

# Update on the International Lattice Data Grid

Frithjof Karsch  
Bielefeld University



- ILDG – past, present and future
- steps towards FAIR data handling in the lattice QCD community
- invitation to participate in the ILDG lunch break session

**Particles, Universe,  
NuCleus and Hadrons  
for the NFDI**  
A consortium in the NFDI



CRC-TR 211  
Strong-interaction matter  
under extreme conditions



Deutsche  
Forschungsgemeinschaft

# 30<sup>th</sup> anniversary of hep-lat

April 8<sup>th</sup>, 1992: Robert Edwards et al (SCRI) uploaded 16 papers

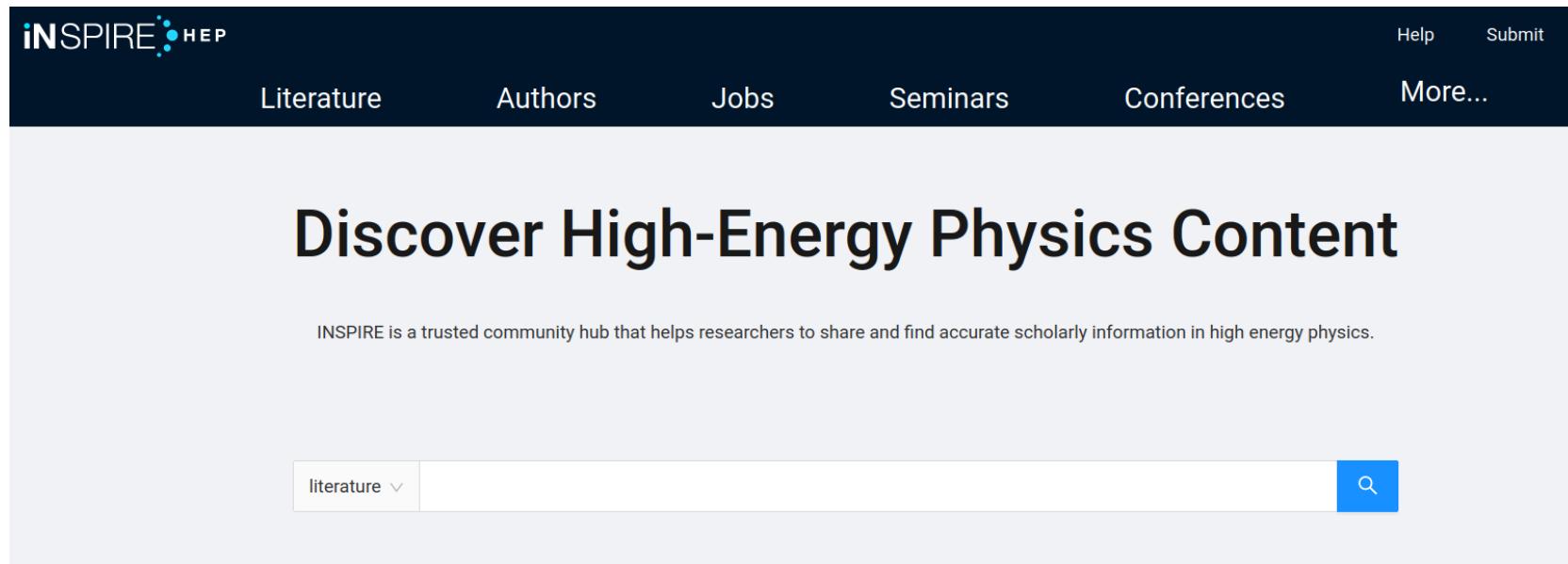
[hep-lat/9201001](#) – [hep-lat/9201007](#)

[hep-lat/9202001](#) – [hep-lat/9202004](#)

[hep-lat/9203001](#) – [hep-lat/9203002](#)

[hep-lat/9204001](#)

08/1991: P. Ginsparg (Los Alamos)  
started **arXiv** with hep-th



The screenshot shows the INSPIRE HEP homepage. At the top, there is a navigation bar with links for Literature, Authors, Jobs, Seminars, Conferences, and More... On the far right of the bar are Help and Submit buttons. Below the navigation bar, the text "Discover High-Energy Physics Content" is prominently displayed. Underneath this text, a subtitle states: "INSPIRE is a trusted community hub that helps researchers to share and find accurate scholarly information in high energy physics." At the bottom of the page, there is a search bar with a dropdown menu set to "literature" and a magnifying glass icon.

[arXiv/hep-lat](#) -- [INSPIRE](#)

A FAIR combination of services to make physics research results

**Findable, Accessible, Interoperable, Reusable**



# 20<sup>th</sup> anniversary of the International Lattice Grid

**ILDG: established in 2002**

a UKQCD initiative, C.T.H. Davies et al., arXiv:hep-lat/0209121

A. Ukawa, arXiv:hep-lat/0409084

## main motivation

L-QCD data sets are valuable, costly to be produced,  
should be made available to the community

**UKQCD (QCDgrid/DiGS),  
UK, Edinburgh**

**LDG (LatFor),  
Germany/France/Italy  
DESY**

**USQCD, USA  
Fermilab/JLab**

**JLDG, Japan  
Tsukuba**

**ILDG: a grid of grids**

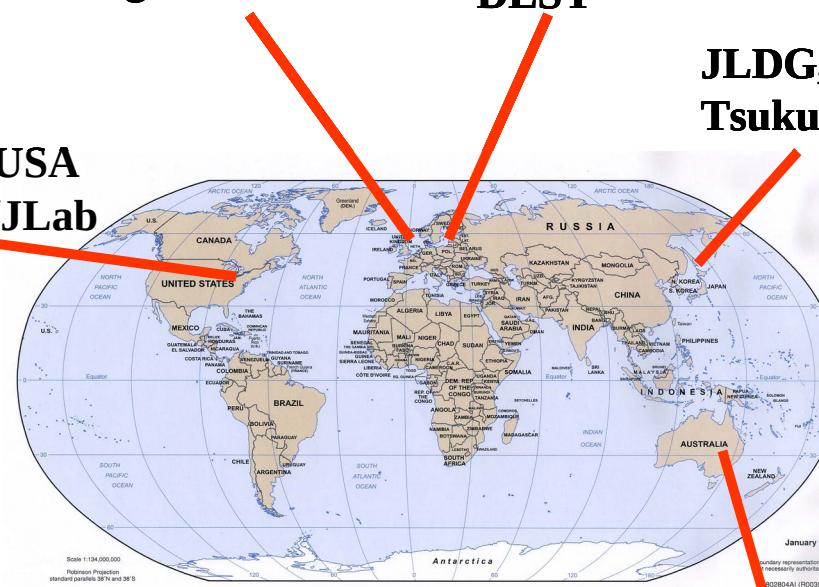


figure:  
Tomoteru Yoshie

**interim homepage of ILDG:**  
<https://hpc.desy.de/ildg/>

**CSSM, Australia  
Adelaide**



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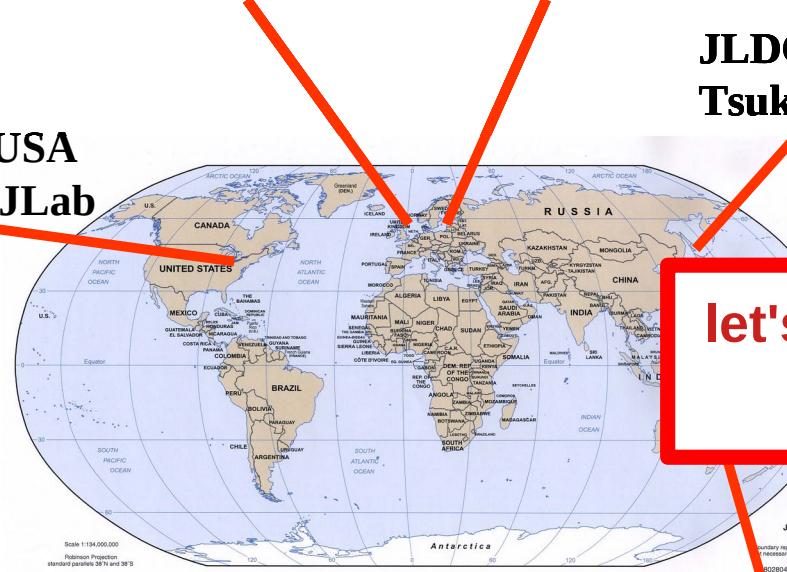
**USQCD, USA  
Fermilab/JLab**

**JLDG, Japan  
Tsukuba**

**ILDG: A grid of grids**

**let's modernize ILDG and  
make it FAIR**

interim homepage of ILDG:  
<https://hpc.desy.de/ildg/>



**CSSM, Australia  
Adelaide**



# FAIR data management

## Box 2 | The FAIR Guiding Principles

### To be Findable:

- F1. (meta)data are assigned a globally unique and persistent identifier
- F2. data are described with rich metadata (defined by R1 below)
- F3. metadata clearly and explicitly include the identifier of the data it describes
- F4. (meta)data are registered or indexed in a searchable resource

### To be Accessible:

- A1. (meta)data are retrievable by their identifier using a standardized communications protocol
  - A1.1 the protocol is open, free, and universally implementable
  - A1.2 the protocol allows for an authentication and authorization procedure, where necessary
- A2. metadata are accessible, even when the data are no longer available

### To be Interoperable:

- I1. (meta)data use a formal, accessible, shared, and broadly applicable language for knowledge representation.
- I2. (meta)data use vocabularies that follow FAIR principles
- I3. (meta)data include qualified references to other (meta)data

### To be Reusable:

- R1. meta(data) are richly described with a plurality of accurate and relevant attributes
  - R1.1. (meta)data are released with a clear and accessible data usage license
  - R1.2. (meta)data are associated with detailed provenance
  - R1.3. (meta)data meet domain-relevant community standards

<https://www.nature.com/articles/sdata201618.pdf>  
<https://force11.org/info/the-fair-data-principles/>  
[https://www.go-fair.org/wp-content/uploads/2022/01/FAIRPrinciples\\_overview.pdf](https://www.go-fair.org/wp-content/uploads/2022/01/FAIRPrinciples_overview.pdf)



# FAIR data management in Lattice QCD context

## Box 2 | The FAIR Guiding Principles

### To be Findable:

- F1. (meta)data are assigned unique identifiers
- F2. data are described with rich metadata
- F3. metadata clearly define the data
- F4. (meta)data are registered in metadata catalogues

**F** rich & searchable metadata, persistent identifier  
– metadata catalogues and conventions, DOI

### To be Accessible:

- A1. (meta)data are registered in accessible protocols
- A1.1 the protocol is open and standard
- A1.2 the protocol allows for transparent access control
- A2. metadata are accessible via standard protocols

**A** open and standard protocols, persistent metadata  
– transparent access control (VO registration)

### To be Interoperable:

- I1. (meta)data use a formal, broadly applicable schema
- I2. (meta)data use vocabularies and ontologies
- I3. (meta)data include links to other data

**I** integration of data with other data on different compute platforms – broadly applicable metadata schema, data formats, conversion tools

### To be Reusable:

- R1. meta(data) are rich, accurate and domain-relevant
- R1.1. (meta)data are reusable
- R1.2. (meta)data are reusable under a clear license
- R1.3. (meta)data meet community standards

**R** rich, accurate and domain-relevant metadata  
– data usage licenses, community standards

<https://www.nature.com/articles/sdata201618.pdf>

<https://force11.org/info/the-fair-data-principles/>

[https://www.go-fair.org/wp-content/uploads/2022/01/FAIRPrinciples\\_overview.pdf](https://www.go-fair.org/wp-content/uploads/2022/01/FAIRPrinciples_overview.pdf)



# Coordinated data management

**it's not just for our own satisfaction**

- the ease with which information can be spread (also in an uncontrolled manner) in the WWW makes it important for us to establish a transparent research practice in our community
- funding agencies demand well handled, transparent (FAIR) data management strategies on national and international level;
  - this is a prerequisite for successful grant applications
    - US: DOE Policy for Digital Research Data Management
      - ... data management involves all stages of the digital data lifecycle including capture, analysis, sharing, and preservation.  
The focus of this statement is Data Sharing and Data Preservation of Digital Research Data.
    - Germany started building of a modern, FAIR national research infrastructure (NFDI)
    - **similar policies exist in many other research communities worldwide**



# Coordinated data management in Lattice QCD community

ILDG: P. Coddington et al, arXiv:0710.0230 → QCDml markup language  
T. Yoshie, arXiv:0812.0849; → using the ILDG  
M.G. Beckett et al., arXiv:0910.1692 → implementation of the ILDG

## Steps toward a modern, FAIR data sharing:

### US:

USQCD data management plan

[https://www.usqcd.org/documents/USQCD\\_tape\\_DM.pdf](https://www.usqcd.org/documents/USQCD_tape_DM.pdf)

DOE Data Explorer: <https://www.osti.gov/dataexplorer/>

MILC-Collaboration: <https://github.com/milc-qcd/sharing/wiki/LatticeSharing>

### Japan:

Japan Lattice Data Grid: <https://www.jldg.org/>

T. Amagasa et al., J.Phys.Conf.Ser. 664 (2015) 4, 042058

Open-access to configurations with DOI: <https://www.jldg.org/DOI/>

### Germany:

European regional grid (LDG): modernize the LDG and interfaces to ILDG

<https://www.zeuthen.desy.de/ape-cgi-bin/ildg-mdc.cgi?action=listEnsemble>



# data management efforts in the US

<https://www.osti.gov/dataexplorer/search/product-type:Dataset/semantic:lattice%20QCD>

DOE  
Data Explorer

U.S. Department of Energy  
Office of Scientific and Technical Information

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36 Search Results

Sorted by Relevance ▾ Save Results ▾

< Prev

...

Next >

SEARCH FOR:

KEYWORDS

lattice QCD [x]

[x clear all]

[🔍 modify this search]

RFFINF RY:

1. Lattice QCD gauge ensemble: USQCD/MILC/asqtad /2048f21b6566m00484m0484

Aubin, Christopher Alan ; Bernard, Claude W. ; Burch, Tommy ; ...

MILC asqtad QCD SU(3) gauge ensemble; series=a; a=0.14fm; Ls=2.7fm;  
Nf=2+1; u0.m0=(0.00484,0.0484)

<https://doi.org/10.15484/milc.asqtad.en25a/1477430> | View Dataset



# data management efforts in the US

<https://www.osti.gov/dataexplorer/search/product-type:Dataset/semantic:lattice%20QCD>

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36 Search Results

SEARCH FOR:

KEYWORDS

lattice QCD [x]

[x clear all]

[ modify this search

RFFINF RY:

Search

Volumes

Spacing

Action

Collaboration

Domains

Gallery

Instructions

Globus Online

Bookmarks

Manage

Sign In

Home / configs / MILC / 2048f21b6566m00484m0484 /

configs/MILC/2048f21b6566m00484m0484

ensemble group:su(3) domain:usqcd collaboration:milc action:asqtad volume:20^3x48 flavor:2+1 beta:6.566 mass:0.00484 mass:0.0484 spacing:0.14fm length:2.8fm

arXiv DOI Edit

I2048f21b6566m00484m0484.nnnnn (604 files)

Download Link Download/Convert Instructions Copy via GlobusOnline

Filename	Date	Size	Download
configs/MILC/2048f21b6566m00484m0484/I2048f21b6566m00484m0484.1000	2011-08-05	110.0 MB	
configs/MILC/2048f21b6566m00484m0484/I2048f21b6566m00484m0484.1005	2011-08-05	110.0 MB	



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<https://www.osti.gov/dataexplorer/search/product-type:Dataset/semantic:lattice%20QCD>

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SEARCH FOR:

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[x clear all]

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RFFINF RY:

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The Gauge Connection

Home / configs / MILC / 2048f21b6566m00484m0484 /

configs/MILC/2048f21b6566m00484m0484

ensemble group:su(3) domain:usqcd collaboration:milc action:asqtad volume:20^3x48 flavor:2+1 beta:0.566 mass:0.00484 mass:0.0484 spacing:0.14fm length:2.8fm

arXiv DOI Edit

I2048f21b6566m00484m0484.nnnnn (604 files)

Download Link

Download/Co

qcd.nersc.gov

You must sign-in first!

OK

- Steve Gottlieb:**
- Gauge connection is moribund...
  - contact us if you need help

	2011-08-05	110.0 MB	Download
configs/MILC/2048f21b6566m00484m0484/I2048f21b6566m00484m0484.1000			
configs/MILC/2048f21b6566m00484m0484/I2048f21b6566m00484m0484.1005	2011-08-05	110.0 MB	



# Japan Lattice Data Grid

– open access part of JLDG is integrated and compatible with ILDG standards



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JLDG is a data-grid for lattice QCD community in Japan, and works as a regional grid of the [International Lattice Data Grid](#).

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## What's New

- A new 2+1 flavor full QCD ensemble (on 8fm lattice and near the physical quark mass point) is open to the public by the PACS Collaboration (March 2020)
  - An Announcement to ILDG users: [How to download JLDG public configurations \(pdf\)](#) (June 17 2018)
  - 2+1 flavor full QCD configurations by T. Yamazaki et al. for nuclei calculation are in public release (June 06 2013)
  - JLQCD Nf=2 configurations generated with overlap quarks are in public release (Apr 19, 2010)
  - [National Grid Hands-on meeting \(Jan. 27, 2010\)](#)
  - PACS-CS configurations are in public release (Sept 28, 2009)
  - ILDG interface is upgraded (Sept 22, 2009)
  - JLDG file system is upgraded to Gfarm V2 (Sept 17, 2009)
  - [QCDml faceted navigation system](#) is released for public use (Aug 18, 2009)
- 

## Index

- [System Overview](#)
  - [QCD ensembles/configurations publicly available through JLDG](#)
  - [QCDml Faceted Navigation](#)
  - [DOI indices of public QCD ensembles](#)
  - [National Grid \(in Japanese\)](#)
  - [JLDG Web Services](#)
  - [List of publications related to JLDG](#)
- 

NEW:

Last update: 26 July 2022, H.Ohno

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## QCDml Faceted Navigation

### rgrid

[JLDG \(60\)](#)

[ldg \(247\)](#)

### collaboration

[CP-PACS \(12\)](#)

[CP-PACS+JLQCD \(30\)](#)

[dik \(1\)](#)

[etmc \(91\)](#)

[JLQCD \(6\)](#)

[PACS Collaboration \(1\)](#)

[PACS-CS \(11\)](#)

[qcdfs \(147\)](#)

[rqcd \(1\)](#)

[theta \(7\)](#)

### Filter Condition(s):

[clear conditions](#)

### #Ensemble(s): 307

**#1** [12/12/12/24] [mc://JLDG/CP-PACS/RCNF2/RC12x24-B1800K014090C1600](#)

iwasakiRGluonAction (beta=1.800)

tpCloverQuarkAction (nf=2/kappa=0.14090)

[\[Show XML\]](#) [\[Show LFNs\]](#)

**#2** [12/12/12/24] [mc://JLDG/CP-PACS/RCNF2/RC12x24-B1800K014300C1600](#)

iwasakiRGluonAction (beta=1.800)

tpCloverQuarkAction (nf=2/kappa=0.14300)

[\[Show XML\]](#) [\[Show LFNs\]](#)

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- An Announcement to ILDG users: [How to download JLDG public configurations \(pdf\)](#) (June 17 2018)  
2+1 flavor full QCD configurations for the valence gluon field generated by the PACS collaboration and its public release (June 17 2018)

## Lattice QCD gauge ensemble: Public dataset DOI index

<https://www.jldg.org/DOI/>

DOI	Description
<a href="https://doi.org/10.34845/PACS-CS.000001">10.34845/PACS-CS.000001</a>	Lattice QCD gauge ensemble: JLDG/PACS-CS/RCNF2+1/RC32x64_B1900Kuc
<a href="https://doi.org/10.34845/PACS-CS.000002">10.34845/PACS-CS.000002</a>	Lattice QCD gauge ensemble: JLDG/PACS-CS/RCNF2+1/RC32x64_B1900Kuc
<a href="https://doi.org/10.34845/PACS-CS.000003">10.34845/PACS-CS.000003</a>	Lattice QCD gauge ensemble: JLDG/PACS-CS/RCNF2+1/RC32x64_B1900Kuc
<a href="https://doi.org/10.34845/PACS-CS.000004">10.34845/PACS-CS.000004</a>	Lattice QCD gauge ensemble: JLDG/PACS-CS/RCNF2+1/RC32x64_B1900Kuc
<a href="https://doi.org/10.34845/PACS-CS.000005">10.34845/PACS-CS.000005</a>	Lattice QCD gauge ensemble: JLDG/PACS-CS/RCNF2+1/RC32x64_B1900Kuc
<a href="https://doi.org/10.34845/PACS-CS.000006">10.34845/PACS-CS.000006</a>	Lattice QCD gauge ensemble: JLDG/PACS-CS/RCNF2+1/RC32x64_B1900Kuc

NEW:

# European Lattice Data Grid (LDG)

The screenshot shows the "HPC and Data for Lattice QCD" website. On the left, there is a sidebar with links: HOME, ILDG, LDG, Metadata Indices (highlighted with a red arrow), UserDoc, FAQ, AdminDoc, TechDoc, Publications, Links, SIMLAB, QCD MACHINES, and HELMHOLTZ. The main content area has a blue header "HPC" and "HPC and Data for Lattice QCD". It shows a navigation path "Home / LDG" and a title "LDG". Below it is "Latfor DataGrid (LDG)". A text block says: "The Latfor Data Grid (LDG) is the regional grid for continental Europe within the ILDG project. It operates ILDG services (metadata catalogue, file catalogue, storage elements) at the following institutions:". To the right is the "ILDG" logo. A red arrow points from the "Metadata Indices" link in the sidebar to the "Simple listings (LDG)" section in the main content.

The screenshot shows the "HPC and Data for Lattice QCD" website. The sidebar is identical to the previous screenshot. The main content area has a blue header "HPC" and "HPC and Data for Lattice QCD". It shows a navigation path "Home / LDG / Metadata Indices" and a title "Metadata Indices". Below it is a section titled "Simple listings (LDG)" with the subtext "Currently includes only ensembles of JLDG and LDG". This section is highlighted with a red box. Below it are three items: "Faceted navigator (JLDG)" (with a warning: "Warning: may not be up-to-date"), "DOI index of JLDG", and "DOE Data Explorer for USQCD". A red arrow points from the "Faceted navigator (JLDG)" item to the "Faceted navigator (JLDG)" link in the sidebar. At the bottom, there is a footer with links: Contact | Imprint | Data Privacy Policy | Declaration of Accessibility (in German) and © 2020, Deutsches Elektronen-Synchrotron DESY. The "HELMHOLTZ" logo is also present.

provides access to JLDG and LDG data sets using ILDG standards



# European Lattice Data Grid (LDG)



## List all registered Ensembles

[LDG Home](#)

[JLDG Home](#)

Number of ensembles from JLDG	59
Number of ensembles from LDG	251
Total number of ensembles	310

- ~ 40.000 configs.
- ~ 380.000 configs.

### Warnings/errors:

- [USQCD] Failed to retrieve ensemble list (501 Protocol scheme 'https' is not supported)
- [UKQCD] Failed to retrieve ensemble list (500 Can't connect to edqcdgrid.epcc.ed.ac.uk:8080)
- [JLDG] Failed to retrieve ensemble list (500 Can't connect to ws.jldg.org:80)
- [JLDG] Using backup data of Metadata Catalogue from 2022-08-02 12:09:52

### Ensembles from JLDG:

- [mc://JLDG/CP-PACS+JLQCD/RCNF2+1/RC16x32\\_B1830Kud013655Ks013710C1761](#) [JLDG]
- [mc://JLDG/CP-PACS+JLQCD/RCNF2+1/RC16x32\\_B1830Kud013655Ks013760C1761](#) [JLDG]
- [mc://JLDG/CP-PACS+JLQCD/RCNF2+1/RC16x32\\_B1830Kud013710Ks013710C1761](#) [JLDG]
- [mc://JLDG/CP-PACS+JLQCD/RCNF2+1/RC16x32\\_B1830Kud013710Ks013760C1761](#) [JLDG]
- [mc://JLDG/CP-PACS+JLQCD/RCNF2+1/RC16x32\\_B1830Kud013760Ks013710C1761](#) [JLDG]
- [mc://JLDG/CP-PACS+JLQCD/RCNF2+1/RC16x32\\_B1830Kud013760Ks013760C1761](#) [JLDG]
- [mc://JLDG/CP-PACS+JLQCD/RCNF2+1/RC16x32\\_B1830Kud013800Ks013710C1761](#) [JLDG]

### Ensembles from LDG:

- [mc://ldg/dik/clover\\_nf2/b5p29kp13632-32x64](#) [LDG]
- [mc://ldg/dik/clover\\_nf2/b5p40kp13640-24x48](#) [LDG]
- [mc://ldg/dik/clover\\_nf2/b5p40kp13640-32x64](#) [LDG]
- [mc://ldg/dik/clover\\_nf2/b5p40kp13660-32x64](#) [LDG]
- [mc://ldg/etmc/tmqcd\\_nf2/tlSym\\_b3.75\\_L24T48\\_k0.1660\\_mu0.0200](#) [LDG]
- [mc://ldg/etmc/tmqcd\\_nf2/tlSym\\_b3.8\\_L20T48\\_k0.164099\\_mu0.0060](#) [LDG]
- [mc://ldg/etmc/tmqcd\\_nf2/tlSym\\_b3.8\\_L20T48\\_k0.164099\\_mu0.0090](#) [LDG]
- [mc://ldg/etmc/tmqcd\\_nf2/tlSym\\_b3.8\\_L20T48\\_k0.164111\\_mu0.006](#) [LDG]
- [mc://ldg/etmc/tmqcd\\_nf2/tlSym\\_b3.8\\_L24T48\\_k0.164111\\_mu0.0045](#) [LDG]

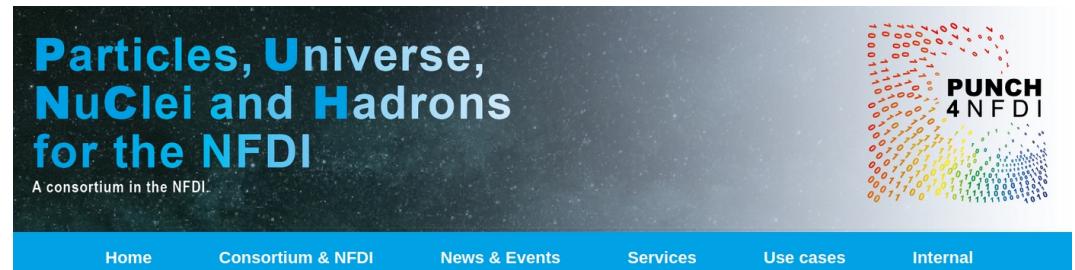
retrieve configurations  
using e.g.

gsiftp://www2.jldg.org/gfarm/public/ILDG/JLDG/PACS-CS/RCNF2+1/RC32x64\_B1900/  
Kud01370000Ks01364000/RC32x64\_B1900Kud01370000Ks01364000C1715-b-002510



# European Lattice Data Grid (LDG)

- contributions from France, Germany, Italy, ..
- recent activities driven by participation of German Lattice-QCD groups in the National Infrastructure Research Project PUNCH4NFDI



<https://www.punch4nfdi.de/>

- modernize the LDG and its integration into ILDG;
- create user-friendly interfaces to ILDG services
  - Enable data publishing (**DOI registration**, landing pages) within LDG
  - Establish **Authentication and Authorization Infrastructure** (AAI) for future (token-based) **Virtual Organization (VO)** registration for ILDG



# parallel session on data management at Lattice 2022

plans for sharing of  
configurations

14:00 <b>CLQCD:</b>	Sun Peng (remote)	open data project
14:10 <b>PACS:</b>	Yoshinobu Kuramashi (remote)	ILDG (in future)
14:20 <b>FASTSUM:</b>	Ryan Bignell	ILDG (in future)
14:30 <b>OpenLAT:</b>	Anthony Francis	ILDG (in future)
14:40 <b>MILC:</b>	Steven Gottlieb	contact MILC
14:50 <b>JLab/W&amp;M/LANL/MIT:</b>	Rajan Gupta	US-open access
15:00 <b>JLQCD:</b>	Issaku Kanamori	ILDG
15:10 <b>Firenze-Jülich-Samara:</b>	Andrey Kotov	public in future
15:20 <b>RBC-UKQCD:</b>	Robert Mawhinney	contact RBC
15:30 <b>HotQCD:</b>	Christian Schmidt-Sonntag	ILDG (in future)
15:40 <b>CLS:</b>	Wolfgang Soeldner	ILDG (in future)
15:50 <b>ETMC:</b>	Bartosz Kostrzewa	ILDG
<b>HAL QCD</b>	Takumi Doi	
<b>QCDSF-CSSM-UKQCD</b>	James Zanotti	ILDG (in future)



# ILDG lunch break session

starting NOW in **CP1-HSZ/Ground-0.021 - SR3**

– snacks/sandwiches will be available

**session chair:** Carleton DeTar (Utah)

**Agenda:**

- Introduction and report from ILDG working groups,  
**Hubert Simma (DESY):**
- open discussion

