

Numerical Libraries for Fugaku

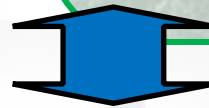
FUJITSU

SSL/II
(FFT, PRNG, direct solver, etc)

Netlib
(BLAS, LAPACK, ScaLAPACK)

FP16 extension

Co-design



Open Source Software



RIKEN CCS

R-CCS math software

- EigenExa
- KMATH_FFT3D
- KMATH_RANDOM

Enhancement of BLAS-X

- D&C framework
- 2.5D PDGEMM
- batchedBLAS

Priority Issues (9 Issues) on post-K computer
(+ Exploratory Challenges (4 challenges) of post-K)

Overview of FUJITSU MATH LIBs

- **BLAS**

- Assembly coded (ARMv8+SVE)
- Thread-parallelized with OpenMP
- FP16 extension

- **LAPACK**

- Most of important routines are tuned in serial & thread-parallel

- **ScaLAPACK**

- Hybrid parallel is usable

- **SSL II (Scientific Subroutine Library)**

- Covers wide range of area (FFT, Sparse matrix problems, Random numbers, Non-Linear Equations, Interpolation, Quadrature, ODE, Special Functions, etc.)
- Developed since 1970's through collaboration with Japanese Academia and ANU(The Australian National University)

Component	Serial	Thread-Parallel	Process-Parallel
BLAS LAPACK	✓	✓	—
PLASMA	—	✓	—
ScaLAPACK	—	✓	✓
SSL II	✓	—	—
Thread-Parallel SSLII	—	✓	—
C-SSL II	✓	—	—
Thread-Parallel C-SSLII	—	✓	—
SSL II/MPI	—	✓	✓