

Scientific Report

Executive Summary

The Summer School consisted of three parts: Lectures, Discussion sessions and Posters.

Lectures were delivered by a chosen faculty of high international standard in their respective fields as well as several selected student participants.

Discussion sessions were scheduled between the lectures, intermingling with joint meals and social activities, sauna, gastrophysics, and walking excursions of the Utö island, introducing its history.

Posters had been made by 12 out of the total of 21 students. The posters were accessible and discussed throughout the week.

To organize the summer school on the remote island of Utö at the edge of the Finnish Archipelago involved a number of logistical challenges, mainly because of the fact that the conditions could not be described in detail to the participants, making it impossible for many to realize that the site was not at the end of regular bus service. Nevertheless, the outcome more than justified the extra efforts needed on the behalf of the organizers in order to run the summer school smoothly as a structured event. The exposure of the participants to the unique surroundings was highly appreciated and provided with an astonishing experience to people of different nationalities. Accordingly, participants could enjoy scientific discussions in a truly unique and relaxing atmosphere. The lecturers were accessible to the students for the time of the school not only in the meeting room, but also during the breaks, meals and times for recreation, enjoying the Finnish sauna culture, for instance.

The faculty comprised of leading experts in the fields, such exemplified by professors Thomas Heimburg, Ole Mouritsen, Stephen White, Björn Lindman, Motomu Tanaka and Erich Sackmann. Importantly, they have extensive teaching experience which was readily seen in the quality of their presentations. Erich Sackmann's participation was of particular importance as he has a very warm and fatherly attitude towards students and he is very supportive to the careers of female scientists, in particular from economically and politically strained regions. As the contents of the lectures were in general on a very high level and demanded the full attention of the students, care was taken to schedule the program in a manner allowing participants to digest the contents in a relaxed manner. In the evaluations obtained people commented exceptionally positively both the site as well as the selection of

the faculty, many people stating that this was the best summer school they had ever attended, 'mainly because of the unique mix of people'.

From the abstracts received from the students several were additionally selected for brief oral presentations and awards were given for the best poster as well as the most interdisciplinary poster. This process was taken very seriously by the students and the outcomes were very much appreciated. Posters were evaluated by a jury comprised of:

- Prof. (emer.) Erich Sackmann TUM, Munich, Germany,
- Prof. Stephen White UCI, CA, USA and
- Prof. Björn Lindman, Lund Univ, Lund, Sweden,

who selected the (1) Best poster and (2) the most interdisciplinary poster.

The best poster: "*Nanocomposite production for anticancer drug encapsulation using supercritical fluid in SAS process*" was presented by Dr. Zahra Akbari of the University of Teheran, Iran.

The most interdisciplinary poster: "*Liposomes for Targeted Drug and Gene Delivery and Magnetic Imaging*" was presented by MSc. Sanjeev Ranjan, HBBG, BECS, Aalto University, Finland.

All in all, the summer school could be readily deemed as a great success, receiving an overall score of 9.7/10 in the anonymous rating given by the participants.

Scientific Content

The summer school was organized in order to expose the students to interdisciplinary approaches in molecular engineering, focusing on the material properties of biomembranes and their constituents, aiming at the development of novel drug delivery systems and sensors. For this purpose, the school started with presentation on the fundamental properties of lipids and biopolymers (proteins, nucleic acids) governing their self assembly in living systems and in a laboratory. These aspects were discussed not only from the point of view of biophysics and biology but also as colloidal systems. As paradigm systems the assembly of lipid membranes and protein folding were thoroughly discussed. These two systems were then merged in describing the thermodynamics of interaction of peptides with lipid bilayers. Sufficiently deep understanding of the biological structures and their functions readily open up the possibility to reverse engineer such modalities in the laboratory as a man-made devices, with functions not yet seen in biological systems. Bridging these views demonstrated in a very concrete manner to the students the necessity to involve an interdisciplinary approach in order to obtain solid and rationale understanding of the behavior of these biological systems. Likewise, it also became very clear that this approach further allows for rational design in using molecular self assembly to generate new technologies, such as nanoparticles for drug and gene delivery. For drug delivery the design and use of liposomes was discussed in detail, in particular in connection to modern MRI imaging combined with high intensity focused ultrasound. Targeting of liposomes was described also in poster presentations.

From fundamental research point of view it was of importance that the molecular basis of some of the major ailments (Alzheimer's and Parkinson's disease, type 2 diabetes, prion disease) was discussed in considerable detail, again demonstrating the power of biophysics in providing rational understanding of these pathological processes, which still puzzle the medical community and present a considerable burden to the healthcare system in all industrial states. It became obvious that further research along the lines described will be able to introduce ground breaking novel approaches not only to cure but also to intervene with the progression of the above diseases for prevention.

Additionally, while the school did not focus on methods per se, some important developments were deemed worthwhile of introduction because of limited use so far or because of exceptional value for future activities in the relevant areas. These methods were neutron scattering, computer simulations, NMR and Langmuir films.

Future directions

The summer school contributed to two areas as follows. First, emphasizing the crucial importance of rational, understanding of basic biomaterial properties in order to allow to exploit these materials in molecular engineering and design of novel devices, drug delivery systems, and sensors. Second, the school illustrated concretely how the understanding of the colloidal and biophysical properties of biomaterials allows to decipher the principles of self-assembly in biological systems, organizing on different length- and time-scales. Several participants discussed actively about collaborations and new opening for this have been made also after the event.

Final Program

4.6.2011 Saturday

13:00	17:00	Ferry from Turku - Aspö
17:00	17:30	Check in
17:30	19:30	Dinner & Get together
19:30	20:00	Welcoming address: Paavo Kinnunen

5.6.2011 Sunday

7:30	09:00	Breakfast
11:00	12:30	Introduction of the students
12:30	14:00	Lunch
14:00	15:00	Hanna Kovanen: Information on Utö
15:00	17:30	Poster set up
17:30	19:00	Dinner
19:00	20:00	Opening Lecture: Erich Sackmann: Adhesion induced micro-domains as biochemical reaction centres - Immunological Synapses

6.6.2011 Monday

7:30	09:00	Breakfast
9:00	10:00	Björn Lindman: Basic aspects of self-assembly and association of surfactants
10:00	11:00	Thomas Heimburg: Lipids of biomembranes
11:00	11:30	Coffee break
11:30	12:30	Stephen White: Dynamics of lipid bilayer
12:30	14:00	Lunch

14:00	15:00	Tommy Nylander: Lipolysis and lipid phase behaviour
15:00	16:00	Louise Serpell: Protein folding and misfolding 1
16:00	16:30	Coffee
16:30	17:30	Louise Serpell: Protein folding and misfolding 2
17:30	19:00	Dinner
19:00	20:00	Hanna Kovanen: Utö history & people

7.6.2011 **Tuesday**

7:30	09:00	Breakfast
9:00	10:00	Björn Lindman: Surfactant-polymer systems
10:00	11:00	Gerhard Gröbner: Lipid protein interactions
11:00	11:30	Coffee break
11:30	12:30	Galyna Gorbenko: Electrostatics of lipid protein interactions
12:30	14:00	Lunch
14:00	15:00	Stephen White: Thermodynamics of peptide-bilayer association
15:00	16:00	Maria da Graça Miguel: DNA-surfactant interactions
16:00	16:30	Coffee
16:30	17:30	Pavel Jungwirth: Lipids and interfaces in silico
17:30	19:00	Dinner
19:00	20:00	Ole G. Mouritsen: Marine treasures

8.6.2011 **Wednesday**

7:30	09:00	Breakfast
9:00	10:00	Ole G. Mouritsen: Liposomes in drug delivery
10:00	11:00	Maria da Graça Miguel: DNA gels, gel particles and transfection
11:00	11:30	Coffee break

11:30	12:30	Motomu Tanaka: Building interface between biomolecules and digital world
12:30	14:00	Lunch
14:00	15:00	Tommy Nylander: Drug delivery using self-assembly systems and the interaction with biomembranes
15:00	16:00	Robert Corkery: Cubic phases in biomembranes
16:00	16:30	Coffee
16:30	17:00	Roman Volinsky: Lipid monolayers: theory and applications
17:00	17:30	Vladimir Zamotin: Liposomes and MRIgHIFU in targeted drug delivery
17:30	19:00	Dinner

9.6.2011

Thursday

7:30	09:00	Breakfast
9:00	10:00	Erich Sackmann: How composite cell membranes control cell processes: from locomotion to killing cells and catching pathogens
10:00	11:00	Thomas Heimburg: Phospholipid phase transitions
11:00	11:30	Coffee break
11:30	12:30	Åke Wieslander: How lipids control their own synthesis I
12:30	14:00	Lunch
14:00	15:00	Juha-Matti Alakoskela: Drug-lipid Interactions: principles and applications
15:00	15:30	Lukasz Cwiklik: Interactions of monovalent ions with charged phospholipid membranes
15:30	16:00	Sanjeev Ranjan: Liposomes for targeted drug and gene delivery and magnetic Imaging
16:00	16:30	Coffee
16:30	17:30	Åke Wieslander: How lipids control their own synthesis II
17:30	19:00	Main Dinner

10.6.2011 Friday

7:30	09:00	Breakfast
9:00	10:00	Gerhard Gröbner: Biomembrane structural dynamics by NMR
10:00	11:00	Galyna Gorbenko: Lipid protein interactions as seen by FRET
11:00	11:30	Coffee break
11:30	12:30	Motomu Tanaka: Membrane assemblies as seen by scattering techniques
12:30	14:00	Lunch
14:00	14:30	Mario Vazdar: Adsorption of arginine and lysine peptides at the POPC bilayer
14:30	15:00	Kateryna Vus: Novel bromobenzanthrone derivatives for amyloid studies
15:00	15:30	Manju Singh: Anionic porous alumina as a stable microarray for biosensor
15:30	16:00	Ajay Mahalka: Hsp70-phospholipid membrane interaction opens new avenues for therapeutics
16:00	16:30	Coffee
16:30	17:30	Results of poster competition; award ceremony and Discussion: Future of biomembrane research
17:30	19:00	Dinner
19:00	20:00	Paavo Kinnunen: Closing remarks

11.6.2011 Saturday

07:30	08:30	Breakfast
8:30	12:00	Departure: Ferry Eivor to Pärnäs
12:30	14:00	Lunch
17:30	19:00	Dinner

12.6.2011

Sunday

13:00 16:30 Departure 2: Ferry Aspö to Turku

Statistical information on participants

Name	Age	Gender	Country of origin
Anna Kastorna	21	F	Ukraine
Kateryna Vus	21	F	Ukraine
Sirius Vuorikoski	21	F	Finland
Zahra Akbari	34	F	Iran
Manju Singh	31	F	India
Pauli Mikael Suhonen	23	M	Finland
Alexander Körner	27	M	Germany
Elmo Christian Saarentaus	24	M	Finland
Petteri Parkkila	21	M	Finland
Aniket Suresh Magarkar	26	M	India
Oleg Golubev	30	M	Estonia
Lukasz Cwiklik	34	M	Poland
Mario Vazdar	32	M	Croatia
Piotr Jurkiewicz	34	M	Poland
Pyry Kivisaari	25	M	Finland
Riku Paananen	22	M	Finland
Rohit Sood	32	M	India
Roberto Tejera- Garcia	33	M	Spain
Aqeel Ahmad	31	M	India
Ajay Mahalka	30	M	India
Sanjeev Ranjan	30	M	India

Participants, faculty

		Affiliation	Country	E-mail
1	Prof. Galyna Gorbenko	U Kharkov,	Ukraine	galyna.p.gorbenko @ univer.kharkov.ua
2	Prof. Maria da Graça Miguel	U Coimbra	Portugal	
3	Prof. Gerhard Gröbner	U Umeå	Sweden	
4	Prof. Thomas Heimburg	Niels Bohr Institute, Copenhagen	Denmark	theimbu @ nbi.dk
5	Juha-Matti Alakoskela	HBBG, Helsinki	Finland	juha-matti.alakoskela @ helsinki.fi
6	Prof. Pavel Jungwirth	Czech Acad Sci, Prague	Czech Republic	pavel.jungwirth @ uochb.cas.cz
7	Prof. Paavo Kinnunen	Aalto University	Finland	paavo.kinnunen @ aalto.fi
8	Prof. Björn Lindman	Lund University	Sweden	bjorn.lindman @ fkem1.lu.se
9	Prof. Ole G. Mouritsen	SDU, Odense	Denmark	ogm @ memphys.sdu.dk
10	Prof. Tommy Nylander	Lund University	Sweden	tommy.nylander @ fkem1.lu.se
11	Prof. Erich Sackmann	TUM, Munich	Germany	sackmann @ physik.tu- muenchen.de
12	Prof. Louise Serpell	U Sussex	UK	l.c.serpell @ sussex.ac.uk
13	Prof. Motomu Tanaka	Univ. Heidelberg	Germany	tanaka @ uni- heidelberg.de
14	Dr. Roman Volinsky	HBBG, Helsinki	Finland	roman.volinsky @ aalto.fi
15	Prof. Stephen White	UCI, Irvine	USA	stephen.white @ uci.edu
16	Prof. Åke Wieslander	U Stockholm	Sweden	ake @ dbb.su.se
17	Vladimir Zamotin	HBBG, Helsinki	Finland	vladimir.zamotin @

				aalto.fi
18	Robert Corkery	YKI, Stockholm	Sweden	robert.corkery @ yki.se

Participants, students

1. Anna Kastorna, V.N. Karazin Kharkiv National University, Ukraine
2. Katerina Vus, V.N. Karazin Kharkiv National University, Ukraine
3. Sirius Vuorikoski, Aalto University school of science, Finland
4. Zahra Akbari, Tehran University, Iran
5. Manju Singh, Genova University, Italy
6. Pauli Mikael Suhonen, Aalto University school of science, Finland
7. Alexander Körner, University of Heidelberg, Germany
8. Elmo Christian Saarentaus, Aalto University school of science, Finland
9. Petteri Parkkila, Aalto University school of science, Finland
10. Aniket Suresh Magarkar, University of Helsinki, Finland
11. Oleg Golubev, University of Turku, Finland
12. Lukasz Cwiklik, Academy of Sciences of the Czech Republic, Czech Republic
13. Mario Vazdar, Academy of Sciences of the Czech Republic, Czech Republic
14. Piotr Jurkiewicz, Academy of Sciences of the Czech Republic, Czech Republic
15. Pyry Kivisaari, Aalto University school of science, Finland
16. Riku Paananen, Aalto University school of science, Finland
17. Rohit Sood, HBBG, Aalto University, Finland
18. Roberto Tejera-Garcia, HBBG, Aalto University, Finland
19. Aqeel Ahmad, HBBG, Aalto University, Finland
20. Ajay Mahalka, HBBG, Aalto University, Finland
21. Sanjeev Ranjan, HBBG, Aalto University, Finland

Molecular Engineering Summer School, Utö island, Finland 4-11 June 2011

ANNEX I

Detailed report of Expenditure

Accommodation		Amount in Euro
Utö Havshotel, MESS2011 venue, accommodation 4.-11.6.2011		10 380,00
White, Stephen hotels 3.-4.6.2011 and 11.-12.6.2011		314,73
Sackmann, Erich, hotels 3.-4.6.2011 and 12.-13.6.2011		224,20
Nylander, Tommy, hotels 3.-4.6.2011 and 11.-12.6.2011		226,00
Serpell, Louise hotels 3.-4.6.2011 and 8.-9.6.2011		190,32
Tanaka, Motomu 5.-6.6.2011 and 11.-12.6.2011		431,00
Akbari, Zahra hotels 3.-4.6.2011 and 12.-13.6.2011		118,44
Singh, Manju hotels 3.-4.6.2011 and 11.-12.6.2011		75,70
Jurkiewicz, Piotr hotels 3.-4.6.2011 and 11.-12.6.2011		186,00
Wieslander, Åke hotel 7.-8.6.2011		107,00
Körner, Alexander hotels 3.-4.6.2011 and 11.-12.6.2011		151,61
Gröbner, Gerhard hotels 3.-4.6.2011 and 11.-12.6.2011		208,00
Lindman, Björn hotels 3.-4.6.2011 and 11.-12.6.2011		273,00
Total		12 886,00
Travel		Amount in Euro
White, Stephen		923,78
Sackmann, Erich		596,83
Nylander, Tommy		64,99
Serpell, Louise		460,11
Tanaka, Motomu		152,50
Akbari, Zahra		682,78
Singh, Manju		385,21
Magarkar, Aniket		56,30
Jungwirth, Pavel		287,91
Cwiklik, Lukasz		252,52
Vazdar, Mario		252,52
Jurkiewicz, Piotr		284,87
Wieslander, Åke		334,23
Suhonen, Pauli		29,60
Kastornaya, Anna		190,72
Vus, Kateryna		197,46
Gorbenko, Galya		113,26
Kivisaari, Pyry		77,10
Körner, Alexander		281,80
Mouritsen, Ole		818,84
Gröbner, Gerhard		68,81
Lindman, Björn		1 448,71
Raz, Jelinek		197,15
Collective train ticket Helsinki - Turku - Helsinki 4.6.2011 and 11.6.2011*		809,00
Ferry to/from Utö island 4.6.2011 and 11.6.2011		950,00
Charter boat to/from Utö 8.6.2011 (to: Wieslander, Corkery, from: Mouritsen, Serpell)		800,00
Charter bus from Nauvo to Turku to all participants 11.6.2011		190,00
Total		10 907,00
Meals		Amount in Euro
Utö Havshotel, MESS2011 venue:	people	
4.-11.6.2011 Breakfasts	40	1 290,00
4.6.2011 Lunch / Dinner	1/36	700,79
5.6.2011 Lunch, two coffee breaks, dinner, evening snack	37	1 232,00
6.6.2011 Lunch, two coffee breaks, dinner, evening snack	37	1 938,50
7.6.2011 Lunch, two coffee breaks, dinner, evening snack	37	2 766,50
8.6.2011 Lunch, two coffee breaks, dinner, evening snack	37	1 670,00
9.6.2011 Lunch, two coffee breaks, main dinner, evening snack	37	3 751,71
10.6.2011 Lunch, two coffee breaks, dinner, evening snack	36	1 709,00
11.6.2011 Lunch, dinner	3	335,00
Lunch at the ferry to/from Utö 4.6.2011 and 11.6.2011	38	813,50
Total		16 207,00
Total		40 000,00

* Train tickets to Helsinki - Turku - Helsinki:

Sanjeev Ranjan
Ajay Mahalka
Rohit Sood
Aqeel Ahmad
Roberto Tejera-Garcia
Roman Volinsky
Vladimir Zamotin
Juha-Matti Alakoskela
Sirius Vuorikoski
Petteri Parkkila
Riku Paananen
Galina Gorbenko
Katarina Vus
Anna Kastornaya

Espoo 24.8.2011

Paavo Kinnunen
Professor

Eva Lampinen
Controller

