Curriculum Vitae: Markus Babst

PERSONAL DATA

Date of Birth: May 8 1964
Place of Birth: Zürich, Switzerland

Private address: 1378 Thornton Avenue
Salt Lake City, Utah 84105
USA

Office address: University of Utah
Crocker Science Center
1390 Presidents Circle, Room 124B
Salt Lake City, Utah 84112
USA

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EDUCATION

1990 **Diploma, Biochemistry**, Federal Institute of Technology (ETH), Zurich, Switzerland.
Research at the Institute of Molecular Biology and Biophysics: Single amino acid substitutions in the B870 α□and β□light-harvesting polypeptides of *Rhodobacter capsulatus*: structural and spectral effects.
Advisor: Prof. H. Zuber

1995 **Ph.D., Natural Sciences**, Federal Institute of Technology (ETH), Zurich, Switzerland.
Research at the Institute for Microbiology: 1. Functional studies of the transcriptional activator protein NifA from *Bradyrhizobium japonicum.* 2. Characterization of the function and regulation of the *groESL* multigene family in *Bradyrhizobium japonicum.*
Advisor: Prof. H. Hennecke

1995-2001 **Postdoctoral Fellow**, Howard Hughes Medical Institute, University of California San Diego, La Jolla, California, USA.
Research: Protein trafficking in endosomal system of yeast.
Advisor: Prof. Scott D. Emr

PERSONAL STATEMENT

My research focuses on basic questions in cell biology that are broadly associated with membrane-based systems. Over the years, the main topic of my lab has moved from the ESCRT machinery to cell surface protein quality control to metabolism-regulated protein trafficking and finally to plasma membrane tension and environmental stress sensing. My research mantra is: follow the data wherever it might lead. This research approach requires broad knowledge of cell biology and technical understanding of methodologies used in many fields including cellular imaging, biochemistry, and genetics. My education and experience have equipped me with such understanding and expertise and have prepared me well for this challenge. My formative studies in biochemistry were conducted at the Federal Institute of Technology in Switzerland, where I later completed my Ph.D. thesis research in Microbiology. My postdoctoral work was conducted

in the laboratory of Scott Emr at UCSD, where I identified and characterized most of the components of the ESCRT machinery in yeast. I then joined a California Biotech company, MicroGenomics, which focused on the identification of novel antibiotics from non-culturable bacteria. There I headed the natural product chemistry group, which gave me insight into the methodology of small molecule structure identification in addition to valuable experience in the management of laboratory personnel. When I joined the Biology Department at the University of Utah in 2003, I resumed my research on ESCRT function. However, within a few years my research topics broadened, and our data led us into new areas of cell biology. One of the current research projects of my lab focuses on the study of nutrient transporter regulation and its crosstalk with cellular metabolism. Of particular interest is the finding that yeast prefers synthesis over import of certain amino acids. A pool of these synthesized amino acids is secreted by yeast thereby feeding the neighboring cells. When secretion is blocked, the accumulating intracellular amino acids impair mitochondrial respiration and cause a severe metabolic defect. This interplay between amino acid levels and the energy metabolism is highly relevant for the study of amino acid regulated insulin secretion and the potential implications for diabetes.

Another factor I consider key for the success of my research is the interaction with trainees at all levels and stages of their career. In particular, undergraduate students are the ultimate outsiders in a research field, and I appreciate the enthusiasm and fresh ideas they bring to the research effort. Therefore, at any time I have 3-5 undergraduates working in my lab as volunteer researchers, not to prepare media or wash the dishes, but to learn the basic research methods of my lab and to work on their own small projects. Furthermore, I am part of a new initiative at the University of Utah, called the Science Research Initiative (SRI), which plans to involve 400-500 undergraduate students in their first year in real research experiences. I developed an SRI project for ~20 students (The 4200 Genomes Project) that is based on the fact that the genomes of yeast knockout collection strains acquired in average 5-20 second-site suppressor mutations that help the strains dealing with the initial gene loss. The identity of the suppressor mutations can give important insights into the cell biological functions of the deleted gene. The project focuses on genome analysis, identification of suppressors, proposing models that might explain the suppressor activity, and testing of these models by cell biological experiments. The hope is that the SRI project will provide the spark that ignites the enthusiasm for research or at least corrects false expectations the students have about a research career.

I am committed to provide excellent training for graduate students and help these students to reach their career goals. Over the years, I mentored 13 graduate students in my lab, and I have been teaching graduate-level courses for over 10 years. Furthermore, I have been very active in the university-wide graduate programs that recruit, train and mentor first-year graduate students. I served on the admissions committee for the Molecular Biology Graduate Program and I functioned as the Director for the Biological Chemistry Graduate Program.

In addition to research and mentoring, some of my current time is dedicated to the development of the Center for Cell and Genome Science at the University of Utah. As the director, I am responsible for the implementation of the Center’s mission, which includes hiring a diverse group of Biology, Chemistry, Physics and Mathematics researchers that are interested in studying cell biological questions using a multidisciplinary and collaborative approach. In addition, the Center houses core facilities to give researchers easy access to state-of-the-art microscopes and other instruments.

PROFESSIONAL POSITIONS

2001-2003 **Senior Scientist**, MicroGenomics, Inc., Carlsbad, California, USA. Purification and structure elucidation of natural products.

2003-2010 **Assistant Professor**, University of Utah, Salt Lake City, Utah, USA. Studies in MVB protein sorting in eukaryotic cells

2010-2017 **Associate Professor**, University of Utah, Salt Lake City, Utah, USA. Studies in MVB protein sorting in eukaryotic cells

2018-present **Director**, Center for Cell and Genome Science

2018-present **Professor**, University of Utah, Department of Biology

AWARDS AND HONORS

1996-1997 Postdoctoral Fellowship: Swiss National Science Foundation

1997-1998 Postdoctoral Fellowship: Human Frontiers Science Program

1998-2001 Postdoctoral Fellowship: Howard Hughes Medical Institute

RESEARCH SUPPORT

2004-2005 Funding Incentive Seed Grant, University of Utah. Identification of Regulators of the MVB Sorting Pathway (role: PI; $29,500)

2006-2007 Synergy, Universtiy of Utah. High Resolution Spectroscopy and Microscopy Studies of the ESCRT Machinery Reconstituted on Planar Membranes. Collaboration with Dr. John Conboy (Chemistry) and Dr. Jordan Gerton (Physics) ($100,000)

2005-2008 American Heart Association (0530210N). Vps4 and the MVB Sorting Pathway (role: PI; $260,000).

2008-2009 Funding Incentive Seed Grant, University of Utah. Simultaneous biomass reduction and nutrient removal in activated sludge process- a mechanistic and molecular approach ($30,000). Collaboration with Dr. Ramesh Goel (Civil & Environmental Engineering).

2006-2011 NIH, R01 (GM074171-01). Vps4 and the MVB Sorting Pathway (role: PI; $950,000).

2009-2011 Administrative Supplement to R01 (role: PI; $200,000)

2013 Funding Incentive Seed Grant, University of Utah. Quality control of transporters and channels (role: PI; $30,000).

2011-2015 NIH, R01 (GM074171-06). Vps4 and the MVB Sorting Pathway (role: PI; $900,000).

2016 Funding Incentive Seed Grant, University of Utah. Toxicity of Amyloidosis (role: PI; $34,000).

2017-2021 NIH, R01 (GM123147). Regulation of Nutrient Transporters (role: PI; $953,000).

2018 Administrative Supplement to R01 (role: PI; $75,000)

2019-2020 Funding Incentive Seed Grant, University of Utah. The 4200 Genomes Project (role: PI; $30,000).

2020-2023 NSF 19-577. Imaging and Quantifying Lipid Membrane Asymmetry in Living Cells with Sum-Frequency Vibrational Microscopy (role: co-PI; $300,000)

2022-2027 NIH, R25 (GM144253). Inter-Mountain Postbaccalaureate Research Education Program (IM-PREP; role: co-PI with Keke Fairfax and Charles Murtaugh)

Pending: NIH, R01 (GM152758). Plasma membrane stress response (role: PI; $1,250,000).

NSF (2350389). BioFoundry: Building the Utah Foundry (role: PI; $23,993,939)

Role: PI

TEACHING

2005-2017 Biol5210, Undergraduate Course in Cell Biology: Cell Structure and Function.

2004-2019 MBIOL6480, Graduate Course in Cell Biology: Advanced Cell Biology, 2 lectures per year

2011 Journal Club/Grant Writing graduate course

2013-2020 Seminal Papers, Graduate Course for Biology, 4 lectures per year

2013-2020 Bootcamp, Graduate Course for Biology, 1 lecture per year

2018-present Biol2020, Undergraduate course Biol 2020: Principles in Cell Biology

2021-present Biol7962, Graduate course in Cell Biology and Biochemistry (co-taught with Julie Hollien and Toto Olivera)

STUDENT TRAINING

Undergraduate Students: Chad Spain (2004), Warren Xanthos (2006), Kelsey Field Fulkerson (2008), Aditi Chaubal (2008), Scott Wall (2009), Sapna Rathan (2010). Karen Senne (2012-13), William Barbeau (2013-present), Paige Woodward (2013-14), Casey Caduff (2014-15), Rachelle Reed (2015-2016), Michael Elden Larsen (2015-2016), Hyelan Lee (2016-2018), Coleson Kastelic (2016-2018), Anthony Palmer (2018-2020), Talon Tarone (2018-2020), Yunus Ashtijou (2018-2020), Sanjana Aujla (2018-2020), Hai Chau Ngoc Le (2018-2020), Caitlyn Greenburg (2018-2020), Sharrieff Shah (2019-2020), Yung-Chi Lan (2019-2023).

High School Students: Lila Thulin (2011-12), Sydney Maves (2012), Ann Kim (2013)

Exchange Student: Henning Arlt (Christian Ungerman Lab, Germany, 2008-09). Niels Busse (Christian Ungerman Lab, Germany, 2011-12) Anika Baier (Christian Ungerman Lab, Germany, 2019) Robin Kohlmeyer (Christian Ungerman Lab, Germany, 2022), Romy Ruethemann (undergraduate student ETH Zurich, 2023).

Graduate Students: Stacey Drosner (2004-06), Charles Jones (2005-12), Betsy Ott (2005-11), Shrawan Kumar (2007-14), Justin Keener (2007-14), Anna Shestakova (2006-11), Katelyn Froehlich (2013-2016), Akintunde Mike Akinjero (2014-2016), Akshay Moharir (2013-2019), Daniel Appadurai (2013-2020), Lincoln Gay (2016-2019), Madison Smith (2019-present), Jasmine Phan (2019-present), Suprim Tha (2022-present).

Postdoctoral Fellows: Christian Dimaano (2004-07), Abe Hanono (2006-09).

CONTRIBUTION TO SCIENCE

1. In my early studies of protein trafficking in yeast I identified and characterized a group of proteins complexes I named ESCRT (Endosomal Sorting Complex Required for Transport). The ESCRTs function in the degradation of transmembrane proteins, an activity that is essential for the regulation of many cellular pathways including cell signaling and metabolism. Furthermore, ESCRT activity is not only limited to protein trafficking but has been shown to be important for many other pathways that require membrane remodeling and fission. For example, ESCRTs execute cytokinesis in higher eukaryotes, are involved in the release of retroviruses, aid in the sealing of plasma membrane ruptures, prune synapses, and function in the formation of nuclear pores.
    a. Katzmann, D.J.*, M. Babst* and S.D. Emr**.** 2001. Ubiquitin-dependent sorting into the multivesicular body pathway requires the function of a conserved endosomal protein sorting complex, ESCRT-I. *Cell* **106**:145-155. (PMID 11511343; * authors contribute equally) PMID: 11511343
    b. Babst, M.**,** D.J. Katzmann, E.J. Estepa, T. Meerloo, and S.D. Emr. 2002. ESCRT-III: An endosome-associated heteroollgomeric protein complex required for MVB sorting. *Dev. Cell* **3**: 271-282. (PMID 12194857) PMID: 12194857
    c. Babst, M.*, D.J. Katzmann*, W.B. Snyder, B. Wendland, and S.D. Emr. 2002. Endosome-associated complex, ESCRT-II, recruits transport machinery for protein sorting at the multivesicular body. *Dev. Cell* **3**: 283-289. (PMID 12194858; * authors contribute equally) PMID: 12194858

2. Studies from my lab gave important insight into MVB cargo sorting by the ESCRTs and showed that the early ESCRT complexes, ESCRT-0 and ESCRT-I, are not essential components of the ESCRT machinery. Furthermore, our work demonstrated that ubiquitin is not a unique sorting signal, but that any interaction with the ESCRT machinery is sufficient to sort cargo into the MVB pathway. These studies changed the view of the ESCRT field with regard to the mechanisms of ESCRT-mediated vesicle formation.
    a. Mageswaran, S.K., M.G. Dixon, M. Curtiss, J.P. Keener, and M. Babst. 2013. Binding to any ESCRT can mediate ubiquitin-independent cargo sorting. *Traffic* **15**(2): 212-229. (PMID 24148098) PMCID: PMC3947099
    b. Mageswaran, S.K., N.K. Johnson, G. Odorizzi and M. Babst. 2015. Constitutively active ESCRT-II suppresses the MVB sorting phenotype of ESCRT-0 or ESCRT-I mutants. *Mol. Biol. Cell* **26**(3): 554-568. (PMID 25501366) PMCID: PMC4310745

3. The studies in my lab on nutrient transporters have given important insight into protein-intrinsic mechanisms that regulate the degradation of these cell surface proteins. We identified a conformation sensor build into the transporters called LID that regulates the accessibility of a ubiquitination site (degron). The LID-degron system functions both in the substrate-dependent degradation of the transporters as well as their quality control. This

intrinsic quality control system does not require chaperones, an unexpected finding that has given important new insight into the mechanisms that protect the cell from unfolded proteins.

a. Jones, C.B., E.M. Ott, J.M. Keener, M. Curtiss, V. Sandrin, and M. Babst. 2012. Regulation of protein degradation by starvation-response pathways. *Traffic* **13**:468-482. PMCID: PMC3276697
b. Keener, J.M., and M. Babst. 2013. Quality control and substrate-dependent downregulation of the nutrient transporter Fur4. *Traffic* **14**(4): 412-427. (PMID 23305501)
c. Babst, M. 2014. Quality control at the plasma membrane: one mechanism does not fit all. *J. Cell Biol*. **205**(1): 11-20. PMCID: PMC3987138

4. Our recent work identified yeast eisosomes as a membrane domain that links the regulation of nutrient transporters to the plasma membrane stress response. Eisosomes are furrows in the plasma membrane that have been shown to function upstream of TORC2 signaling in maintaining plasma membrane homeostasis. We found that eisosomes store nutrient transporters in an inactive state, which aids in the regulation of nutrient import and reduces the turnover of these transporters. Eisosomes respond to environmental conditions that increase the fluidity of the plasma membrane (e.g., heat-shock, hypoosmotic shock, alkaline stress) by flattening and partial disassembly, which activates TORC2 and aids in the degradation of nutrient transporters. This link between plasma membrane stress and nutrient import is sensible considering the natural environment of yeast. The change from growing in fruit juice to being washed away by a rainstorm causes not only starvation but also a hypoosmotic shock.
    a. Moharir, A., L. Gay, D. Appadurai, J. Keener and M. Babst. 2018. Eisosomes are metabolically regulated storage compartments for APC-type nutrient transporters. *Mol. Biol. Cell* **29**(17): 2113-27. PMCID: PMC6232963
    b. Babst, M. 2019. Eisosomes at the intersection of TORC1 and TORC2 regulation. *Traffic* **20**(8): 543-551. PMCID: PMC6663646
    c. Daniel Appadurai, D., L. Gay, A. Moharir, M.J. Lang, M.C. Duncan, O. Schmidt, D. Teis, T.N. Vu, M. Silva, E.M. Jorgensen and M. Babst. 2020. Plasma Membrane Tension Regulates Eisosome Structure and Function. *Mol. Biol. Cell* **31**(4): 287-303. PMCID: PMC7183764
    d. Babst, M. 2020. Regulation of Nutrient Transporters by Metabolic and Environmental Stresses. *Curr. Opin. Cell Biol.* 65: 35-41. PMID: 32200208

5. New or improved imaging methods are often the basis for rapid progress in cell biology. In recognition of this fact, my lab focuses on implementing or developing new microscopy techniques, which include the recently published live cell imagining of GFP- and mCherry-tagged proteins at 25nm resolution (in X/Y; Appadurai *et al*., 2020). In collaboration with the lab of Erik Jorgensen (University of Utah) we are currently developing cryo-EM methods for the yeast membrane stress studies. Finally, I am co-PI of an NSF-funded study that develops a new type of microscopy, called Sum-Frequency Vibrational Microscopy, that has not yet been employed for live cell imaging (PI of the study: John Conboy, University of Utah). This type of microscope can visualize the lipid asymmetry of the plasma membrane without using modified lipids, which for the first time would allow us to get insight into the cross-bilayer dynamics of natural lipids.

SERVICE TO THE UNIVERSITY

2003-2004	Faculty Search Committee, Biology Department
2005-2006	Department of Biology Communications Committee
2005-2006	Department of Biology Safety Committee
2005-2006	Molecular Biology Program Graduate Admissions Committee
2007	Biological Chemistry Program Advisor
2004-present	Thesis Committee Member of over 60 graduate students (currently ~30)
2004-present	Training of 20 rotation students of the Molecular Biology, Biological Chemistry and Biology graduate programs
2005-2010	Department of Biology Graduate Admissions Committee, Co-Chair since 2006
2006-2017	Executive Committee, Center for Cell and Genome Science
2006-2009	Faculty Search Committee, Center for Cell and Genome Science
2006-2010	Biology Representative for the Molecular Biology Program
2008-2009	Faculty Search Committee, USTAR
2009	Biology Graduate Program Committee
2010	Internal Review Committee for the Oncological Sciences Department
2011	Faculty Search Committee, Biology Department
2010-2014	Biology Admissions Committee
2011-2012	Curriculum committee, Biology Department
2012-2014	Faculty Search Committee Chair, Center for Cell and Genome Science
2012	Advocate for Julie Hollien 4th year RPT review
2013	AFTR committee, Biology Department
2013-2016	Director, Biological Chemistry Graduate Program
2013-2016	Executive Committee, Biology Department
2013-2014	Faculty Search Committee (Cell Biology), Biology Department
2014-2017	Member of the Crocker Science Center design committee
2016	Chair of the faculty search committee for the CCGS
2016, 2022	Chair of Julie Hollien's tenure RPT committee
2016-2019	Faculty Search Committee (cryo-EM search), CCGS
2016-present	Co-Chair of the Membrane Trafficking Interest Group
2017	TEP Faculty Search Committee member (Neurobiology/Biophysics)
2018-2021	TEP Faculty Search Committee Chair, Biophysics
2021	Chair, Sophie Caron's tenure RPT committee
2021-present	Co-Director of the NIH funded IM-PREP program (NIH R25 grant)

2020-present	Faculty of the College of Science SRI initiative
2018-present	Director, Center of Cell and Genome Science
2022-2023	Chair, Faculty Search Committee

SERVICE TO THE SCIENTIFIC COMMUNITY (SINCE 2004)

Manuscript reviewed for: Nature Cell Biology, Journal of Cell Biology, Molecular Biology of the Cell, Journal of Cell Science, Developmental Biology, Nature, Current Biology, Nature Chemical Biology, Traffic, PNAS, Chemical Reviews, Molecular and General Genetics, BBAMCR, Science, Autophagy, Molecular and Cellular Biology, PLOSone, FSEB J., EMBO J., Critical Reviews in Bioch. And Mol. Biol., Developmental Cell. Frontiers Cell and Developmental Biology, Microbial Cell

Grants reviewed for: Cancer Research Grant (UK), NSF Grant (USA), Programme Blanc (France), Wellcome Trust (UK), University of Utah Seed Grant, American Diabetes Association, Austrian Science Fund, NIH.

Grant Study Section: American Heart Association (2005), NIH F05-D Fellowships (2015, 16, 17, 19), NIH UC2 nutrient transporter center grant (2023)

SCIENTIFIC COLLABORATIONS

2006	Janet Shaw (University of Utah): Characterization of Dnm1.
2007-2008	Dr. Winfried Weissenhorn (University of Grenoble, France): ESCRT-I assembly.
2007-2008	Dr. Chris Hill (University of Utah): Crystal structure analysis of Ist1.
2006-2008	Dr. Collin Dale (University of Utah): Signaling in bacteria-insect symbiosis.
2005-2014	Dr. David Katzmann (Mayo Clinic): Characterization of Vps4 and its regulators.
2006-2013	Dr. Ramesh Goel (University of Utah, Civil & Environmental Engineering): Waste water treatment.
2006-2012	Dr. Jordan Gerton (University of Utah, Physics), Dr. John Conboy (University of Utah, Chemistry): High-resolution spectroscopy and microscopy studies of the ESCRT machinery.
2007-2013	Dr. Mark Ashe (University of Manchester, UK): Function of Vps4 in translation initiation.
2007-2013	Dr. Wesley Sundquist (University of Utah): Characterization of Ist1.
2009-2011	Dr. Peter Deen (Nijmegen Center of Molecular Life Sciences (NCMLS) andRadboud University Nijmegen Medical Center (RUNMC), Netherlands): Trafficking of humanAQP2 in yeast.
2012-present	Jim Keener (University of Utah, Mathematics): Modeling of cellular systems
2013-present	Michael Vershinin and John Conboy (University of Utah): Lipid flip-flop

2016-present	Erik Jorgensen: Advanced cellular imaging
2021-present	Saveez Saffarian: Viral escape by ER-plasma membrane fusion
2021-present	Claudio DeVirgiolio, University of Freiburg, Switzerland
2021-present	Christian Ungermann, University of Osnabrueck, Germany

INVITED SEMINARS

2004	Mayo Clinic.
2005	Ohio State University, University of California Davis.
2006	Johns Hopkins University, Washington University St. Louise, University of Freiburg Germany, ETH Zürich Switzerland.
2007	University of North Carolina.
2008	Mayo Clinic.
2009	University of Oregon, University of Goettingen Germany
2010	Lysosome Gordon Conference, Conference: Biochemistry and Cell Biology of ESCRTs in Health and Disease, University of Goettingen Germany, University of Osnabrueck Germany, University of Pennsylvania
2011	The Children's Hospital of Philadelphia
2012	University of Goettingen Germany, Unversity of Osnabrueck Germany, University of Bochum Germany, Yale University, ETH Zürich Switzerland
2013	Bio-Center University of Basel Switzerland
2014	Yale University, University of Innsbruck (Austria)
2016	Lysosomes and Endocytosis Gordon Conference
2017	University of Osnabrueck, Germany
2018	LMO 13 Conference (Switzerland), SMYTE 36 Conference (Italy)
2019	Lysosomes and Endocytosis Gordon Conference
2021	University of Pittsburgh

PUBLICATIONS

Babst, M., H. Albrecht, I. Wegmann, R. Brunisholz and H. Zuber**.** 1991. Single amino acid substiturions in the B870 α and β light-harvesting polypeptides of *Rhodobacter capsulatus*: structural and spectral effects. *Eur. J. Biochem*. **202**:277-284.

Fischer, H.M., **M. Babst,** T. Kaspar, G. Acuña, F. Arigoni and H. Hennecke. 1993. One member of a *groESL*-like chaperonin multigene family in *Bradyrhiobium japonicum* is co-regulated with symbiotic nitrogen fixation genes. *EMBO J*. **12:**2901-2912.

Fischer, H.M., G. Acuña, D. Anthamatten, F. Arigoni, **M. Babst,** P. Brouwer, T. Kaspar, I. Kullik, O. Preisig, B. Sherb, M. Weidenhaupt and H. Hennecke. 1993. Two oxygen-responsife regulatory cascades control nitrogen fixation genes in *Bradyrhizobium japonicum*. In: *New*

Horizons in Nitrogen Fixation. R. Palacios, J. Mora and W.E. Newton, eds. Netherlands: Kluwer Academic Publishers, pp. 411-416.

Hennecke, H., D. Anthamatten, **M. Babst,** M. Bott, H.M. Fischer, T. Kaspar, I. Kullik, H. Loferer, O. Preisig, D. Ritz and M. Weidenhaupt. 1993. Genetic and physiologic requirements for optimal bacteroid function in the *Bradyrhizobium japonicum-Soybean* symbiosis. In: *Advances in Molecular Genetics of Plant-Microbe Interactions*. E. W. Nester and D.P.S. Verma,. eds. Netherlands: Kluwer Academic Publishers, pp. 199-207.

Hopper, S., **M. Babst,** V. Schlensog, H.M. Fischer and H. Hennecke. 1994. Regulated expression *in vitro* of genes coding for formate hydrogenlyase components of *Escherichia coli*. *J. Biol. Chem*. **269**:19597-19604.

Fischer, H.,M., **M. Babst,** P. Brouwer and H. Hennecke. 1994. Products of a differentially regulated *groESL* multigene family in *Bradyrhizobium japonicum* are required for symbiotic nitrogen fixation. In: *Proceedings of the 1st European nitrogen fixation conference.* G.B Kiss,. and G Endre, eds. Hungary: Officina Press, Szeged, pp. 33-37.

Babst, M., H. Hennecke and H.M. Fischer. 1996. Two different mechanisms are involved in the heat-shock regulation of chaperonin gene expression in *Bradyrhizobium japonicum*. *Mol. Microbiol*. **19**:827-839.

Minder, A.C., F. Narberhous, **M. Babst,** H. Hennecke and H.M. Fischer. 1997. The *dnaKJ* operon belongs to the s^{32}-dependent class of heat shock genes in *Bradyrhizobium japonicum*. *Mol. Gen. Genet*. **254**:195-206.

Hennecke,H., **M. Babst,** H. M. Fischer, T. Kaspar, I. Kullik, D. Nellen-Anthamattan, O. Preisig, P. Rossi, K. Scheider, L. Thöny-Meyer and R. Zufferey. 1997. Genetic regulation and bioenergetics of symbiotic nitrogen fixation in *Bradyrhizobium japonicum*. In: *Biological Fixation of Nitrogen for Ecology and Sustainable Agriculture*. A. Legocki,., H. Bothe, and A. Pühler, eds. Springer-Verlag, Berlin Heidelberg.

Babst, M., T. K. Sato, L. M. Banta and S.D. Emr. 1997. Endosomal tranport function in yeast requires a novel AAA-type ATPase, Vps4p. *EMBO J*. **16**:1820-1831.

Nellen-Anthamatten,D., P. Rossi, O. Preisig, I. Kullik, **M. Babst,** H.M. Fischer and H. Hennecke. 1998. *Bradyrhizobium japonicum* FixK2, a crucial distributor in the FixLJ-dependent regulatory cascade for control of genes inducible by low oxygen levels. *J. Bacteriol*. **180**:5251-5255.

Babst, M., B. Wendland, E.J. Estepa and S. D. Emr. 1998. The Vps4p AAA ATPase regulates membrane association of a Vps protein complex required for normal endosome function. *EMBO J*. **17**:2982-2993.

Burd,C.G., **M. Babst** and S.D. Emr. 1998. Novel pathways, membrane coats and PI kinase regulation in yeast lysosomal trafficking. *Semin. Cell Dev. Biol.* **9:**527-533.

Odorizzi, G., **M. Babst** and S.D. Emr. 1998. Fab1p PtdIns(3)P 5-kinase function essential for protein sorting in the multivesicular body. *Cell* **95**:847-858.

Fischer, H.M., K. Schneider, **M. Babst** and H. Hennecke. 1999. GroEL chaperonins are required for the formation of a functional nitrogenase in *Bradyrhizobium japonicum*. *Arch. Microbiol.* **171**:279-289.

Odorizzi, G., **M. Babst** and S.D. Emr. 2000. Phosphoinositide signaling and regulation of membrane trafficking in yeast. *TIBS* **25**:207-256.

Babst, M., G. Odorizzi, E.J. Estepa and S.D. Emr. 2000. Mammalian tumor susceptibility gene 101 (TSG101) and the yeast homologue, Vps23p, both function in late endosomal trafficking. *Traffic* **1**:248-258.

Katzmann, D.J.*, **M. Babst*** and S.D. Emr**.** 2001. Ubiquitin-dependent sorting into the multivesicular body pathway requires the function of a conserved endosomal protein sorting complex, ESCRT-I. *Cell* **106**:145-155. (* authors contribute equally)

Babst, M., D.J. Katzmann, E.J. Estepa, T. Meerloo, and S.D. Emr. 2002. ESCRT-III: An endosome-associated heteroollgomeric protein complex required for MVB sorting. *Dev. Cell* **3**: 271-282.

Babst, M.*, D.J. Katzmann*, W.B. Snyder, B. Wendland, and S.D. Emr. 2002. Endosome-associated complex, ESCRT-II, recruits transport machinery for protein sorting at the multivesicular body. *Dev. Cell* **3**: 283-289. (* authors contribute equally)

Odorizzi, G., D.J. Katzmann, **M. Babst**, A. Audhya, and S.D. Emr. 2003. Bro1 is an endosome-associated protein that functions in the MVB pathway in *Saccharomyces cerevisiae*. *J. Cell Sci.* **116**: 1893-1903.

Katzman, D.J., C.J. Stefan, **M. Babst** and S.D. Emr. 2003. Vps27 recruits ESCRT machinery to endosomes during MVB sorting. *J. Cell Biol.* **160**: 413-423.

Babst, M. GGAing ubiquitin to the endosome. 2004. *Nat. Cell Biol.* **3**: 175-177.

Babst, M. A protein's final ESCRT. 2005. *Traffic* **6**: 2-9.

Azmi, I., Davies, B., Dimaano, C., Payne, J., Eckert, D., **Babst, M.*** and D.J. Katzmann*. 2006. Recycling of ESCRTs by the AAA-ATPase Vps4 is regulated by a conserved VSL region in Vta1. *J. Cell Biol.* **172**(5): 705-717. (* corresponding authors)

Bahr, D., M.A. Karren, **M. Babst** and J.M. Shaw. 2006. Dimeric Dnm1-G385D interacts with Mdv1 on mitochondria and can be stimulated to assemble into fission complexes containing Mdv1and Fis1. *J. Biol. Chem.* **281**(25): 17312-17320.

Babst, M. A close-up of the ESCRTs. 2006. *Dev. Cell* **10**: 547-548.

Curtiss, M., C. Jones and **M. Babst**. 2007. Efficient cargo sorting by ESCRT-I and the subsequent release of ESCRT-I from MVBs requires the subunit Mvb12. *Mol. Biol. Cell* **18**: 636-645.

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