2075.
20. Kraas, F. I., **Giessen, T. W.** and Marahiel, M. A.† Exploring the mechanism of lipid transfer during biosynthesis of the acidic lipopeptide antibiotic CDA, ***FEBS Letters***, **2012**, *586*, 283-288.

21. **Giessen, T. W.**, Franke, K. B., Knappe, T. A., Kraas, F. J., Bosello, M., Xie, X., Linne, U. and Marahiel, M. A.† Isolation, structure elucidation and biosynthesis of an unusual hydroxamic acid ester-containing siderophore from *Actinosynnema mirum*, **Journal of Natural Products**, **2012**, 75, 905-914.
22. **Giessen, T. W.**, Kraas, F. I. and Marahiel, M. A.† A four-enzyme pathway for 3,5-dihydroxy-4-methylantranilic acid formation and incorporation into the antitumor antibiotic sibiromycin, **Biochemistry**, **2011**, 50, 5680-5692.

#### *Preprints:*

23. **Giessen, T. W.**†, Orlando, B. J., Verdegaal, A. A., Chambers, M. G., Gardener, J., Bell, D. C., Birrane, G., Liao, M.†, Silver, P. A.† Structure and function of a 9.6 megadalton bacterial iron storage compartment, **bioRxiv**, **2019**, 511345.
24. Ziesack, M., Gibson, T., Shumaker, A. M., Oliver, J. K. W., Riglar, D. T., **Giessen, T. W.**, DiBenedetto, N. V., Lall, K., Hsu, B. B., Bry, L., Way, J. C., Silver, P. A.† Inducible cooperation in a synthetic gut bacterial consortium introduces population balance and stability, **bioRxiv**, **2018**, 426171.
25. Tscherner, M., **Giessen, T. W.**, Markey, L., Kumamoto, C. A., Silver, P. A.† A synthetic system that combats fungal infections, **bioRxiv**, **2018**, 342287.
26. Lau, YH\*, **Giessen, T. W.**\*, Altenburg, W. J. and Silver, P. A.† Prokaryotic nanocompartments form synthetic organelles in a eukaryote, **bioRxiv**, **2018**, 244095.
27. **Giessen, T. W.** and Silver, P. A.† Microbes use encapsulin protein organelles to sequester toxic reactions, **bioRxiv**, **2016**, 085266.
28. Liu, X., Lopez, P. A., **Giessen, T. W.**, Giles, M., Way, J. C. and Silver, P. A.† Engineering genetically-encoded mineralization and magnetism via directed evolution, **bioRxiv**, **2016**, 085233.

#### *Manuscripts in preparation and submitted manuscripts:*

29. Altenburg, W. J., Rollins, N, Lau, YH and Silver, P. A., **Giessen, T. W.**† Controlling *in vivo* cargo-loading of protein nanocompartments. (in preparation)
30. Tracey, J., Coronado, M., **Giessen, T. W.**, Lau, M. C. Y., Silver, P. A., Ward, B. The discovery of six new genes encoding for encapsulin nanocompartments in metagenomes. (submitted)
31. Ziesack, M., Gibson, T., Shumaker, A. M., Oliver, J. K. W., Riglar, D. T., **Giessen, T. W.**, DiBenedetto, N. V., Lall, K., Hsu, B. B., Bry, L., Way, J. C., Silver, P. A.† Engineered inter-species amino acid cross-feeding increases population evenness in a synthetic bacterial consortium. (submitted)

## **Research Support**

#### *Ongoing:*

Gordon and Betty Moore Foundation (GBMF5506)

Award amount: \$100,000

Award period: 10/10/16 – 11/1/19

Role: Co-PI with Pamela A. Silver and Bess Ward

Title: Exploring Nitrogen Cycling in the Ocean from the Macro to the Molecular Scale

The goal of this project is to investigate the distribution and diversity of encapsulin nanocompartments in the oxygen minimum zones of the oceans and to analyze their impact on the global nitrogen cycle.

University of Michigan, Ann Arbor (Mcubed 9163)

Award amount: \$20,000

Award period: 2/11/2019 – 12/31/2020

Role: PI

Title: Mining the gut microbiome for novel protein organelles involved in host-microbe interactions

The major goal of this project is to analyze gut microbiota metagenomic data for the presence of protein organelle genes.

NIH (MIRA R35)

Award amount: \$1,908,130

Award period: 9/1/2019 – 8/31/2024

Role: PI

Title: Protein organelles in human-associated bacteria

The major goal of this project is to discover and study protein organelle systems found in human-associated microbes involved in stress resistance, detoxification, nutrient utilization and pathogenesis.