

Chroma with Domains

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SciDAC5 meeting 12/2/2022

Chroma software suite

- ▶ Numerical calculations in lattice QCD
- ▶ Clean separation of application (Chroma) and data types/operations (QDP++)
- ▶ Chroma: HMC, RHMC, Krylov-space iterative solvers, spectroscopy and hadron structure routines.
- ▶ Framework: QDP++, provides data-parallel types and operations as C++ expressions (embedded “DSL”)
→ Single global grid, Lattice/Scalar

QDP-JIT

- ▶ Drop-in replacement for QDP++
- ▶ Expressions execute on GPUs (NVIDIA, AMD, Intel)
- ▶ Emphasis on ease-of-use and performance
 - Automatic memory management
 - GPU-friendly data layout
 - Overlapping MPI comms and compute
 - Divide/conquer on propagator operations
- ▶ Just-In-Time (JIT) compilation off-loading GPU kernels
- ▶ Uses LLVM compiler to build kernels
 - (NVPTX backend) → PTX → (NV driver)
 - (AMDGPU backend) → AMD GCN → (dynamic linker)
 - LLVM IR → (Khronos translator) → SPIR-V → (L0)

Support for Domains?

What already exists:

- ▶ Set/Subset
`psi[cb[0]] = (expr)`
(range limiter)

- ▶ Multi reduction
`sumMulti((expr) , Set)`
(per-subset sum)

User-defined via:
`SetFunc`

Support for Domains?

A possibility:

- ▶ Definition of Subdomains:
 - Discrete geometry: blocks, hyper-planes
 - Concepts: inner, outer, frames
 - Domain ops: intersection, union, difference
- ▶ Boundary conditions
- ▶ Bundling of Subdomains into domains
- ▶ Extend expressions to domains/subdomains

`psi[domain/subdomain][subset] = (expr)`