

# Two-minute meeting 2012

Department of Theoretical Particle Physics and Cosmology  
The Niels Bohr Institute  
University of Copenhagen

October 25<sup>th</sup>, 2012

## New group members since last meeting

- Visiting Professors: Jeff Greensite (San Francisco), Subir Sarkar (Oxford), Gordon Semenoff (UBC)
- Long-term staff: Simon Caron-Huot (Princeton IAS), Troels Harmark (NORDITA)
- Postdocs: Timothy Budd (Utrecht), Tristan Dennen (UCLA), Matti Herranen (Aachen), Joyce Myers (Groningen).
- PhD students: Anne Mette Frejesel (NBI), Christine Hartman (NBI & Santa Barbara), Asger Ipsen (NBI), Laura Jenniches (RWTH,Aachen), Mads Søgård (NBI),
- Master students: 11 (at least)

## Upcoming events

- Elite PhD School: “Black Holes and Applied Holography,” Nov. 12-16

## Scientific Group Activities

- Seminars (Organizers: Jelle Hartong, Donal O'Connell)
- Journal club (Organizer: Ricardo Monteiro)
- PhD meetings (Organizers: Agnese Bissi, Jakob Gath)

## Group secretary:

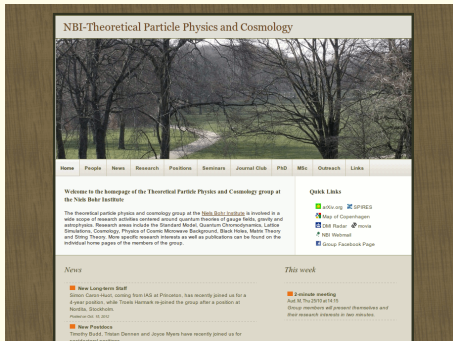
- Anna Maria Rey (Tue-Wed-Thu) in FB8A.  
(F-building is the building of the canteen, B first floor, C second floor)

## Utility items

- “Lounge” FB6 for discussions, journal club, other social activities, coffee
- Two group bikes (Pick up the key and note your name on the sheet in the kitchen of the FC floor).
- Group homepage, face-book page, mailing lists (—→ Costas Zoubos)

# The group website

<http://hetcosmo.nbi.dk>



- Please check your personal page and send any corrections to Costas at [kzoubos@nbi.dk](mailto:kzoubos@nbi.dk).
- Comments and suggestions are welcome!
- Whoever wants to get involved is even more welcome!!

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K.Zoubos



# The group facebook page



- Can be accessed without a facebook account
- Could be used for sharing interesting links (online talks, conferences, articles), pictures from group events etc.

# The group mailing lists

- There exist several mailing lists for different subsets of the group members
  - ▶ `het-seminars@nbi.ku.dk` All group members, but also **non-members** who might be interested in the group's seminars, journal clubs, workshops etc. Widest possible list
  - ▶ `hetcosmo-all@nbi.ku.dk` All group members and long-term visitors (but not master's students!)
  - ▶ `hetcosmo-staff@nbi.ku.dk` Permanent group members
  - ▶ `hetcosmo-postdocs@nbi.ku.dk` Postdocs, long-term staff
  - ▶ `hetcosmo-phd@nbi.ku.dk` PhD students
  - ▶ `hetcosmo-msc@nbi.ku.dk` Master's students
  - ▶ `hetcosmo-guests@nbi.ku.dk` Current visitors and guests
  - ▶ `hetcosmo-alumni@nbi.ku.dk` Under construction
- Apart from `het-seminars`, any member of a list can post to that list.
- Suggestions for improvements are welcome!

DT: Dynamical Triangulations. A lattice regularization of the path integral over geometries.

CDT: Causal Dynamical Triangulations. DT with a time foliation.

Some projects where JA is a participant:

- 4d CDT renormalization group.
- 4d DT extended phase diagram.
- CDT transfer matrix project (2d and 4d)
- CDT coupled to matter project.
- Construction of a measure on 2d geometries (a generalization of the Wiener measure for particles)

General present theme: quantum geometry

- NBIA & Discovery Center
- Perturbative QCD, “On-shell” methods
- Precision predictions for SM backgrounds at the LHC
- Multi-leg amplitudes at NLO

[with Valery Yundin]

- Numerical evaluation of one-loop amplitudes in QCD
- NLO multi-jet production at the LHC

[NJET]

- Beyond NLO?

[NNLO required to get errors  $< 10\%$ ]

- Integrand reduction methods for multi-loop amplitudes

[with Hjalte Frellesvig and Yang Zhang]

## Some of the Projects on which I am Working Just Now:

- String Field Theory (with M. Ninomiya).
- Dark Matter having fallen in Tunguska, and making Kimberlites, when the dark matter balls fall? (with C. Froggatt).
- Formal investigation of e.g. Harmonic Oscillator (and inverse harmonic oscillator) with **complex action** or non-Hermitean Hamiltonian, Slow Roll Problem ? (with K. Nagao)
- Gravity in Plebansky formulation (L. Laperashvili, D. Bennett, ...)

# Agnese Bissi



- I am PhD student under the supervision of Charlotte Kristjansen, I will graduate in March 2013.
- I am working on integrability in the context of the AdS/CFT correspondence, in particular computing three point correlation functions both from the gauge and string theory side.

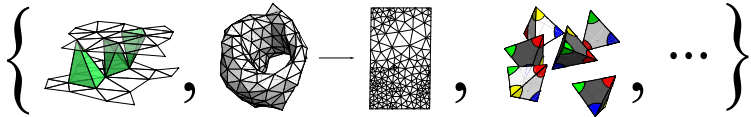
# Emil Bjerrum-Bohr

NBIA & DISCOVERY, Office, Bb.1

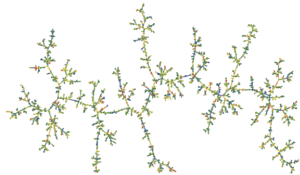
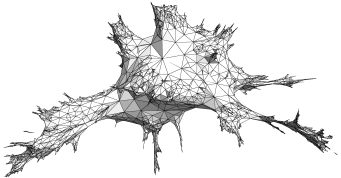
## Research interests:

- Field theory and String Theory  
Gauge and Gravity theories
- Gauge theory / Gravity links (KLT)  
Monodromy and BCJ relations between gauge  
amplitudes  
New KLT forms
- Amplitudes and Spinor-Helicity / Twistor  
formalism  
Amplitudes relevant for the LHC

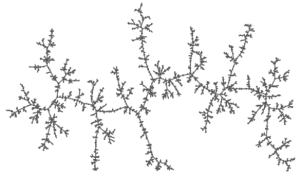
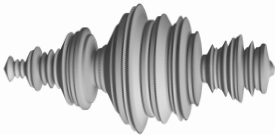
# Gravity from random geometry



Dynamical Triangulations



Causal Dynamical Triangulations





# Simon Caron-Huot (NBIA)

## *2-minute (non)-talk*

- Various interests in high-energy theory:
  - Integrable field theories, such as  $N=4$  super Yang-Mills: what can we learn from them?
  - Background in heavy ion physics: physics of weakly coupled plasmas
  - Scattering in the high-energy 'Regge' limit  
(= why I am not here today!)
- Other interests (if anyone cares!):
  - Bicycling (as soon as get a decent bike again!), tennis, ...

**Current research interests:**

- QCD amplitude calculations (two loops!)
- Broken conformal invariance and anomalous dimensions
- $\mathcal{N}=4$  Super Yang Mills theory on the lattice
- Fluctuations and statistics of multiplicity distributions in  $p - p$  and heavy ion collisions

**Interested in moving more towards:**

- Astroparticle physics and cosmology
- Particle physics phenomenology (data!)

# *Tristan Dennen*

- **Scattering Amplitudes**
- **BCJ Color-kinematics duality**
  - **Ultraviolet properties of supergravity theories**
  - **N=4 SYM and N=4 SUGRA**
- **Integrability in N=4 SYM**
  - **OPE construction of remainder function**

# Work in progress

Paolo Di Vecchia

- 1 High energy scattering on a stack of Dp-branes: **compare string scattering amplitudes with the string in the background of the classical solution** [G. D'Appollonio, R. Russo and G. Veneziano].
- 2 Interaction of the super-particle with an external supersymmetric gauge fields in terms of the physical gauge field [J. Greitz].
- 3 Study of the dependence on the  $\theta$  angle in technicolour theories [F. Sannino]
- 4 One-loop scattering amplitude in  $\mathcal{N} = 2$  string theory and comparison with self-dual Yang-Mills theory [D. O'Connell].

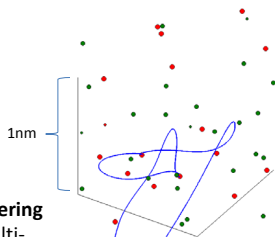
## Sonoluminescence:

(with Mogens Levinsen)

Investigate competing theories of the emission of light from the compressed heated gas in the collapsed bubble:

bremssstrahlung – bound-free molecular transitions – line broadening – black body radiation

Working on bremssstrahlung calculation with **coherent multiscattering** of electrons moving in a mixture of ions and atoms. Coherent multi-Scattering (see illustration) depresses emission of long wavelengths



## Density of levels in spherical and deformed nuclei

(with Sven Åberg et. al)

Shed new light on an old unsolved problem: level density in deformed nuclei is enhanced due to the presence of the deformed shape. On the other hand, the degrees of freedom of the shape are basically generated by nucleons, and should not be counted twice.

Working on comprehensive calculations of **nucleon excitations** in a **well described mean field**, comparing to existing data and motivating new experiments.

# New Physics with Planck

Anne Mette Frejsel  
PhD student in Cosmology

Name: Hjalte Frellesvig

Title: PhD-student (start Jan. 2011)

Affiliation: NBIA and Discovery Center

Advisors: Poul Henrik Damgaard and  
Simon Badger

Research: Field theory, Scattering  
amplitudes, Generalized unitarity.

Current Project: Unitarity cuts at higher loop order.



Jakob Gath

PhD student, supervisor Niels Obers

*Research:*

Effective descriptions of gravity: (Fluid/Solid/Gravity)

Holography for non-AdS space-times

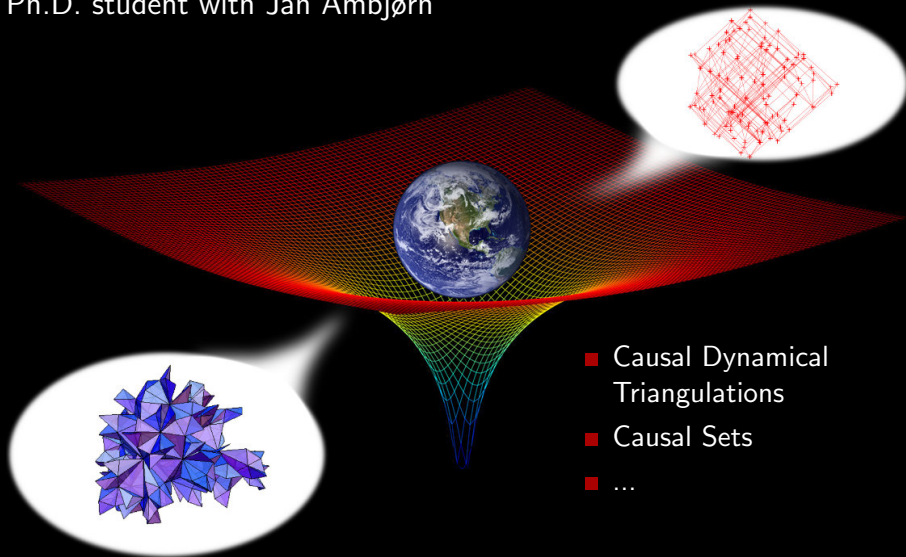
*Advertisement:*

The PhD Meetings

<http://www.nbi.dk/~gath/>

# Lisa Glaser

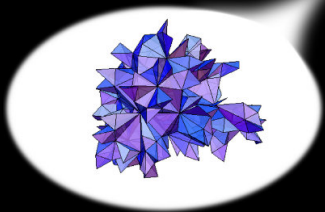
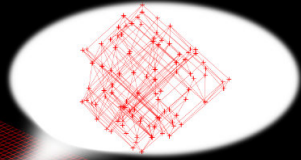
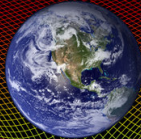
Ph.D. student with Jan Ambjørn



- Causal Dynamical Triangulations
- Causal Sets
- ...

Lisa Glaser

?



## Quantum gravity - Causal Dynamical Triangulations

- Emergent background geometry
  - Quantum fluctuations
  - Flow of coupling constants
  - Matter fields and multicritical models
- } 4D  
} 2D

New *crinkled* phase in four dimensional Euclidean DT.

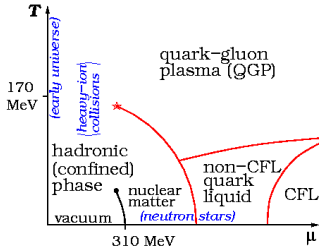
## Random matrix theory

Relation between the eigenvalue spectrum of covariance matrix and its estimator for a class of non-gaussian random matrices.

## Quantum computing

Description of quantum gates (*NOT*, *CNOT*) based on *SQUIDS* with emphasis on quantum decoherence.

*Jeff Greensite. Visiting Professor (2012)  
from San Francisco State University*



*Maybe* the phase diagram looks like this. Nobody knows for sure.

I am currently working on the QCD “**sign problem.**” The motivation is to determine the QCD phase diagram at finite temperature and baryon density. To get a finite baryon density, we introduce a quark chemical potential  $\mu$  into the QCD Lagrangian.

The problem is that this addition makes  $S_{\text{QCD}}$  complex, and  $\exp[S_{\text{QCD}}]$  oscillatory. Standard Monte Carlo simulation via importance sampling breaks down! *This is the sign problem.*

My approach ([arXiv:1209.5697](https://arxiv.org/abs/1209.5697)) is to try to extract the effective Polyakov line action from the underlying lattice gauge theory, by a method that I call “relative weights.” There are reasons to think that the sign problem may be milder in the Polyakov line theory, which may be solved by various methods such as reweighting, stochastic quantization, flux representation, or mean field. If this is true in the interesting region of parameter space (weak couplings, small quark masses), then we could determine the QCD phase diagram in the  $\mu$ - $T$  plane from the corresponding Polyakov line theory.

Troels Harmark

Back at NBI after trip to Nordita@Stockholm

Current research projects:

- Holography and AdS/CFT w/ Orselli

Conf/deconf temperature  
In planar N=4 SYM on  $S^1 \times S^3$



Hagedorn temperature of  
tree-level string theory on  $AdS_5 \times S^5$

Challenge: Interpolating from weak to strong coupling

Our previous work 2006-2008: Interpolate near critical point

Now: Compute Hagedorn temperature for any value of 't Hooft coupling and chemical potentials

- Effective description of brane dynamics in gravity/string theory

D-brane in open string sector: Effective description is DBI action

We found the effective description in closed string sector (AKA blackfolds)

w/ Emparan, Niarchos & Obers + w/ Grignani, Marini, Obers & Orselli

Comparing open and closed sector (weak and strong coupling)  
for near-extremal D3-branes

w/ Grignani, Marini & Orselli

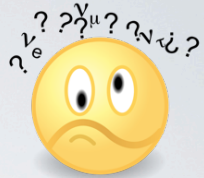
Thermal Giant Gravitons w/ Armas, Obers, Orselli & Pedersen

Review of blackfolds w/ Obers

# My PhD

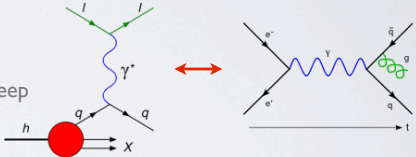
## 1. Neutrino physics

In collaboration with professor A. Zee at the KITP:  
Study of neutrino mixing using group theory.



## 2. QCD

Under the supervision of P.H. Damgaard:  
Study relations between “space” like (e.g Deep inelastic scattering) and “time” like (e.g  $e^+e^-$  annihilation) interactions.



## 3. Beyond the standard model

Under the supervision of Christophe Grojean:  
Research at CERN for a 6 month period from January



- By Christine Hartmann

## Jelle Hartong

- Holography for Schroedinger Space-Times and relations to the Kerr/CFT correspondence (extremal rotating black holes) in collaboration with Blaise Rollier.
- Subtracted geometry: putting black holes in a 'box' (AdS type confining potential) and hidden conformal symmetry in collaboration with Finn Larsen.
- Lifshitz and hyperscaling violating Lifshitz space-times with Jakob Gath, Ricardo Monteiro and Niels Obers.
- Lifshitz and hyperscaling violating Lifshitz black holes with Bert Vernocke and Wissam Chemissany.
- The NSVZ beta function and anomaly matching in  $N = 1$  SYM with Nicola Ambrosetti, Daniel Arnold and Jean-Pierre Derendinger.



# Matti Herranen

## Background

- PhD at the University of Jyväskylä, Finland, 2006 - 2009
- Postdoc at the RWTH Aachen University, Germany, 2009 - 2012
- Postdoc at the NBIA since October 2012

## Research Interests

- Particle physics of the early Universe:
  - Baryogenesis and Leptogenesis (origin for the observed baryon asymmetry of the Universe)
$$\frac{n_B}{n_\gamma} = (6.19 \pm 0.15) \times 10^{-10}$$
  - Quantum dynamics of cosmological inflation
  - Neutrino oscillations
- Methods of nonequilibrium quantum field theory
  - Schwinger-Keldysh formalism - 2PI
  - Quantum coherence effects
  - Thermal field theory

# Rijun Huang

PhD Student

Supervisor:

Poul Henrik Damgaard

Emil Bjerrum-Bohr

E-mail: [huang@nbi.dk](mailto:huang@nbi.dk)

S-matrix

Unitarity Cut  
On shell method  
KLT relation  
Higher loop  
One loop  
Loop  
Tree  
Grobner Basis  
Gravity Amplitude  
Integrand Reduction  
BCFW-recursion relation  
Gauge Amplitude  
Spinor Formalism  
Partial Amplitude  
Double copy  
BCJ relation  
Two loop

# Asger C. Ipsen

PhD student, advisor Jan Ambjørn.

Interests (physics related, in arbitrary order)

- Nonperturbative QFT
- Quantum gravity: CDT, DT
- Integrability, solvable models

Master thesis (advs. P. H. Damgaard & G. Akemann (Bielefeld U.))

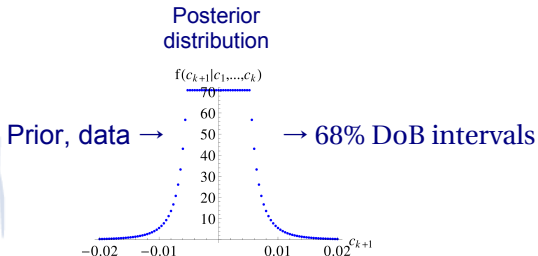
- Chiral random matrix theory
- QCD with imaginary isospin chemical potential
- Individual Dirac operator eigenvalues

# Laura Jenniches – two-minute-meeting 2012

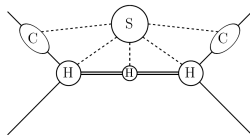
## • Perturbative QCD

- ✗ Theoretical uncertainty estimates
- ✗ Evolution equations (DGLAP ...)
- ✗ Renormalization scale variation
- ✗ Factorization scale variation

## • Bayesian statistics



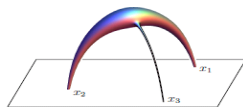
## • SCET in SUSY



### 3-body decay at NLO

- ✗ Expansions in different regions
  - $\rightarrow$  resonant
  - $\rightarrow$  non-resonant
- ✗ Plus distributions
- ✗ Different scales
  - $\rightarrow$  many small parameters

- Integrability in the AdS/CFT correspondence:  
The spectral problem of  $\mathcal{N} = 4$  SYM, ABJM and ABJ theory, integrable spin chains and their Bethe equations, Wilson loops, giant gravitons, amplitudes
- Beyond integrability of the AdS/CFT correspondence: Nonplanar effects, three-point functions, defect conformal field theories (a holographic description of graphene)



- Discrete models of quantum gravity, matrix models, coloring and folding problems.

# About me

- Hao Liu, Chinese
- USTC (University of Science and Technology of China) → IHEP (Institute of High Energy Physics of China)
- Main Interest: Data analysis, especially CMB (Cosmic Microwave Background) data, like WMAP (Wilkinson Microwave Anisotropy Probe, an American spacecraft used to detect CMB)
- Here in NBI:
  - Arrival: July, 2012    As: Postdoctor
  - Work target: Same thing
  - Work together with: Pavel Naselsky
  - Office: FB-4
  - Current language: Chinese, English, 1% Danish++??



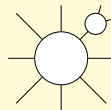
## Symmetries in Gauge Theories

Integrability in  $\left\{ \begin{array}{l} 4d \mathcal{N} = 4 \text{ super Yang-Mills theory} \\ 3d \mathcal{N} = 6 \text{ super Chern-Simons theory} \end{array} \right.$

- Symmetry constraints on **Observables**
- Recursive construction of **Observables**

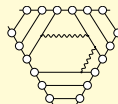
## Scattering Amplitudes

- How to use integrability efficiently?
- $(\text{Gauge Theory})^2 = \text{Gravity!}$   $(\text{Integrability})^2 = ?$



## Conformal Structure Constants

- What to learn from the spectral problem?
- Recursion relations in the loop order?



# AdS/CFT & Integrability

Guido Macorini (NBIA & Discovery Center)

With M. Beccaria, F. Levkovic, CA. Ratti, A.A. Tseytlin, S. Valatka

$$AdS_5 \times S^5 \Leftrightarrow \mathcal{N} = 4 \text{ SYM}$$

$$AdS_4 \times \mathbb{CP}^3 \Leftrightarrow ABJM$$

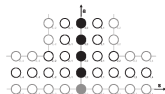
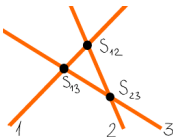
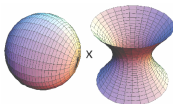
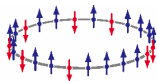
$$AdS_3 \times S^3 \times S^3 \times S^1 \Leftrightarrow ?$$

...mysterious  $CFT_2$

## Spectral problem

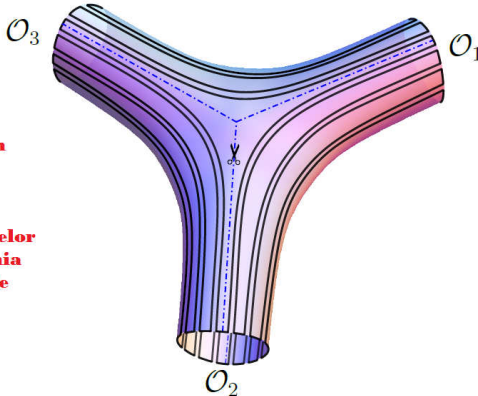
Anomalous dimensions  
vs String energies

Bethe Eq., TBA, Y-system,  
semiclassical strings,  
algebraic curve...





# Ara Martirosyan



**I started my PhD at NBI last year under supervision of Charlotte Kristjansen**

**I have done my Bachelor and Master in Armenia at YSU (Yerevan State University)**

**My research interests include relations between gauge and string theories as well as integrability in them.**

**Calculations of structure constants of three point functions made out of gauge invariant single trace operators in different sectors of planar N=4 SYM and ABJM**

Ricardo Monteiro - postdoc NBIA, 2010/13

Interests

Scattering amplitudes: symmetry between colour and kinematics in gauge theory, relations between gravity and gauge theory amplitudes.

Black holes: phase diagrams (existence, stability) in higher dimensions / anti-de-Sitter.

Gauge-gravity correspondence (AdS/CFT): “phenomenological” applications, holographic dictionary.

# QCD and related theories with $\mu \neq 0$ for $N_c, N_f \rightarrow \infty$

Problems of QCD with  $\mu \neq 0$

Joyce Myers

- No conventional lattice simulations (sign problem)
- No conventional perturbation theory unless  $T \rightarrow \infty$  or  $\mu \rightarrow \infty$

Possible ways to calculate

- Instead of  $S^1 \times \mathbb{R}^3$  with  $S^1 \ll \Lambda_{QCD}^{-1}$  consider  $S^1 \times S^3$  with  $S^3 \ll \Lambda_{QCD}^{-1}$ .
- Large  $N_c$  lattice QCD with heavy quarks from the strong coupling and hopping expansions
- Consider another theory: 2-color QCD or SQCD.

Other recent projects

- Bekenstein entropy bound,  $S \leq 2\pi RE$ , for weakly-coupled field theories on  $S^1 \times S^3$

Future

- Gauge theories, large  $N_c$ ,  $\mathbf{B} \neq 0$ ,  $\mu \neq 0$ , chiral perturbation theory
- QCD-like theories from AdS/CFT: string theories with fundamental flavor branes

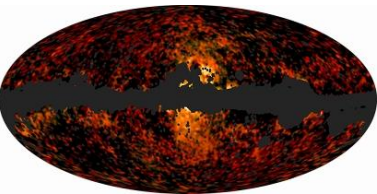
***PLANCK collaboration***

***DISCOVERY***

***HEP&C***

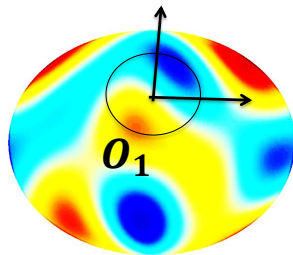
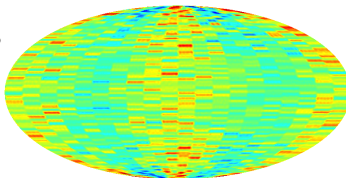
***15 papers, 2 MS, 3 PhD***

***Scientific results***



***The PLANCK haze***

***CMB-ALICE***



***CCCP***

## Research interests, Niels Obers (2 min. meeting 2012)

### Blackfolds: dynamics of black branes in gravity and string theory

- black holes as “fluids” and “materials”
- transport and response coefficients for charged branes
- time-dependence + stability



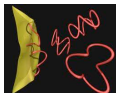
### Aspects of the AdS/CFT correspondence

- thermal Giant Gravitons and bubbling black holes
- fluid/gravity correspondence
- Lifshitz black holes/branes in string theory/supergravity
- holographic applications and AdS/CMT
- other holographies: Kerr/CFT, higher-spin...



### Wishlist

- ST amplitudes in curved backgrounds (pp-wave, CFTs, AdS ?)
- Partition functions and localization techniques in QFT/ST



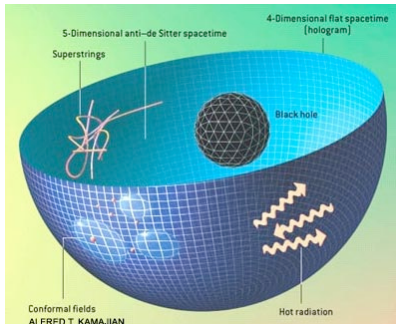
With:

Troels Harmark, Jelle Hartong, Ricardo Monteiro, Costas Zoubos

Vasilis Niarchos (Crete), Gianluca Grignani & Marta Orselli (Perugia), Gabriel Lopes Cardoso (Lisbon), Kostas Siampos (Paris)

Jay Armas, Jakob Gath, Andreas Vigand Pedersen (PhDs)

Heidar Moradi, Morten Holm Christensen (MsC)



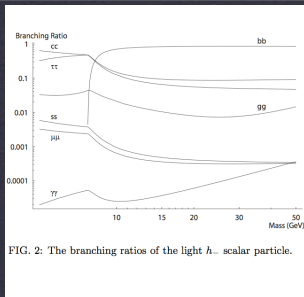
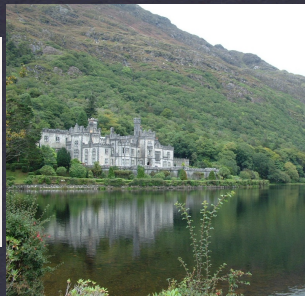


FIG. 2: The branching ratios of the light  $h_-$  scalar particle.



$$\begin{array}{c} 2 \\ \diagdown \quad \diagup \\ 1 \quad 4 \end{array} \begin{array}{c} 3 \\ \diagup \quad \diagdown \\ 2 \quad 1 \end{array} + \begin{array}{c} 3 \\ \diagdown \quad \diagup \\ 4 \quad 1 \end{array} \begin{array}{c} 2 \\ \diagup \quad \diagdown \\ 3 \quad 4 \end{array} + \begin{array}{c} 3 \\ \diagdown \quad \diagup \\ 4 \quad 1 \end{array} \begin{array}{c} 3 \\ \diagup \quad \diagdown \\ 2 \quad 4 \end{array} = 0$$



**DONAL O'CONNELL**  
PHENOMENOLOGY & AMPLITUDES

# Poul Olesen-Work which may/may not lead to something

October 23, 2012

## **W-Condensation:**

Old idea, goes back to 1989, Ambjørn and me. I want to investigate if the deviations found in (preliminary) data from LHC on  $\text{Higgs} \rightarrow \gamma\gamma$  can be understood from W-condensation. There are more events than expected from perturbative calculations.

This decay proceeds through W or quark loop. Simple idea: If W condense, there are more W's, result in more  $\gamma$ 's

## **Some new solutions of the Liouville equation:**

Some time ago I found new solutions of the Liouville equation with periodic boundary conditions, which have been generalized by mathematicians. I now found some other types of new solutions. Work on applications to general relativity in progress.

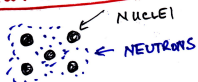


## MANY-BODY PROBLEMS OF VARIOUS SORTS

2 MIN TALK  
2012

CHRIS PETHICK  
(NBSIA & NORDITA)

### NEUTRON STAR CRUSTS



COLLECTIVE  
OSCILLATIONS

(MITYA KOBYAKOV, UTEA)

### NEUTRINOS IN DENSE MATTER

MEDIUM EFFECTS



(PIL SAUGMANN)

### GALPAGUE DISPOSAL IN n EDM EXPT.

IDEA. See neutron precession in electric field.

See precession by measuring capture rate of  
neutron on polarized  $^3\text{He}$ .

$^3\text{He}$  is in liquid  $^4\text{He}$ . Sweep out depolarized  $^3\text{He}$   
by wind of phonons.

(GORDON BATH & DOUG BECK)

What if Universe started off or passed through the conformal phase?

- Flat spectrum of primordial perturbations (Rubakov'09).
- Horizon and flatness problems are resolved (Hinterbichler–Khoury'11).

At least one field with conformal weight  $\Delta \neq 0$ .

At least one conformal field with the weight  $\Delta = 0$ .

Background solution for the field with  $\Delta \neq 0$  breaks  $SO(4, 2) \rightarrow SO(4, 1)$ .

Field with  $\Delta = 0$  acquires flat spectrum!

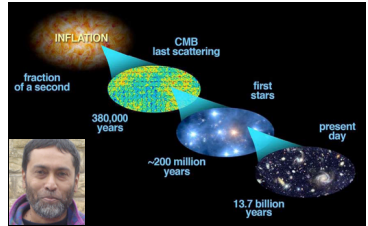
CMB predictions: non-Gaussianity, statistical anisotropy.

Quite large prospects for model building: ideas are welcome!

# Subir Sarkar

On sabbatical leave (2012-13) from Oxford  
where he is head of the Particle Theory Group

... will return 2013-18 as Niels Bohr Professor  
at NBIA to set up astro-particle physics group  
(in collaboration with DISCOVERY & DARK)

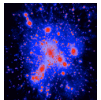
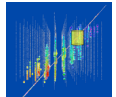
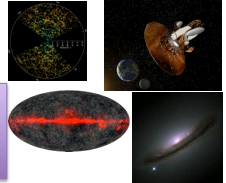


**Early universe** – Models of inflation based in SUSY & supergravity, leptogenesis, domain wall formation ...

**Inhomogeneous cosmology** – as alternative to dark energy  
– fitting CMB anisotropies, large-scale structure and  
SN Ia Hubble diagram ... understanding 'back reaction'

**Cosmic rays,  $\gamma$ -rays & neutrinos** – origin/acceleration/propagation  
+ related phenomenology (UHE  $\nu$  #-section, backgd. for DM signals)  
Participation in experiments: **Auger, IceCube & CTA**

**Dark matter** – relic abundance/phenomenology/detection signatures,  
– Constructing models of new strong dynamics for non-WIMP  
asymmetric particle candidates (effects on stellar evolution ...)

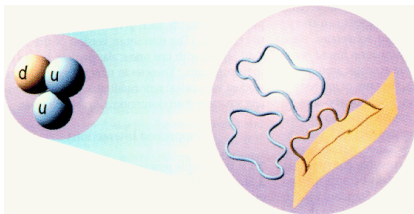


**Name:** Yuki (勇貴) Sato (佐藤)  
Ph.D. student @ Nagoya University

**Advisers:** Prof. Jan Ambjørn (in NBI)  
Prof. Tadakatsu Sakai (in Nagoya)

**Interests:** Quantum gravity on the lattice (CDT),  
BH physics, strings, matrix models  
and non-relativistic gravity (n-DBI)





**Gordon Semenoff**

*Visiting Professor at NBI*

- AdS/CFT holography using probe branes - find some evidence that it all makes sense – and use it to construct a holographic model of an anyonic superconductor
- formulate experimental tests of the hypothesis that graphene is a physical realization of a 3D conformal field theory
- examine how condensed matter Majorana states distribute (quantum) information

# MADS SØGAARD

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## **Position and affiliation**

PhD student at NBIA/Discovery

## **Scientific trajectory**

B.Sc. '09, NBIA/HET; M.Sc. '12, NBIA/Discovery

## **Academic advisors**

Emil Bjerrum-Bohr, Poul Henrik Damgaard

## **Research interests**

Analytic properties of scattering amplitudes in supersymmetric gauge and gravity theories; enhanced computational methods; hidden structures

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“One of the most remarkable discoveries in elementary particle physics has been that of the existence of the complex plane” – Julian Schwinger

Strong Phases  
*- from first principls*



*The Danish Council for Independent Research, Sapere Aude*

**[Who]** Jeff Greensite  
Poul Henrik Damgaard  
Konstantinos Zoubos  
Joyce Myers

Christian Marboe, Therkel Olesen, Anders Møllgaard

**[What]**  $a \rightarrow 0$ ,  $V \rightarrow \infty$  and  $m_q \rightarrow 0$  in lattice QCD at nonzero  $\mu_q$

**[How]** Chiral Perturbation Theory  
Random Matrix Theory  
Spin models  
AdS/CFT



**[Who]** Jeff Greensite  
Poul Henrik Damgaard  
Konstantinos Zoubos  
Joyce Myers

Christian Marboe, Therkel Olesen, Anders Møllgaard

**[What]**  $a \rightarrow 0$ ,  $V \rightarrow \infty$  and  $m_q \rightarrow 0$  in lattice QCD at nonzero  $\mu_q$

**[How]** Chiral Perturbation Theory  
Random Matrix Theory  
Spin models  
AdS/CFT

**[Wait!]** Chiral Perturbation Theory = continuum theory (no  $a$ ) of pions (no  $\mu_q$ ) !?

Anders Tranberg

Trajectory:

NBI(-2000) → Amsterdam(2000-4) → Sussex/Cambridge(2004-7) →  
Oulu/Helsinki(2007-10) → NBI(A)(2010-12) → Stavanger(2013-)

What I have been up to and am still working on:

In- and out-of-equilibrium quantum and classical field theory for  
phenomena that may, may not or maybe ought to have taken place  
in the Early Universe. If possible with large computers.

Topics include:

Electroweak Baryogenesis, Leptogenesis, Inflation, Curvaton, QFT  
in curved space-time, QCD phase transition (ERG), lattice  
methods (real-time fermions, 2PI simulations, classical  
simulations), topological and non-topological defects, oscillons.

# Andreas Vigand Pedersen

vigand@nbi.dk

*Two Minute Meeting*

*NBI*

*October 25th 2012 AD*

PhD student (@ Niels Obers)

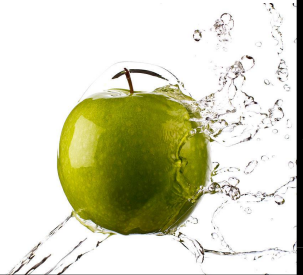
Background: Master from NBI

Interests:

- Physics
- Gravity theories
- Higher dimensional gravity and Fluid/gravity
- AdS/CFT and applied AdS/CFT

Currently investigating:

- New aspects of flat space fluid/gravity
- Blackfolds in AdS/CFT



# Valery Yundin

## Research interests

- ▶ Multi-leg NLO corrections to Standard Model
  - ▶ Four jet XS for LHC
- ▶ Methods for evaluation of loop integrals
  - ▶ One loop tensor reduction
  - ▶ Efficient Mellin-Barnes integration
- ▶ Automation in particle physics research



# Yang Zhang

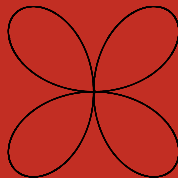
NBIA & Discovery Center

Ph.D. 2011, Cornell University



working on two and three-loop amplitudes via  
generalized unitarity and algebraic geometry

Integrand  $\int \frac{d^D l_1}{(2\pi)^D} \cdots \int \frac{d^D l_L}{(2\pi)^D} \frac{N}{D_1 \dots D_k}$



*Primary Decomposition*

$$I = \cap_i I_i$$

*Groebner Basis*

$$N = \sum_j f_j g_j + r$$

# Konstantinos (Costas) Zoubos

## My Scientific Trajectory (so far):

- BSc '97 U. of Patras, MSc '98 Imperial College London
- PhD '04 Stony Brook, NY, USA
- Postdoc '05-'07 at Queen Mary, University of London
- At NBI since October 2007

## My Research Interests:

- Mathematical aspects of AdS/CFT (Conformal geometry)
- Amplitudes in Gauge Theory (e.g. MHV lagrangian)
- Integrability (and its breaking) in Gauge and String Theory
- Finite Field Theories in  $D > 2$  (Hidden symmetry?)
- Correlation Functions of Semiclassical Operators
- Minimal Model/Higher Spin Duality
- New Project: QCD at Finite Density, Sign Problem

## Other Roles in the Group:

- Involved in workshops, teaching, MSc projects, outreach...
- Co-maintaining the Group website (mainly news and member pages)