

Recent Advances in the Use of Phospholipid Excipients

Workshop organized by the
Phospholipid Research Center Heidelberg/Germany



INTEGRATING
Delivery Science
ACROSS DISCIPLINES



Recent Advances in the Use of Phospholipid Excipients

First session (Chair: Simon Drescher)

„*Phospholipids as excipients*“

- **Simon Drescher**, PRC Heidelberg: *The Phospholipid Research Center Heidelberg: An introduction and ongoing research projects*
- **Peter van Hoogevest**, University Basel: *An Introduction on the use and properties of phospholipid excipients*
- **Paulina Skupin-Mrugalska**, Poznan University of Medical Sciences: *Phospholipids as excipients in (amorphous) solid dispersions*
- **Paola Luciani**, University Bern: *Phospholipids in parenteral depot formulations: recent advances, current challenges, and future opportunities*



Recent Advances in the Use of Phospholipid Excipients

Second session (Chair: Paola Luciani)

„Liposomes and LNPs“

- **Mans Broekgaarden**, University Grenoble: *Radiocontrolled drug delivery with high-Z element-functionalized liposomes*
- **Davide Brambilla**, University Montréal: *Phospholipid nanoparticles for lipase deficiency gene replacement therapy*
- **Manuela Gaspar**, University of Lisbon: *Advancing the treatment of infectious diseases – the key role of liposomes as delivery systems*
- **Félix Sauvage**, Ghent University: *Photo-induced destruction of vitreous opacities using nanobubbles generating liposomes*



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Summary

Goals of the workshop are to inform on the basic properties of phospholipid excipients, including physical chemistry aspects, and their use in pharmaceutical technology.

Target group are interested academic researchers as well as pharmaceutical industrial scientists interested in the use of phospholipid excipients.

The audience will be informed on selection and use of phospholipids in obtaining optimal liposomal dosage forms for various applications, including parenteral depot formulations and hot-melt extrusion for oral formulations of poorly soluble drugs, and on the latest advances on phospholipids in gene replacement therapy, infectious diseases, targeted therapy, nanobubble ablation in ophthalmology.



Recent Advances in the Use of Phospholipid Excipients

Learning Objectives

- To demonstrate the correlation between the physicochemical properties of the used phospholipids and phospholipid-based dosage forms and the performance of the drug substance (toxicity, efficacy, bioavailability and pharmacokinetics) with mentioned delivery systems.
- The audience will be informed on the latest advances in this phospholipid area in two sessions: The first session is a more general session on the use of phospholipids as excipients, whereas the second session will focus on application examples from liposomes and lipid nanoparticles (LNPs).





Phospholipid Research Center

The Phospholipid Research Center Heidelberg:
An introduction and ongoing research projects

PD DR. HABIL. SIMON DRESCHER

PHOSPHOLIPID RESEARCH CENTER, HEIDELBERG, GERMANY

CRS Annual Meeting & Exposition | Bologna, Italy | July 08, 2024

History

Founded in September 2006 by:

- A group of international scientists
- Lipoid GmbH/Germany
- PHOSPHOLIPID GmbH/Germany

Non-profit organization:

- Independent and self-contained

Management team:

- PD Dr. habil. Simon Drescher
- Dr. Richard Wibel (Research Associate)
- Ms. Britta Merz (Assistant)
- Dr. Franziska Drescher (Management)

Honorary President – Dr. Herbert Rebmann



HIGHLIGHTS

114

FUNDED PROJECTS

250+

PUBLICATIONS

90+

MEMBERS

Mission

The **Phospholipid Research Center** is dedicated to enhance the use of various kinds of phospholipids by:

- Promoting the use of phospholipids in pharmaceutics
- Sharing information among scientists and practitioners
- Expanding knowledge about phospholipids and their applications

Funding

Networking

Information

ACTIVITIES: PROJECT FUNDING



Research Proposal

- Encouragement of research groups to apply for project funding (PhD, Postdoc)
- Next deadline for PRE-proposal: **November 30, 2024**

Workshop Proposal / Funding of Meetings, Conferences

- Promotion of events offering practical demonstration courses and lively discussion rounds
- Next deadline: **November 30, 2024**



ACTIVITIES: MEETINGS AND SYMPOSIA

Researcher's Day

Main objective is to discuss the progress of the **funded projects** and to offer a platform for discussion and the exchange of scientific knowledge (**July 2023**)

Symposia "Phospholipids in Pharmaceutical Research"
2009 – 2022, biannually (**September 9–11, 2024**)

- Ca. 150–175 participants from all over the world (50-60 % from academia, 40-50 % from the industry)
- Up to sixty posters
- Highly reputed speakers
- Thudichum Young Scientist Award, Thudichum Life Award



ACTIVITIES: AWARDS

Poster Awards

Thudichum Young Scientist Award

For outstanding publications that focus on recent significant contributions to research into phospholipids

Thudichum Life Award

Honors lifelong, outstanding, and innovative scientific research in the field of phospholipids

- 2017: Professor Dr. Daan Crommelin (Utrecht University)
- 2019: Professor Dr. Yechezkel (Chezy) Barenholz (Hebrew University of Jerusalem)
- 2022: Professor Dr. Pieter Cullis (University of British Columbia)
- 2024: ???

ACTIVITIES: EDUCATION



Online Seminar Series Since December 2021, nearly every two months

ONLINE-SEMINAR
JANUARY 17, 2024, 3:30 PM (CET)



Analysing peptide/lipid interactions by affinity photocross-linking coupled to MS

Assist.-Prof. Dr. Astrid Walrant
Sorbonne University, Paris, France

 Phospholipid Research Center

ONLINE-SEMINAR
MARCH 13, 2024, 3:30 PM (CET)



Exogenous loading of extracellular vesicles with nucleic acids

Professor Dr. Jean-Christophe Leroux
ETH Zürich, Switzerland

 Phospholipid Research Center

ONLINE-SEMINAR
APRIL 24, 2024, 3:30 PM (CEST)



Pioneering a versatile LNP production process for mRNA vaccines, therapeutics, and gene editing - Unveiling the proof of concept

Dr. Andreas Wagner
Polymun Scientific GmbH, Klosterneuburg, Austria

 Phospholipid Research Center

ONLINE-SEMINAR
JUNE 12, 2024, 3:30 PM (CEST)



Phospholipid-containing nanocarrier systems for oral peptide delivery

JunProf. Dr. Philipp Uhl
Heidelberg University, Germany

 Phospholipid Research Center

Scientific Advisory Council

Prof. Dr. Alfred Blume

University Halle/GER

Biophysics of phospholipids

Prof. Dr. Gert Fricker

University Heidelberg/GER

Oral drug delivery systems, brain delivery, *in vitro* models to study transport mechanisms

Prof. Dr. Gert Storm

University Utrecht/NL

Liposomal delivery; drug delivery

Dr. Ralf-Olaf Quinkert

Lipoid GmbH/GER

Phospholipid analytics

Prof. Dr. Judith Kuntsche

University Southern Denmark/DK

Pharmaceutical technology
phospholipids/liposomes/cochleates

Prof. Dr. Paola Luciani

University Bern/CH

Physiological action,
phospholipids, liposomes

Dr. Frank Martin

Delpor Inc./USA

Broad range of expertise in drug delivery
systems / liposomal dosage forms

Dr. Peter Hölig

Lipoid GmbH/GER

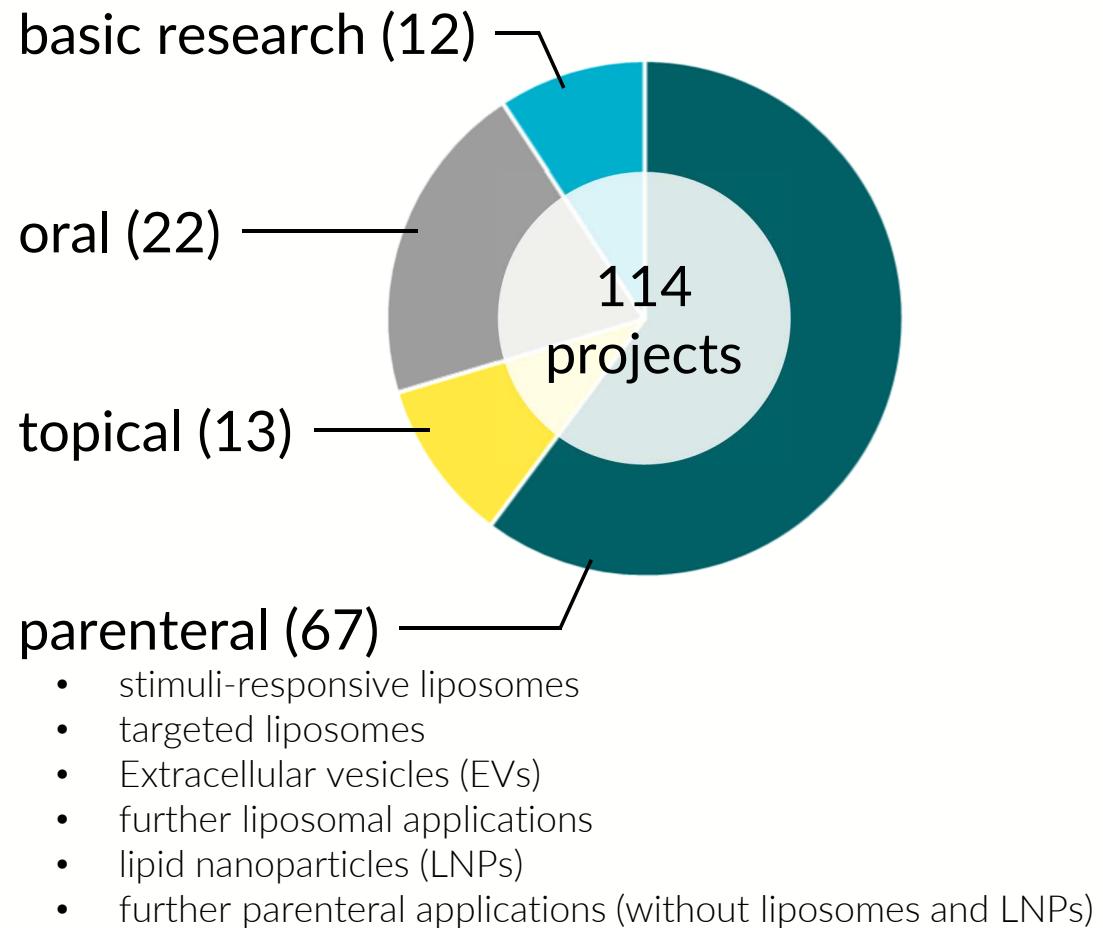
Industrial applications

PD Dr. Peter van Hoogeveest

Pharmanovation Consulting/GER

Drug delivery, Industrial applications

Funded Projects



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Phospholipid Research Center

Funded Projects

France (2)

Finland (2)

Portugal (2)

Canada (2)

GB (3)

USA (3)

Norway (3)

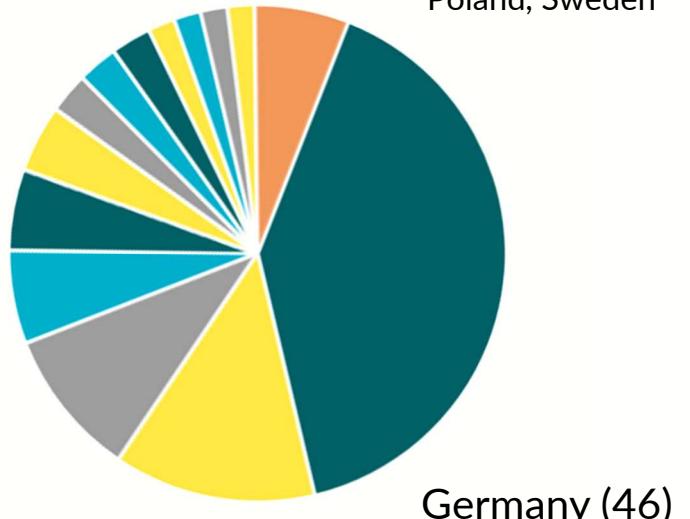
Italy (5)

Austria (6)

Denmark (7)

Switzerland (11)

the Netherlands (15)



Wibel, van Hoogevest, Drescher: The role of phospholipids in drug delivery formulations – Recent advances presented at the Researcher's Day 2023 Conference of the Phospholipid Research Center Heidelberg,
Eur. J. Pharm. Biopharm. 2024, 197, 114215.



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PARENTERAL STIMULI-RESPONSIVE LIPOSOMES

PI	Host	Start	Title of project
Stefaan De Smedt, Félix Sauvage	Ghent University, Belgium	2023	Photo-induced destruction of protein aggregates and liquefaction of vitreous humour using nanobubbles generating liposomes

Ongoing | In preparation | presentation in this workshop

PARENTERAL TARGETED LIPOSOMES

PI	Host	Start	Title of project
Michele Bernaconi	Bern University Hospital, Switzerland	2020	Targeted liposomal drug delivery to pediatric sarcomas: beyond the EPR effect
Jai Prakash	University Twente, the Netherlands	2020	Immunstimulating liposomes targeting M2 macrophages to eradicate cancer
Timo Laaksonen	University of Helsinki, Finland	2023	Targeted disruption of multidrug resistance (TARDIS)
Christian Buchholz	Paul-Ehrlich- Institut, Germany	2024	Receptor-targeted lipid nanoparticles for mRNA delivery into T lymphocytes

PARENTERAL EXTRACELLULAR VESICLES

PI	Host	Start	Title of project
Jean- Christophe Leroux	ETH Zurich, Switzerland	2023 <i>finished</i>	Hybridization of extracellular vesicles with lipid nanovectors
Pieter Vader	University Medical Center Utrecht	2024	Therapeutic RNA delivery by Extracellular Vesicle mimetics

Ongoing | [In preparation](#) | presentation in this workshop

PARENTERAL FURTHER LIPOSOMAL APPLICATIONS

PI	Host	Start	Title of project
Ruchi Bansal	University Twente, the Netherlands	2019	Bioactive liposomes for the treatment of non-alcoholic steatohepatitis (NASH)
Enrico Mastrobattista	Utrecht University, the Netherlands	2020	Liposome-based coatings for immune stimulation and bone regeneration
Manuela Gaspar	University of Lisbon, Portugal	2021	Rifabutin liposomes: a novel nanotechnological strategy for effective treatment of systemic methicillin-resistant <i>staphylococcus aureus</i> infections
Naomi Benne	Utrecht University, the Netherlands	2024	A genome-wide CRISPRi screen to unravel the role of liposomal phospholipid composition in phagocytic cell uptake and subsequent tolerogenic immune responses

Ongoing | In preparation | presentation in this workshop

PARENTERAL LIPID NANOPARTICLES (LNP)

PI	Host	Start	Title of project
Jörg Huwyler	University Basel, Switzerland	2021	Design of lipid based nanoparticles for gene delivery
Davide Brambilla	University of Montréal, Canada	2022	Phospholipid nanoparticles for lysosomal acid lipase deficiency gene replacement therapy
Christoffer Åberg	University of Groningen, the Netherlands	2023	Improving endosomal escape of lipid nanoparticles

Ongoing | In preparation | presentation in this workshop

PARENTERAL FURTHER APPLICATIONS (WITHOUT LIPOSOMES AND LNPS)

PI	Host	Start	Title of project
Katarina Edwards	Uppsala University, Sweden	2019	Lipodisks for dual delivery of chemotherapeutic drugs and anticancer peptides
K. Mäder, A. Meister	University Halle, Germany	2020	PS and PG enriched extrudates and nanofibers for local anti-inflammatory therapies
Wolfgang Friess	LMU Munich, Germany	2021	Lyso phosphatidylcholine for the stabilization of pharmaceutical proteins against adsorption and aggregation
Ulrich Massing	University Freiburg, Germany	2022	Stabilization of Lyso-Phosphatidylcholine- levels in patients with cancer

Ongoing | In preparation | presentation in this workshop

ORAL

PI	Host	Start	Title of project
Anthony Attama	University of Nigeria	2018	Development of phospholipid based depot antimalaria tablets of <i>azadirachta indica</i> leaf extract and artemether/lumefantrine for oral delivery
Paulina Skupin-Mrugalska	Poznan University of Medical Sciences, Poland	2020	PLs as excipients in amorphous solid dispersions: an attempt to establish hot-melt-extrusion for oral formulations of poorly soluble drugs
Meike van der Zande	Wageningen, the Netherlands	2020	Liposomes as oral delivery systems for poorly soluble compounds: behavior during digestion and absorption processes
Philipp Uhl, Walter Mier	University Hospital Heidelberg	2021	Liposomal formulation of resistance breaking vancomycin derivatives
Martin Brandl	University of Southern Denmark	2023	In depth mechanistic biopharmaceutical investigation of oral phospholipid-based formulations for poorly soluble drugs

Ongoing | In preparation | presentation in this workshop

DERMAL

PI	Host	Start	Title of project
Victoria Klang	University of Vienna, Austria	2022	Phospholipid-based emulsifiers for sunscreen development: impact of UVA and effect on skin properties in vitro, ex vivo, and in vivo
Mohamadreza Amin	Erasmus Medical Center, Rotterdam, the Netherlands	2024	Formulation of lipid nanoparticles (LNP) encapsulating micro-RNA for topical treatment of high-grade squamous intraepithelial lesions (HSIL) lesion
Simon Mattoori	University of Montréal, Canada	2024	A hydrogen peroxide-sensing liposomal hydrogel for molecular diagnostics in diabetic wounds

Ongoing | In preparation | presentation in this workshop

BASIC RESEARCH

PI	Host	Start	Title of project
H. Heerklotz, L. Naßwetter	University Freiburg, Germany	2020	Establishing a fundamental understanding of the fate of mixed micellar formulations after iv administration
Christian Nehls	Research Center Borstel, Germany	2022	Liposome-based microfluidic platform for standardized analysis of antibacterial compounds
Vincent Faivre	University Paris-Saclay, France	2023	Key-roles of phospholipids in anisotropic lipid-based nanoscale dispersions: From self-assembly mechanism and manufacturing process to properties as drug delivery vehicles for iv administration
Sarah Gordon	University of Birmingham, UK	2024	Probing the interaction of liposome delivery systems with Gram negative bacterial cell envelopes: a comprehensive investigative approach

Ongoing | In preparation | presentation in this workshop



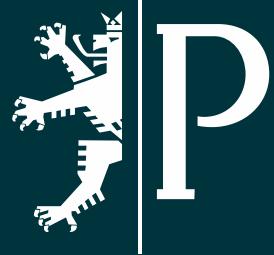
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