# Heavy Quark Diffusion ResearchProduct in PUNCH4NFDI

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https://doi.org/10.1103/PhysRevLett.130.231902

## Heavy Quark Diffusion from $2+1$ Flavor Lattice QCD with 320 MeV Pion Mass

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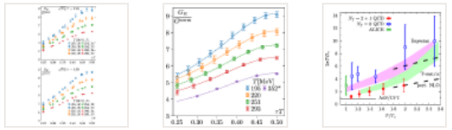
Phys. Rev. Lett. **130**, 231902 – Published 6 June 2023

Article | References | No Citing Articles | Supplemental Material | PDF | HTML | Export Citation

ABSTRACT

We present the first calculations of the heavy flavor diffusion coefficient using lattice QCD with light dynamical quarks corresponding to a pion mass of around 320 MeV. For temperatures $195\,\mathrm{MeV} < T < 352\,\mathrm{MeV}$, the heavy quark spatial diffusion coefficient is found to be significantly smaller than previous quenched lattice QCD and recent phenomenological estimates. The result implies very fast hydrodynamization of heavy quarks in the quark-gluon plasma created during ultrarelativistic heavy-ion collision experiments.



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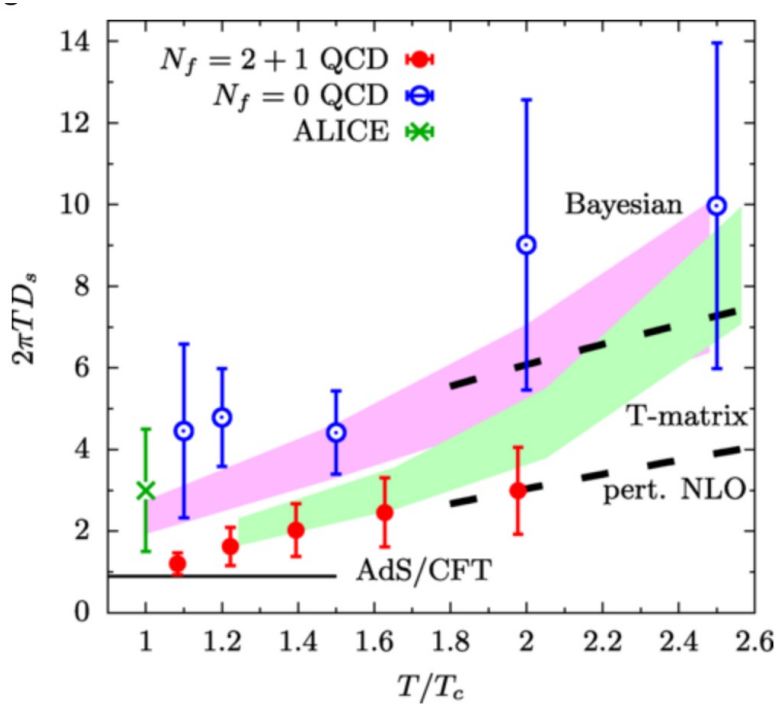
DOI: https://doi.org/10.1103/PhysRevLett.130.231902



# Heavy Quark Diffusion ResearchProduct in PUNCH4NFDI

**Project already benefits from PUNCH developments and could profit more in the future**

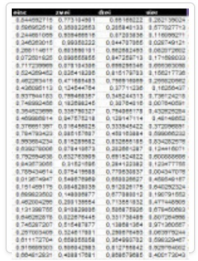
**All analysis performed on Bielefeld PUNCH compute server (not yet in Compute4Punch)**

**All data and lattice and analysis software as well as a workflow (bash/python) of the project published as open access**

Dataset for "Heavy Quark Diffusion from 2+1 Flavor Lattice QCD with 320 MeV Pion Mass"

Kaczmarek O, Altenkort L, Larsen R, Mukherjee S, Petreczky P, Shu H-T, Stendebach S (2023)
Bielefeld University.

**Datenpublikation**



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README.sh 12.89 KB
data_pub_altenkort_2023_complete.tar.gz 3.17 GB
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DOI https://doi.org/10.4119/unibi/2979080

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|---|---|
| Name | README.sh 12.89 KB |
| Access Level | Open Access |
| Zuletzt Hochgeladen | 2023-05-22T13:40:31Z |
| MD5 Prüfsumme | f33ce74ad32f2653c49403efd2ff74c1 |

| | |
|---|---|
| Name | data_pub_altenkort_2023_complete.tar.gz 3.17 GB |
| Access Level | Open Access |

https://doi.org/10.4119/unibi/2979080

# Heavy Quark Diffusion - SIMULATeQCD code development

June 1, 2023

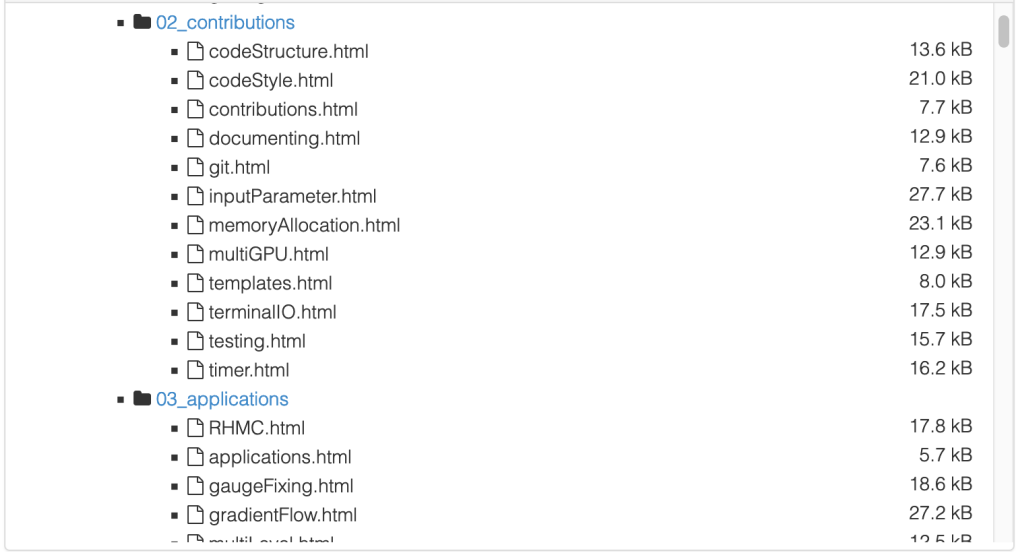
Software | Open Access

## LatticeQCD/SIMULATeQCD: v1.0.1

Mazur, Lukas; Bollweg, Dennis; Clarke, David A.; Altenkort, Luis; Kaczmarek, Olaf; Larsen, Rasmus; Shu, Hai-Tao; Goswami, Jishnu; Scior, Philipp; Sandmeyer, Hauke; Neumann, Marius; Dick, Henrik; Ali, Sajid; Kim, Jangho; Schmidt, Christian; Petreczky, Peter; Mukherjee, Swagato

SIMULATeQCD is a multi-GPU Lattice QCD framework that makes it easy for physicists to implement lattice QCD formulas while still providing competetive performance.

Preview




Files (5.1 MB)

| Name | Size | |
|---|---|---|
| LatticeQCD/SIMULATeQCD-v1.0.1.zip | 5.1 MB | Preview Download |

61 views

0 downloads

See more details...

Available in GitHub

Indexed in OpenAIRE

**Publication date:**
June 1, 2023

**DOI:**
DOI 10.5281/zenodo.7994983

**Keyword(s):**
lattice QCD, CUDA, HIP, GPU

**Related identifiers:**
Supplement to
https://github.com/LatticeQCD/SIMULATeQCD/tree/v1.0.1

**Communities:**
The PUNCH4NFDI consortium in the German NFDI

## TA3 ongoing work

Lattice and Analysis Software development

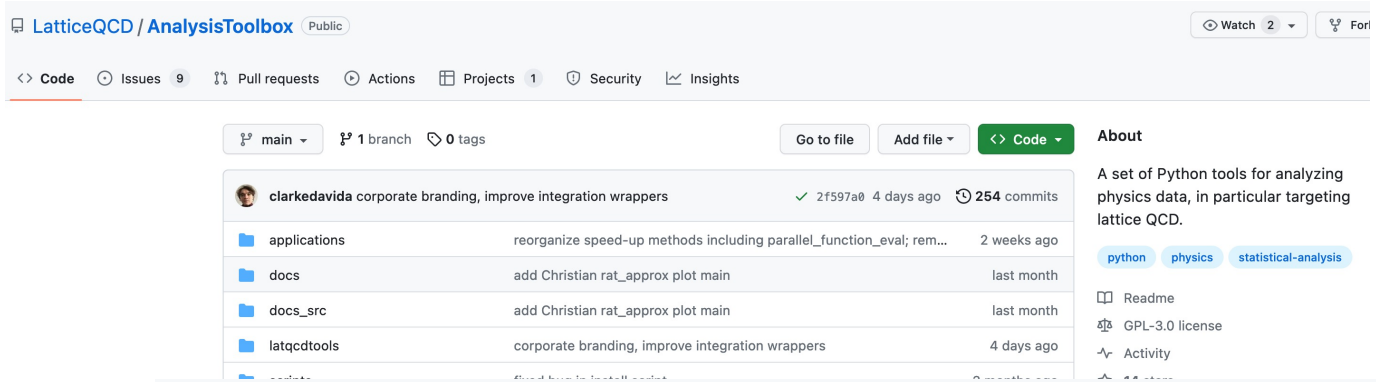
Optimization for supercomputing resources

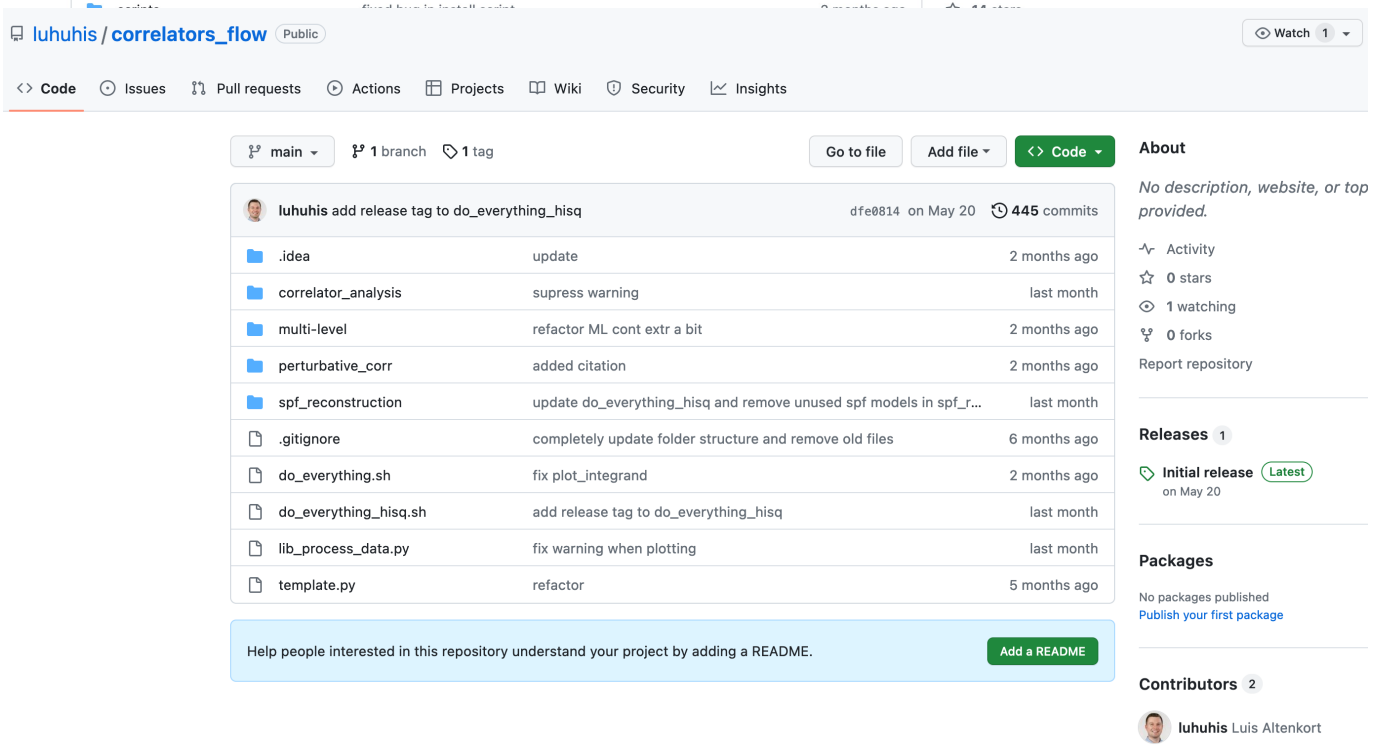
Frontier, LUMI-G, JUWELS, Leonardo

https://doi.org/10.5281/zenodo.7994982
https://arxiv.org/abs/2306.01098

## Already “FAIR” Research Software

# Heavy Quark Diffusion – Analysis Software




## TA3 ongoing work

Analysis Toolbox Software development

https://github.com/LatticeQCD/AnalysisToolbox

Heavy quark diffusion analysis based on this

https://github.com/luhuhis/correlators_flow

**Already “FAIR” Research Software**

# Heavy Quark Diffusion RDP in PUNCH4NFDI

## TA2

Storage of gauge field configurations in LDG

- Upload of ~ 500TB to storage elements at NERSC and JSC planned for 2023

Metadata Catalogue and Storage of data in LDG/PUNCH

- metadata server and file server in PUNCH → LDG MDC/FC for non-lattice data

Analysis workflow on Storage4PUNCH and Compute4PUNCH

(Lattice calculations on supercomputers outside of PUNCH)

## TA3

Software development of optimized lattice code and analysis tools and workflows

## TA4

metadata and file formats to be developed for all data in the analysis workflow
metadata integration of software, ILDG gauge field configurations, analysis software, raw data, analyzed data, final results
publish the whole project on the SDP

# LDG MDC/FC for non-lattice (gaugefield) data

## Open for any use case and any metadata scheme

- Astro (Jörn Künsemöller) and Heavy quark diffusion project planned

## Some work is still needed in the LDG development

- change of database server to postgres

- authentification : certificate → token based

- interface for Open Archives Initiative Protocol for Metadata Harvesting (OAI-PHM API)