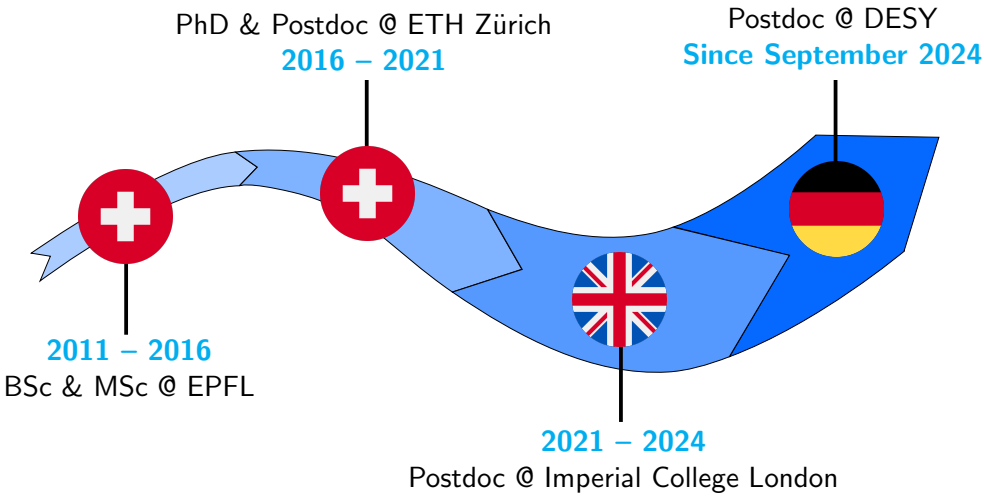
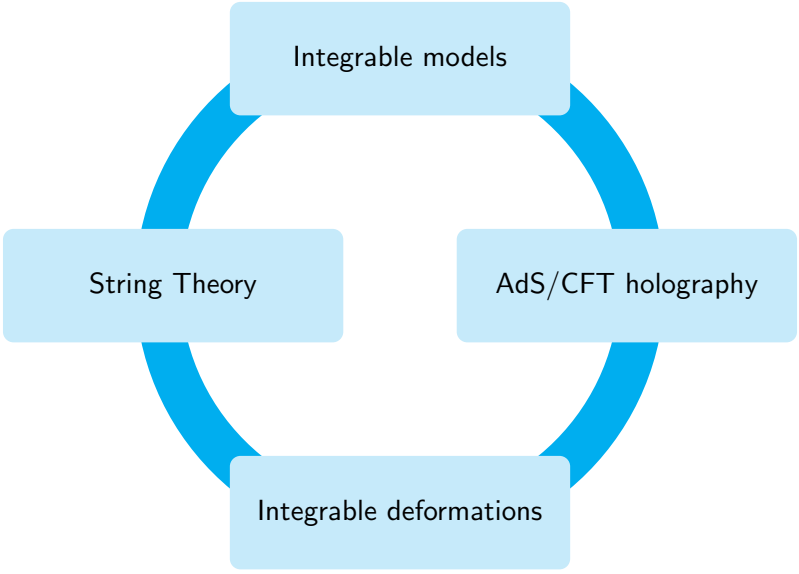
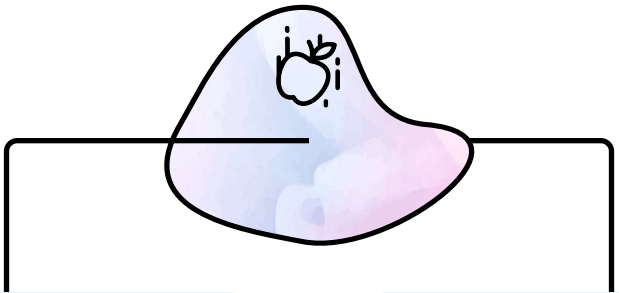
Integrable string theories

Fiona Seibold


PhD & Postdoc @ ETH Zürich
2016 – 2021
Postdoc @ DESY
Since September 2024
2011 – 2016
BSc & MSc @ EPFL
2021 – 2024
Postdoc @ Imperial College London

- I like sports...
  - Hiking
  - Running
  - Tennis
  - ...
- I play the trumpet


Integrable models
String Theory
AdS/CFT holography
Integrable deformations



String theory in an n-dimensional Anti-de-Sitter space

Conformal field theory in an $(n-1)$-dimensional flat space

Type IIB superstring theory on $AdS_5 \times S^5$ $\longleftrightarrow$ $\mathcal{N} = 4$ super-symmetric Yang-Mills theory in four-dimensional flat space

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$\Longleftrightarrow$

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$\left(T \sim \sqrt{\lambda} \quad , \quad g_s \sim \frac{\lambda}{N}\right)$

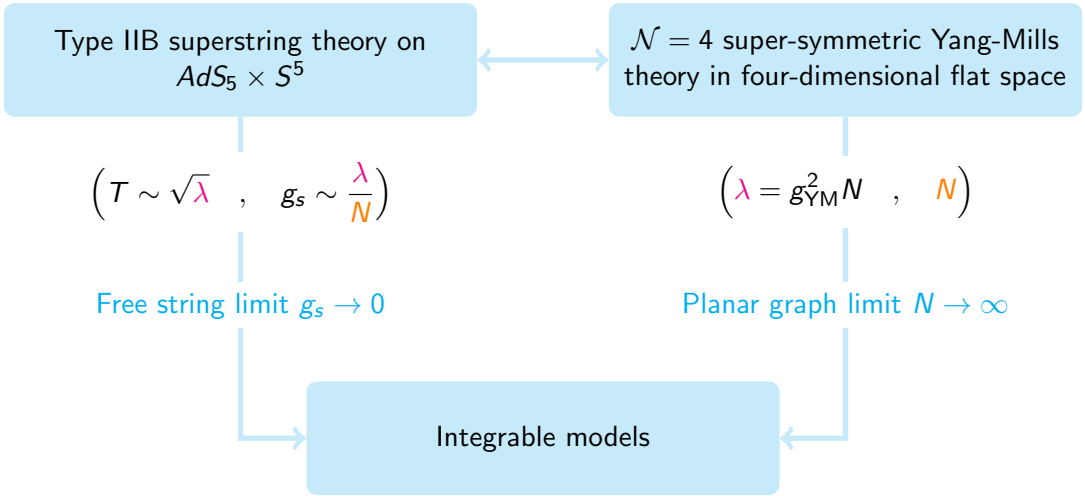
String coupling

String tension

$\left(\lambda = g_{\mathrm{YM}}^2 N \quad , \quad N\right)$

't Hooft coupling

Rank of gauge group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$\left(T \sim \sqrt{\lambda} \quad , \quad g_s \sim \frac{\lambda}{N}\right)$
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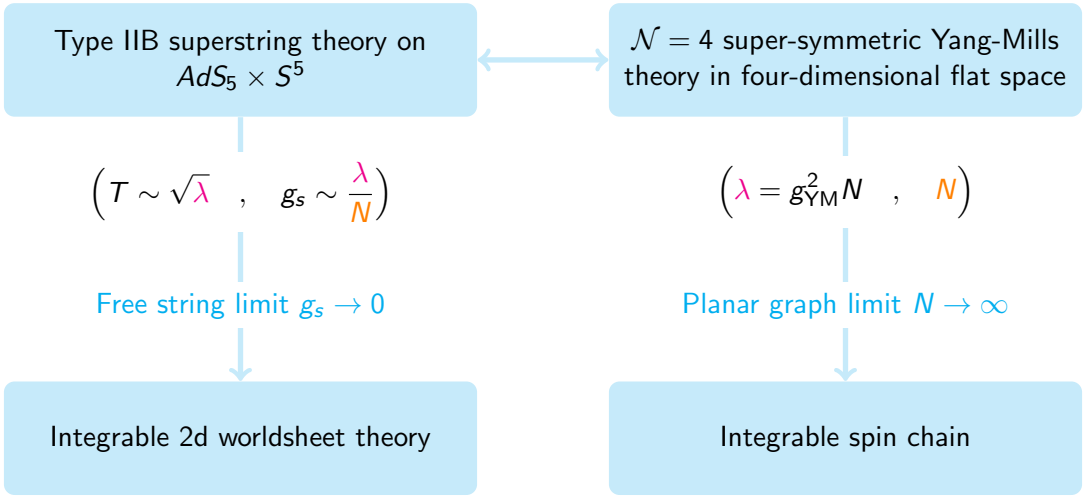
Free string limit $g_s \to 0$
Planar graph limit $N \to \infty$
Integrable models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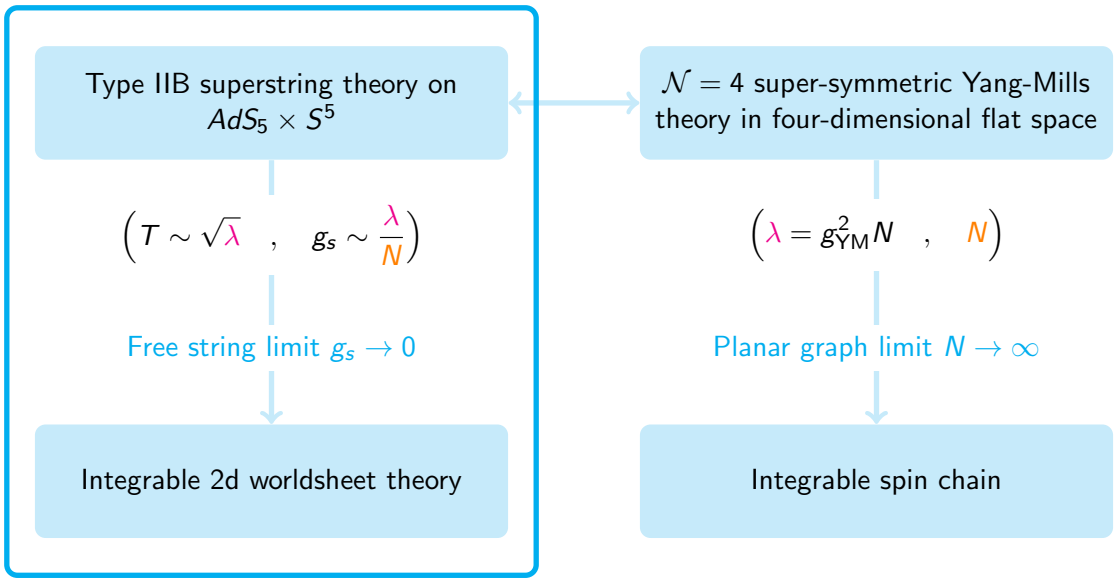
Integrable 2d worldsheet theory
Integrable spin chain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$$\text{e.o.m.} \quad \Leftrightarrow \quad \partial_\tau \mathcal{L}_\sigma(z) - \partial_\sigma \mathcal{L}_\tau(z) - [\mathcal{L}_\tau(z), \mathcal{L}_\sigma(z)] = 0 \ , \qquad \forall z \in \mathbb{C} \ .$$

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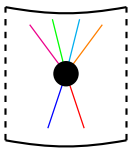
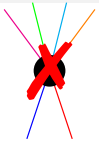
- Quantum integrability: important ingredient is the **worldsheet S-matrix**



- No particle production



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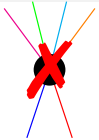
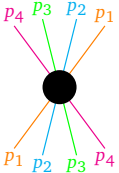


- Transmitted momenta



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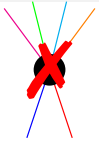

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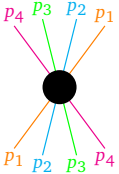
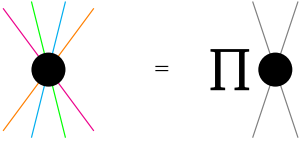
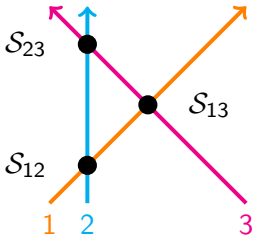
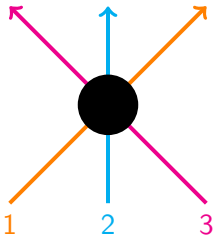
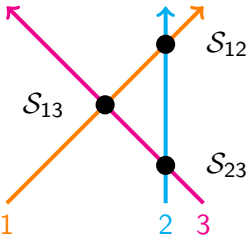


- Factorisation









quantum Yang-Baxter equation

- Apply the integrability machinery to obtain the spectrum

ABA: Asymptotic Bethe Ansatz

TBA: Thermodynamic Bethe Ansatz

QSC: Quantum Spectral Curve

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  ABA: Asymptotic Bethe Ansatz

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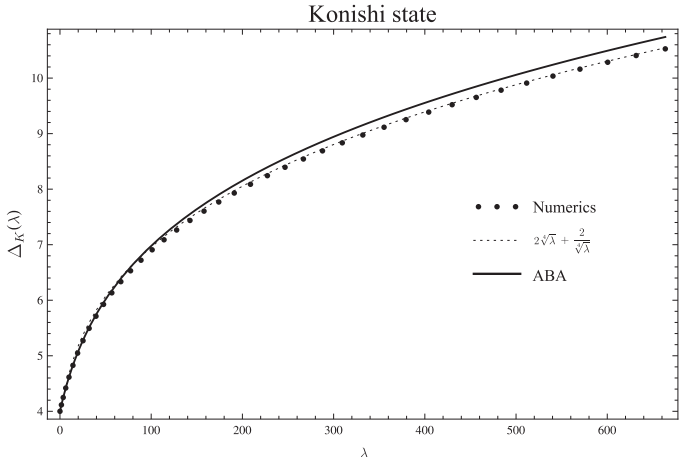
- Check matching with anomalous dimension in the dual theory!
  (In the finite λ but $N \to \infty$ limit)



[Gromov Kazakov Vieira '09]

- More integrable theories from **lower-dimensional** AdS/CFT setups

$AdS_5 \times S^5$

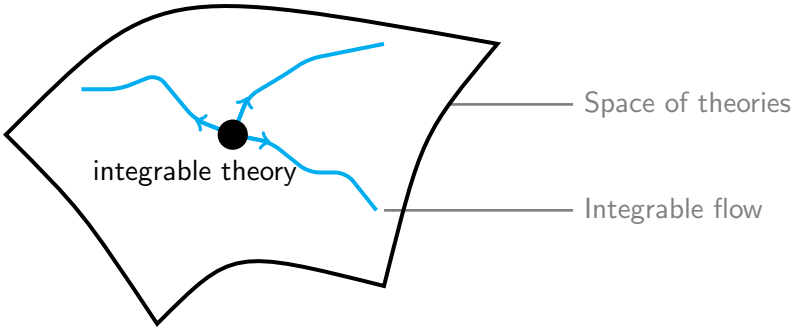
$AdS_4 \times CP^3$

$AdS_3 \times S^3 \times T^4$

$AdS_2 \times S^2 \times T^6$

- Less and less (super)symmetries
- Larger space of parameters
- Massless modes

- More integrable theories from **integrable deformations**



Thank you !