

# STRONG2020 NA2-Small-x

## Physics at the LHC and future DIS experiments

### Interim Report: Jyväskylä

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ACADEMY OF FINLAND



JYVÄSKYLÄN YLIOPISTO  
UNIVERSITY OF JYVÄSKYLÄ



HELSINKI  
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PHYSICS

# Jyväskylä group

3 permanent:

- ▶ Tuomas Lappi
- ▶ Kari J. Eskola
- ▶ Hannu Paukkunen
  
- ▶ 2 senior, non-permanent I. Helenius, H. Niemi
- ▶ ~ 6 postdocs
- ▶ ~ 6 students
  
- ▶ No Strong-2020 money spent yet: travels  $\implies$  COVID
- ▶ Joint postdoc with USC (Cougoulic) starting soon
- ▶ Note: question of acknowledgement to S2020 vs. actual money ...

Next: some highlights most relevant to Strong-2020 topics

# Task 1: Nuclear parton distributions

EPS09 NPDF paper from 2009 reaches  $> 1000$  citations!

- ▶ Now focusing on including LHC Run2 data in nPDF fits and implementing new processes in fits.
- ▶ Some recent works
  - ▶ D-meson production: K. J. Eskola, I. Helenius, P. Paakkinen and H. Paukkunen, "A QCD analysis of LHCb D-meson data in p+Pb collisions," JHEP **05** (2020), 037
  - ▶ Multiparton innteractions H. Mäntysaari and H. Paukkunen, "Saturation and forward jets in proton-lead collisions at the LHC," Phys. Rev. D **100** (2019) no.11, 114029
  - ▶ Improvements in NPDF fits H. Paukkunen and P. Zurita, "Can we fit nuclear PDFs with the high-x CLAS data?," Eur. Phys. J. C **80** (2020) no.5, 381

## Task 2: New NLO-based precision phenomenology in CGC and BFKL

- ▶ Most important progress: first fit of HERA inclusive DIS data in dipole picture with full NLO impact factor: G. Beuf, H. Hänninen, T. Lappi and H. Mäntysaari, "Color Glass Condensate at next-to-leading order meets HERA data," (arXiv:2007.01645 (hep-ph))
- ▶ Finite  $N_c$  corrections to the NLO BK equation: T. Lappi, H. Mäntysaari and A. Ramnath, "Next-to-leading order Balitsky-Kovchegov equation beyond large  $N_c$ ," (arXiv:2007.00751 (hep-ph))
- ▶ Systematic NRQCD light cone wave functions: needed for exclusive vector meson production at small  $x$  T. Lappi, H. Mäntysaari and J. Penttala, "Relativistic corrections to the vector meson light front wave function," (arXiv:2006.02830 (hep-ph))

## Task 4: Multi-particle correlations & Thermalization

- ▶ Heavy ion phenomenology: building a realistic impact parameter distribution of matter created in heavy ion collision, with models constrained by DIS data:
  - ▶ H. Mäntysaari, N. Mueller, F. Salazar and B. Schenke, "Multigluon Correlations and Evidence of Saturation from Dijet Measurements at an Electron-Ion Collider," Phys. Rev. Lett. **124** (2020) no.11, 112301
  - ▶ S. R. Klein and H. Mäntysaari, "Imaging the nucleus with high-energy photons," Nature Rev. Phys. **1** (2019) no.11, 662-674
  - ▶ H. Mäntysaari and B. Schenke, "Accessing the gluonic structure of light nuclei at a future electron-ion collider," Phys. Rev. C **101** (2020) no.1, 015203
- ▶ Understanding universal behavior and transport coefficients in overoccupied gluon plasma, such as present in the thermalization stage of a heavy ion collision
  - ▶ K. Boguslavski, A. Kurkela, T. Lappi and J. Peuron, "Highly occupied gauge theories in 2+1 dimensions: A self-similar attractor," Phys. Rev. D **100** (2019) no.9, 094022
  - ▶ K. Boguslavski, A. Kurkela, T. Lappi and J. Peuron, "Heavy quark diffusion in an overoccupied gluon plasma," JHEP **09** (2020), 077