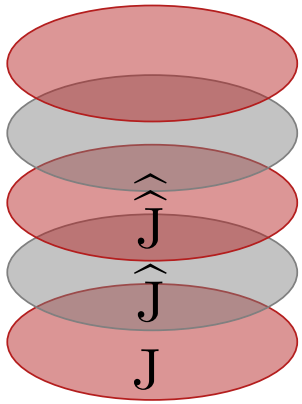
Dennis Müller (FB11)

dennis.mueller@nbi.ku.dk

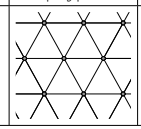
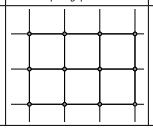
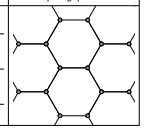
About:

- PhD at HU Berlin (2014-2018)
- Postdoc in Charlotte Kristjansen's group (since 10/2018)



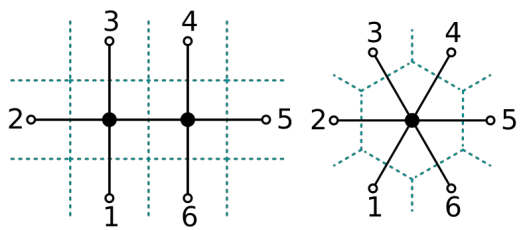
Past research activities:

- Yangian symmetry of super Wilson loops in $\mathcal{N} = 4$ SYM
- Yangian symmetry of fishnet Feynman graphs

Dimension	$d = 3$	$d = 4$	$d = 6$
Propagator	$\lvert x_{ij}\rvert^{-1}$	$\lvert x_{ij}\rvert^{-2}$	$\lvert x_{ij}\rvert^{-4}$
Scalar Fishnet			

Current projects:

- Hypergeometric differential equations from Yangian symmetry
- One-point functions in defect $\mathcal{N} = 4$ SYM

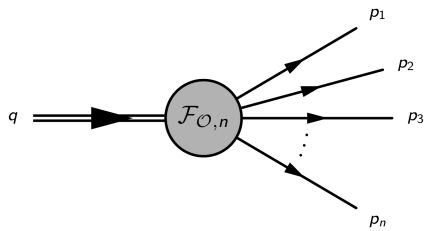


Matthias Wilhelm
Assistant Professor, Fc10 and Cc3

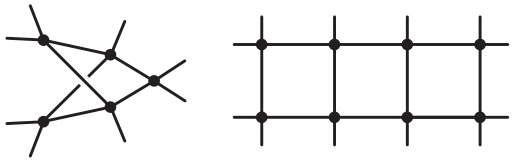
Goal Analytic and preferably non-perturbative understanding of the structure of gauge theories
$\rightarrow$ $\mathcal{N} = 4$ supersymmetric Yang-Mills theory and beyond

Scattering amplitudes and Integrability

- On-shell methods beyond scattering amplitudes: form factors, anomalous dimensions, beta functions

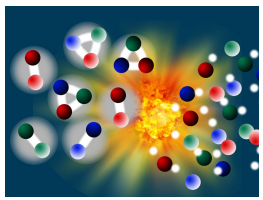


- Number theory of Feynman integrals



- Defect CFTs: One-point functions, particle-interface potential

- Thermodynamics of gauge theories: Hagedorn temperature, towards finite N



Poul Henrik Damgaard

Current research interests:

- Amplitudes in general
- Classical gravity from scattering amplitudes, gravitational waves

Interested in moving more towards:

- Astrophysical aspects of gravitational waves

Stefano Baiguera

Research areas during the PhD:

- Non-relativistic field theories
  - Constraints and monotonicity properties of Renormalization Group flows
  - Classification of trace anomaly for theories coupled to Newton-Cartan background
  - Supersymmetric version of the Galilean group and consequences on the renormalization properties
- Holographic complexity
  - Relation between black holes and information physics: evolution of the Einstein-Rosen bridge
  - Tool to investigate non-relativistic holography

Upcoming investigations:

- Study of consistent backgrounds admitted by non-relativistic versions of string theory (with Niels, Troels, Gerben, Yang)
- Renormalization properties of supersymmetric Galilean-invariant QFTs with gauge fields
- Complexity from QFT side

Emil Bjerrum-Bohr

Office, Bb.1

Current research interests:

- Amplitudes and Spinor-Helicity magic
- Amplitudes and the Post-Minkowskian expansions in Einstein's gravity
- Amplitudes and the Large-Hadron-Collider

Methods:

- Gauge theory / Gravity relationship (Kawai-Lewellen-Tye relations)
- Monodromy and Color-Kinematic relations (Bern-Carrasco-Johansson) for amplitudes
- CHY formalism for amplitudes
- Effective field theory

Come and see me about BSc/MSc thesis projects on these topics!

Courses:

- Lectures on 'Modern methods for particle scattering' [BLOCK 3] (starting now)
- MAT F2

Workshops & Network:

- An organizer of the yearly meeting (together with Christian and Matthias): 'Current Themes in High-Energy Physics and Cosmology'.
- An organizer of the Nordic Winter School 2021 (together with Michele, Poul and Niels). Interesting program for MSc and Ph.D. students in the group.
- An organizer of AMPLITUDES 2021 (to be hosted in Copenhagen)
- Local PI for the EU Marie-Curie project SAGEX, and local coordinator for EU COST network on precision physics.

Sara Bonansea

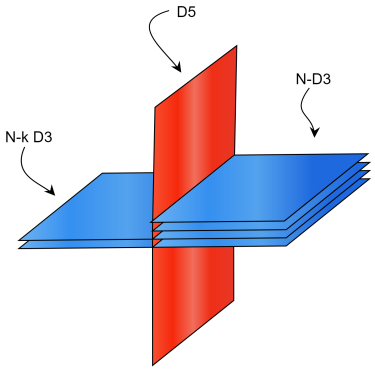
Research fellow

Two-minute meeting 2020

- PhD at Florence University (2016-2019) with Domenico Seminara
- Research fellow in Charlotte Kristjansen's group (since 02/2020)

Past research activity

- Analysis of the circular Wilson loop operator in a defect version of $\mathcal{N} = 4$ SYM dual to the D3-D5 probe-brane system
  - generalization of previous computations both at strong and weak-coupling
  - use of a mixture of analytical and numerical methods to cover the full parameter space of the string solution



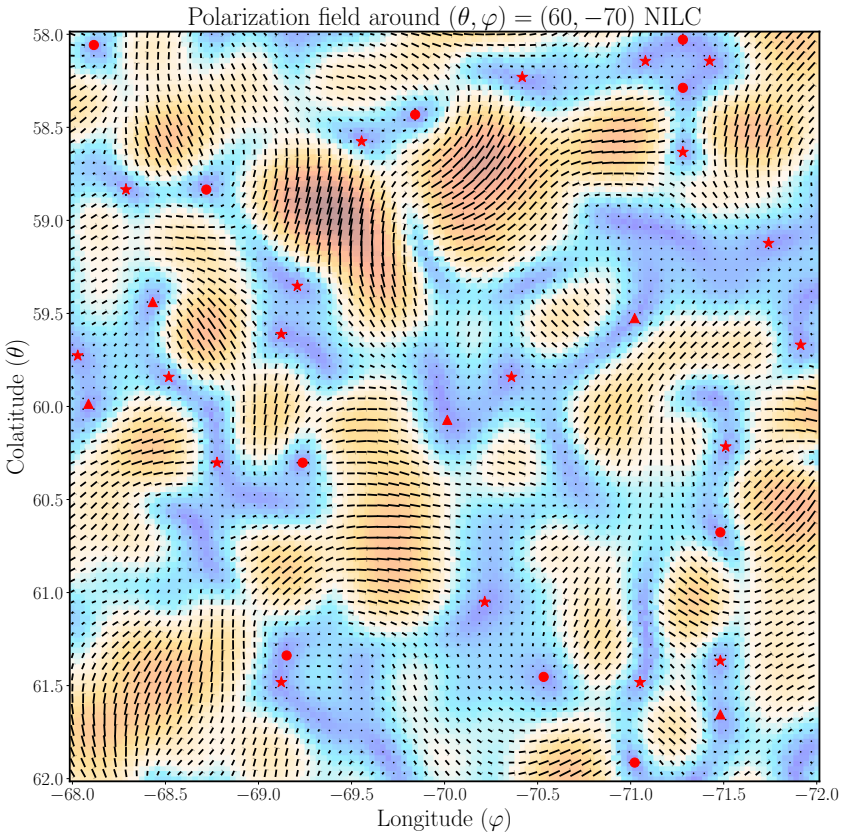
Present research activity

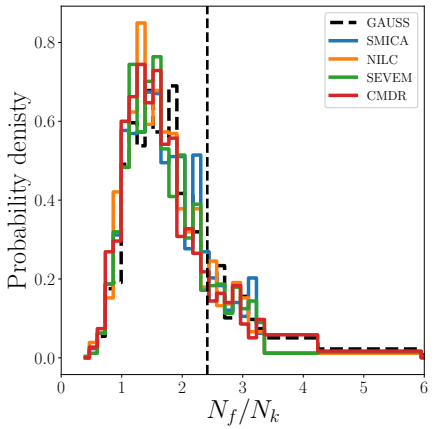
- Correlator of two circular Wilson loops in the D3-D5 set-up $\Rightarrow$ complicate pattern of Gross-Ooguri like phase transitions
- Study of Wilson loops in the non-supersymmetric D3/D7 system
- Understanding of the integrability structure of these probe-brane models from the string theory point of view

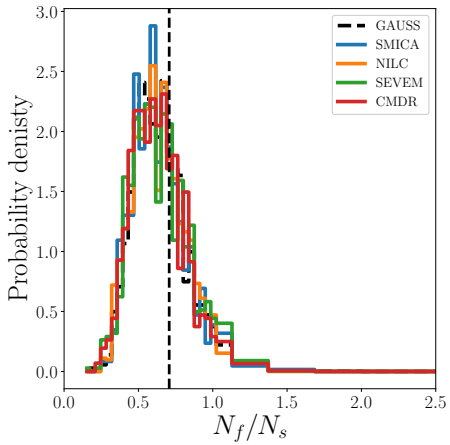
James Creswell

PhD student

Classification of singular points in the CMB polarization field



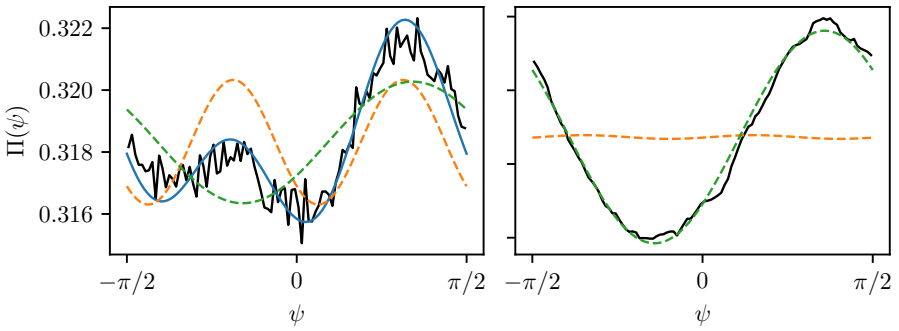


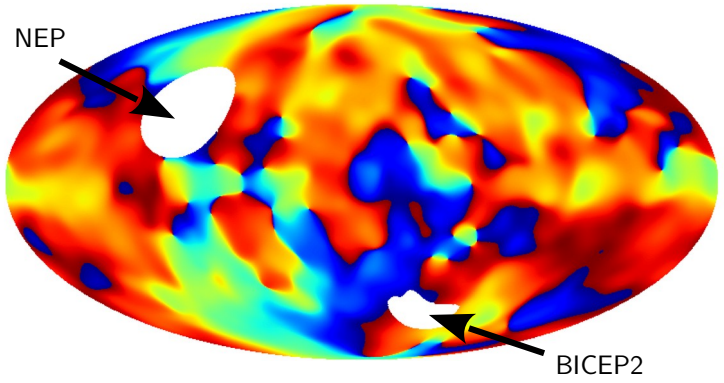


with MSc student Jaan Kasak

Statistics of CMB polarization angles

$$\psi = \frac{1}{2}\arctan\left(\frac{U}{Q}\right)$$





arXiv:2001.01757

Work in progress

Paolo Di Vecchia

1. Use modern quantum field theory methods to extract classical quantities in theories of gravity in a much simpler way than using the formalism of CGR. They can be used to describe the initial state of black hole merging before emission of gravitational waves.
   - Extend the recent calculations done in $N = 8$ supergravity to the case with masses.
   - Check deflection angle at 3PM recently computed by Bern et al.
   - Deflection angle and potential for arbitrary D.
   - Extend to the case with spin.

   I am discussing these issues with many people. They include [E. Bjerrum-Bohr, A. Cristofoli, P.H. Damgaard, H. Johansson, M. Hadjiantonis, C. Heissenberg, S. Naculich, R. Russo, G. Veneziano, C. White]
2. Construction of an N-point string amplitude for pions with Adler zeroes generalizing the Lovelace-Shapiro model for 4 pions. It corresponds to a string extension of the non-linear σ-model. [M. Bianchi and D. Consoli]

Troels Harmark

Holographic dualities:

Spin Matrix theory, non-relativistic string theory and geometry

New non-relativistic string theories
Quantization of non-relativistic strings
Gravity from beta-functions

J. Hartong, N. Obers, G. Oling, L. Menculini, Z. Yan

More recently also: S. Baiguera, L. Bidussi, Y. Lei

Non-relativistic field theories from Spin Matrix theory

New field theories from non-relativistic limits of N=4 Super Yang-Mills theory
Dual FTs to non-relativistic strings

N. Wintergerst

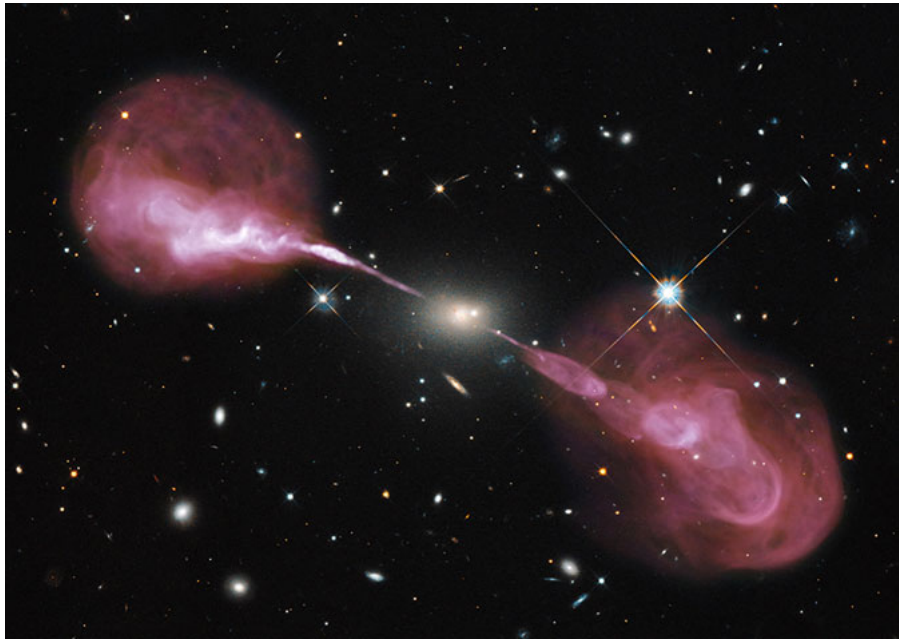
Hagedorn temperature in AdS/CFT

Hagedorn temperature at all orders in the ‘t Hooft coupling
Now also with chemical potentials

M. Wilhelm

Troels Harmark

Astrophysical black holes:



Force-free electrodynamics around the Kerr black hole

Most used analytical model of Blandford and Znajek 1977 doesn't work
How can one resolve this?

G. Grignani and M. Orselli

More recently also: F. Camilloni, R. Oliveri

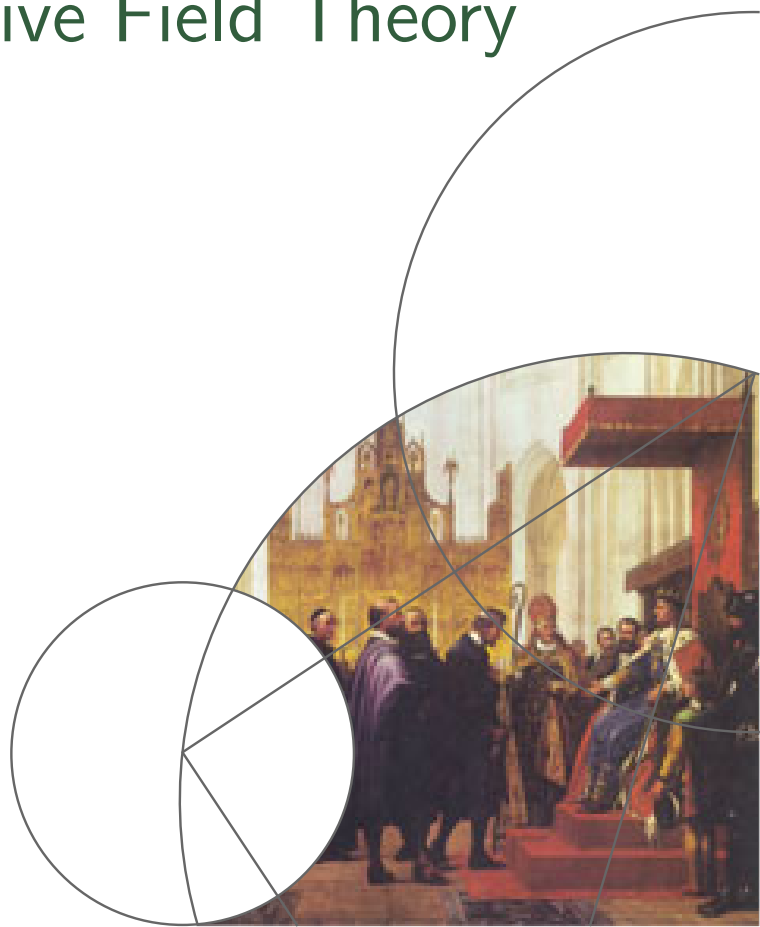
PhD students (with Perugia): F. Camilloni, L. Menculini, A. Placidi
Postdocs (with N. Obers): S. Baiguera, Y. Lei, G. Oling, N. Wintergerst

Head of section

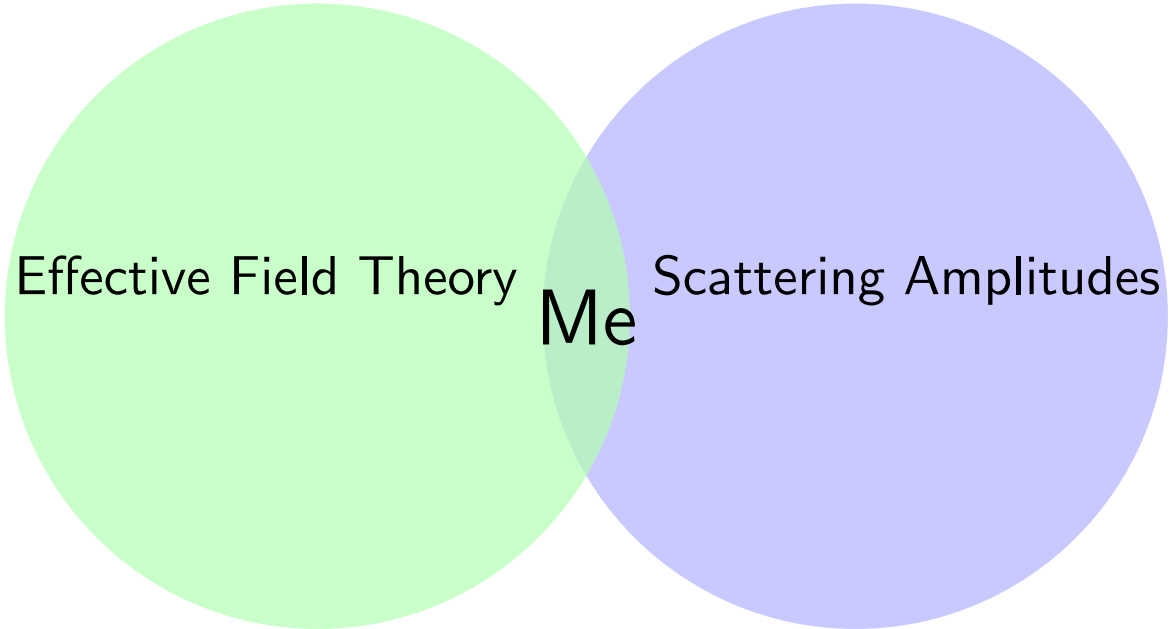
I teach "General Relativity and Cosmology" and "Introduction to string theory"

Scattering Amplitudes & Effective Field Theory

Andreas Helset
Niels Bohr International Academy



My research



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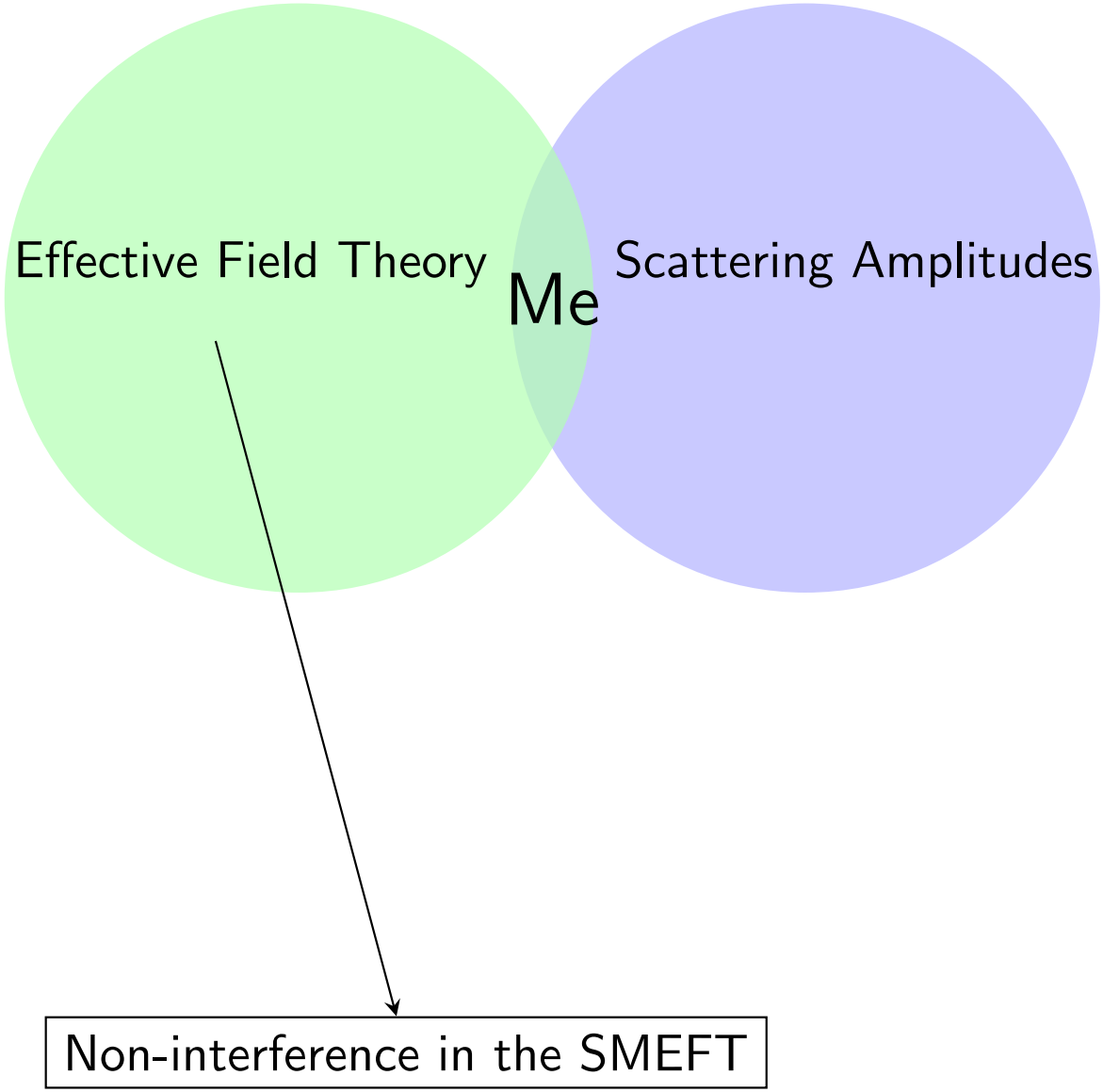
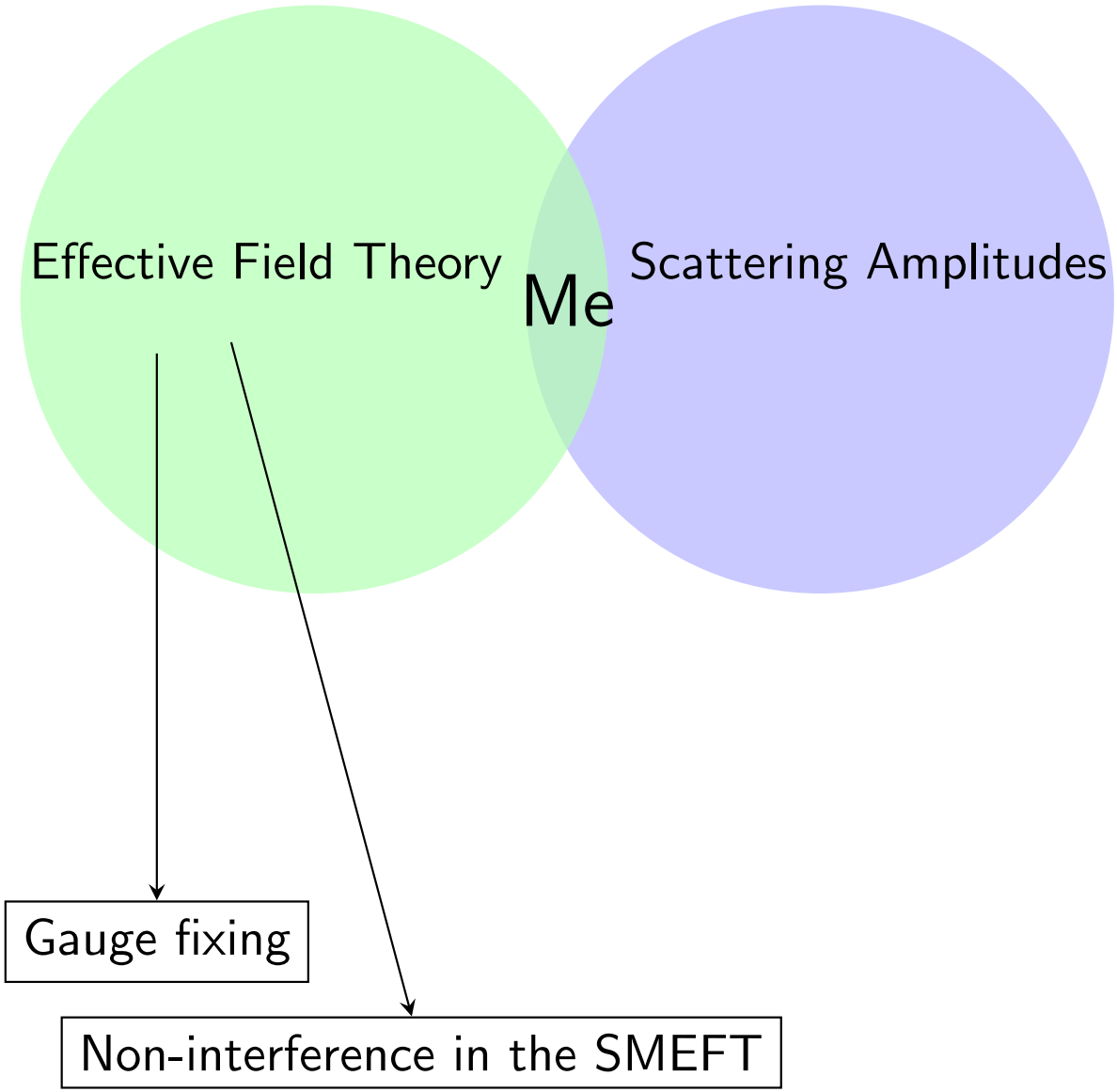

Effective Field Theory
Me
Scattering Amplitudes
Non-interference in the SMEFT

My research


Effective Field Theory
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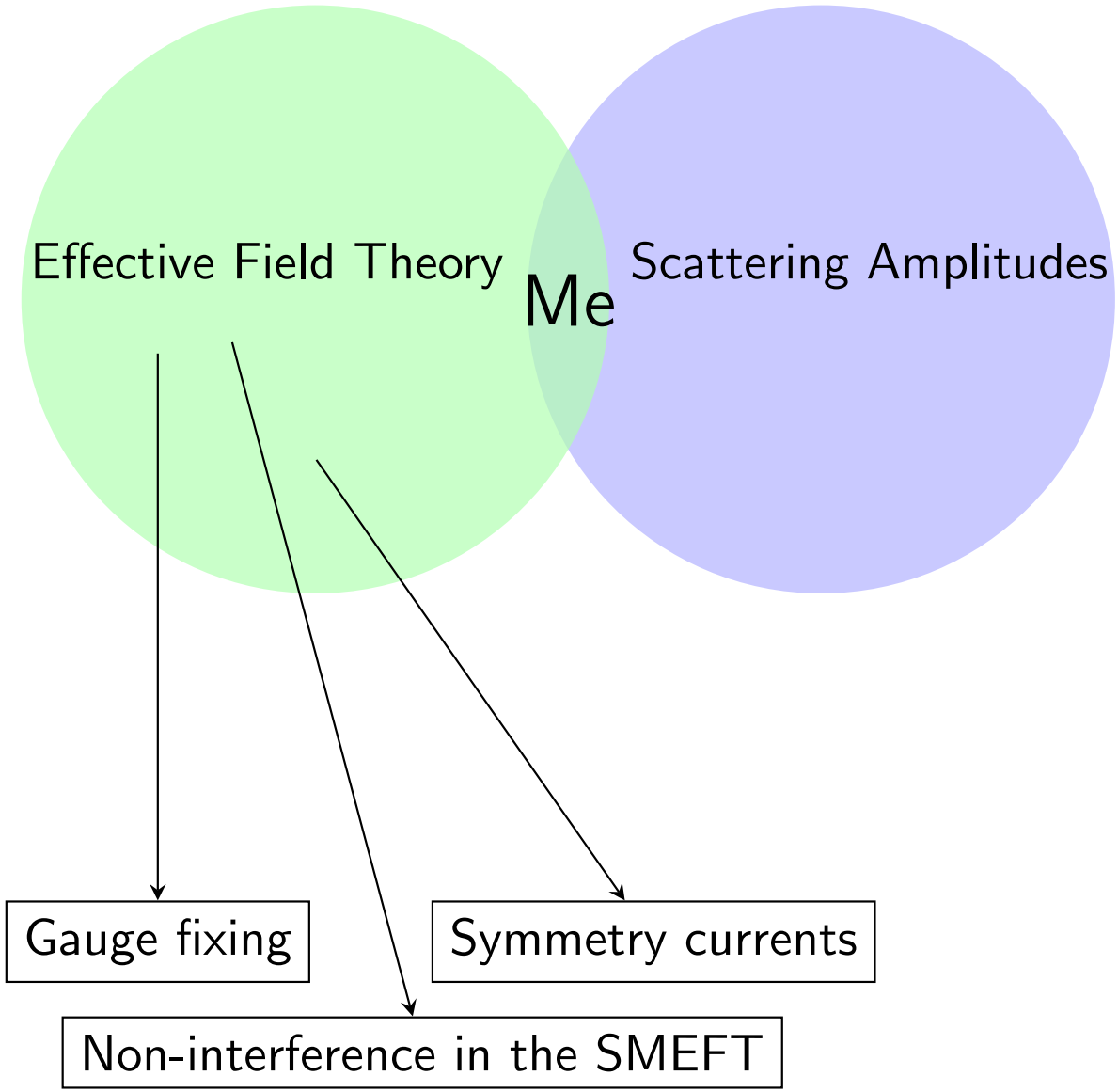
Scattering Amplitudes
Gauge fixing
Non-interference in the SMEFT

My research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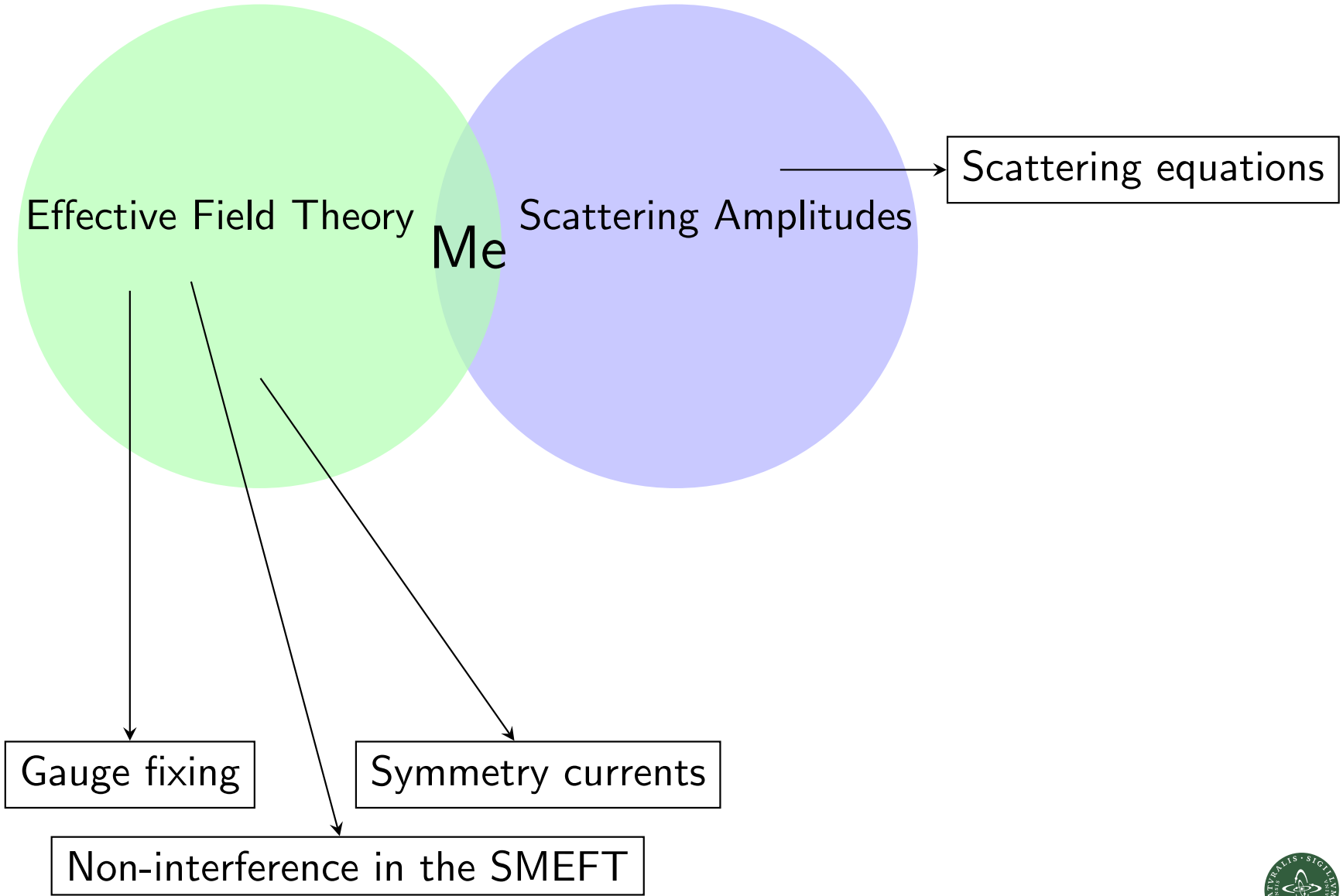
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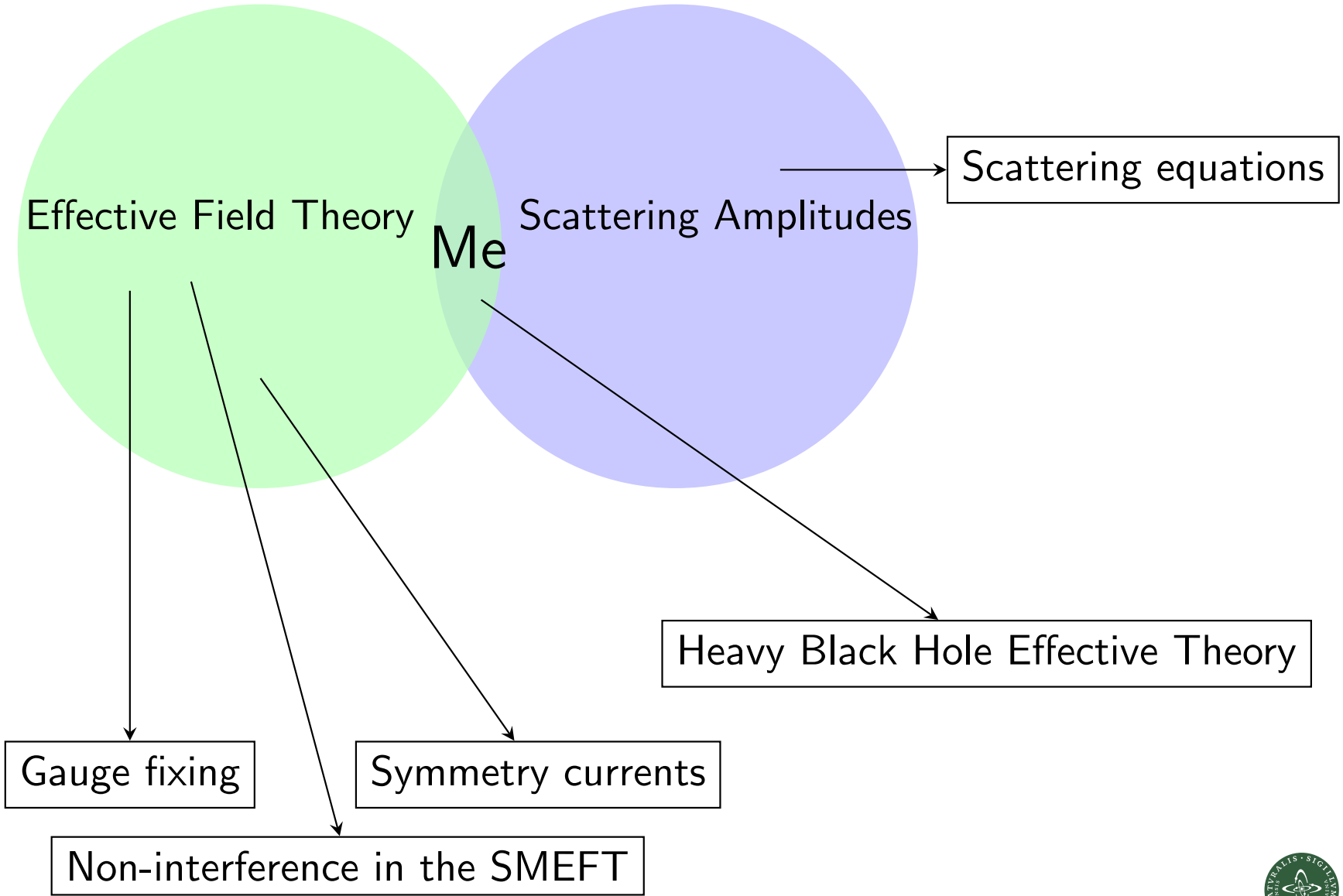
Effective Field Theory
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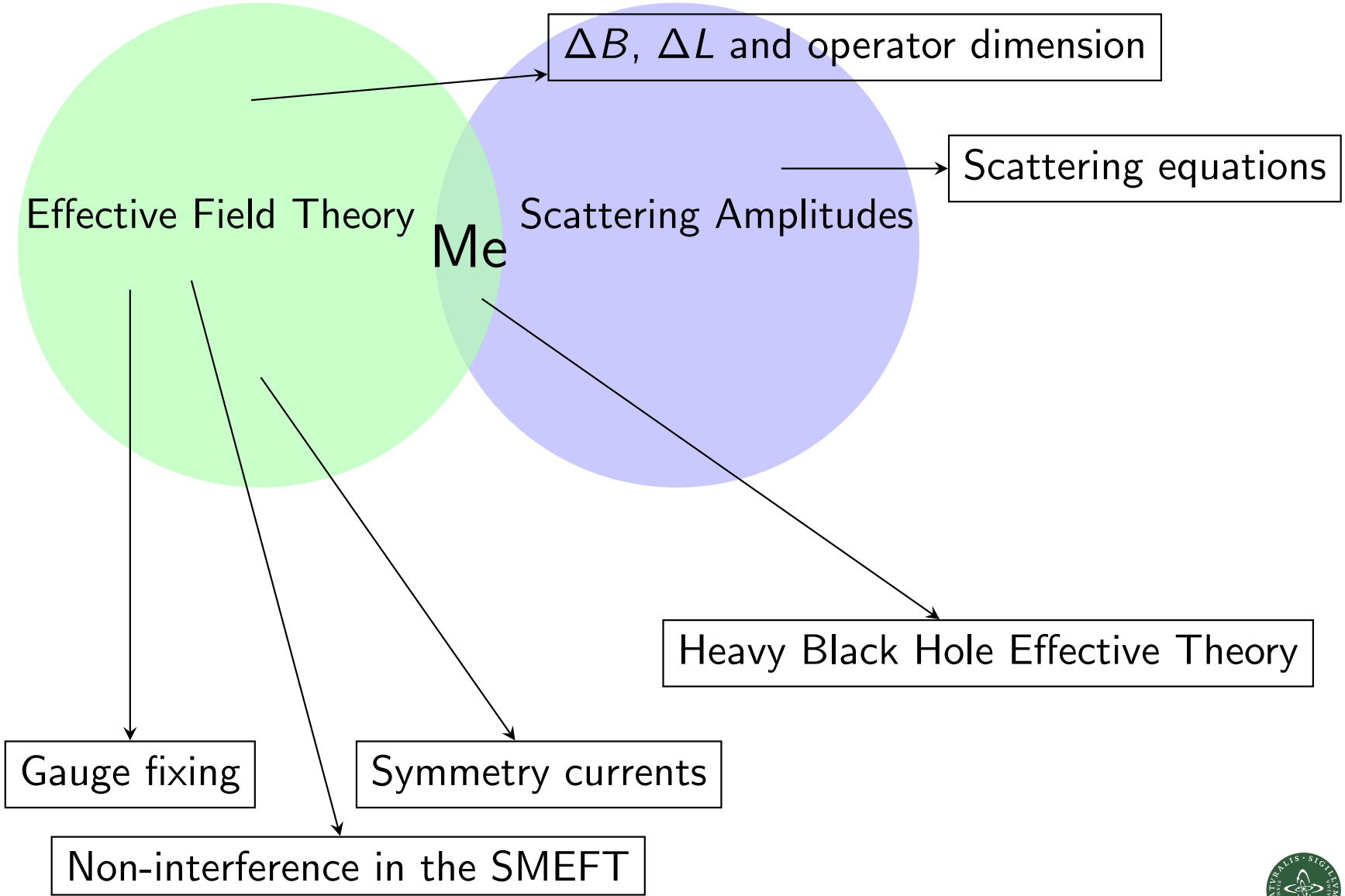
ΔB, ΔL and operator dimension
Scattering equations
Effective Field Theory
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Scattering Amplitudes
Heavy Black Hole Effective Theory
Gauge fixing
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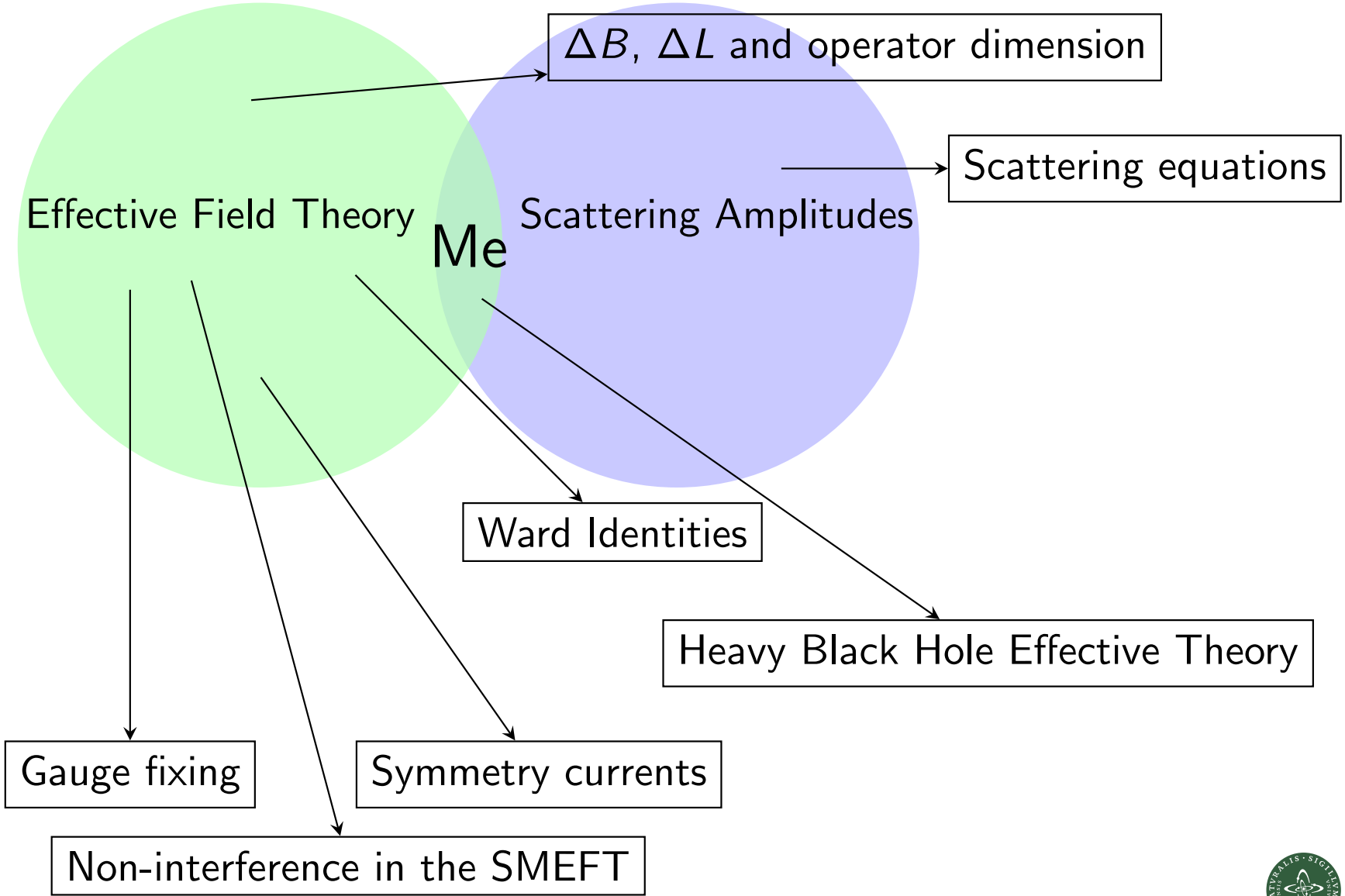
My research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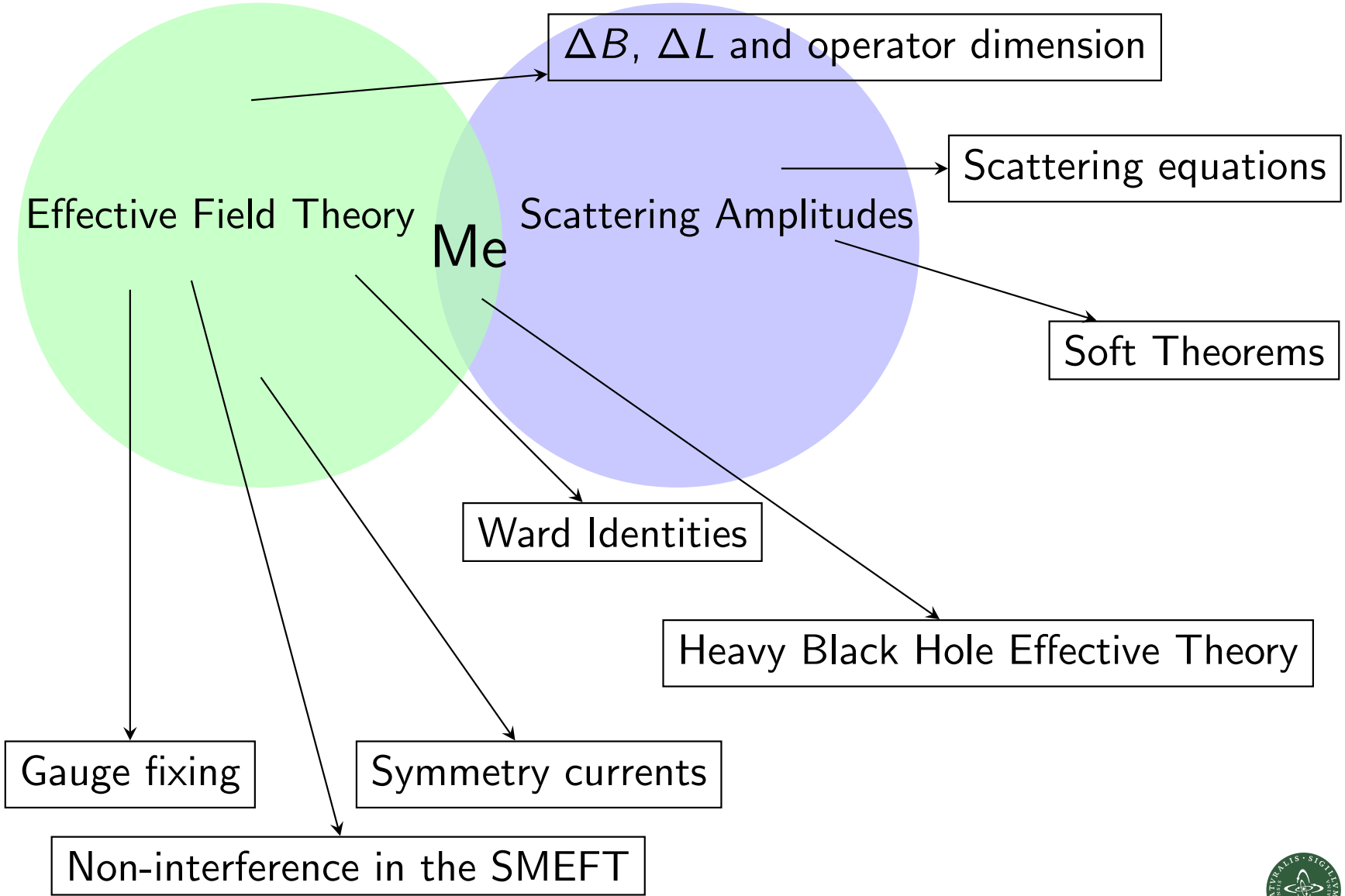
ΔB, ΔL and operator dimension
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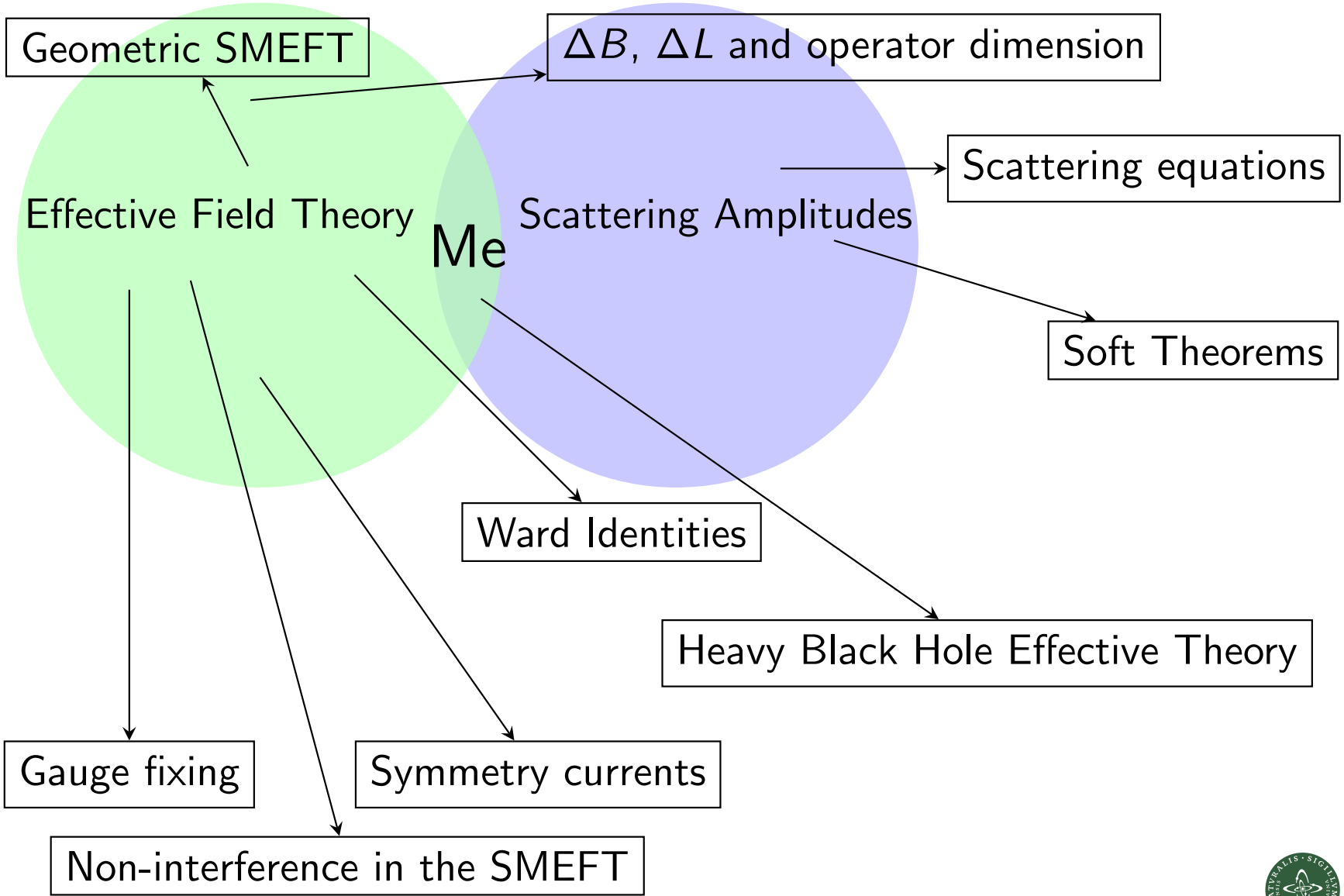
Geometric SMEFT
ΔB, ΔL and operator dimension
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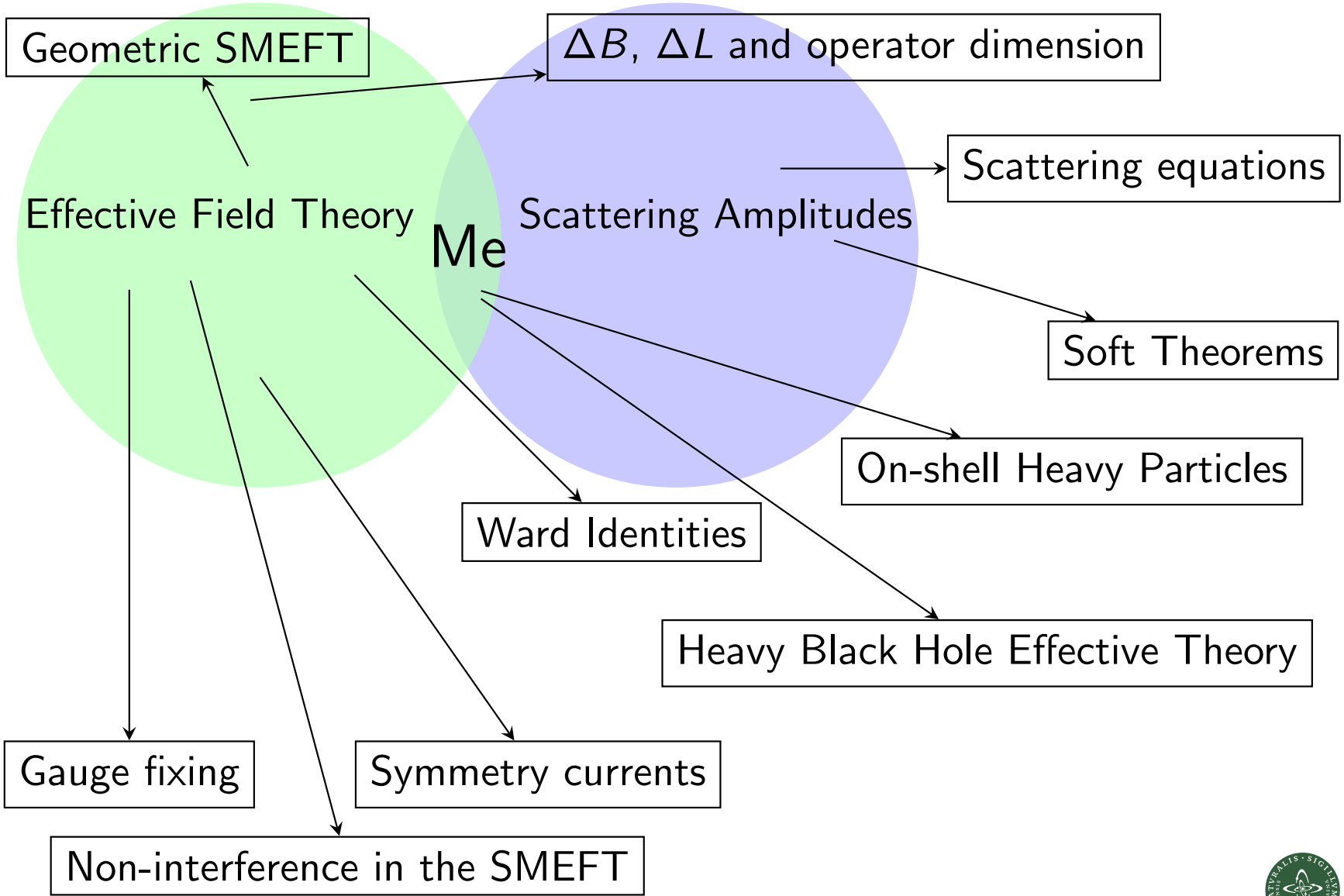
Geometric SMEFT
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On-shell Heavy Particles
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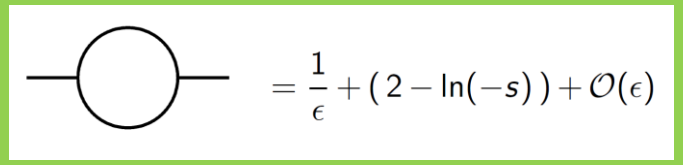
Functions in Scattering Amplitudes:

Well-Known



• • •

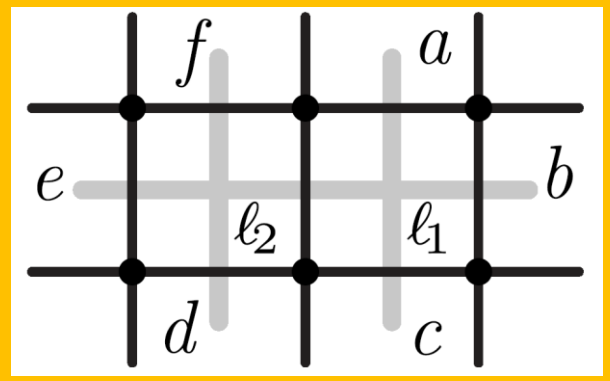
$$G(w_1, w_2, \ldots; z) = \int_0^z \frac{1}{x - w_1} G(w_2, \ldots; x) dx$$

• • •

Amplitudes bootstrap:

- Planar N=4 SYM: 7L 6pt!
- More complicated at 8+pt, “square root letters”
- Correlation functions?

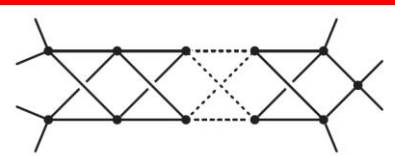
Known?

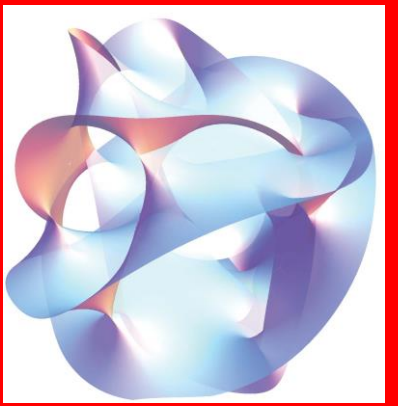


Elliptic functions in N=4:

- Can we understand them with new tools?
- Bootstrap them?

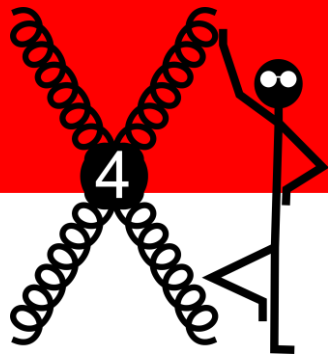
Unknown





“Calabi-Yau functions”:

- Very little known, lots to explore!



Matt von Hippel

Plus outreach at
4gravitons.wordpress.com

Alexander T. Kristensson

(PhD – Supervised by Matthias Wilhelm & Charlotte Fløe Kristjansen)

Thermodynamics of $\mathcal{N} = 4$ Super Yang-Mills at finite *N*

- Understand phase transition of QCD
- $\mathcal{N} = 4$ contains phase transition in $\mathbb{R} \times S^3$
  - *Counting gauge invariants → Partition function* [Sundborg 2000]
- Investigate theory at finite *N*
  - *Hagedorn vs. Confinement/Deconfinement* [Aharony 2005]
  - *Gravity dual: Hawking-Page phase transition* [Hawking, Page 1983] [Witten 1998] [Maldacena 1999]

Charlotte Kristjansen

Main theme: Integrability and beyond in AdS/CFT

Currently: AdS/dCFT (with applications to cond-mat and stat phys):

4D defect conformal field theories ⟷ Probe brane models

New types of correlation functions,
e.g. one-point functions

Boundary conformal bootstrap

Matrix product states & Quantum Quenches
(Cold atom experiments)

Fractional topological insulator

A holographic model of graphene

In the Past: Giant gravitons, Wilson loops, Finite N in N=4 SYM, ABJ(M) theory, wrapping interactions, Integrable spin chains, BMN limit, (causal) dynamical triangulations, Matrix models of 2D gravity

In the future: Entanglement entropy, Mellin techniques for boundary Conformal bootstrap, quenched action approach

Yang Lei (NBI/Wits)

- Non-relativistic string theory. To understand how to acquire non-relativistic gravity from non-relativistic string theory
  Collaborator: Niels Obers, Troels Harmark, Gerben Oling, Stefano Baiguera, Jelle Hartong ..
- Understanding higher dimensional AdS black hole from hidden symmetry. The near horizon limit has Virasoro symmetry.
  Aim: prove Cardy-Verlinde formula.
  Collaborator: Vishnu Jejjala, Kevin Goldstein, Sam Leuven, Wei Li (1910.14293)
- Nearly-AdS_2 (Jackiw–Teitelboim gravity/CGHS model).
  Collaborator: Cheng Peng, Shinji Hirano (1910.12542)

Holger Bech Nielsens Projects in 2020

- The 3.55 keV radiation from Dark Matter ? The by sattelites observed X-ray line at 3.55 keV is interpreted in our dark matter model in which dark matter consists of pearls of cm size being 100000 tons heavy bubles of new type of vacuum.(w. C. Froggatt).
- Development of Complex Action, Periodicity, Bouncing Cosmology. A way formulating quantum mechanics by means of the "weak value"

$$< O >= \frac{< f|O|i >}{< f|i >}, \tag{1}$$

for maximized $| < f|i > |^2$ (with $|i>$, $|f>$ normalized.) were inspired by the complex action theory. (w. K.Nagao).

Holger Bech Nielsen 2020 projects

- Generalizing our Novel String field theory We interprete our previous writting of a several string description - really a string field theory - as were the strings bound states of "objects" (slightly but essntially deviating from Charles Thorns string-bits). Then it is hoped that another internal structure for these bound states would give the p-adic string theory. w. M. Ninomiya..
- Deriving Locallity **Without** assuming **locality** at first we derive it under the assumption mainly of diffeomorphism symmetry (and some analyticity as a functional of a very abstract action

$$S[\phi] = S[\phi = 0] + \int \frac{\delta S}{\delta \phi(x)} \phi(x) d^d x + \frac{1}{2!} \int \int \frac{\delta^2 S}{\delta \phi(x) \delta \phi(y)} \phi(x) \phi(y) d \quad (2)$$

). w. Astri Kleppe.

Holger Bech Nielsen projects 2020

- Small deviations - anomalies - from the Standard Model in B-meson-decay, g-2, and ϵ'/ϵ are interpreted as due to non-perturbative effects. The Standard Model quite correct in spite of these anomalies: we fit them with one parameter, which in priniciple could be calculated. (w. C. Froggatt).
- Gravitational anomaly using Dirac sea thinking. Recalculate gravitational anomaly already found by Alwares-Gaumets Witten. (w. M. Ninomiya).

Holger Bech Nielsens projects Yet continued.

- Fermionization and Spin Statistics Theorem etc... (w. N.Borstnik-Mankoc.)
- Alternative Second Quantization Formalism (w. N.Borstnik-Mankoc.)
- Upper Bound on Couplings in Effective Field Theory From existence of some physics at shorter length scale than the scale μ^{-1} considered a practical or statistical upper bound on effective couplings is estimated.(w. Sekino and Ninomiya.)

AdS/dCFT & Integrability in $\mathcal{N} = 4$ SYM

Breaking SUSY in AdS/CFT

Master student: Rasmus Nielsen
Supervisor: Charlotte Kristjansen

Two Minutes Talk, January 2020

Probe branes and spontaneously broken SUSY

String theory setup vs. Field theory setup

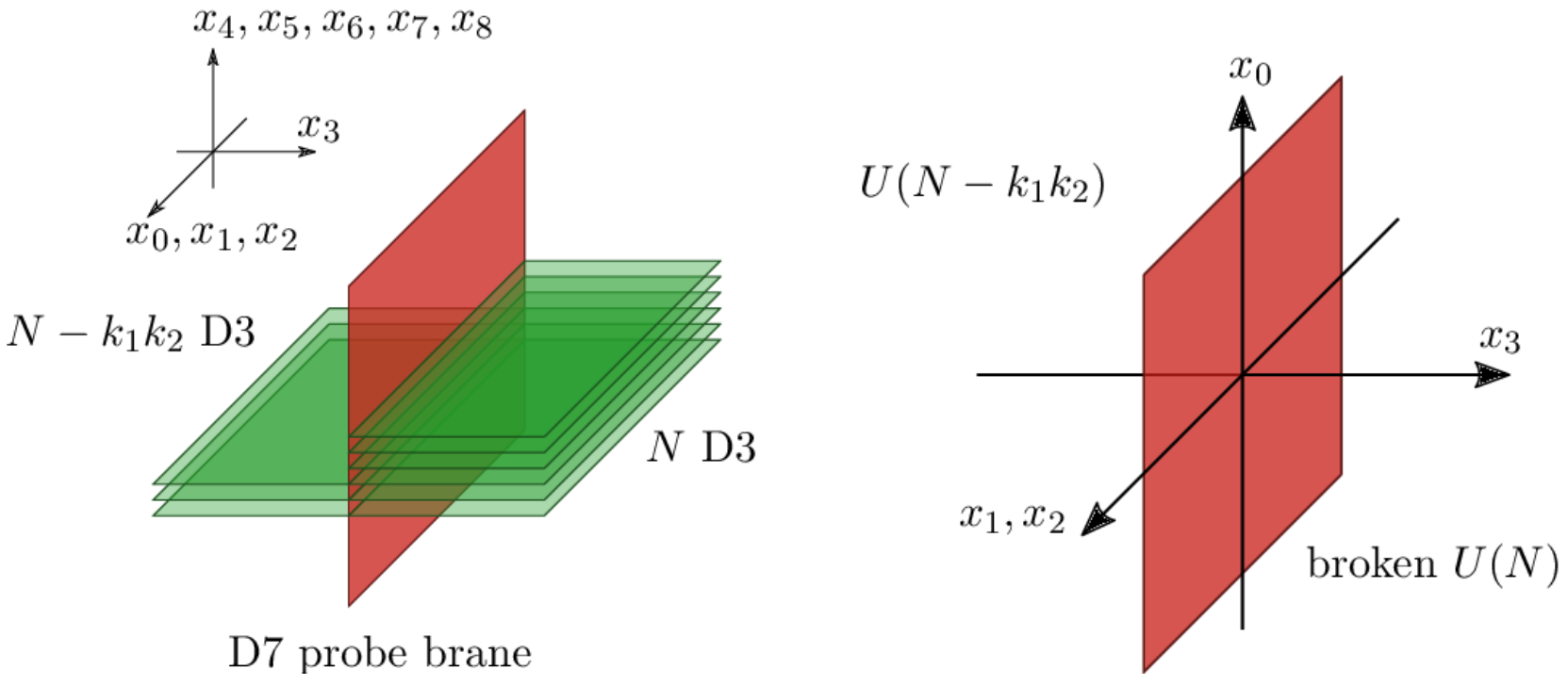


Figure: arXiv:1810.11463 [hep-th]

Anomalous dimensions and $SO(6)$-spin chains

Closed $SO(6)$-spin chain with associated Hamiltonian

$$\Gamma = \frac{\lambda}{16\pi^2} \sum_{\ell=1}^{L} (2 - 2\,P_{\ell,\ell+1} + K_{\ell,\ell+1})$$

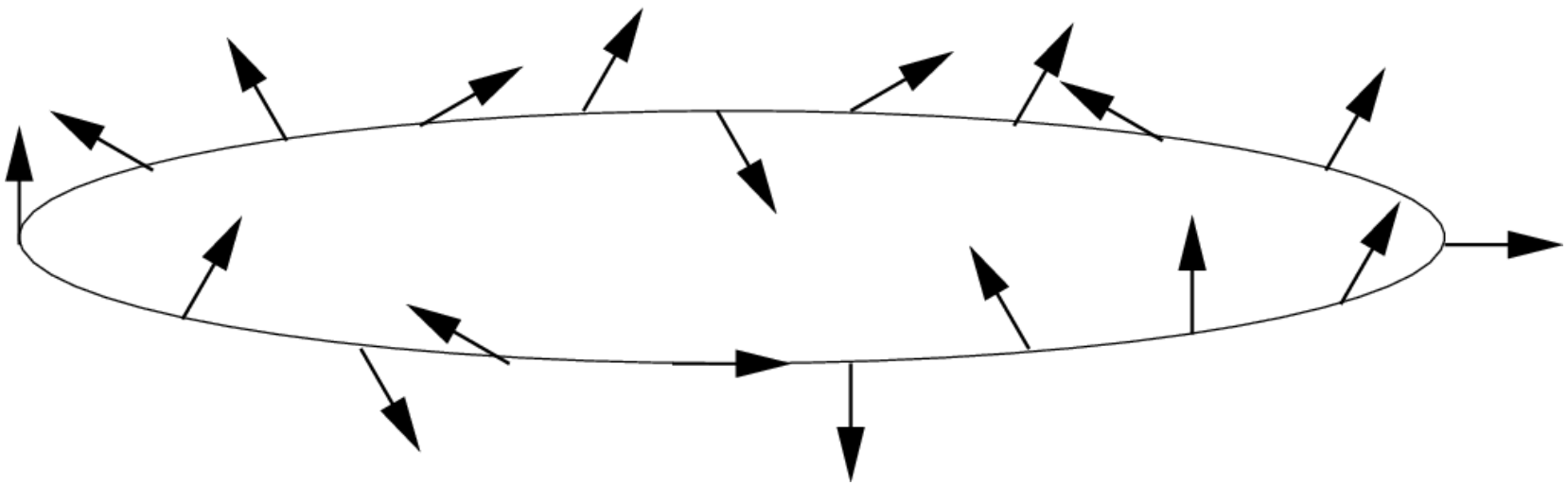
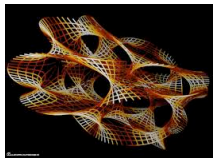


Figure: arXiv:1012.3983 [hep-th]

Research interests, Niels Obers (2 min. meeting 2020)

- Non-relativistic gravity from 1/c expansion of GR & applications to real-world GR and non-relativistic (quantum) gravity and holography

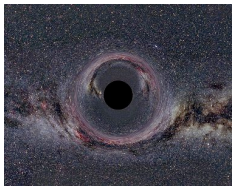
- Non-relativistic strings and limits of AdS/CFT correspondence including connections with spin Matrix theory



- Hydrodynamics of non-boost invariant (quantum critical) systems and fluid/gravity correspondence

- Newton-Cartan submanifolds and applications to soft CMT

- blackfolds and the construction of SUSY-breaking (anti-brane_ solutions in string theory



- astrophysical black holes:
  BH shadows, force-free electrodynamics & jets

Research interests, Niels Obers (2 min. meeting 2020) cont'd

PhD student: Hoapeng Yan, Shanzhong Han
MSc student: Jørgen Sandøe Musaeus

(recent) Collaborators:

Troels Harmark, Gerben Oling, Nico Wintergerst, Stefano Baiguera (NBI)
Jan de Boer, Jay Armas (Amsterdam)
Vasilis Niarchos (Durham)
Jelle Hartong, Emil Have, Leo Bidussi (Edinburgh)
Dennis Hansen (ETH)
Watse Sybesma (Iceland)
Thomas van Riet (Leuven)
Ziqi Yan (Perimeter)
Stefan Vandoren (Utrecht)
Yang Lei (Wits)
Kevin Grosvenor (Wurzburg)
Lorenzo Menculini (Perugia)

Gerben Oling (FC.9)

non-relativistic *gravity*

✓still coordinate-independent
✓low-velocity limit of GR
✓contains strong gravity

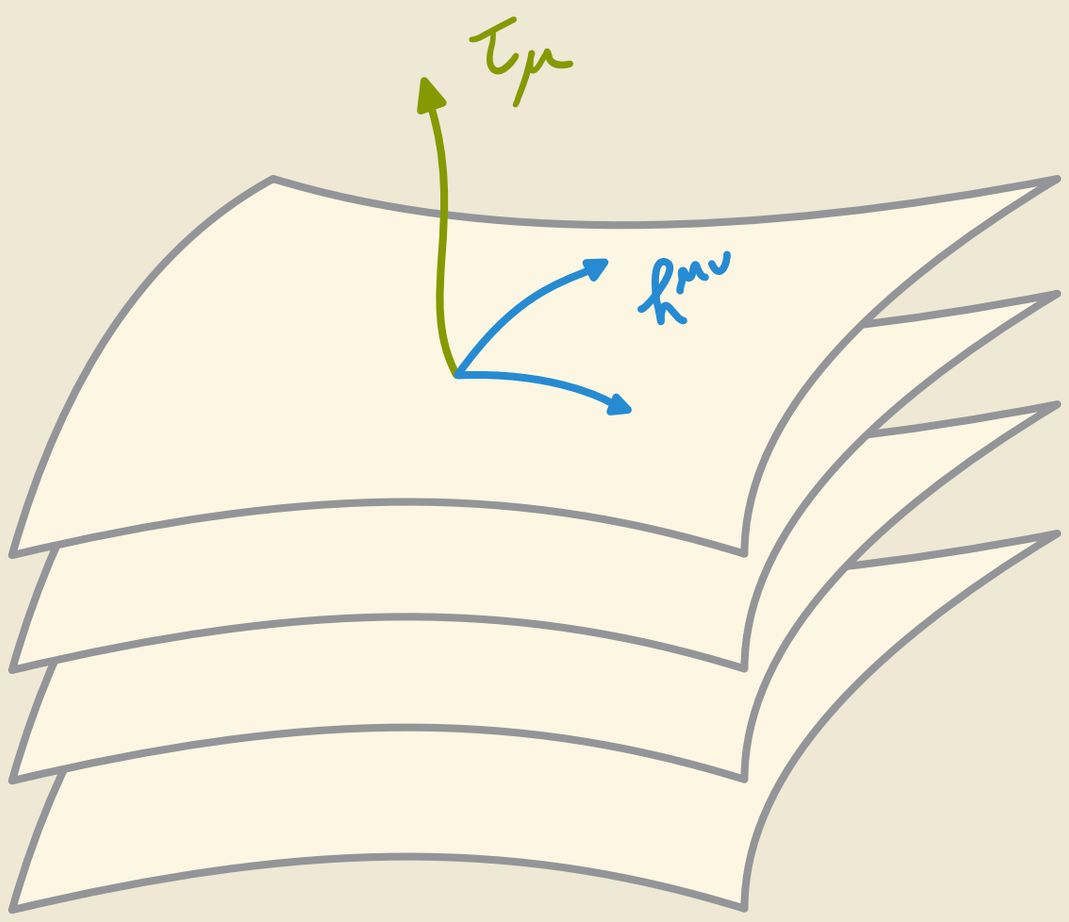
➡ define conserved charges

non-relativistic *strings*

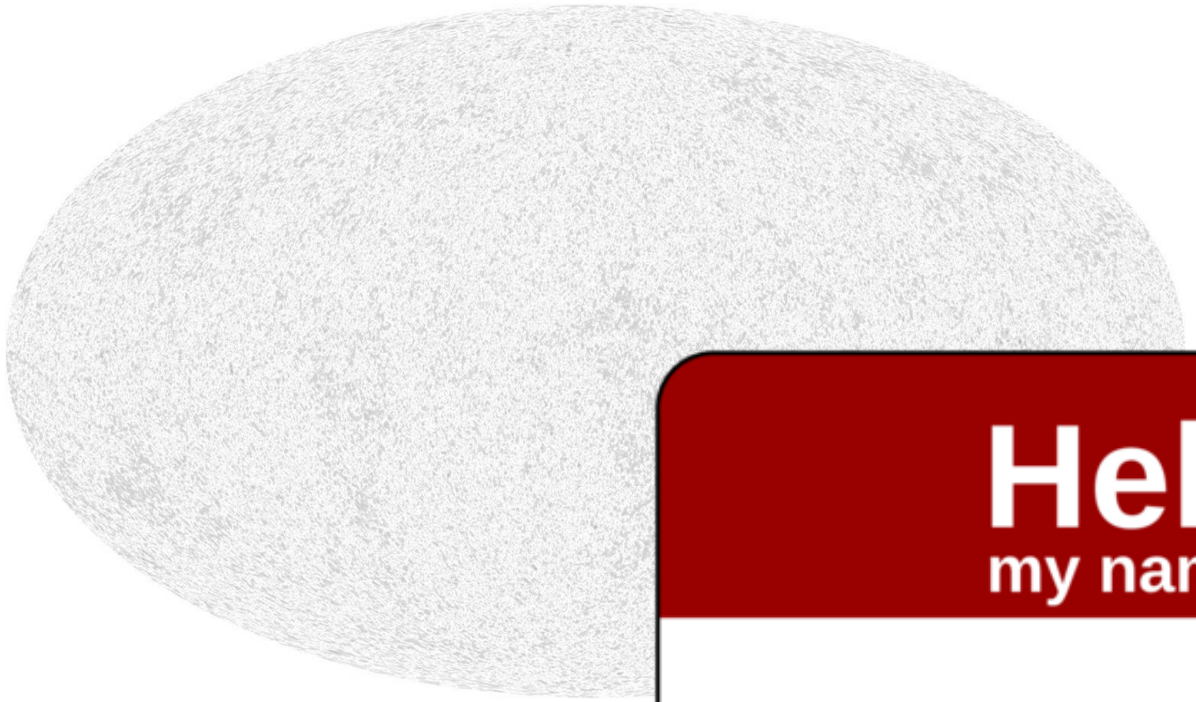
✓from limits of AdS/CFT
✓from null T-duality
✓quantized consistently

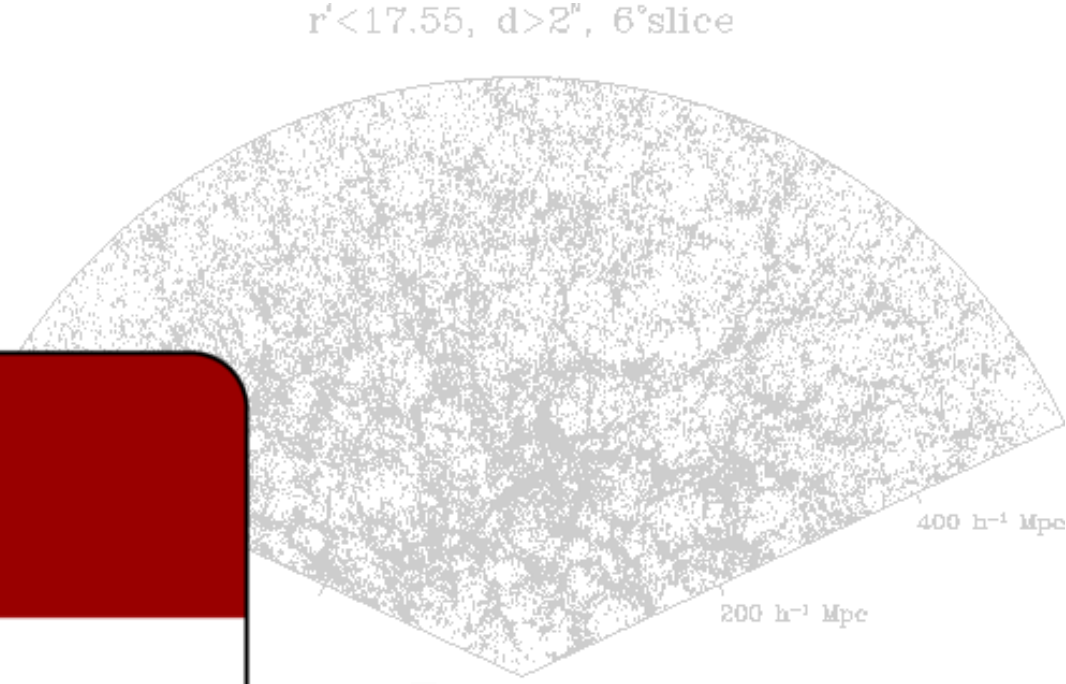
➡ match spectrum in AdS/CFT

Newton-Cartan geometry



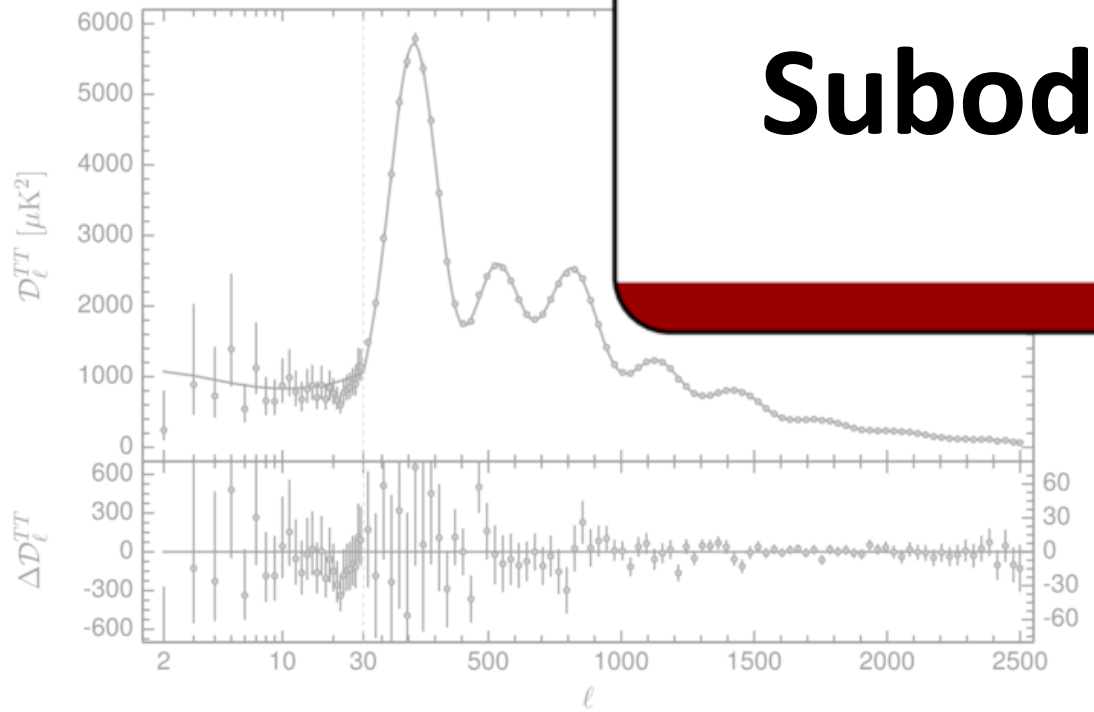
with Troels Harmark, Lorenzo Menculini, Niels Obers, Jørgen Sandøe Musaeus and Ivan Soler Calero at NBI and Leo Bidussi, Dennis Hansen, Jelle Hartong and Manus Visser elsewhere

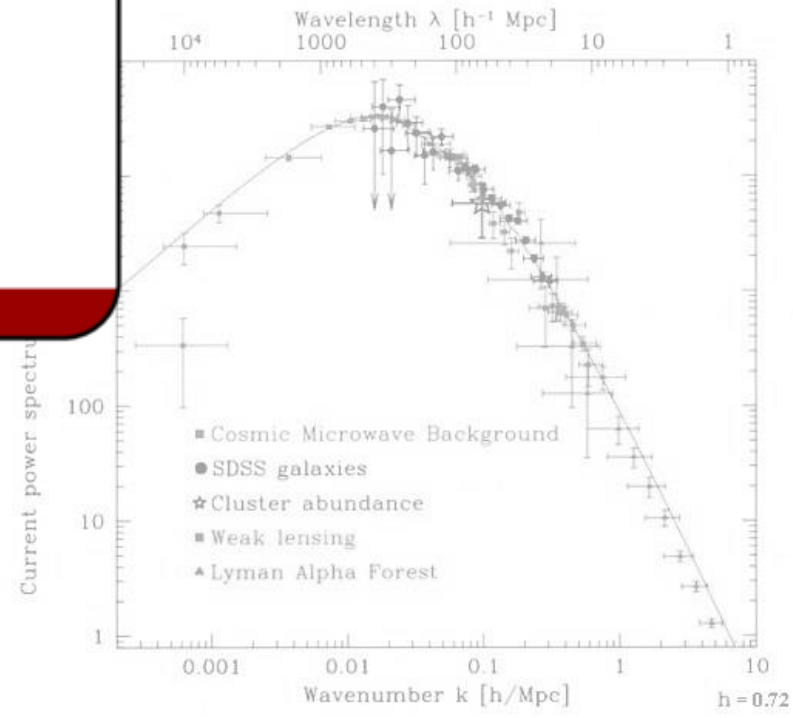




Hello
my name is

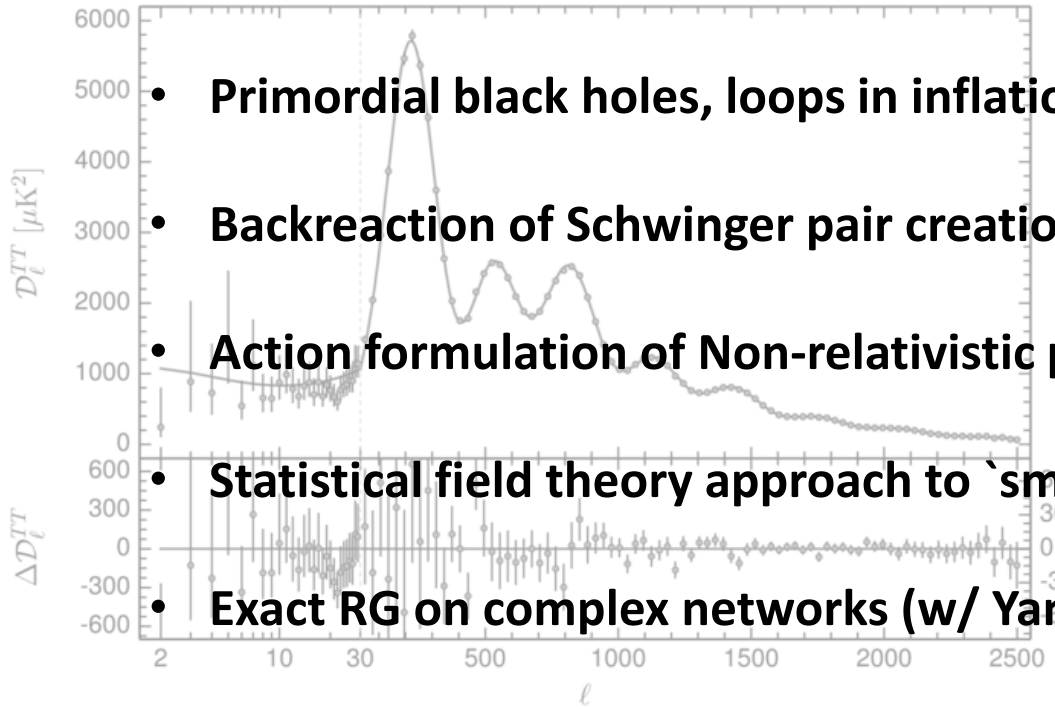
Subodh Patil



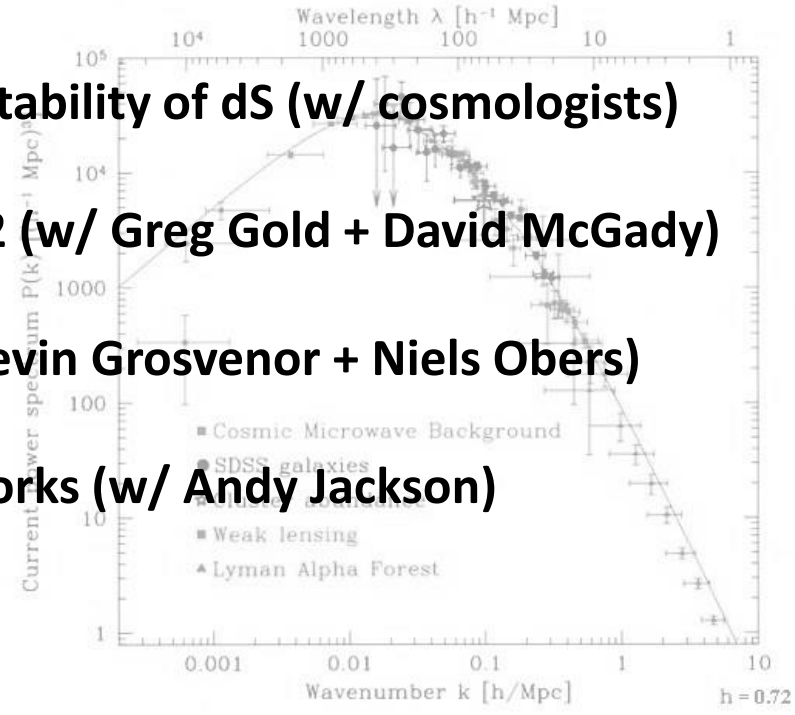


I primarily identify as a hep-th kind of person, but I mostly work on early universe cosmology

- Foundational aspects of EFT on time dependent backgrounds.
- Signatures of higher dimensional operators in cosmological observables, such as CMB anisotropies, distortions*, large scale structure surveys, primordial gravitational waves.
- Relationship to BSM/ string phenomenology.
- **But I also work on other topics – e.g. some ongoing collaborations:**



- **Primordial black holes, loops in inflation – semi-classical stability of dS (w/ cosmologists)**
- **Backreaction of Schwinger pair creation in massive QED_2 (w/ Greg Gold + David McGady)**
- **Action formulation of Non-relativistic perfect fluids (w/ Kevin Grosvenor + Niels Obers)**
- **Statistical field theory approach to `small worlds' in networks (w/ Andy Jackson)**
- **Exact RG on complex networks (w/ Yaneer Bar Yam)**



PASTA PHASES IN NEUTRON STARS

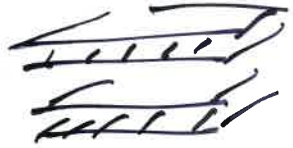
(TWO MINUTE TALK)
FALL 2020

CHRIS PETHICK
(NBIA + NORDITA)

① INNER CRUST (OUTER 1km of star)

Nuclei become strings or slabs

(spaghetti) (lasagna)



② IMPORTANT FOR OBSERVATION

a) Transport

b) Elastic properties (Grav. waves)

③ CURRENT PROJECTS

ⓐ Oscillations
(Like supersolids.)

ⓑ Elastic properties of "polycrystals".
(Domains)

COLLABORATORS: MITYA KOBYAKOV (Nizhny Novgorod)
ZHAOWEN ZHANG (NBIA)

From Classical Theory to Quantum Cosmology

Shanzhong Han

(A new PhD student of Niels Obers)

In the past:

- How big is a black hole?
- Black hole thermodynamics and photon spheres

Current and future:

- Black holes and the double copy
- GWs

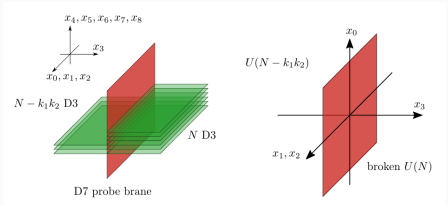
Matthias Volk

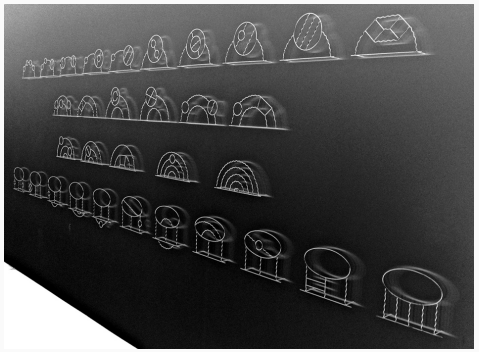
PhD student (since November 2018)

Supervisors: Jacob Bourjaily, Charlotte Kristjansen

Work and interests:

- Defect CFTs with holographic dual (D3-D5, D3-D7 system)
- One-point functions (all-loop results via integrability)
- Transport properties across the defect
- Geometry of Feynman integrals (elliptic curves, Calabi-Yaus)
- Analytic structure of loop amplitudes (symbol letters)





Something new I would like to learn about: Tensor networks as models for AdS/CFT and the connection to quantum information theory.

Nico Wintergerst

Postdoc, Fc-3

- **(Limits of) holography:**
  - Weak coupling:
    - Role of singlet constraint in weakly coupled O(N)/U(N) vector and matrix models
    - Thermalization in free and integrable theories, in particular after quantum quench
  - Non-relativistic:
    - NR limits of N = 4 SYM and their implications for holography
  - Bulk solitons and their boundary interpretation: Cosmic strings and fractional statistics, skyrmions and discrete gauge symmetries
- **Cold quantum gases**
  - Critical Bose condensates with BH like information properties, e.g. large entropy, scrambling, …
  - Quantum gravity in AMO, e.g. SU(N) Gross-Neveu from Hubbard <-> HS gravity
  - BEC / Confinement correspondence - stay tuned…
- **QFT**
  - Details of the confinement/deconfinement transition in large N Yang-Mills
- **Gravity**
  - Information paradox in the large-D limit, 2-D <-> ∞-D correspondence

Haopeng Yan, PhD student of Niels Obers since Sep. 2017

2-minute meeting, January 23, 2020

Astrophysical Black Holes & Non-relativistic gravity

Previously: Black hole shadow and image of orbiting star

- in modified gravity (Kerr-MOG) M. Guo, N. Obers, HY
- with charge (in GR and beyond) M. Guo, S. Song, HY
- influence of a surrounding plasma HY

Currently: Large-c expansion of GR and relevance to PN theory

- Non-relativistic spinning particle (NR analogy of MPD eq.)

Other interests:

- Photon rings, lensing rings (shown in the first BH picture)
- Force-free electrodynamics and jets
- Post-Newtonian dynamics of binary BH in (TT)NC