Program

Miniworkshop “From toric to hyperbolic”

University of Antwerp, Belgium

March 15-16, 2022

Organizers:
Yannick Gullentops (University of Antwerp)
Sonja Hohloch (University of Antwerp)

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SCHEDULE

*The additional **Zoom links** will be send to all registered participants by email.*

Tuesday, March 15, 2022		
When?	**What?**	**Where?**
09:55 – 10:00h Brussels time	*Arriving/connecting to workshop*	*M.G.010 or Zoom*
10:00 – 11:00h	**Talk by Bohuan Lin**	**M.G.010 + Zoom**
11:00 – 11:15h	Questions/discussion	M.G.010 + Zoom
11:15 – 12:15h	**Talk by Dmitrii Sadovskii**	**M.G.010 + Zoom**
12:15 – 12:30h	Questions/discussions	M.G.010 + Zoom
12:30 – 14:00h	**Lunch break**	**Cafeteria**
14:00 – 15:00h	**Talk by Aldo Witte**	**M.G.010 + Zoom**
15:00 – 15:15h	Questions/discussions	M.G.010 + Zoom
15:15 – 16:30h	**Talk by Simone Gutt**	**M.G.010 + Zoom**
16:30 – 16:45h	Questions/discussions	M.G.010 + Zoom

Wednesday, March 16, 2022		
When?	**What?**	**Where?**
09:55 – 10:00h Brussels time	*Arriving/connecting to workshop*	*G.V.009 or Zoom*
10:00 – 11:00h	**Talk by Oliver Fabert**	**G.V.009 + Zoom**
11:00 – 11:15h	Questions/discussion	G.V.009 + Zoom
11:15 – 12:15h	**Talk by Boris Zhilinskii**	**G.V.009 + Zoom**
12:15 – 12:30h	Questions/discussions	G.V.009 + Zoom
12:30 – 14:00h	**Lunch break**	**Cafeteria**
14:00 – 15:00h	**Public PhD defense by Yannick Gullentops**	**M.G.010 + Zoom**
15:00 – 15:15h	Questions/discussions	M.G.010 + Zoom
15:15 – 17:00h	**Workshop reception**	**Entrance Hall Building G**

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Floer theory
for Hamiltonian particle-field systems

Oliver Fabert

(VU Amsterdam)

While in classical mechanics the dynamics of particles are determined under the assumption that the fields are known a priori, in coupled particle-field systems one views the fields equally as part of the dynamical process. While it is apparent that point particles need to be replaced by extended particles with sufficiently regular shape functions for classical solutions to exist, it turns out that the nonlinearities in the resulting infinite-dimensional Hamiltonian systems still exhibit enough compactness properties so that Floer theory can be suitably generalized, even despite the presence of a small divisor problem. This is joint work with my PhD student Niek Lamoree.

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Hyperbolic singularities in the presence of S^1-actions and Hamiltonian PDEs

Yannick Gullentops

(University of Antwerp)

Hamiltonian systems are dynamical systems which have at least one conservation law. These systems are of particular interest because they allow us to use geometric tools to obtain dynamical results. This thesis focuses on two distinct types of Hamiltonian systems: proper S^1-systems and Hamiltonian PDEs.

Proper S^1-systems are Hamiltonian systems on four dimensional manifolds, where we have two conservation laws one of which is a proper map inducing an S^1-action. The presence of the S^1-action allows us to link the minimal period (dynamical feature) of that S^1-action to the local shape of hyperbolic fibers (topological feature). This allows us to establish a one-to-one correspondence between the topology of hyperbolic fibers and a graph theoretical construction, called a generalized bouquet. After the theoretical classification of hyperbolic fibers we focus on explicit examples. We study the bifurcation behaviour of a family of proper S^1-systems and discuss what happens locally around hyperbolic fibers.

For the investigation of Hamiltonian PDEs, we start with a ‘triholomorphic’ Dirac-type equation, called the Cauchy-Riemann-Fueter equation, on a so-called hyperkähler manifold that can be transformed into a Hamiltonian PDE. Then, we discuss scale manifolds as preferred underlying function space for the study this equation. Finally, we describe the problems concerning convergence behaviour.

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Almost complex structures, transverse complex structures, and (p,0) Dolbeault cohomology

Simone Gutt

(ULB, Brussels)

An almost complex structure j on a manifold M is integrable if and only if its Nijenhuis tensor N^j vanishes, and this is true iff the distribution $T_j^{\{1,0\}} \subset TM^C$ is involutive.

When it is not integrable, we relate properties of M to properties of distributions associated to j. In particular, we study conditions for j to define a complex tranverse structure and we relate the transverse (p, 0) Dolbeault cohomology to the (p, 0) generalized Dolbeault cohomology of (M, j) as introduced recently by Cirici and Wilson.

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Dynamics on Maslov S^1-Bundles

Bohuan Lin

(Groningen)

By saying Maslov S^1-bundle over a symplectic manifold (M, ω) we mean the determinant bundle of the unitary frame bundle of an almost complex structure compatible with the symplectic structure.

In this talk we will take a look at some interesting properties related to this bundle with dynamics on M. This is joint work with Konstantinos Efstathiou and Holger Waalkens.

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Universal local form of quaternionic slow-fast systems

Dmitrii Sadovskii

(Université du Littoral, Dunkerque)

We construct an elementary quaternionic slow-fast Hamiltonian dynamical system with one formal control parameter and two slow degrees of freedom as half-integer spin in resonance 1:1:2 with two slow oscillators, and which we call "Quaternionic Dirac oscillator". Invariant under spin reversal and having a codimension-5 crossing of its fast Kramers-degenerate semi-quantum eigenvalues, our system is the dynamical equivalent of the spin-quadrupole model by *Avron, Sadun, Segert, and Simon [Commun. Math. Phys. 124 (4), 595 – 627 (1989)]*, exhibiting non-abelian geometric phases. The equivalence is uncovered through the equality of the spectral flow between quantum superbands and Chern numbers c_2 computed by *Avron et al.*

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Moment maps of toric manifolds as Lie algebroid submersions

Aldo Witte

(KU Leuven)

The moment map of a toric manifold fails to be a submersion in a very controlled way. Therefore, it is possible to describe it as a submersion between two Lie algebroids. Using this observation it is possible to extend the theory of symplectic fibrations to Lie algebroids, which is then used to construct examples of singular symplectic structures. This is a joint work with Gil Cavalcanti and Ralph Klaasse.

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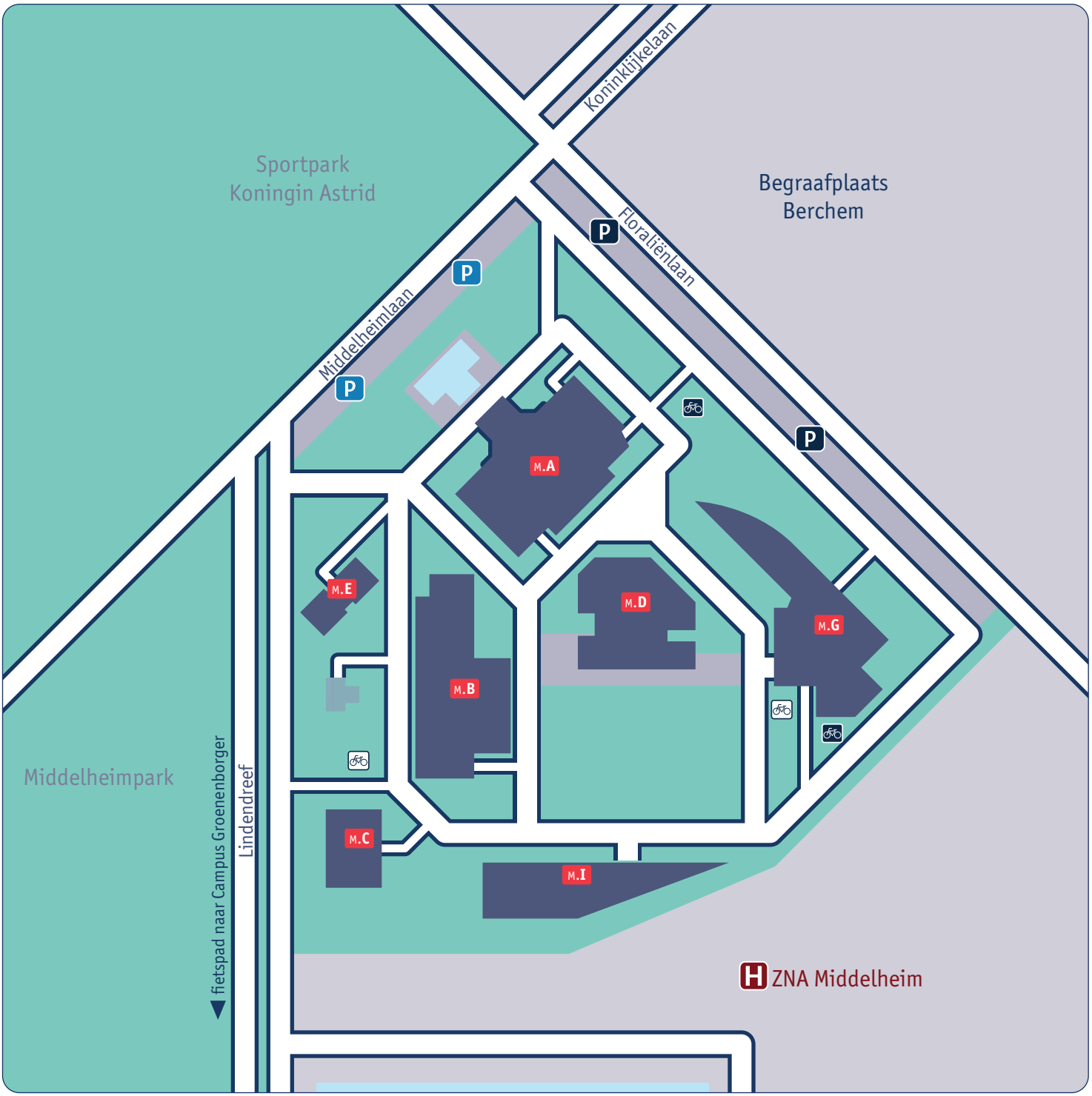
Rearrangement of molecular energy bands: From physical systems to mathematical models

Boris Zhilinskii

(Université du Littoral, Dunkerque)

There exist a number of simple physical quantum systems (mainly isolated molecules) which show generic qualitative effect: formation of energy bands and rearrangement of energy levels between bands under variation of control parameter. I will explain construction of simple mathematical models describing such generic qualitative phenomena for different classes of physical systems.

Campus Middelheim



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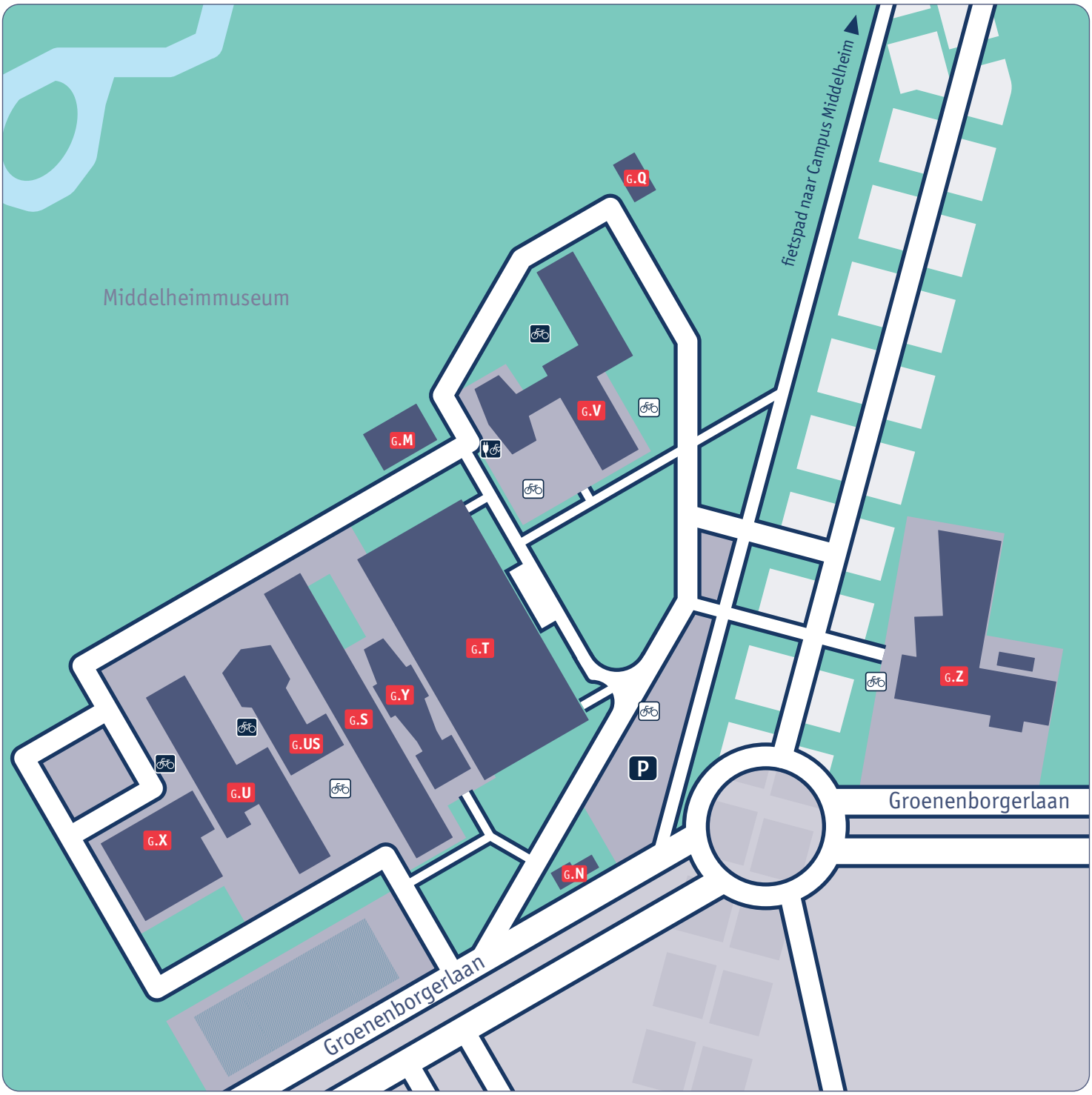

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