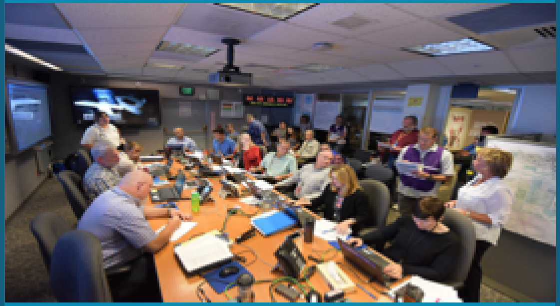
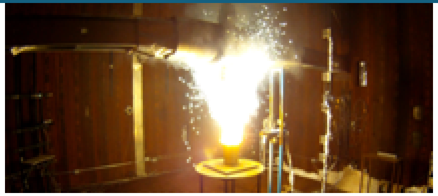
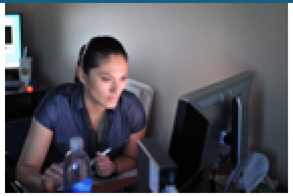
Sandia National Laboratories

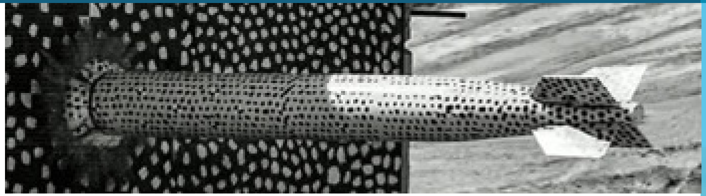
SAND2021-4541C

Sake: Solvers and Kernels for Exascale









PRESENTED BY

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PE

Trilinos: Open-Source Toolkit of Mathematical Algorithms for HPC

Trilinos Software

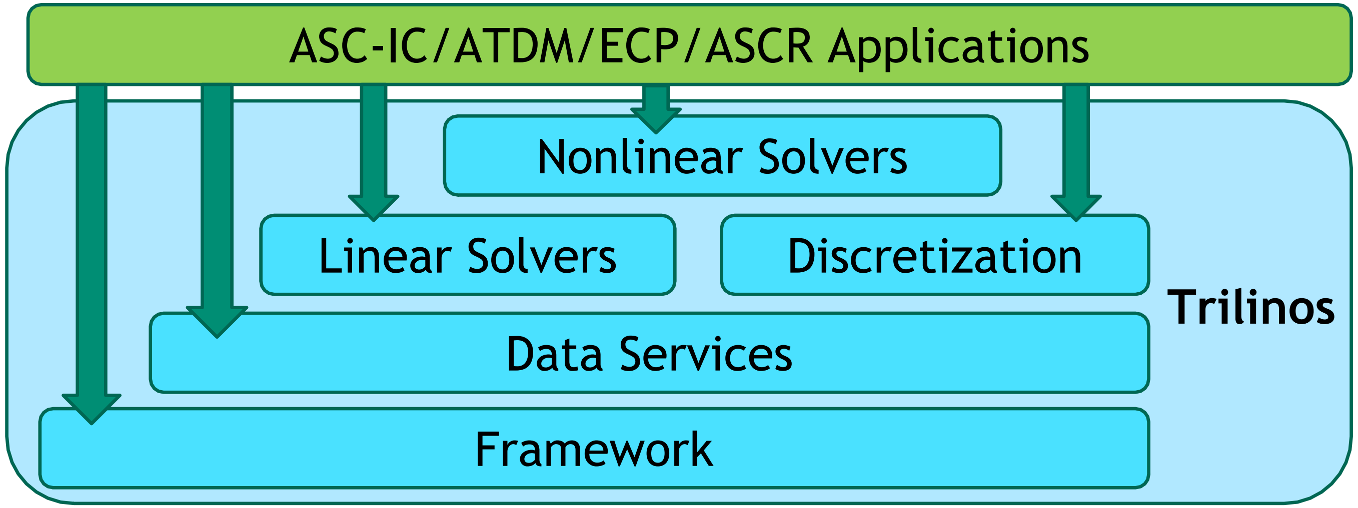
53 packages in five areas

~100 contributors in total

~50+ active contributors

30-140 commits per week

221 forks



Application Impact

- Solid mechanics, fluid dynamics, electrical circuits, etc.
- SIERRA, Empire, SPARC, Xyce, Drekar, Charon, etc.

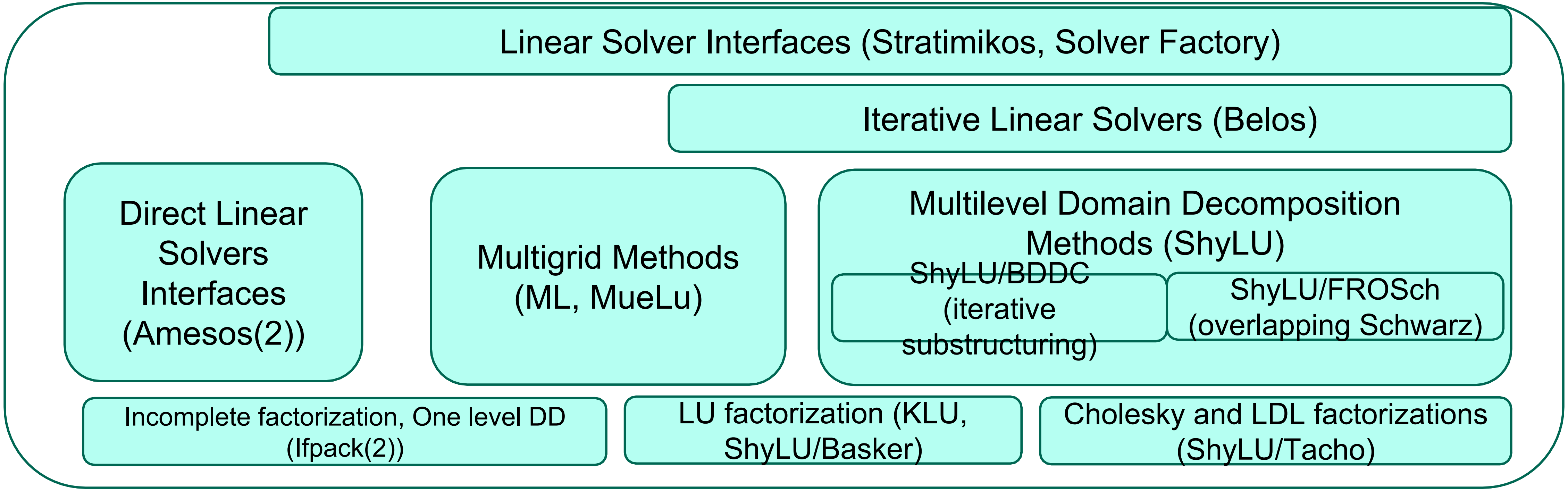
Two main codes paths:
- 32-bit stack (maintenance)
- Templated C++ stack (active)

Trilinos product areas (Lead : Heroux)

- **Framework** – Build, install, and test infrastructure; application integration (Product Lead: Willenb
- **Data Services** – Linear algebra, **Kokkos** performance-portability, **load balancing**, mesh services (Product Lead: Devine)
- **Linear Solvers** – Iterative/direct solvers, preconditioners (domain-decomposition, multigrid, block) (Produ Rajamanickam)
- **Nonlinear Solvers** – Time-stepping methods, non-linear solvers (Product Lead: Pawlowski)
- **Discre

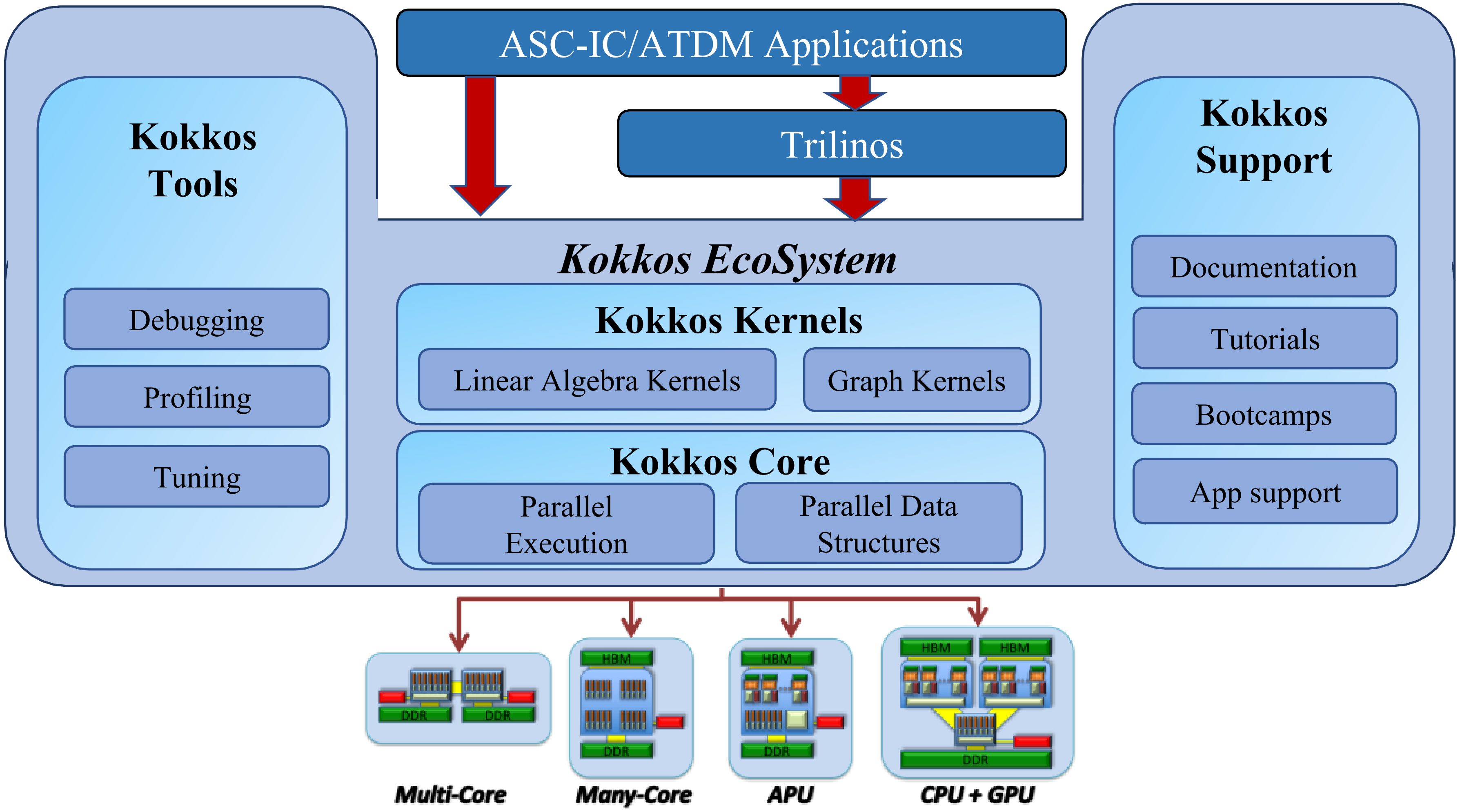
Trilinos provides scalable algorithms to ASC-IC/ATDM applications, enabling high performance on current and next generation HPC platforms

Trilinos Solvers Overview



- Comprehensive suite of solvers that covers entire spectrum of ASC IC/ATDM solver needs
  - Direct linear solvers for highly ill-conditioned, unsymmetric, problems (Xyce)
  - Schur complement solvers for distributed-memory direct solvers (Xyce)
  - Iterative linear solvers that cover broad suite of applications (SIERRA, Xyce, Charon, EMPIRE, SPARC)
  - Multigrid methods for broad suite of applications (Fluid dynamics, Charon, EMPIRE, SPARC)
  - Multilevel domain decomposition methods (SIERRA-SD, SIERRA-SM)
  - Incomplete factorization preconditioners (Smoother for multigrid methods)

Kokkos Ecosystem for Performance Portability



Kokkos Core: parallel patterns and data structures; supports several execution and memory spaces

Kokkos Kernels: performance portable BLAS; sparse, dense and graph algorithms

Kokkos Tools: debugging and profiling support

Write-once using Kokkos for portable performance on different architectures

Kokkos Ecosystem addresses complexity of supporting numerous many/multi-core architectures that are central to DOE HPC enterprise