Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

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Soft Limits and Symmetries in Perturbative Gauge Theory and Gravity

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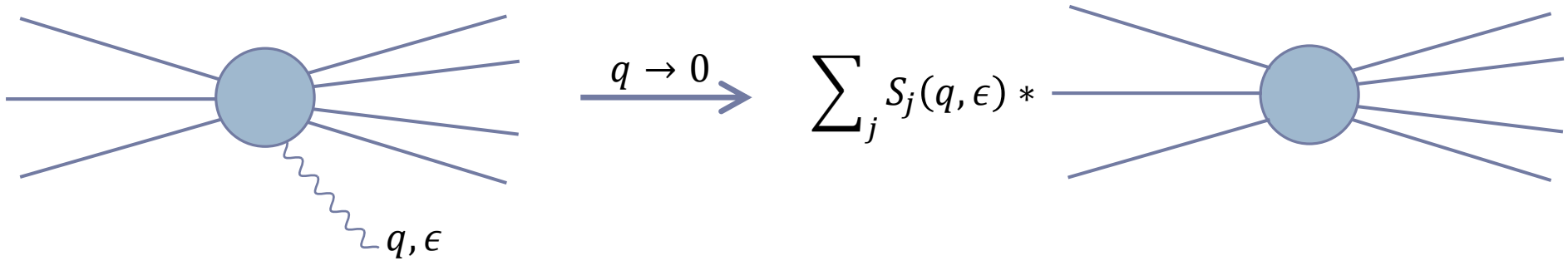
supervision by Tristan McLoughlin

SAGEX Project Review Meeting
QMUL, 08/11/19

ESR 13 Facts

- before SAGEX
  - from Berlin, Germany
  - Bachelor's & Master's degree in physics at Humboldt University (Berlin)
    - with theses on the basics of String Theory and Yangian symmetry
    - [arXiv:1805.11993, F. Loebbert, AS]
  - summer student at Desy Hamburg
    - with project on the calculation of massive quark effects via SCET
    - [arXiv:1703.09702, P. Pietrulewicz, D. Samitz, F. Tackmann, AS]
- within SAGEX
  - since Sept 2018 at Trinity College Dublin
  - 1st supervisor: Tristan McLoughlin
  - 2nd supervisor: Ruth Britto
  - mentor: Chris White

Project: Soft Limits and Symmetries in Perturbative Gauge Theory and Gravity



scattering amplitudes with soft external particles show universal properties [Weinberg '65]
these are related to the existence of "asymptotic symmetries" [Strominger '14...]

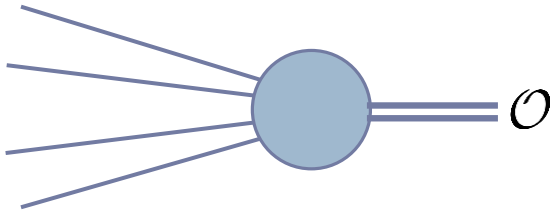
- Part 1: explore the connection between asymptotic charges and Ward identities of scattering matrices and their soft limits
  "Asymptotic Charges and Coherent States in QCD"
  [arXiv:1906.11763, R. Gonzo, T. McLoughlin, D. Medrano, AS]
  QCD asymptotic charge → Ward identity
  tree-level result does not receive quantum corrections at leading order

Project: Soft Limits and Symmetries in Perturbative Gauge Theory and Gravity

- Part 2: investigate the soft structure of form factors in deformed versions of $\mathcal{N} = 4$ SYM, with T. McLoughlin and R. Pereira
- important operator in $\mathcal{N} = 4$ SYM and its conformal deformations:

  dilatation operator

  action of dilatation operator ~ form factors up to infrared divergencies [Caron-Huot, Wilhelm '16]

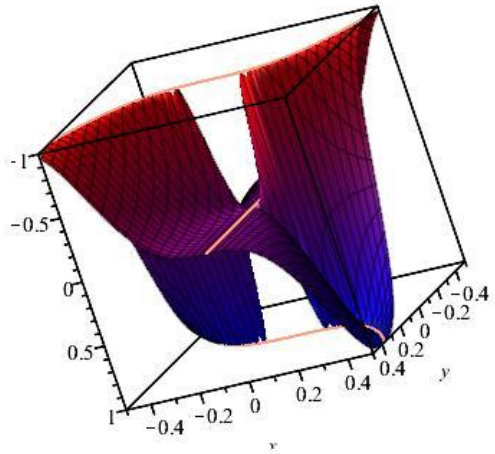


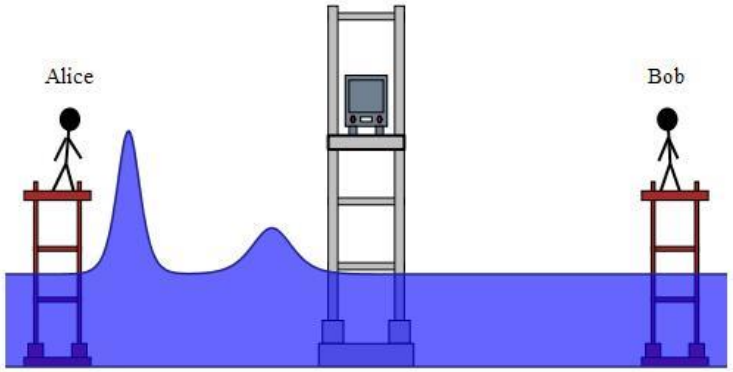
- β-deformed $\mathcal{N} = 4$ SYM

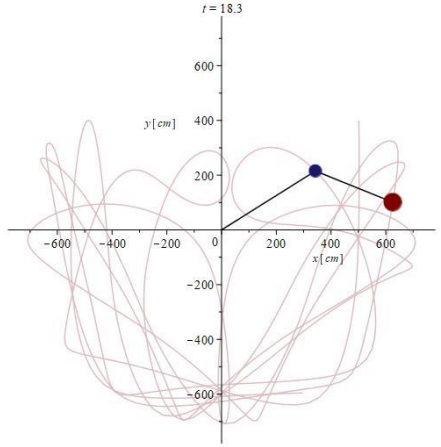
  form factors and their infrared structure used for the calculation of the complete one-loop dilatation operator

SAGEX Secondment and Training

- Secondment at Maplesoft in Waterloo, Canada (03/08/19 – 03/11/19)
  goal: create a Maple MathApp on bivariate limits
  plus: Maple MathApps on solitons (KdV) and the double pendulum



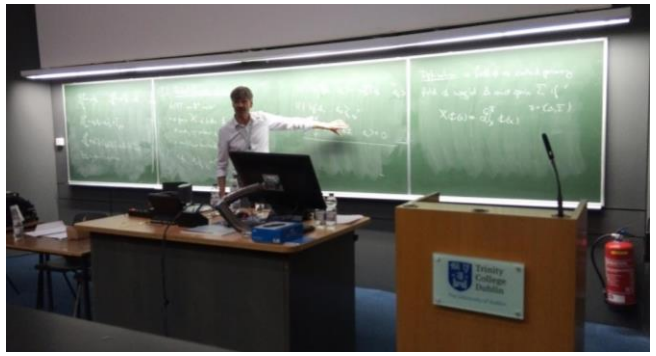


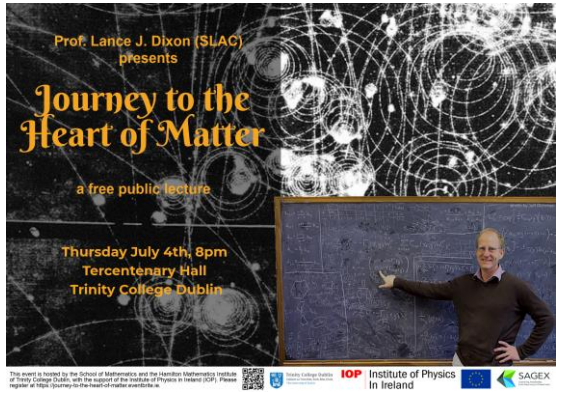


- Events: outreach planning (Berlin), ESR welcome meeting (Durham), Amplitudes (Dublin), 1st SAGEX school and workshop (Hamburg);
  Workshop on High-Energy Physics and Gender (CERN), Nordic Winter School on Particle Physics (Oslo), YRISW (Vienna), HMI School and IQF (Dublin)

SAGEX Interaction, Outreach and Beyond

- SAGEX interaction: at Trinity, training events, mentor and Maple secondment





- Outreach: SAGEX Twitter account (April/May 2019), video diary, exhibition planning, co-organisation of Amplitudes 2019 public talk by Lance Dixon
- Beyond SAGEX: hope to reach necessary stage to successfully apply for a postdoctoral position, but also keep open the possibility to pursue directions outside academia