



ChEESE

Flagship Code: Elmer/Ice

Thomas Zwinger

CSC-IT Center for Science Ltd.



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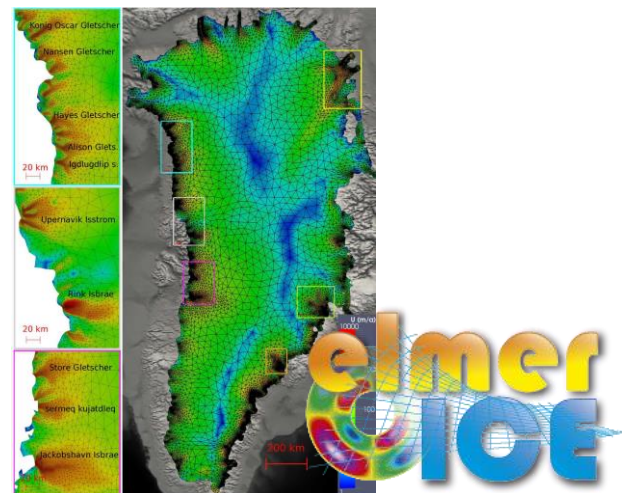
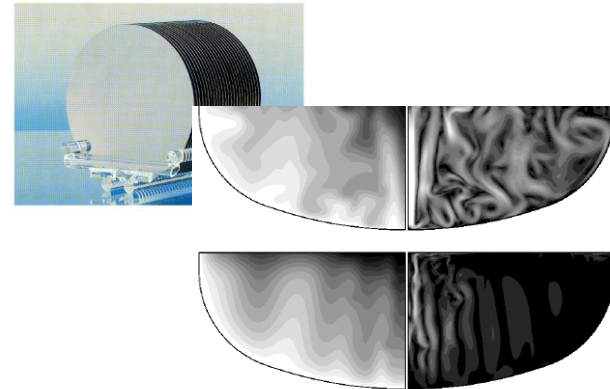


EuroHPC
Joint Undertaking



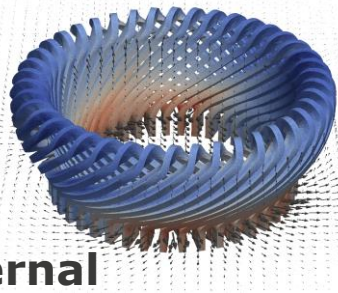
Elmer/Ice and Elmer history

- Elmer started as Multi-Physics code in 1995
- First applications to silicon crystal growth
- Elmer contains solvers for fluid flow, heat transfer, mass transfer, solid deformation, electrodynamic, DFT
- Elmer code was published under GPL 2008, later the library under LGPL
- At the same time, Elmer/Ice, the glaciological add-on to Elmer was started
- Almost 200 peer reviewed publications
- Contributions to recent IPCC AR's



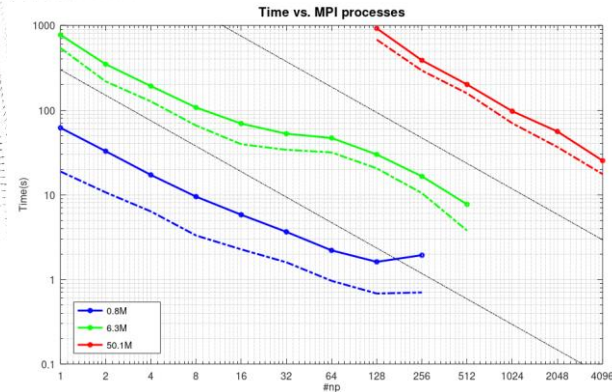
Elmer/Ice fact sheet

- **Code:** ~450,000 lines of active code, Finite Element Method
- ~3/4 in Fortran, 1/4 in C/C++
- ~50 physical models
- ~800 consistency tests (ctest)
- **Parallel paradigms:** MPI + OpenMP (threading + SIMD)
- Existing special version using NVIDIA AMGx for GPU offload
- **Documentation:** ~750 pages manuals (<https://nic.funet.fi>)
- >10 hours webinar talks
- <http://elmerfem.org> (including Forum)
- <http://elmerice.elmerfem.org> (including Wiki)
- **Repository:** <https://github.com/ElmerCSC/elmerfem>
- ~1000 code commits yearly
- **Community:** ~20k downloads (WIN), 2k postings, course/webinar participation
- **Contact** (ChEESE2): [Thomas Zwinger](#)



Elmer(/Ice) status

- Elmer utilizes those **external libraries**: Hypre, Metis, MKL, MMG, MUMPS, ParMMG, Trilinos, AMGX (NVIDIA GPU)
- **I/O formats** supported: A large number of external mesh formats (converted into Elmer native), VTK-output, NetCDF in and output (also unstructured)
- **Performance**: Elmer underwent a POP audit (never got results)
- **Scaling** depends on applicatoin (solver). Some applciations scale easily up to several thousand cores. SIMD enabled BPC Stokes for glaciology



MPI/G PU	5	10	20	40
1	Out of memo ry	11/25 s	27/35 s	AMG X excep tion
2	8/30 s	13/25 s	14/22 s	46/50 s
4	4/26 s	5/16 s	6/12 s	15/20 s

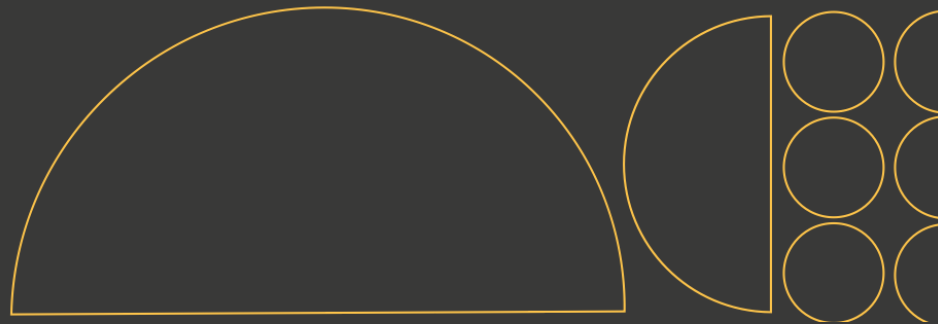


Elmer(/Ice) plans

- Elmer has been successfully installed on LUMI-C using singularity container
- We are planning to use singularity also for LUMI-G (container enabled for ROCM)
- Prepare Elmer to work with ROCALUTION (similar to existing AMGX)
- Look into possibilities to put matrix assembly for dedicated solvers to GPU (OpenMP or HIP kernels)
- Elmer has been successfully compiled on Fugaku (ARM64) and will be tested (collaboration with RIKEN) – later hopefully on JU ARM platform
- Elmer/Ice is maintained at Australian NCI machine gadi (existing cooperation with Univ. Of Tasmania)



Thank you!



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@cheese_coe@techhub.social

