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Section for Molecular Plant Biology
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Short presentation

Languages of the Non-coding Genome

Genomes are the blueprints of life: the genomic DNA sequences contain the instructions for the formation of a given species. DNA sequence polymorphisms between individuals of the same species offer a hypothesis to understand the molecular bases of fitness differences. However, many polymorphisms are located in parts of the genome that we poorly understand: **the non-coding genome**. While polymorphisms that change the protein sequence offer a sufficiently clear path forward, my seminar outlines approaches and solutions to understand the non-coding genome. Results from my laboratory illustrate different molecular mechanisms of how the non-coding genome promotes organismal fitness. We developed methods that reveal where the non-coding genome is transcribed by RNA polymerase II (Pol II) into RNAs. Here, a particular focus is on thousands of RNAs that are missed by many transcriptomics approaches even when located in important regions. While we find some cases of trans-acting RNAs, a common theme resulting from our functional characterization of specific non-coding loci is that the act of Pol II transcription explains the function of non-coding region, rather than the resulting RNA product. Essentially, chromatin-based signaling during Pol II transcription in the non-coding genome represses mRNA initiation when the transcription units overlap. Efforts to characterize non-coding RNA isoforms overlapping with genes involved a new class of non-coding RNAs: short promoter-proximal RNAs (sppRNAs). sppRNAs result from transcriptional termination at sites of promoter-proximal Pol II stalling and are positively correlated with gene expression. In conclusion, our results highlight different ways of how the non-coding genome communicates functional information, with intriguing implications for current models explaining non-coding genome conservation and function.

Qualifications

Biological Sciences, PhD, University of East Anglia
Award Date: 16 Jul 2010

Postdoc in non-coding transcription, postdoctoral researcher, Harvard Medical School
2010 → 2014

Employment

Associate Professor - Promotion Programme

Section for Molecular Plant Biology

Frederiksberg C
31 Dec 2014 → nu

Assistant Professor

Copenhagen Plant Science Center

Frederiksberg C
1 Jan 2015 → 6 May 2015

Publications

A data-driven genome annotation approach for cassava

Chenna, Swetha, Ivanov, M., Nielsen, Tue Kjærgaard, Chalenko, Karina, Olsen, Evy, Jørgensen, Kirsten, Sandelin, Albin Gustav & Marquardt, Sebastian, 2024, (E-pub ahead of print) In: *Plant Journal*.

A ribose world: current status and future challenges of plant RNA biology

Marquardt, Sebastian & Manavella, P. A., 2023, In: *Journal of Experimental Botany*. 74, 7, p. 2203-2207 5 p.

Cotranscriptional RNA processing and modification in plants

Marquardt, Sebastian, Petrillo, E. & Manavella, P. A., 2023, In: *The Plant Cell*. 35, 6, p. 1654-1670

Functional Variation in the Non-Coding Genome: Molecular Implications for Food Security

Gullotta, Giorgio, Korte, A. & Marquardt, Sebastian, 2023, In: *Journal of Experimental Botany*. 74, 7, p. 2338–2351 14 p.

LncRNA FLAIL affects alternative splicing and represses flowering in *Arabidopsis*

Jin, Yu, Ivanov, M., Dittrich, A. N., Nelson, A. D. L. & Marquardt, Sebastian, 2023, In: *EMBO Journal*. 42, 11, 21 p., e110921.

Histone chaperone ASF1 mediates H3.3-H4 deposition in *Arabidopsis*

Zhong, Z., Wang, Y., Wang, M., Yang, F., Thomas, Quentin, Xue, Y., Zhang, Y., Liu, W., Jami-Alahmadi, Y., Xu, L., Feng, S., Marquardt, Sebastian, Wohlschlegel, J. A., Ausin, I. & Jacobsen, S. E., 2022, In: *Nature Communications*. 13, 15 p., 6970.

R-loops at microRNA encoding loci promote co-transcriptional processing of pri-miRNAs in plants

Gonzalo, L., Tossolini, I., Gulanicz, T., Cambiagno, D. A., Kasprovicz-Maluski, A., Smolinski, D. J., Mammarella, M. F., Ariel, F. D., Marquardt, Sebastian, Szweykowska-Kulinska, Z., Jarmolowski, A. & Manavella, P. A., 2022, In: *Nature Plants*. 8, 4, p. 402-418 17 p.

From Single Cells to Flowers – Biological Complexity Driving Plant Reproductive Development

Schwarz, Isabel Aimée, Neumann, M., Vega, R., Xu, X., Cornaro, L., Colombo, L., Vernoux, T., Xu, J., Marquardt, Sebastian & Kaufmann, K., 2021, Preprints.org.

Light-Dependent Translation Change of *Arabidopsis* psbA Correlates with RNA Structure Alterations at the Translation Initiation Region

Gawroński, P., Enroth, Christel Hougård, Kindgren, P., Marquardt, Sebastian, Karpiński, S., Leister, D., Jensen, Poul Erik, Vinther, Jeppe & Scharff, L. B., 2021, In: *Cells*. 10, 2, 22 p., 322.

The Hda1 histone deacetylase limits divergent non-coding transcription and restricts transcription initiation frequency

Gowthaman, U., Ivanov, M., Schwarz, Isabel Aimée, Patel, H. P., Müller, N. A., Garcia Pichardo, Desire, Lenstra, T. L. & Marquardt, Sebastian, 2021, In: *EMBO Journal*. 40, 23, 16 p., 108903.

TranscriptomeReconstructoR: data-driven annotation of complex transcriptomes

Ivanov, M., Sandelin, Albin Gustav & Marquardt, Sebastian, 2021, In: *BMC Bioinformatics*. 22, 15 p., 290.

Winter fields antisense RNAs to kick off flowering

Jin, Yu & Marquardt, Sebastian, 2021, In: *Genes and Development*. 38, 11-12, p. 785-786 2 p.

A G(enomic)P(ositioning)S(ystem) for Plant RNAPII Transcription

Leng, Xueyuan, Thomas, Quentin, Rasmussen, S. H. & Marquardt, Sebastian, 2020, In: *Trends in Plant Science*. 25, 8, p. 744-764

DNA Processing in the Context of Noncoding Transcription

Gowthaman, U., Garcia Pichardo, Desire, Jin, Yu, Schwarz, Isabel Aimée & Marquardt, Sebastian, 2020, In: *Trends in Biochemical Sciences*. 45, 12, p. 1009-1021

Dual sgRNA-based Targeted Deletion of Large Genomic Regions and Isolation of Heritable *Cas9*-free Mutants in *Arabidopsis*

Jin, Yu & Marquardt, Sebastian, 2020, In: *Bio-protocol*. 10, 20, 17 p., 3796.

Native elongation transcript sequencing reveals temperature dependent dynamics of nascent RNAPII transcription in *Arabidopsis*

Kindgren, P., Ivanov, M. & Marquardt, Sebastian, 2020, In: *Nucleic Acids Symposium Series*. 48, 5, p. 2332-2347 16 p.

Organismal benefits of transcription speed control at gene boundaries

Leng, Xueyuan, Ivanov, M., Kindgren, P., Malik, I., Thieffry, A., Brodersen, Peter, Sandelin, Albin Gustav, Kaplan, C. D. & Marquardt, Sebastian, 2020, In: EMBO Reports. 21, 4, 16 p., e49315.

Transcript isoform sequencing reveals widespread promoter-proximal transcriptional termination in Arabidopsis

Thomas, Quentin, Ard, R., Liu, J., Li, B., Wang, J., Pelechano, V. & Marquardt, Sebastian, 2020, In: Nature Communications. 11, 1, p. 1-15

Transcription-driven chromatin repression of Intragenic transcription start sites

Nielsen, M., Ard, R., Leng, Xueyuan, Ivanov, M., Kindgren, P. R., Pelechano, V. & Marquardt, Sebastian, 1 Feb 2019, In: PLOS Genetics. 15, 2, p. 1-33 e1007969.

Efficient termination of nuclear lncRNA transcription promotes mitochondrial genome maintenance

du Mee, D. J. M., Ivanov, M., Parker, J. P., Buratowski, S. & Marquardt, Sebastian, 5 Mar 2018, In: eLife. 7, e31989.

Transcriptional read-through of the long non-coding RNA SVALKA governs plant cold acclimation

Kindgren, P. R., Ard, R., Ivanov, M. & Marquardt, Sebastian, 2018, In: Nature Communications. 9, p. 1-11 4561.

Emerging properties and functional consequences of noncoding transcription

Ard, R., Allshire, R. C. & Marquardt, Sebastian, 2017, In: Genetics (Print). 207, 2, p. 357-367 11 p.

A chromatin-based mechanism for limiting divergent noncoding transcription

Marquardt, Sebastian, Escalante-Chong, R., Pho, N., Wang, J., Churchman, L. S., Springer, M. & Buratowski, S., 2014, In: Cell. 157, 7, p. 1712-23 12 p.

Functional consequences of splicing of the antisense transcript COOLAIR on FLC transcription

Marquardt, Sebastian, Raitskin, O., Wu, Z., Liu, F., Sun, Q. & Dean, C., 2014, In: Molecular Cell. 54, 1, p. 156-165 10 p.

Kinetic competition between RNA Polymerase II and Sen1-dependent transcription termination

Hazelbaker, D. Z., Marquardt, Sebastian, Wlotzka, W. & Buratowski, S., 2013, In: Molecular Cell. 49, 1, p. 55-66 12 p.

Distinct RNA degradation pathways and 3' extensions of yeast non-coding RNA species

Marquardt, Sebastian, Hazelbaker, D. Z. & Buratowski, S., May 2011, In: Transcription. 2, 3, p. 145-154 10 p.

Cullin 4-ring finger-ligase plays a key role in the control of endoreplication cycles in Arabidopsis trichomes

Roodbarkelari, F., Bramsiepe, J., Weigl, C., Marquardt, Sebastian, Novák, B., Jakoby, M. J., Lechner, E., Genschik, P. & Schnittger, A., 2010, In: Proceedings of the National Academy of Sciences of the United States of America. 107, 34, p. 15275-15280 6 p.

Targeted 3' processing of antisense transcripts triggers Arabidopsis FLC chromatin silencing

Liu, F., Marquardt, Sebastian, Lister, C., Swiezewski, S. & Dean, C., 2010, In: Science (New York, N.Y.). 327, 5961, p. 94-7 4 p.

Altered interactions within FY/AtCPSF complexes required for Arabidopsis FCA-mediated chromatin silencing

Manzano, D., Marquardt, Sebastian, Jones, A. M. E., Bäurle, I., Liu, F. & Dean, C., 2009, In: Proceedings of the National Academy of Sciences of the United States of America. 106, 21, p. 8772-7 6 p.

Additional targets of the Arabidopsis autonomous pathway members, FCA and FY

Marquardt, Sebastian, Boss, P. K., Hadfield, J. & Dean, C., 2006, In: Journal of Experimental Botany. Flowering Newsletter. 57, 13, p. 3379-86 8 p.

Novel functions of plant cyclin-dependent kinase inhibitors, ICK1/KRP1, can act non-cell-autonomously and inhibit entry into mitosis

Weinl, C., Marquardt, Sebastian, Kuijt, S. J. H., Nowack, M. K., Jakoby, M. J., Hülskamp, M. & Schnittger, A., Jun 2005, In: Plant Cell. 17, 6, p. 1704-22 19 p.

Partial loss-of-function alleles reveal a role for GNOM in auxin transport-related, post-embryonic development of Arabidopsis

Geldner, N., Richter, S., Vieten, A., Marquardt, Sebastian, Torres-Ruiz, R. A., Mayer, U. & Jürgens, G., Jan 2004, In: Development (Cambridge, England). 131, 2, p. 389-400 12 p.

Activities

EMBO YIP lecture: Languages of the non-coding genome

Marquardt, Sebastian (Other)

17 Aug 2023

EMBO Young Investigator Sectoral Meeting: Chromatin & Transcription

Marquardt, Sebastian (Participant), Messerschmidt, Daniel Martin (Organizer), Schulz, E. (Organizer), Hamon, M. (Organizer) & Cheung, A. (Organizer)

4 Jul 2023 → 7 Jul 2023

Languages of the non-coding genome

Marquardt, Sebastian (Other)

20 Jun 2023

EMBO YIP lecture: Languages of the non-coding genome

Marquardt, Sebastian (Other)

16 Jun 2023

EMBO YIP lecture: Languages of the non-coding genome

Marquardt, Sebastian (Other)

29 Apr 2023

BSc thesis supervision: Julie Overgaard Hansen

Marquardt, Sebastian (Participant)

1 Apr 2023 → 15 Jun 2023

Lucia Gonzalo

Marquardt, Sebastian (Host)

1 Apr 2023 → 30 Jun 2023

EMBO YIP lecture: Languages of the non-coding genome

Marquardt, Sebastian (Other)

6 Mar 2023

BSc thesis supervision: Hilde Yuwan Børner Stax

Marquardt, Sebastian (Participant)

1 Mar 2023 → 15 Jun 2023

EMBO YIP lecture: Languages of the non-coding genome

Marquardt, Sebastian (Other)

1 Mar 2023

EMBO YIP lecture: Languages of the non-coding genome

Marquardt, Sebastian (Other)

27 Feb 2023

EMBO Young Investigator - Joint Lab Meeting on Singel Cell Transcriptomics

Marquardt, Sebastian (Organizer)

16 Feb 2023 → 17 Feb 2023

BSc thesis supervision - Jesper Sølvsten

Marquardt, Sebastian (Participant)

15 Feb 2023 → 15 Jun 2023

Beda Anttila

Marquardt, Sebastian (Host)

15 Feb 2023 → 15 Jul 2023

MSc supervision: Beda Anttila

Marquardt, Sebastian (Participant)

15 Feb 2023 → 15 Jul 2023

EMBO YIP lecture: Languages of the non-coding genome

Marquardt, Sebastian (Other)

30 Jan 2023

Languages of the non-coding genome

Marquardt, Sebastian (Other)

8 Sep 2022

MSc thesis supervision: Nicholas Bolsi

Marquardt, Sebastian (Participant)

1 Sep 2022 → 15 Jun 2023

Languages of the non-coding genome

Marquardt, Sebastian (Other)

31 Aug 2022

Censor BSc thesis, SDU

Marquardt, Sebastian (Examiner)

1 Jul 2022

Languages of the Non-coding Genome

Marquardt, Sebastian (Other)

1 Jun 2022

Languages of the Non-coding Genome

Marquardt, Sebastian (Other)

5 May 2022

Bert de Rybel

Marquardt, Sebastian (Host)

25 Apr 2022

Informed Breeding in the Genomics Era

Marquardt, Sebastian (Other)

19 Apr 2022

BSc thesis supervision

Marquardt, Sebastian (Participant)
Feb 2022 → Jun 2022

BSc thesis supervision

Marquardt, Sebastian (Participant)
Feb 2022 → Jun 2022

BSc thesis supervision

Marquardt, Sebastian (Participant)
Feb 2022 → Jun 2022

PhD thesis supervision

Marquardt, Sebastian (Participant)
Jan 2022 → Dec 2024

Languages of the Non-coding Genome

Marquardt, Sebastian (Other)
7 Dec 2021

Rules and roles of signaling through the non-coding genome

Marquardt, Sebastian (Other)
5 Nov 2021

6th Annual Meeting on RNA

Marquardt, Sebastian (Participant)
4 Oct 2021

Exploring the Functional role of the Non-coding Genome

Marquardt, Sebastian (Other)
20 Sep 2021

Exploring the Functional role of the Non-coding Genome

Marquardt, Sebastian (Other)
17 Sep 2021

BSc thesis supervision

Marquardt, Sebastian (Participant) & La Bonté, A. (Award recipient)
Sep 2021 → Jan 2022

BSc thesis supervision

Marquardt, Sebastian (Participant)
Sep 2021 → Jan 2022

MSc thesis supervision

Marquardt, Sebastian (Participant)
Sep 2021 → Aug 2022

International Conference on Arabidopsis Research, ICAR 2021

Marquardt, Sebastian (Participant)
24 Jun 2021

PhD thesis supervision

Marquardt, Sebastian (Participant)
Apr 2021 → Mar 2024

BSc thesis supervision

Marquardt, Sebastian (Participant)
Feb 2021 → Jun 2021

BSc thesis supervision

Marquardt, Sebastian (Participant)
Feb 2021 → Jun 2021

Genomic Punctuation

Marquardt, Sebastian (Other)
27 Nov 2020

Chairman PhD assesemnt committe

Marquardt, Sebastian (Examiner)
4 Nov 2020

Epigenetics of Genomic Punctuation

Marquardt, Sebastian (Other)
20 Aug 2020

Grzegorz Brzyżek

Marquardt, Sebastian (Host)
11 Aug 2020 → 10 Nov 2020

MSc thesis censor

Marquardt, Sebastian (Examiner)
26 Jun 2020

External opponet, PhD defense at Aarhus University

Marquardt, Sebastian (Examiner)
20 May 2020

Copenhagen Plant Science Center (Organisational unit)

Marquardt, Sebastian (Member)
2020

Franziska Turck

Marquardt, Sebastian (Host)
5 Dec 2019

Szymon Swiezewski

Marquardt, Sebastian (Host)
5 Dec 2019

EMBO Young Investigator Programme

Marquardt, Sebastian (Other)
31 Oct 2019

5th Annual Meeting on RNA: from basic research to industrial applications

Marquardt, Sebastian (Participant)
7 Oct 2019

BSc thesis supervision

Marquardt, Sebastian (Participant)
Sep 2019 → Mar 2020

BSc thesis supervision

Marquardt, Sebastian (Participant)
Sep 2019 → Jan 2020

MSc thesis supervision

Marquardt, Sebastian (Participant)
Sep 2019 → Sep 2020

MSc thesis supervision

Marquardt, Sebastian (Participant)
Sep 2019 → Sep 2020

MSc thesis supervision

Marquardt, Sebastian (Participant)
Sep 2019 → Nov 2020

Censor BSc thesis Aarhus University

Marquardt, Sebastian (Examiner)
19 Jun 2019

Interplay Between Co-Transcriptional Chromatin States and Transcript Isoform Diversity

Marquardt, Sebastian (Other)
14 Jun 2019

MSc thesis supervision

Marquardt, Sebastian (Participant)
Jun 2019 → Dec 2019

MSc thesis supervision

Marquardt, Sebastian (Participant)
Apr 2019 → Mar 2020

MSc thesis censor, SDU

Marquardt, Sebastian (Examiner)
21 Mar 2019

BSc thesis supervision

Marquardt, Sebastian (Participant)
Feb 2019 → Jun 2019

Section for Molecular Plant Biology (Organisational unit)

Marquardt, Sebastian (Member)
2019

EMBO Young Investigator Interview

Marquardt, Sebastian (Other)
30 Oct 2018

4th Annual Meeting on RNA - From basic research to industrial applications

Marquardt, Sebastian (Participant)

9 Oct 2018

My Journey from JIC/TSL Rotation Student to the University of Copenhagen

Marquardt, Sebastian (Other)

6 Oct 2018

Rules and Roles of Non-coding Transcription

Marquardt, Sebastian (Other)

5 Oct 2018

MSc thesis supervision

Marquardt, Sebastian (Participant)

Oct 2018 → Feb 2019

Rules and Roles of Non-coding Transcription

Marquardt, Sebastian (Other)

31 Jul 2018

Gene Repression by the Act of Transcription

Marquardt, Sebastian (Other)

19 Jun 2018

Rules and Roles of non-coding Transcription

Marquardt, Sebastian (Other)

13 Jun 2018

Rules and Roles of non-coding Transcription

Marquardt, Sebastian (Other)

24 May 2018

PhD thesis supervision

Marquardt, Sebastian (Participant)

Mar 2018 → Sep 2021

Rules and Roles of non-coding Transcription

Marquardt, Sebastian (Other)

27 Feb 2018

Gene Repression Through the Act of Transcription

Marquardt, Sebastian (Other)

22 Feb 2018

BSc thesis supervision

Marquardt, Sebastian (Participant)

Feb 2018 → Jul 2018

BSc thesis supervision

Marquardt, Sebastian (Participant)

Feb 2018 → Jun 2018

BSc thesis supervision

Marquardt, Sebastian (Participant)

Jan 2018 → Jun 2018

Gene Regulation By the Act of Upstream RNA Polymerase II Transcription

Marquardt, Sebastian (Other)

20 Nov 2017

3rd Annual Meeting on RNA, 2017

Marquardt, Sebastian (Participant)

10 Oct 2017

Gene Regulation Through the Act of Upstream Transcription in Arabidopsis

Marquardt, Sebastian (Other)

10 Oct 2017

Gene Regulation Through the Act of Upstream Transcription in Arabidopsis

Marquardt, Sebastian (Other)

10 Oct 2017

Rules and Roles of Non-coding Transcription

Marquardt, Sebastian (Other)

10 Oct 2017

PhD thesis supervision

Marquardt, Sebastian (Participant)

Oct 2017 → Mar 2021

PhD thesis supervision

Marquardt, Sebastian (Participant)

Oct 2017 → Apr 2021

Gene Regulation Through the Act of Upstream Transcription in Arabidopsis

Marquardt, Sebastian (Other)

28 Sep 2017

Gene Regulation Through the Act of Upstream Transcription in Arabidopsis

Marquardt, Sebastian (Other)

22 Sep 2017

Stalling DNA processing

Marquardt, Sebastian (Participant)

16 Jun 2017

Stalling DNA processing

Marquardt, Sebastian (Participant)

16 Jun 2017

Rules and Roles of Non-coding Transcription

Marquardt, Sebastian (Other)

9 May 2017

BSc thesis supervision

Marquardt, Sebastian (Participant)

Feb 2017 → Jun 2017

BSc thesis supervision

Marquardt, Sebastian (Participant)
Feb 2017 → Jun 2017

MSc thesis supervision

Marquardt, Sebastian (Participant)
Jan 2017 → Jul 2017

MSc thesis supervision

Marquardt, Sebastian (Participant)
Jan 2017 → Jul 2017

MSc thesis supervision

Marquardt, Sebastian (Participant)
Jan 2017 → May 2017

Caroline Dean

Marquardt, Sebastian (Host)
18 Oct 2016

2nd Annual Meeting on RNA: from basic research to industrial applications - October 11 2016

Marquardt, Sebastian (Participant)
11 Oct 2016

MSc thesis supervision

Marquardt, Sebastian (Participant)
Sep 2016 → Sep 2017

MSc thesis supervision

Marquardt, Sebastian (Participant)
Sep 2016 → Sep 2017

Rules and roles of non-coding transcription

Marquardt, Sebastian (Other)
23 Aug 2016

Andreas Mayer

Marquardt, Sebastian (Host)
7 Jul 2016

Rules and Roles of Long Non-Coding Transcription

Marquardt, Sebastian (Other)
4 Feb 2016

PhD thesis supervision

Marquardt, Sebastian (Participant)
Jan 2016 → Nov 2019

Rules and Roles of Long Non-Coding Transcription

Marquardt, Sebastian (Other)
10 Dec 2015

Danish National Workshop on non-coding RNA - 2015

Marquardt, Sebastian (Participant)
7 Oct 2015

Rules and Roles of Long Non-Coding Transcription

Marquardt, Sebastian (Other)
21 Sep 2015

Rules and Roles of Long Non-Coding Transcription

Marquardt, Sebastian (Other)
28 May 2015

MSc thesis supervision

Marquardt, Sebastian (Participant)
Mar 2015 → Jul 2015

Roles and Rules for Long Non-Coding Transcription

Marquardt, Sebastian (Other)
2 Feb 2015

Danish RNA Society

Marquardt, Sebastian (Participant)
2015 → 2017

Danish RNA society (External organisation)

Marquardt, Sebastian (Member)
2015 → 2018

Prizes**EMBO Young Investigator Program**

Marquardt, Sebastian (Recipient), 1 Jan 2020

European Research Council Starting Grant 2017

Marquardt, Sebastian (Recipient), 2017

Hallas-Møller Investigator Award

Marquardt, Sebastian (Recipient), 2015

Novo Nordisk Ascending Investigator

Marquardt, Sebastian (Recipient), 2021