Recent EUROfusion achievements in support to computationally demanding multi-scale fusion physics simulations and integrated modelling

- ➢ Significant progress in the optimisation and speedup of the EU codes to adapt them to modern HPC architecture (High Level Support Team) → *e.g. speedup factor >400 for REFMULX code used for reflectometry simulations via MPI parallelization, >6 for the B2 part of SOLPS package via optimisation and OpenMP parallelization*

- ➢ Development of the framework for integration of these codes into a single Integrated Modelling tool based on a generic data structure (Core Programming Team) → *EU IM infrastructure (has inspired the design of the IMAS infrastructure), efficient users support*

- ➢ Extension of EUROfusion computational capabilities – HPC MARCONI-FUSION for fusion application in Europe: *conventional partition (Intel Xeon-Broadwell processors, 1 Pflops) is in production mode → 5 Pflops Intel Xeon-Skylake + 1 Pflops Intel Knights Landing processors*

T. Ribeiro, F. da Silva. Execution time for REFMULX: original code (red), its optimised version (blue dotted) and MPI parallel version (blue solid).

Original serial = 14964.9 s

optimisation: speed up x 8.3

Optimized serial = 1802.1 s -> speedup = 8.3x

parallelisation: speed up x 51.5

512 MPI tasks = 35.0 s -> speedup = 427.6x (51.5x)

Original REFMULX (serial)
Optimized REFMULX (serial)
REFMULXp (BullxMPI)
REFMULXp (Hybrid 8 threads)
Ideal scaling

Number of cores (processes)

T. Fehér. Speedup of B2 code (ITER test case)

Speedup — B2 — Amdahl 90%

number of threads

I. Voitsekhovitch, R. Hatzky, D. Coster, F. Imbeaux, et al, TH/P2-12