Two-minute meeting 2014

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

November 25$^{\text{th}}$, 2014

Group Info

New group members since last meeting

- NN, We are hiring a new Associate Professor !

- Visiting Professors : George Savvidy (Demokritos, Athens), Andrzej Görlich, (Jagellonian University)

- Long term staff: Jacob Bourjaily (Harvard U.) , Michael Trott (CERN)

- Postdocs: Marius de Leeuw (ETH, Zürich), Cindy Keeler (Michigan), Stefano Mori (Parma U.)

- PhD students: Laure Bertier (Cambridge), Amel Durakovic (NBI and Imperial), Isak Buhl Mortensen (NBI), Lukas Brunkhorst (visiting student, Bremen)

- Master students: 11 (at least) — Please let me know of new ones.

Scientific Group Activities

- Seminars (Organizer: Tristan Dennen)

- Journal club (Organizer: Guido Festuccia)

- PhD meetings (Organizer: Need a volunteer)

Group Info: Upcoming Events

- PhD School: Nordic Winter School on Cosmology and Particle Physics, Jan. 2-7, 2015, Skeikampen, Norway
  Local organizers: N.E.J. Bjerrum-Bohr, K. Splittorff, P.H. Damgaard

- Nordic String Theory Meeting, Groningen (2 days, end of Feb., 2015).

- Workshop: Cosmology and astro-particle physics: from the LHC to Planck, April 7-9, 2015.

- Oxford-NBIA Colloquium, April 14-16, 2015. Organizer: S. Sarkar

- International Symposium on High Energy Physics (Danish-Israeli) May 4 - May 6, 2015. Organizers: HET and HEP, NBI.

- Elite PhD school: Applications of Holography and Entanglement Entropy, Oct./Nov. 2015 (External speakers: Hartnoll and Takayanagi), Local organizers: Cindy Keeler and Niels Obers

- Nordita program: Holography and Dualities, March 28 - April 22, 2016
  Organizers: B. Stefanski, C. Kristjansen, K. Zarembo

- Workshop: Current themes in Holography, April 25-29, 2016
  Local Organizers: C. Kristjansen and N. Obers

- Nordita program: Holography and Emergent Space-time,
  Four weeks in summer or early fall of 2016
  Organizers: M. Guica, N. Obers, L. Thorlacius

Group Info

Group secretary:

- Anna Maria Rey (Mo-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
- Group homepage, face-book page, mailing lists ($\longrightarrow$ Timothy Budd)
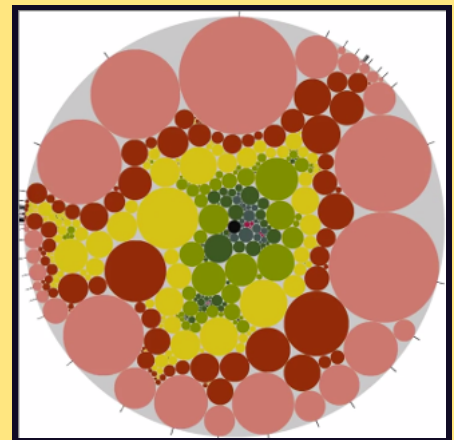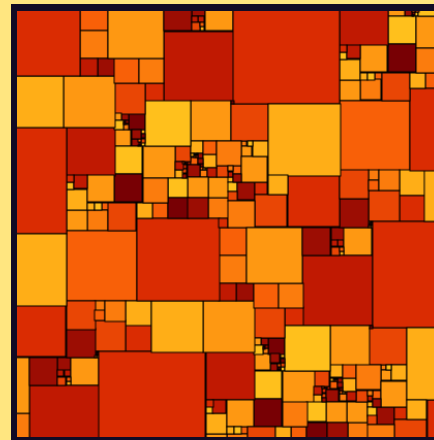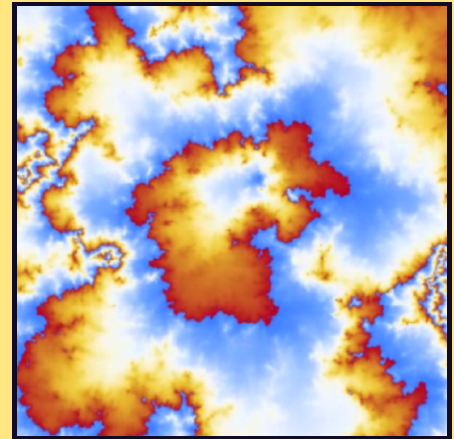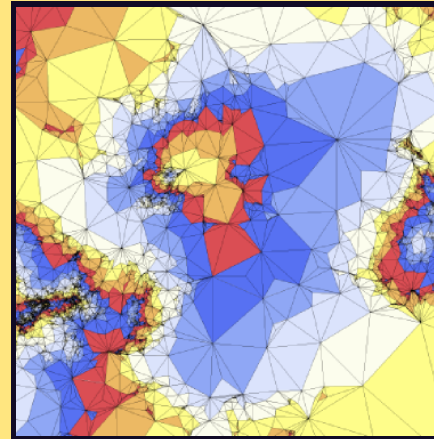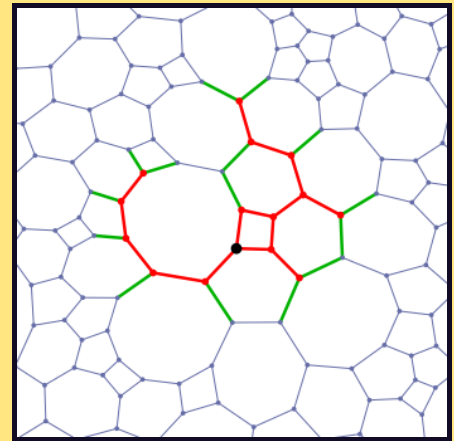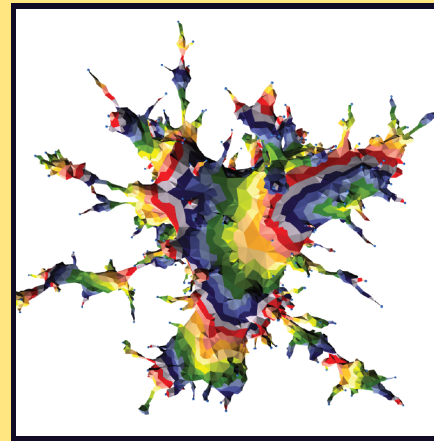
Timothy Budd

Fc-10, budd@nbi.dk

Quantum gravity in lower dimensions
Both analytical & numerical

* Geometry of random surfaces
 - Fractal dimensions
 - Relation to Liouville gravity

* Effect of coupling statistical
 systems coupled to 2d gravity
 - (First-passage) percolation
 - Conformal matter (Ising, O(n))

Our group website

`http://het.nbi.dk`

* Event announcements
  (Add to your Google calendar!)

* Personal pages
  (Check whether your info and photo (!)
  is up to date!)

* New: recent arXiv papers
  (Any inaccuracies?)

Mailing lists

* **het-seminars@nbi.ku.dk**
  For all group members and other people
  interested in the seminars and other events.

* **hetcosmo-all@nbi.ku.dk**
  All group members (but not MSc students).
  Any member can post to this list.

Any updates/suggestions?
  ⟶ Timothy **(budd@nbi.dk)**

NBI-Theoretical Particle Physics and Cosmology

Home | People | News | Research | Positions | Seminars | Journal Club | PhD | MSc | Outreach | Links

Welcome to the homepage of the Theoretical Particle Physics and Cosmology group at the Niels Bohr Institute

The theoretical particle physics and cosmology group at the Niels Bohr Institute is involved in a wide scope of research activities centered around quantum theories of gauge fields, gravity and astrophysics. Research areas include the Standard Model, Quantum Chromodynamics, Lattice Simulations, Cosmology, Physics of Cosmic Microwave Background, Black Holes, Matrix Theory and String Theory. More specific research interests as well as publications can be found on the individual home pages of the members of the group.

Quick Links

arXiv.org · SPIRES
Map of Copenhagen
DMI Radar · movia
NBI Webmail
Group Facebook Page

News

■ Two postdoc positions in theoretical high energy physics and cosmology
Two postdoc position will be available starting latest September 2015. Additional information can be found on our positions page.
Posted on 4 Nov, 2014

■ Postdoc position in theoretical high energy physics
A postdoc position will be available starting October 1st, 2015. Additional information can be found on our positions page.
Posted on 30 Oct, 2014

■ New group members
This fall we have welcomed several new group members: Jacob Bourjaily (assistant professor), Michael Trott (associate professor), Marius de Leeuw (postdoc), Cynthia Keeler (postdoc), Laure Berthier (PhD), Isak Buhl-Mortensen (PhD), and Amel Durakovic (PhD).
Posted on 29 Oct, 2014

More news...

This week

■ **Two-minute meeting**
Aud. A, Tuesday 25 Nov at 14:15

■ **Journal club**
Fb6, Wednesday 26 Nov at 12:15

More events...

Recent arXiv papers

1411.4143 — 15 Nov, 2014
Distribution of Canonical Determinants in QCD
Andrei Alexandru, C. Gattringer, H.-P. Schadler, *K. Splittorff*, J. J. M. Verbaarschot

1411.2570 — 10 Nov, 2014
Phase Diagram of Wilson and Twisted Mass Fermions at finite isospin chemical potential
M. Kieburg, *K. Splittorff*, J. J. M. Verbaarschot, S. Zafeiropoulos

1411.2230 — 9 Nov, 2014
Factorized soft graviton theorems at loop level
Johannes Broedel, *Marius de Leeuw*, Jan Plefka, Matteo Rosso

1411.0166 — 1 Nov, 2014
Results from lattice simulations of N=4 supersymmetric Yang-Mills
Simon Catterall, Joel Giedt, David Schaich, *Poul H. Damgaard*, Thomas DeGrand

Work in progess

Spectral dimension in 2d CDT
J. Ambjorn, A. Goerlich, J.Jurkiewicz and H.-G. Zhang,

Massive phase transition in a 2D CDT gravity model
J. Ambjorn, A. Goerlich, J.Jurkiewicz and H.-G. Zhang,

Spectrum of the closed bosonic string with a physical cut-off
J. Ambjorn and Y.Makeenko

Holonomies in DT and CDT
J. Ambjorn, A. Goerlich, J.Jurkiewicz and R. Loll

Transfer matrix analysis of the phase-transion of CDT
J. Ambjorn, A. Goerlich, J.Jurkiewicz and N. Klitgaard

And other stuff (Budd, Görlich, Jurkiewicz, Jonsson, Durhuus, Savvidy, Ipsen, Glaser.....)

Stuff published 2014

- J. Ambjorn and L. Chekhov,
  The matrix model for hypergeometric Hurwitz numbers,
  arXiv:1409.3553 [hep-th].

- J. Ambjorn and T. Budd,
  Multi-point functions of weighted cubic maps,
  arXiv:1408.3040 [math-ph].

- J. Ambjorn, S. Khachatryan and A. Sedrakyan,
  A matrix model for strings beyond the c=1 barrier: the
  spin-s Heisenberg model on random surfaces,
  arXiv:1407.0076 [hep-th].

- J. Ambjørn, T. Budd and Y. Watabiki,
  Scale-dependent Hausdorff dimensions in 2d gravity,
  Phys. Lett. B **736** (2014) 339 [arXiv:1406.6251 [hep-th]].

📄 J. Ambjorn, A. Goerlich, A. Ipsen and H.-G. Zhang,
A note on the Lee-Yang singularity coupled to 2d quantum gravity,
Phys. Lett. B **735** (2014) 191 [arXiv:1406.1458 [hep-th]].

📄 J. Ambjørn, B. Durhuus and J. F. Wheater,
A restricted dimer model on a two-dimensional random causal triangulation,
J. Phys. A **47** (2014) 365001 [arXiv:1405.6782 [hep-th]].

📄 J. Ambjorn, A. Görlich, J. Jurkiewicz, A. Kreienbuehl and R. Loll,
Renormalization Group Flow in CDT,
Class. Quant. Grav. **31** (2014) 165003 [arXiv:1405.4585 [hep-th]].

📄 J. Ambjørn and T. Budd,
Geodesic distances in Liouville quantum gravity,
Nucl. Phys. B **889** (2014) 676 [arXiv:1405.3424 [hep-th]].

J. Ambjørn and L. Chekhov,
The matrix model for dessins d'enfants,
arXiv:1404.4240 [math.AG].

J. Ambjørn, J. Gizbert-Studnicki, A. Görlich and
J. Jurkiewicz,
The effective action in 4-dim CDT. The transfer matrix
approach,
JHEP **1406** (2014) 034 [arXiv:1403.5940 [hep-th]].

J. Ambjorn, Y. Makeenko and A. Sedrakyan,
Effective QCD string beyond Nambu-Goto,
Phys. Rev. D **89** (2014) 106010 [arXiv:1403.0893 [hep-th]].

Are there Arguments for Backward Causation?

I collected some not so convincing arguments, but still listing up to the letter P) for that there should be some rule governing us towards a specific future.

Novel String Field Theory gives Veneziano Model

Ninomiya and I establish that it indeed gives e.g. the Veneziano model, anomaly correction only agrees for special dimension.

Corrections to Higgs Decay to $\gamma\gamma$ and Higgs Production by Gluonfusion from $6t + 6\bar{t}$ Bound State w. C.D.Froggatt,Larisa Laperashvili

Some other subjects:

Homolumogap, Fermionization, Plebanski gravity and weak unification, Weyl anomaly, Dark matter (also in supernovae), What is Special about Standard Model Group? Deriving Locality from Reparametrization Invariance.

Assaf Ben-David

* Statistical analysis of the Cosmic Microwave Background data

  * Temperature fluctuations

  * Polarization

* Large scale anomalies

  * Foregrounds?

  * Cosmological?

* Surveys of the Large Scale Structure

  * Cross correlation with the CMB

BEYOND THE SM

E
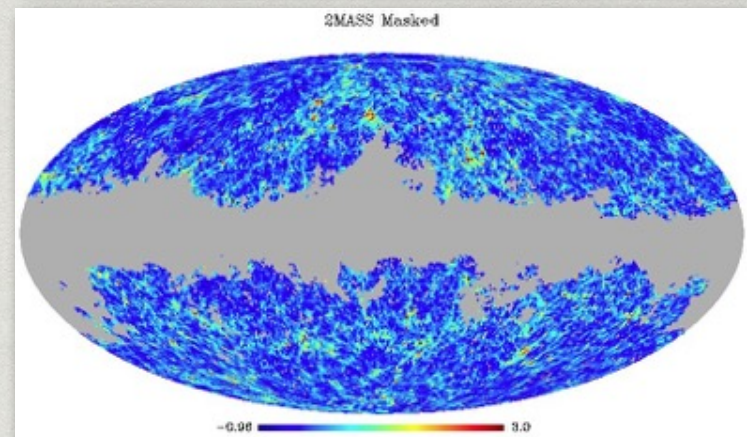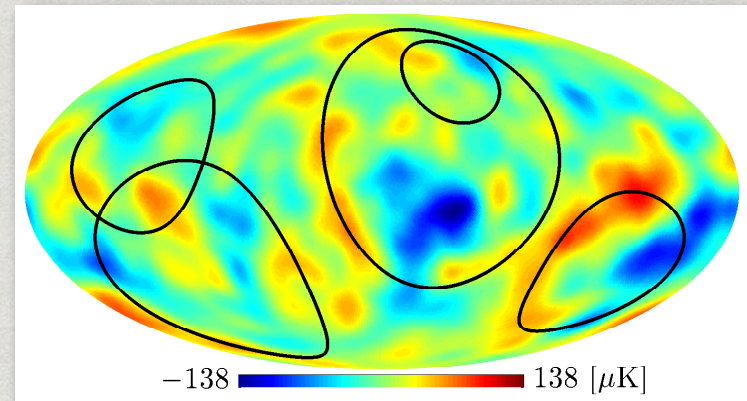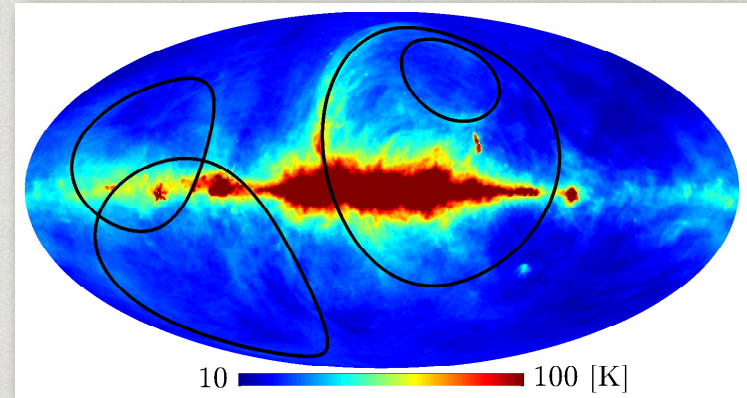
SM an EFT =

SM

+

higher dimension operators
- 1 of dim. 5 → Neutrino masses
- 59 of dim. 6 → Corrections to observables

Theory 2 ?

Theory 1 : SM

Using data we can put constraints on the values of the Wilson coefficients

Laure Berthier phD student

Emil Bjerrum-Bohr
HET & NBIA & DISCOVERY &
Lundbeck Foundation Junior Group
Leader ~ Computation of Amplitudes
Group (CAMP)
Office, Bb.1

Research interests:

Field theory and String Theory
~ Gauge and Gravity theories

- What can we learn about Field Theory in the low energy limit of String Theory.

- Kawai Lewellen Tye relations (KLT), e.g. New KLT forms.

- Monodromy and BCJ relations between gauge amplitudes.

- Scattering equations in Gauge theories.

Amplitudes and Spinor-Helicity / Twistor formalism

- New computational methods.

- Amplitudes relevant for LHC using Twistorial/Spinor-Helicity formalism.

Quantum gravity as an Effective Field Theory

- Leading quantum corrections to General Relativity.

- Use of "amplitude inspired techniques" in EFT computations.

Poul Henrik Damgaard

Current research interests:

- Amplitudes from Scattering Equations
- Broken conformal invariance and anomalous dimensions
- $\mathcal{N}{=}4$ Super Yang Mills theory on the lattice
- Baryogenesis

Interested in moving more towards:

- Astroparticle physics and cosmology
- Particle physics phenomenology (data!)
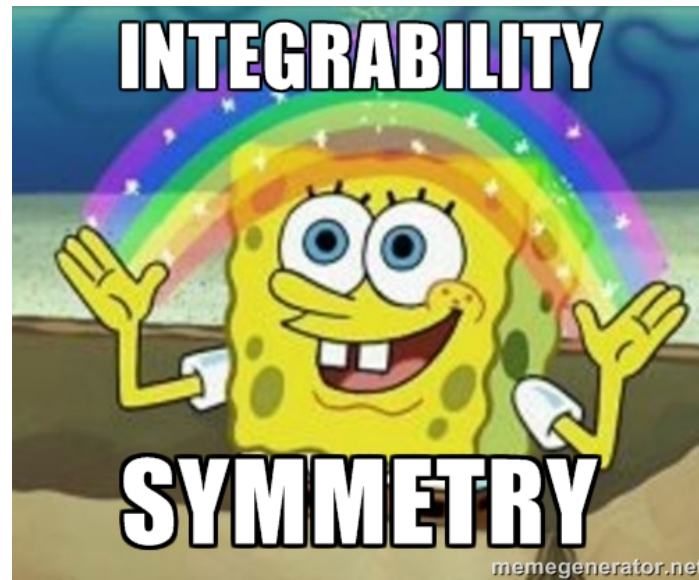
AdS/CFT
- Spectral (Bethe Ansatz, TBA)
- Scattering amplitudes

Cond Mat
- Spin chains
- XXX, Hubbard

Mathematics
- Quantum Algebras
- R-matrix, braids

Work in progress

Paolo Di Vecchia

1. High energy scattering in the Regge limit on a stack of Dp-branes: Recovering unitarity by including the contribution of open strings for small impact parameter and show that the Regge behavior saves string theory from negative Shapiro time delay [G. D'Appollonio, R. Russo and G. Veneziano].

2. Study of soft dilaton behavior in field and string theory [R. Marotta and M. Mojaza]

3. Soft graviton behavior at one-loop [Z. Bern, S. Davies and J. Nohle]

Dynamics of Quantum Field Theories.

- Semiclassical methods
- gauge string duality
- exact methods

Study dynamics of strongly coupled SUSY theories on curved manifolds.
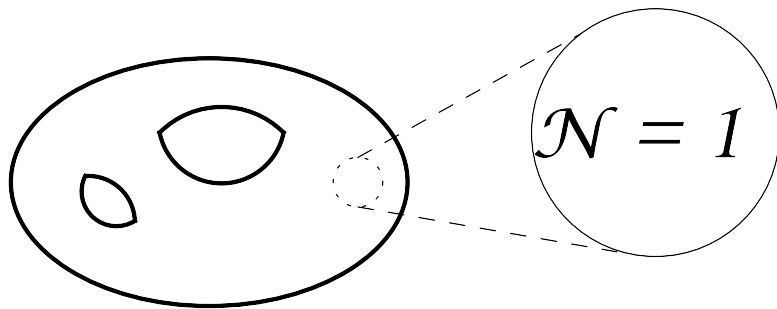
Clarify role of instantons in the study of QCD.

$$\mathcal{N} = 1$$

Quantum gravity

Dynamical **T**riangulations in 2D and 4D:

- Emergent backround geometry
- Quantum fluctuations of geometry
- Interaction with matter fields
- Numerical simulations - Monte Carlo method

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 *SQUID*s with emphasis on quantum decoherence.

LHC phenomenology

- Parton Distribution Functions (NNPDF Collaboration)
  - ☆ PDF studies for LHC Run-II
  - ☆ Nuclear PDFs
- Bayesian Inference techniques for theoretical uncertainties estimation
- Fast interfaces for higher-order QCD computations

Cosmology

- Model independent studies of cosmic acceleration based on SN Ia
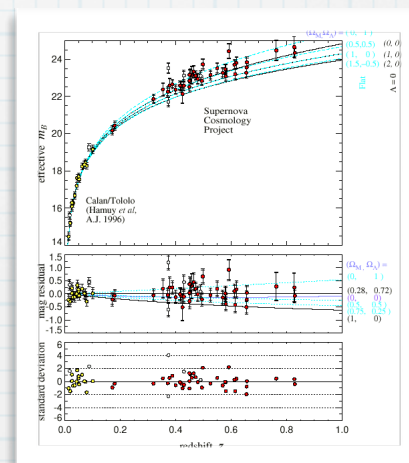
My PhD

Christine Hartmann

Higgs effective field theory:

Supervision: Michael Trott, Poul Henrik Damgaard

Parametrize new physics in terms of higher dimensional operators.

$$\mathcal{L}_{eff} = \mathcal{L}_{SM} + \sum_i \frac{c_i}{\Lambda^2} \mathcal{O}_i$$

Focus on interesting interactions
that still leave room for new physics.

Beyond standard model contributions to
$H \to \gamma\gamma$ decay calculated at loop level.
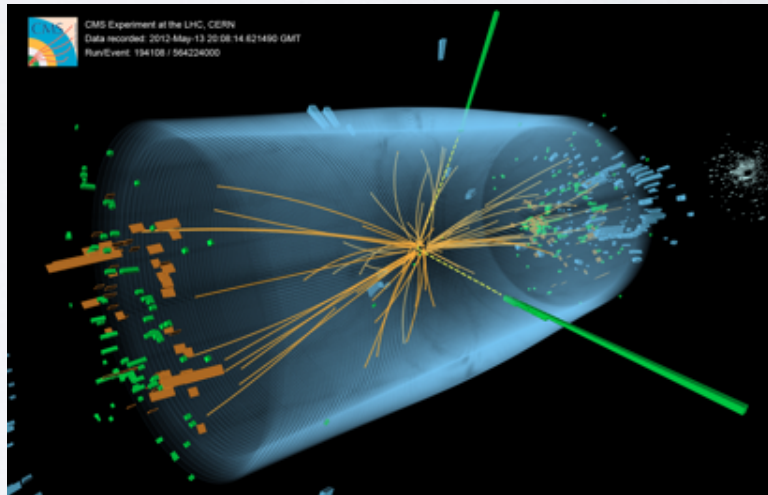
We don't know what new physics to expect - we look for signs of whether it exists.

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)
  $$\frac{n_B}{n_\gamma} = \left(6.1 \pm 0.1\right) \times 10^{-10}$$

  - Quantum effects during cosmological inflation (loop corrections, SM vacuum stability, etc.)

- Quantum field theory...

  - In and out of thermal equilibrium

  - In curved spacetime

  - Schwinger-Keldysh formalism - 2PI

  - Quantum transport

Asger C. Ipsen

PhD student (since 2012), advisor Jan Ambjørn.

General interests (in no particular order):

- Non-perturbative aspects of QFTs
- Quantum gravity
- Solvable models/integrability

Things I am (or have been) working on:

- Dynamical triangulations: CDT, DT/Liouville theory
- Renormalization of gauge theory and spin foam models using tensor network methods
- Random matrix methods for calculating the distribution of the Dirac operator eigenvalues
- The disturbance caused by measurements on quantum systems. Implications of this for the interpretation of weak values.
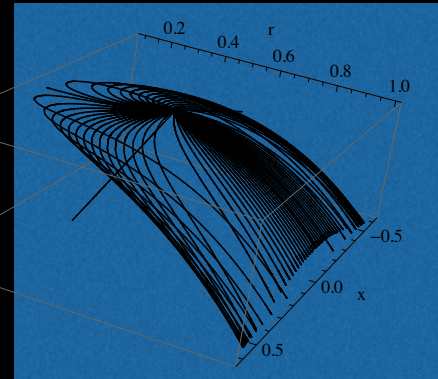
Recent and Forthcoming Work, in 4 parts

Grassmannians for scattering amplitudes in 4d N=4 SYM and 3d ABJM

Schrodinger Holography for z<2
(coming soon: Schrodinger Holography for z=2)
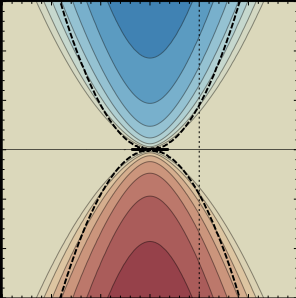
Hidden horizons in non-relativistic AdS/CFT
What do non-relativistic CFTs tell us about Lifshitz spacetimes?
(in progress: bilayer graphene connection)

Logarithmic Corrections to N≥2 Black Hole Entropy
Partition Functions in Even-Dimensional AdS via Quasinormal Mode Methods
(in progress: spin 1/2 and spin 1)

C. Keeler

Charlotte Kristjansen

Integrability *and in particular beyond* in the AdS/CFT correspondende:
Defect CFT's, one-point functions, three-point functions, non-planar effects…
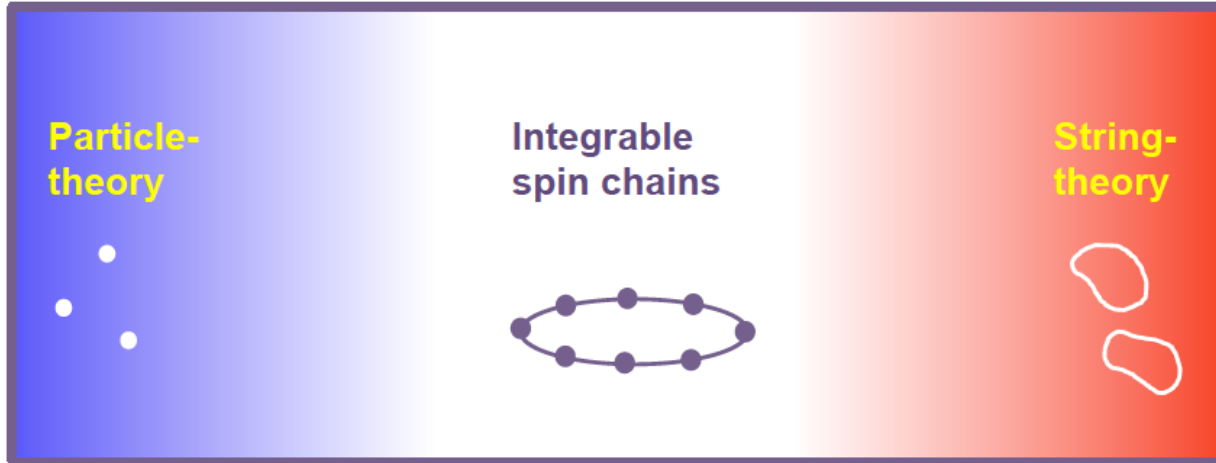
Quantum Hallography: A holographic model of graphene, holographic quantum Hall effect

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

FINGERPRINTS OF GALACTIC LOOP I ON THE COSMIC MICROWAVE BACKGROUND

Object	l (centre)	b (centre)	diameter	distance
Loop I	329°	17.5°	116°	240 pc
Loop II	100°	−32.5°	91°	280 pc
Loop III	124°	15.5°	65°	370 pc
Loop IV	315°	48.5°	39.5°	590 pc

Stefano Mori
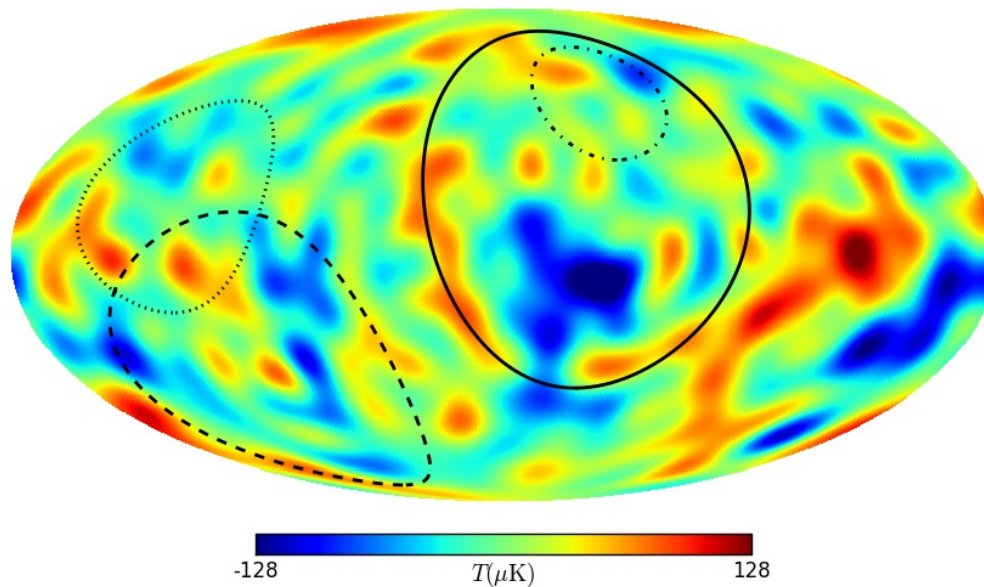
- I'm 30
- I was born in Reggio Emilia (Italy)
- I have two brothers
- I like playing guitar and climbing
  (you can see me smiling on the top of a mountain)
- I had my PhD in 2013 with Prof. Luca Griguolo at the University of Parma

  *"Correlators of Wilson loops on Hopf fibration
  in the $AdS_5 \times S^5$ correspondence"*

  working manly on the string theory side of the correspondence
- I'll work with Prof. Kristjansen group on 3-point functions and integrability
- Someone of you may have met me in may while I was here visiting NBI:
  Hi, everybody! I'm looking forward to be back!

QCD from lattice diagrammatic methods
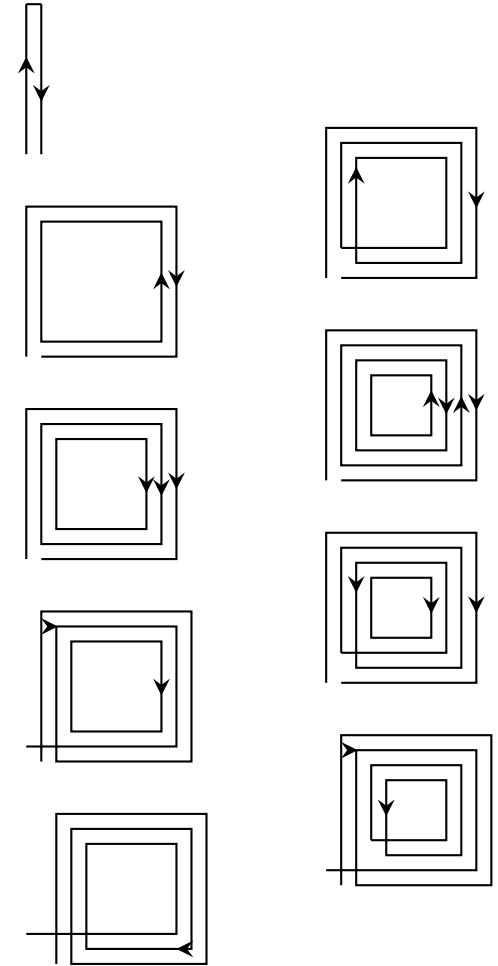
Joyce Myers

QCD with $\mu \neq 0$

- Sign problem : no conventional lattice simulations

- Strong coupling: no conventional perturbation theory (unless $T \to \infty$ or $\mu \to \infty$)

Lattice strong coupling expansion ($g \to \infty$)

- combined with hopping expansion (heavy quarks)

- $\langle \bar{\psi}\psi \rangle$ vs. N_f (light quarks) $\longrightarrow$

Future

- fermions in higher dimensional representations

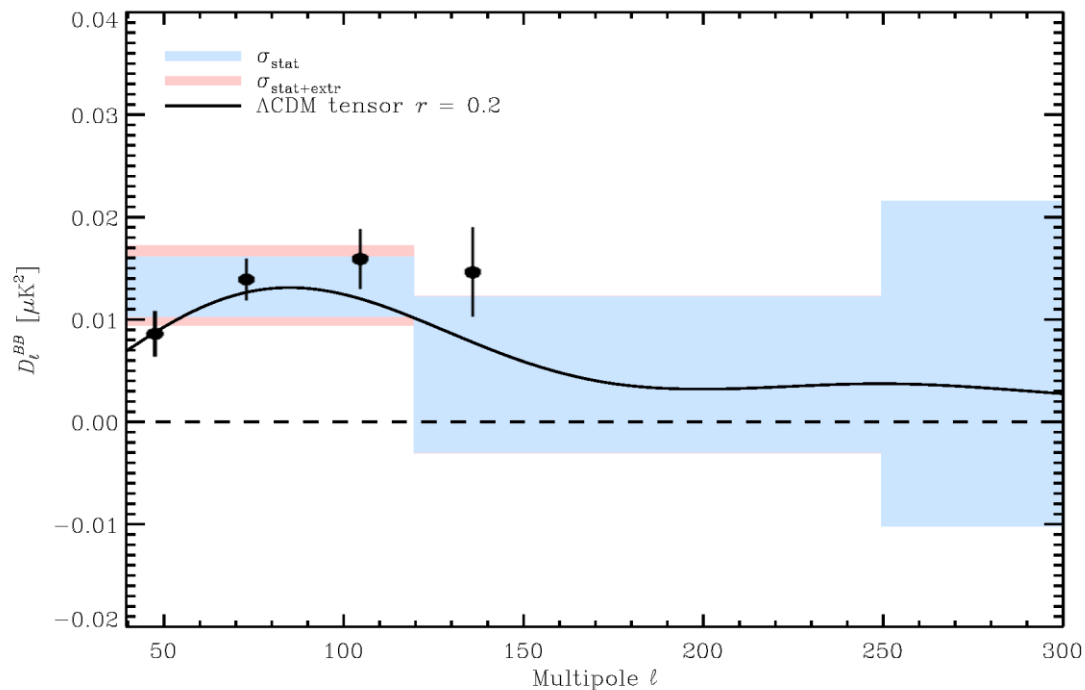- supersymmetric theories

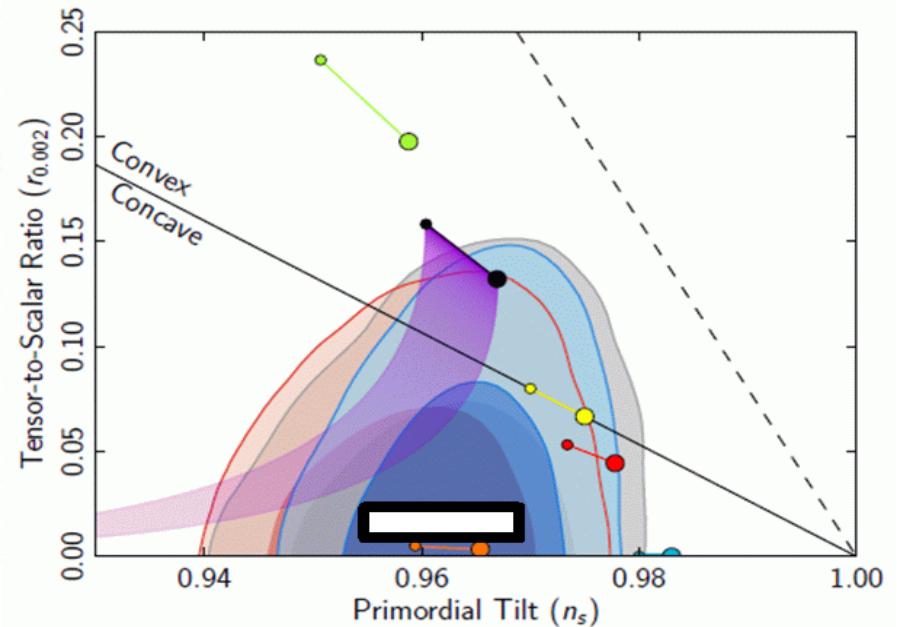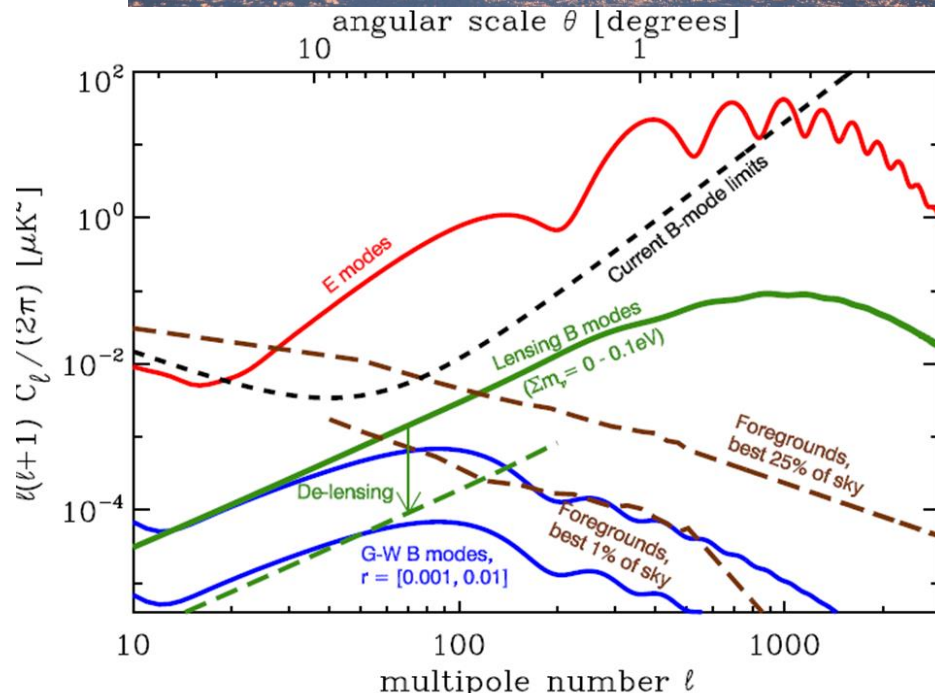- finite g

P. Naselsky,
HEPC NBI & Discovery

37 pub./refer.; 16 in press. Total N of citations -5788

01-05.12.2014- Planck 2014 data release. Member of OC, chairmen of I&S section

BICEP 2 verification with Planck

2015-2019. DEEP SPACE experiment in Greenland

# Research interests, Niels Obers (2 min. meeting 2014)

Blackfolds: dynamics of black holes in gravity and string theory
- new charged spinning branes in AdS and applications to
  gauge/gravity
- transport and response coefficients for charged spinning
  branes in (A)dS
- black holes as "fluids" and "materials": partition function approach
- blackfolds in arbitrary backgrounds
- flux backgrounds and cosmology (brane/flux annihilation)
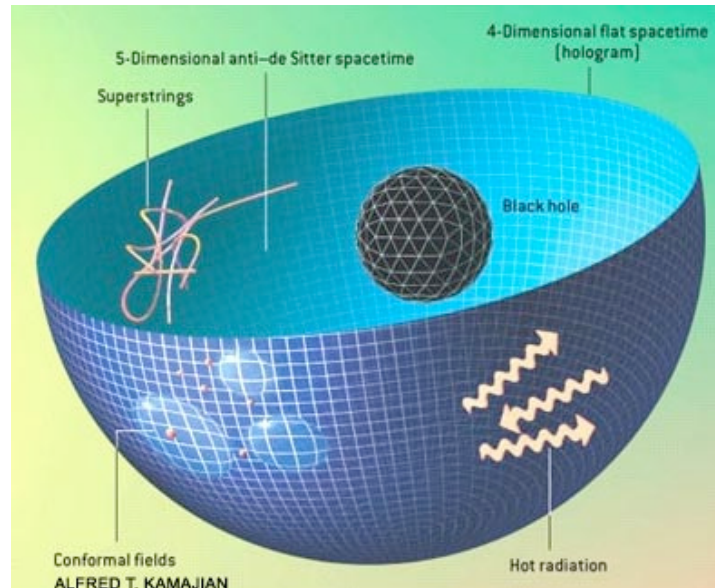
Aspects of holography
- Lifshitz holography and Schroedinger field theories
- coupling of non-relativistic FTs to Newton-Cartan geometry
- applications (e.g. AdS/CMT)
- Lifshitz black holes/branes and fluid/gravity for NRFTs

- thermal Giant Gravitons and bubbling black holes
- subtracted black hole geometries & Kerr/CFT
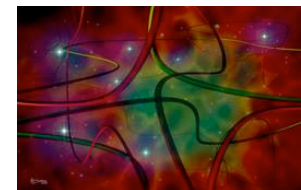
With:

Jay Armas (Bern), Troels Harmark, Jelle Hartong (Brussels),
Jan de Boer (Amsterdam), Elias Kiritsis (Crete), Vasilis Niarchos (Crete),
Jakob Gath (Ecole Polytechnique), Andreas Vigand Pedersen (Berkeley):
Marco Sanchioni (PhD)

Steven Roenhild (MSc), Dennis Hansen (MSc)

5-Dimensional anti–de Sitter spacetime
Superstrings
4-Dimensional flat spacetime (hologram)
Black hole
Hot radiation
Conformal fields
ALFRED T. KAMAJIAN

Wishlist
- entanglement entropy and AdS/CFT
- Partition functions and localization techniques in QFT/ST

CHRIS PETHICK
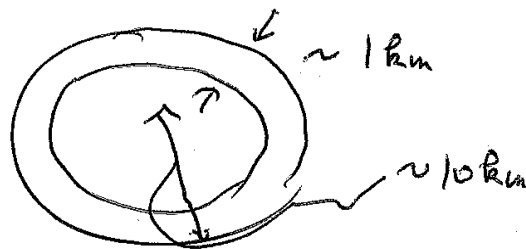## (NBIA & NORDITA, STOCKHOLM)

① DENSE MATTER & NEUTRON STARS

    ⓐ NEUTRINO PROCESSES (HOW DO SUPERNOVAE WORK?)
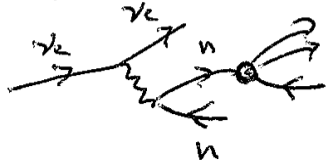
                EFFECTS OF MEDIUM

    ⓑ NEUTRON STAR CRUSTS

      OSCILLATIONS

$\sim 1\ km$

$\sim 10\ km$

② GARBAGE DISPOSAL FOR EXPERIMENT TO MEASURE ELECTRIC DIPOLE MOMENT OF NEUTRON.

    $^3He + n$ (both polarized)

    GET RID OF DEPOLARISED ^3He by PHONON WIND IN SUPERFLUID ^4He

[Who]   Kim Splittorff   (Associate Prof., DFF-Sapere Aude + NBI)

[What] Effective field theory, Random Matrix Theory, Langevin dynamics ...

[Why] Non-perturbative effects in strongly interacting systems:

> QCD at non-zero chemical potential
>
> Lattice QCD effects
>
> Majorana fermions in nano-systems
>
> ...

[Teaching] QM 2 + labs + stop-drop-out + pedagogical suprvisor, ...

[Who] Kim Splittorff   (Associate Prof., DFF-Sapere Aude + NBI)

[What] Effective field theory, Random Matrix Theory, Langevin dynamics ...

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QCD at non-zero chemical potential

Lattice QCD effects

Majorana fermions in nano-systems

...

[Teaching] QM 2 + labs + stop-drop-out + pedagogical suprvisor, ...

[Where]   Fc5

Mads Søgaard

Position and affiliation
PhD student at NBIA/Discovery
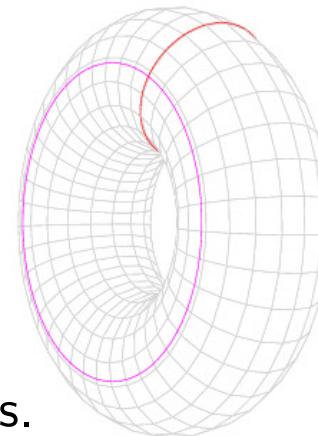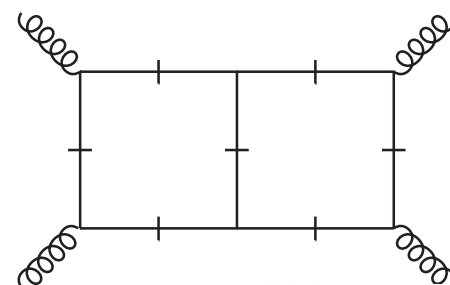
Scientific trajectory
B.Sc. '09, NBI/HET; M.Sc. '11, NBIA/Discovery.

Academic advisors
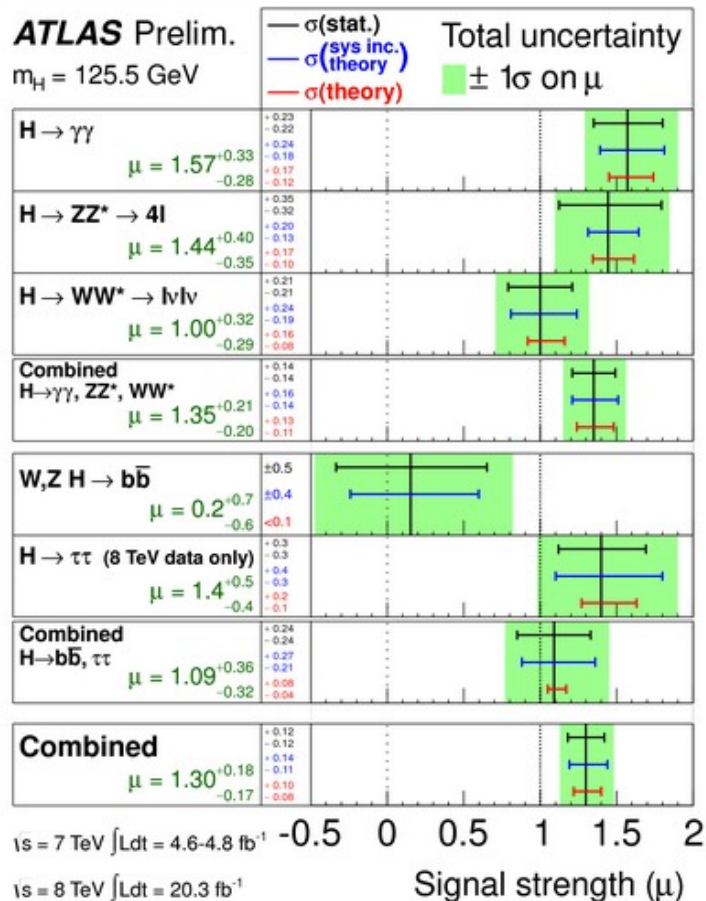Emil Bjerrum-Bohr, Poul Henrik Damgaard

Research interests
Mathematical and computational aspects of multiloop
scattering amplitudes in QCD and $\mathcal{N} = 4$ super Yang-Mills.

Brief Summary: M. Trott

- Sorry i am in discussions at CERN in the Higgs working group for the meeting.

- Current knowledge of higgs couplings:

- Rich prospects for further precision

Facility	LHC	HL-LHC	TLEP (4 IPs)
$\sqrt{s}$ (GeV)	14,000	14,000	240/350
$\int \mathcal{L}dt$ (fb^{-1})	300/expt	3000/expt	10,000+2600
κ_γ	5 − 7%	2 − 5%	1.45%
κ_g	6 − 8%	3 − 5%	0.79%
κ_W	4 − 6%	2 − 5%	0.10%
κ_Z	4 − 6%	2 − 4%	0.05%
κ_ℓ	6 − 8%	2 − 5%	0.51%
$\kappa_d = \kappa_b$	10 − 13%	4 − 7%	0.39%
$\kappa_u = \kappa_t$	14 − 15%	7 − 10%	0.69%

- Second column is expected in next 2 years.

- Standard Model EFT to interpret this information inconsistent for this precision. (Loop corrections required in EFT.)

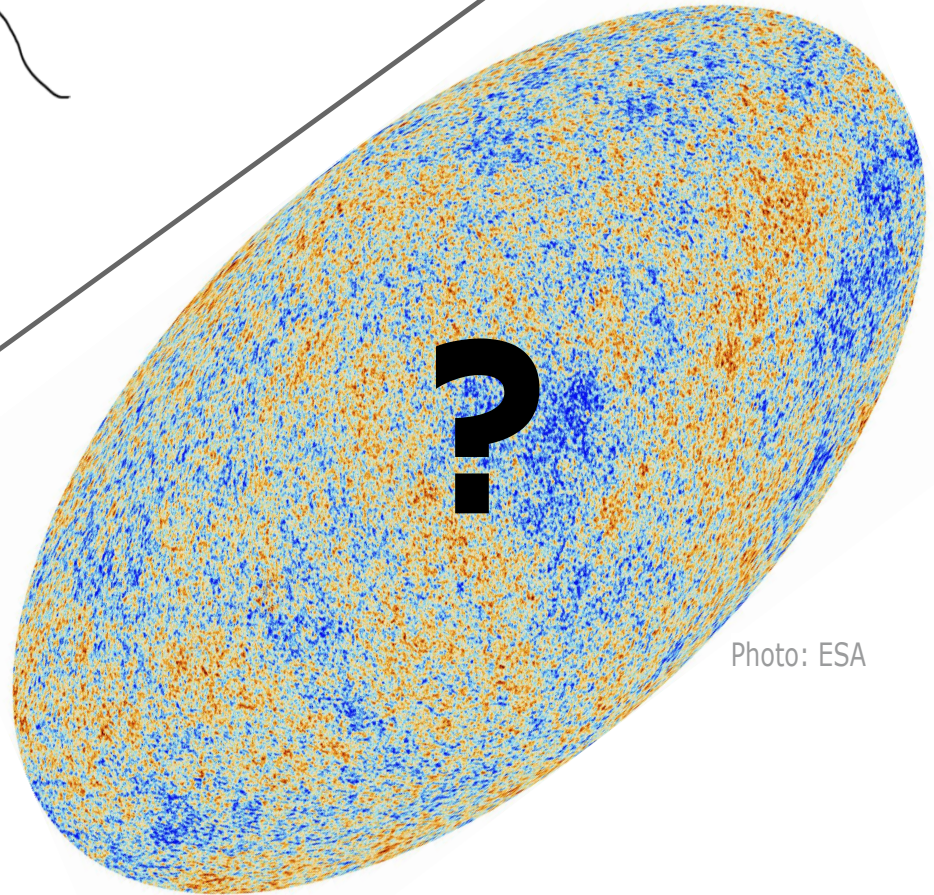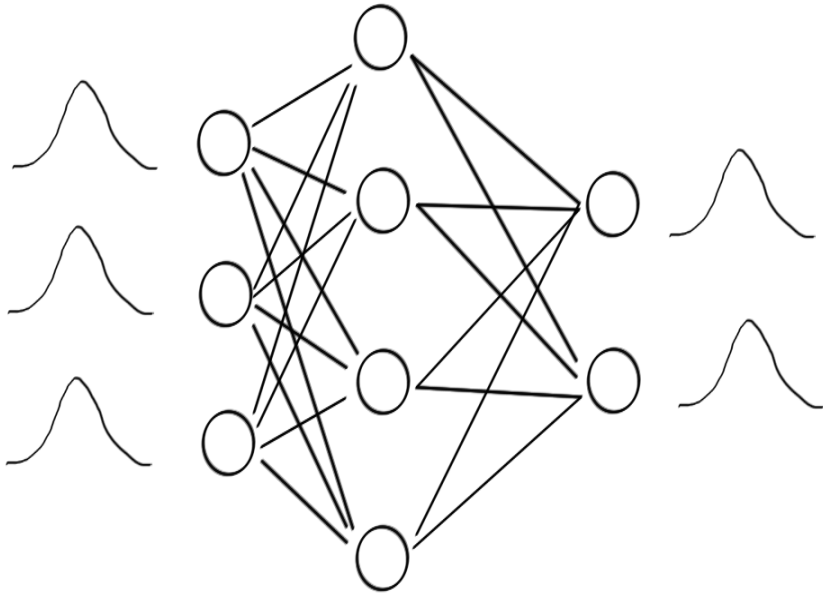- I am systematically developing the EFT so that we can use this data consistently.

Michael Trott, Niels Bohr Institute, Nov 25th 2014

Monday, November 24, 14

Photo: ESA