

# LQCD Data Management

Hubert Simma

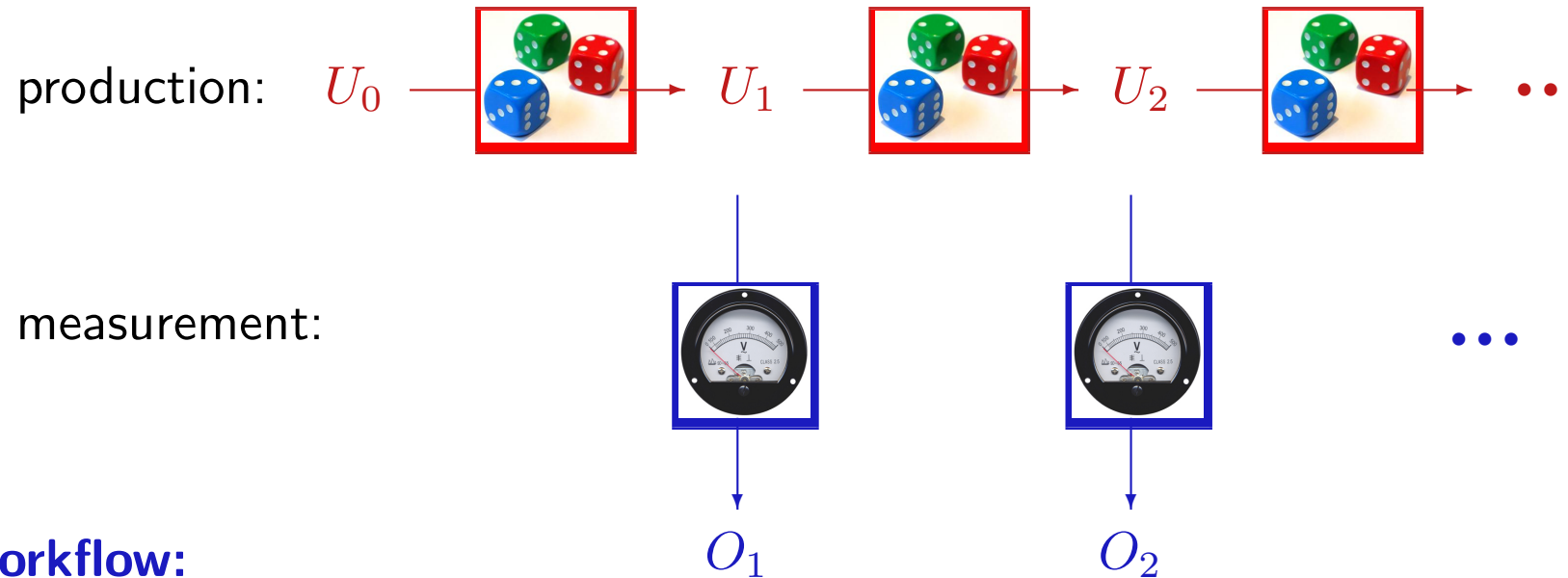
NIC / DESY

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# LQCD Simulations



- Production of “gauge configurations”  $U_i$  by a MCMC (typically on massively parallel machines at HPC centers, “capability computing”)
- Storage of the “gauge ensembles” (gauge ensemble = set of gauge configurations produced in a single Markov chain)
- Measurement of “physical observables”  $\langle O_i \rangle$  on the gauge ensemble(s)
  - often not on the same machines as production (“capacity computing”)
  - typically performed by different groups or even collaborations
  - possibly repeated processing for measurement of different observables
  - possibly years after production

# LQCD Data

## Typical numbers:

- ❑ Gauge configuration: 1 GB ( $64 \times 32^3$ ) . . . 30 GB ( $192 \times 64^3$ )
- ❑ Ensemble: order 1000 . . . 10 000 gauge configurations
- ❑ State-of-the-art physics projects require large-scale simulations of tens of ensembles (with different physics parameters, like lattices spacing, quark masses, etc.)
- ❑ Production of 1 TB configurations costs of the order of 1 Million core hours (strongly depends on physics parameters, algorithms and implementations)
- ❑ Computing cost of measurements is of same order as for production (typically lower, but rapidly grows for more complex physics problems)

## LDG Usage

VO members:	$O(50)$	(LDG only)
LQCD collaborations:	3 (+1)	(ETM, QCDSF, DIK, CLS)
User institutions:	$\geq 21$	
Production hosts:	$O(10)$	(JSC, LRZ, CINECA, HLRN, BSC, . . . )
SE:	6	(dCache etc.)
Data volume:	$\approx 250 (+ 240)$ TB	
# of ensembles:	$\approx 190 (+ 50)$	
# of configurations:	$\approx 2.5$ million	
Uploads:	$O(25) \dots O(100)$ TB / y	
Downloads:	$\geq 40 \dots O(200)$ TB / y	
Measurement hosts:	$\geq O(10)$	

**Caveat:** mostly estimates from 2013

# International Lattice Data Grid (ILDG)

Organized as a “**grid of grids**”, i.e. a set of regional grids (RG), like

- LDG (Continental Europe) [\[http://hpc.desy.de/ldg\]](http://hpc.desy.de/ldg)
- JLDG (Japan) [\[http://www.jldg.org/\]](http://www.jldg.org/)
- USQCD [\[http://www.usqcd.org/ildg\]](http://www.usqcd.org/ildg)
- . . . [\[http://qcd.nersc.gov\]](http://qcd.nersc.gov)

with **shared** or **inter-operable services**:

- VO (ILDG wide)
- XML schema for metadata (describing ensembles + configurations)
- Meta Data Catalogue (MDC)
- File Catalogue (FC)
- Storage Elements (SE)

## Objectives of (I)LDG developments

- \* Increased and simplified data-sharing in LQCD community
- \* Upgrade of LDG to state-of-the-art technologies
- \* Improved integration of and access to (I)LDG at HPC centers
- \* Optional extension beyond configurations (propagators, observables, . . . )

# ILDG Metadata

[PoS (LATTICE 2007) 048], [arXiv:hep-lat/0409055]

see also <http://www2.ccs.tsukuba.ac.jp/ILDG>

## Ensembles: ( $\geq 60$ xml elements)

- Management (who, when)
- Physics (lattice geometry, action, parameters)
- Algorithm (specification, parameters)

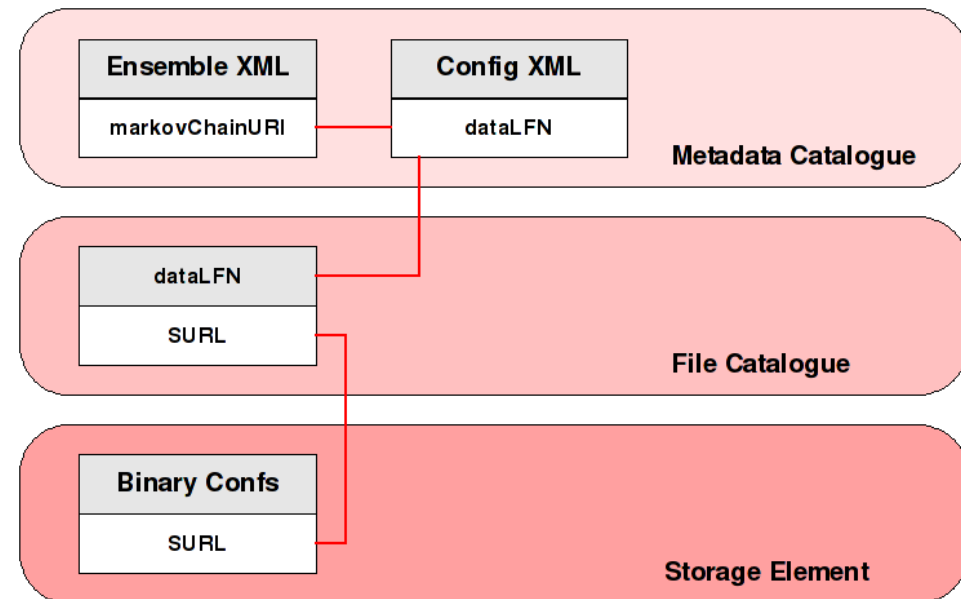
## Configurations: ( $\geq 35$ xml elements)

- Management (who, when, CRC)
- Implementation (machine, code)
- Algorithm parameters (optional)
- Markov chain (markovChainURI, dataLFN, update step, plaquette value)

# LDG Architecture

## Services:

- **VOMS** [[grid-voms.desy.de](http://grid-voms.desy.de)]
- **MDC** (web server with SOAP interface, using eXist data base)
- **FC** (web server with SOAP interface, based on LFC)
- **SE's** (usually also SE of WLCG)



## Clients: (e.g. ltools)

- Query or browse MDC (and FC)
- Download configurations (using lcg / srm / gridftp clients)
- Upload configurations **and** metadata consistently
- Simple installation (RPM's suitable for hosts without root access)

see also DiGS client of UKQCD <http://www.gridpp.ac.uk/news?p=981>



# Objectives for this Meeting

## Technical issues:

- Current and future (technical) directions of LHC Data Management?
  - SE access and transfer protocols
  - replacements of LFC
  - access control mechanisms
- Possible common technical developments / tools ?
- Desirable and realistic support at HPC centers?  
(criteria to become “data sharing certified” )

## CoE issues:

- How much effort (depending on technical choices) is realistic?
- How could sharing of work and persons be organized?
- How to achieve seamless access to data resources at HPC and LHC infrastructures?