

Retos Computacionales en el Finis Terrae

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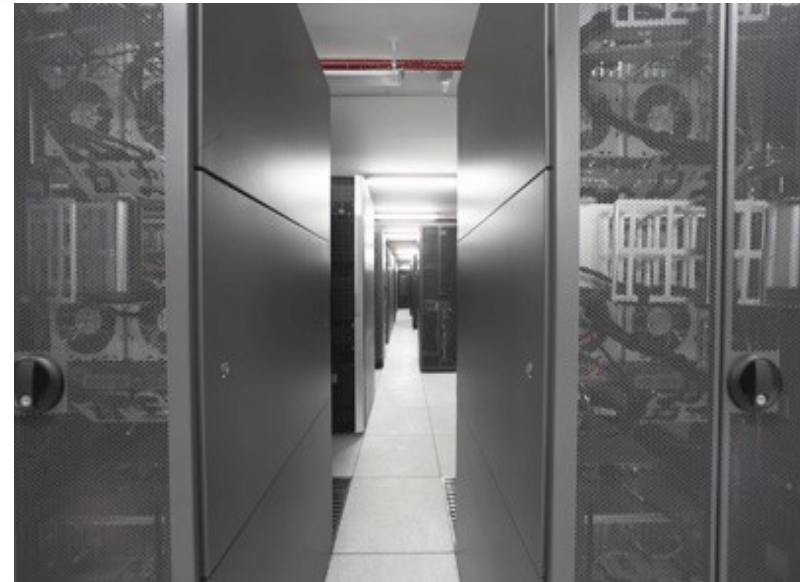
FINISTERRAE

EXPANDING
THE
FRONTIERS OF KNOWLEDGE

SANTIAGO DE COMPOSTELA, SPAIN,



FINISTERRAE



Spanish National Singular Scientific & Technological Infrastructure

More than: **16,000 GFLOPS**

2,580 CPUs

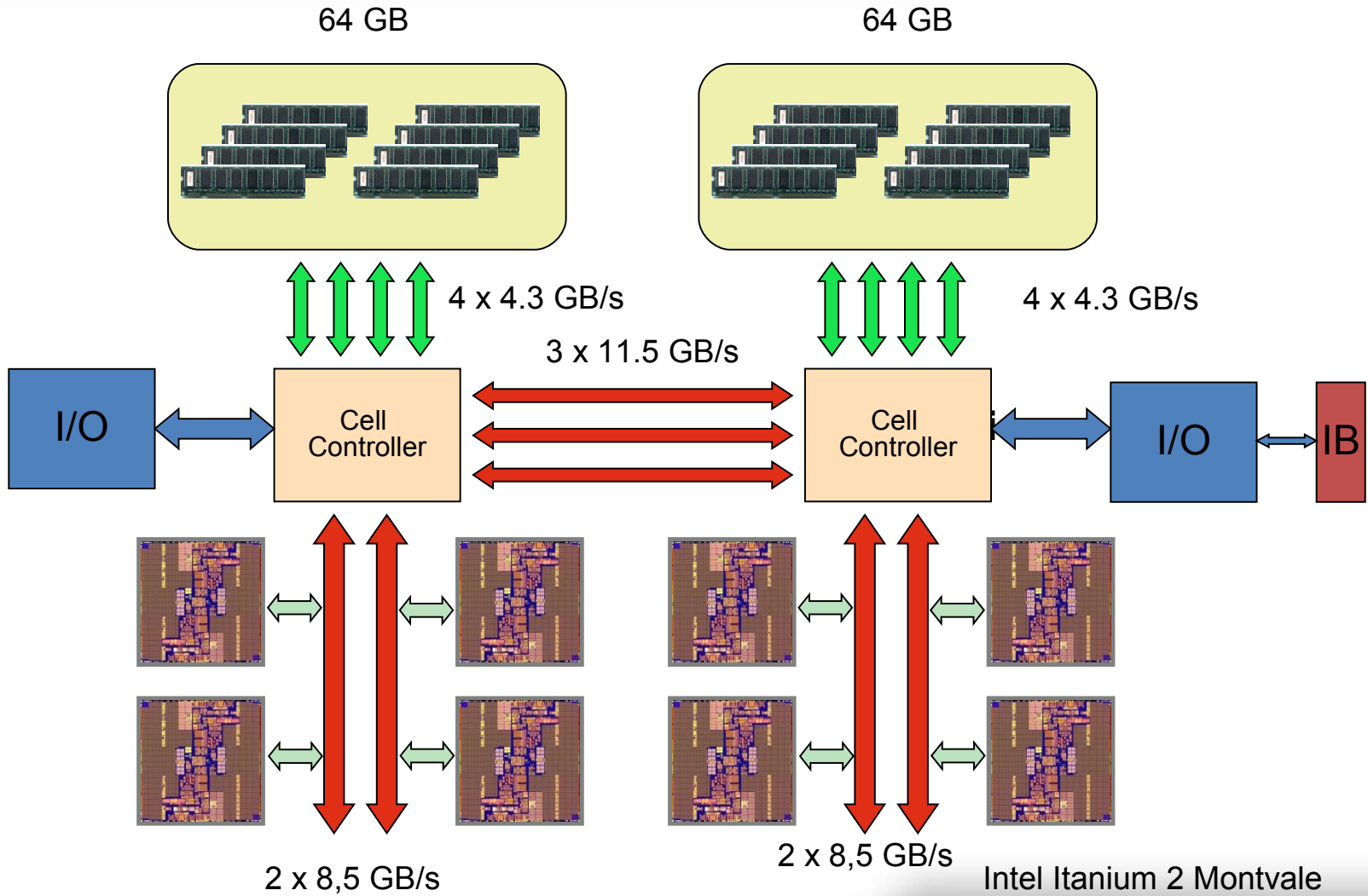
19,640 GB Memory

SuSE Linux Enterprise Server 10

SANTIAGO DE COMPOSTELA, SPAIN

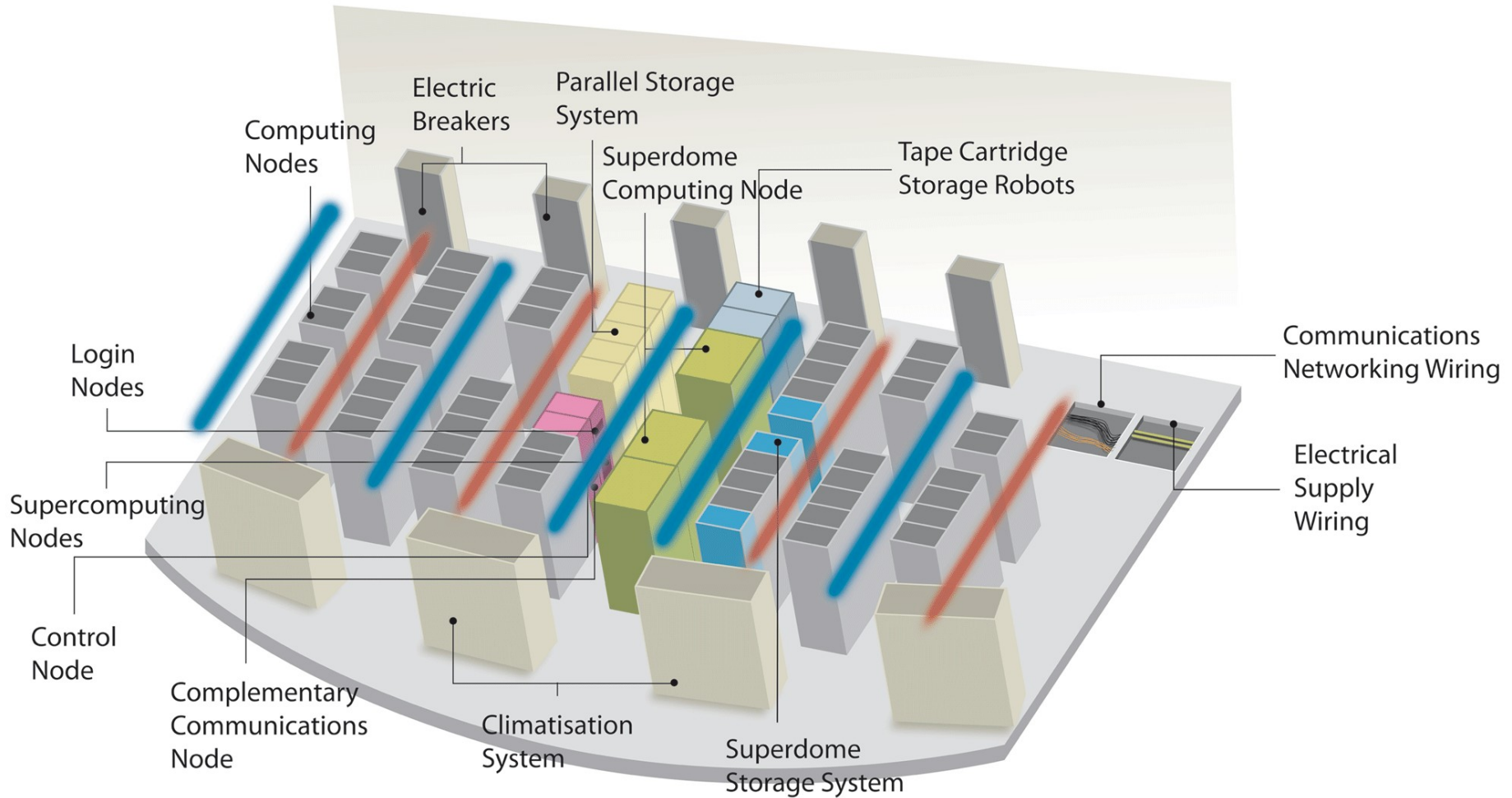


RX 7640 Architecture



Intel Itanium 2 Montvale

The Finis Terrae Cluster



Technical Specs.

Surface Area: 140 m²

Weight:



35.000 Kg

Storage:



2.200.000 GB
on tape

390.000 GB
on disk

Memory:



19.670 GB

2.528 Processing Cores

142 nodes, each with 16 cores & 128 GB memory

1 node with 128 cores & 1.024 GB memory

1 node with 128 cores & 384 GB memory

Node Interconnect INFINIBAND
4x DDR at 20 Gbps

85 Km of interconnect cable

Open Software: Linux, Lustre, Globus...

CHALLENGES SELECTION

- Different scientific fields / know-how
- Coming from different groups / Institutions / research projects
- Computationally highly demanding

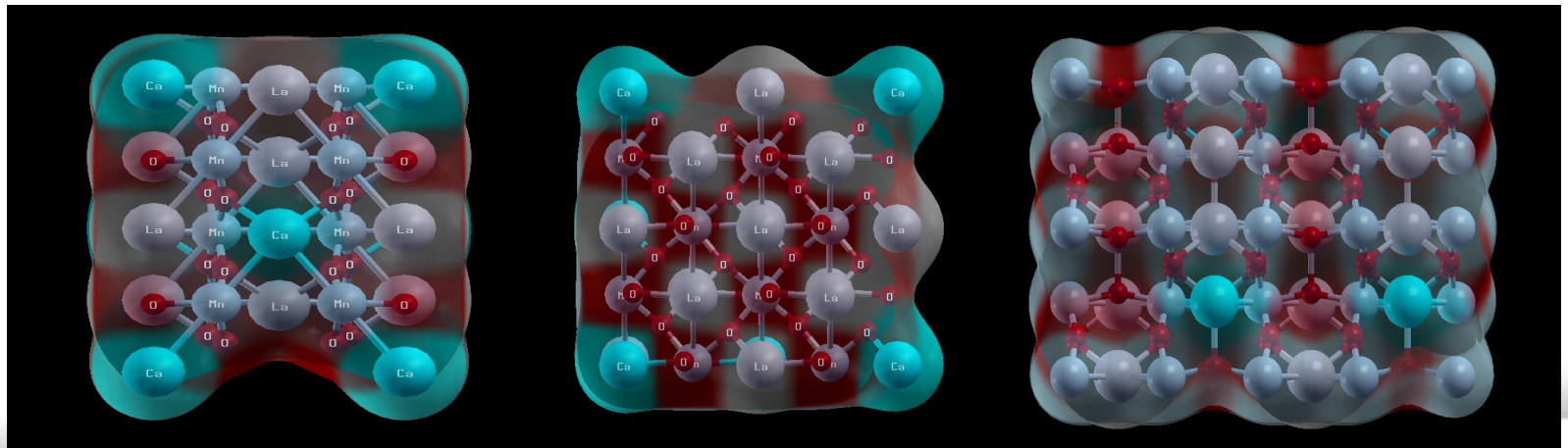


CHALLENGES

- **Phase separation**
- **Massive stars**
- **Fekete Points**
- **HEmCUVE**

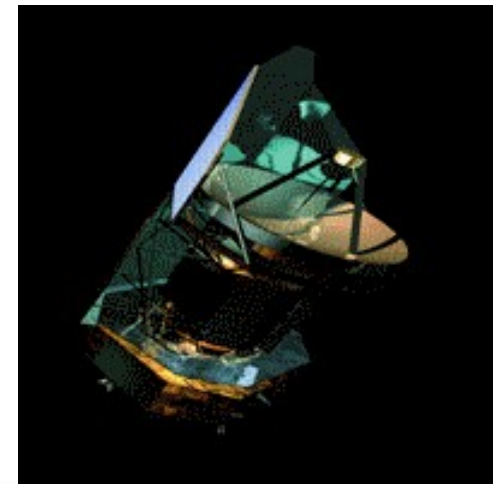
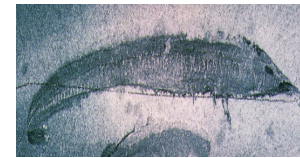
"PHASE SEPARATION"

- **Condensed Matter Physics: Materials Design**
- **3rd/4th physics most important problem of decade (AIP)**
- **Wien2k: electronic structure calculations of solids using density functional theory (DFT).**
- **Two levels parallelism:**
 - **Coarse grain: k points**
 - **Fine grain: ScaLapack**
- **24 nodes: 384 cores, 100G memory, 300G disk -> 68.000h**



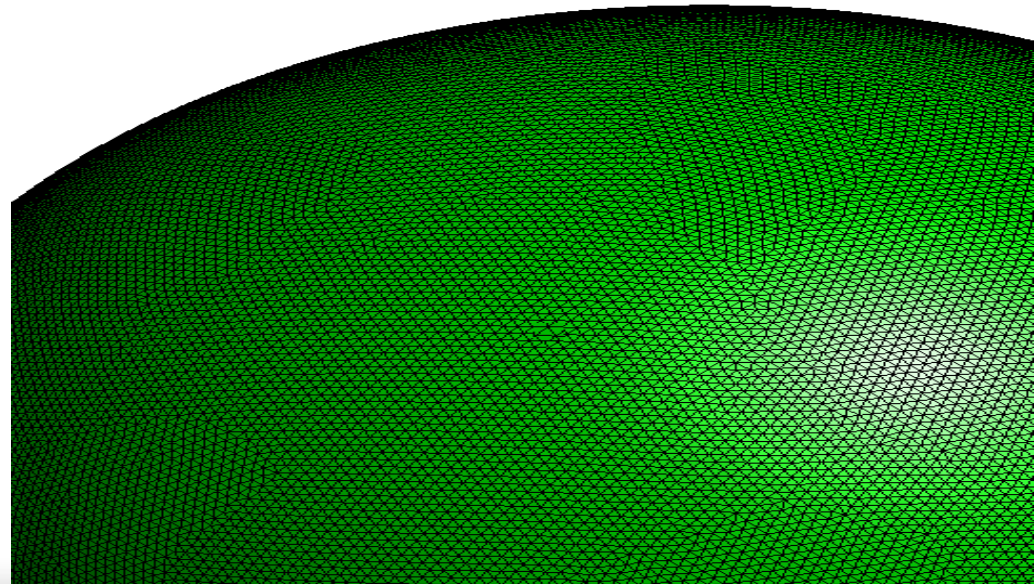
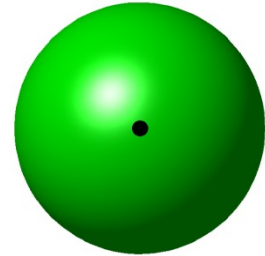
"GENETIC ALGORITHM FOR THE ASTROPHYSICS OF MASSIVE STARS"

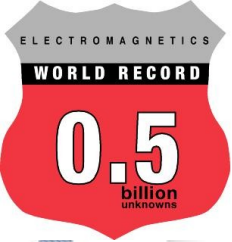
- **Molecular and Infrared Astrophysics**
- **Genetic Algorithms: PIKAIA multimodal optimization problems / FASTWIND**
- **MPI master slave schema:**
 - **master task took care of the GA-related operations**
 - **slave tasks to perform the model calculations**
- **20.000 – 40.000 models (15 min each)**
- **80 cores**



"FEKETE POINTS"

- **I-MATH: Applied Maths (Potential theory/Numerical methods)**
- **Forces Method -> Estimation of Fekete points**
- **7th Smale: Mathematical problems for 21st century**
- **Several parallelizations paradigms:**
 - **MPI**
 - **OpenMP**
 - **MPI/OpenMP**
 - **High Throughput**
- **1024 cores**
- **350.000 hours**
- **50 million executions**





"HEMCUVE"

- Electromagnetic problems in large structures
- HEmCUVE++: Electromagnetic calculations based on FAST MULTIPOLE methods
- MPI/OpenMP
- Highly demanding on memory per process: Balance between CPU time and memory
- 1024 cores, 6T of memory

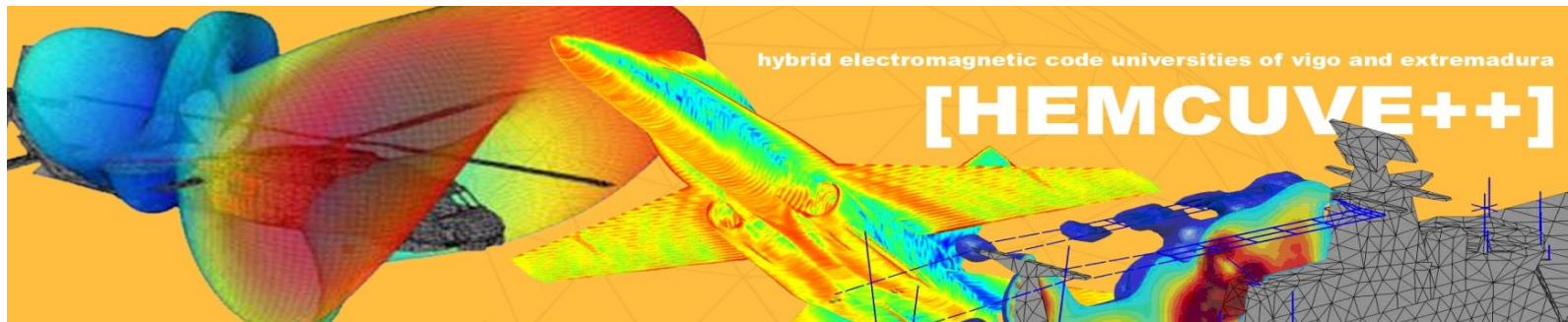


Award 2009

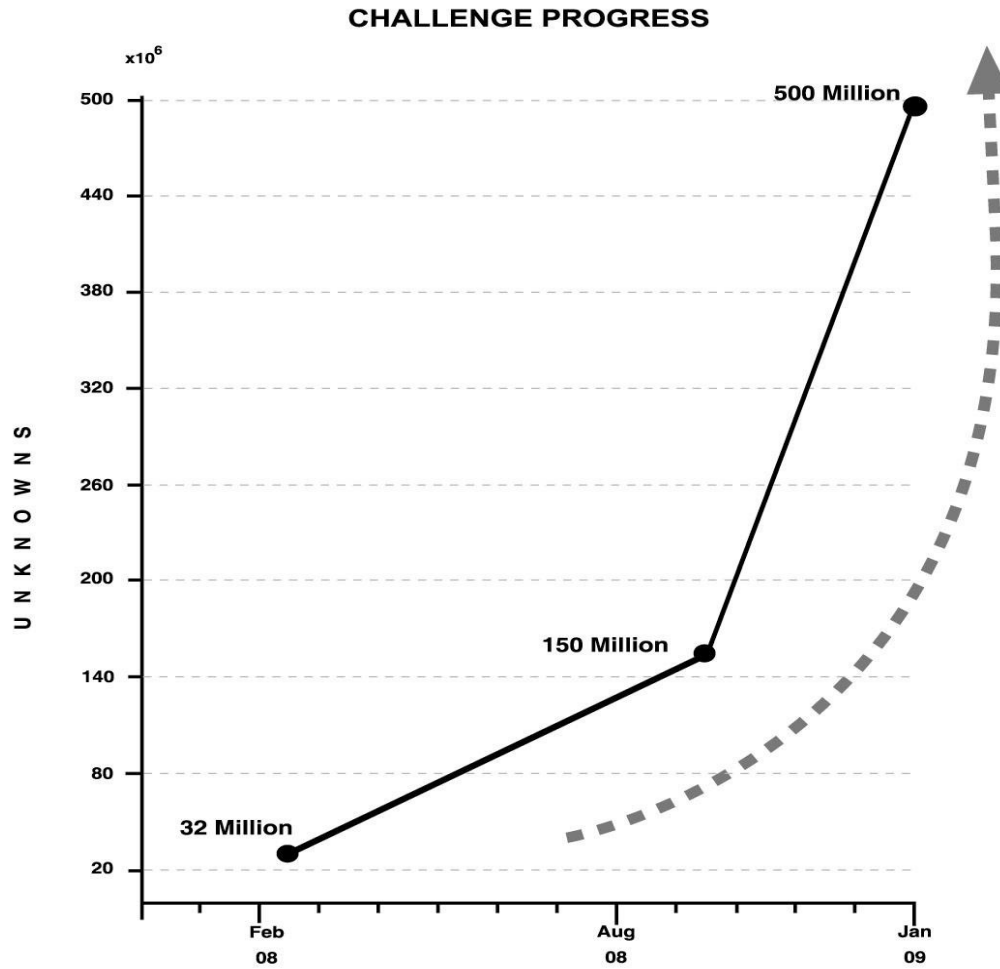
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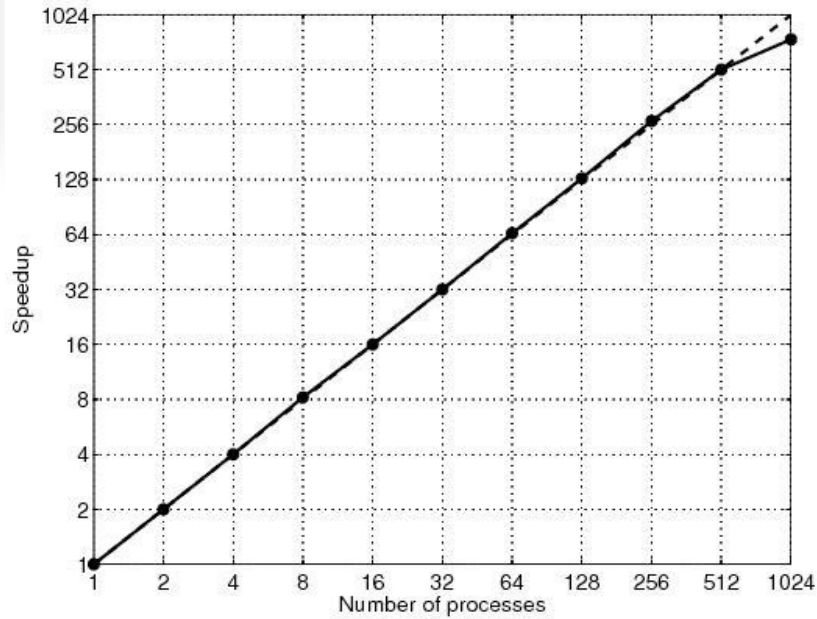
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CONFERENCE



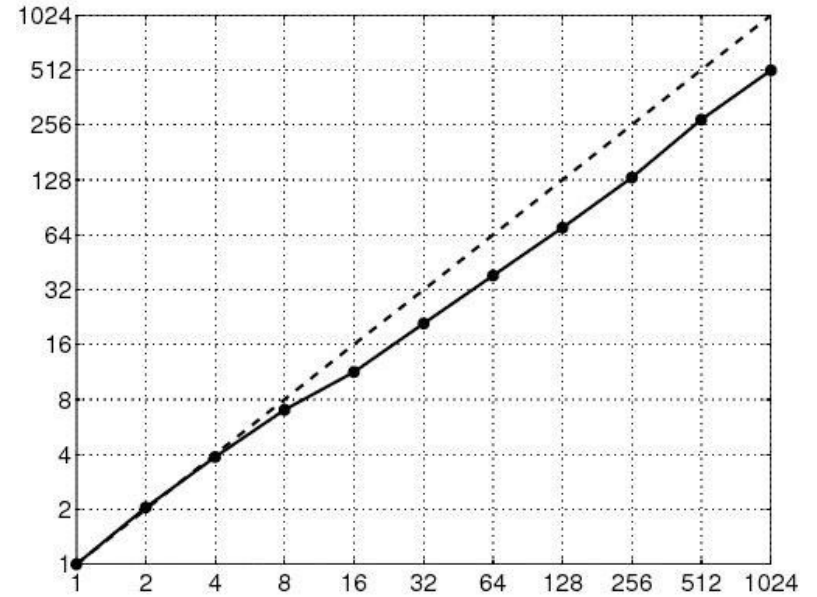
"HEMCUVE"



Scalability



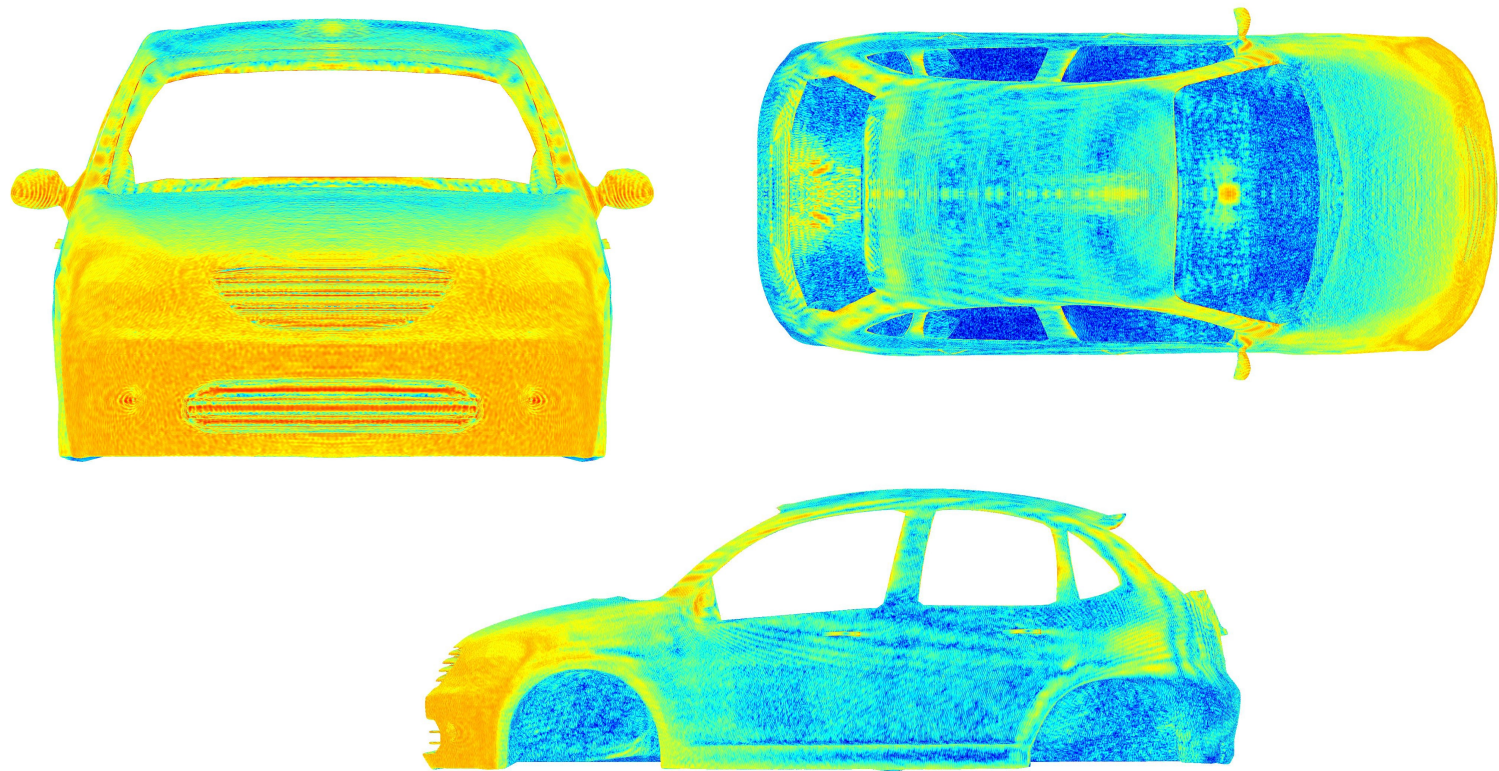
150M code



500M code

"HEMCUVE"

Citröen C3 at 24.125 GHz (radar frequency) 40M unknowns



In progress 79 GHz: 300M – 400M unknowns

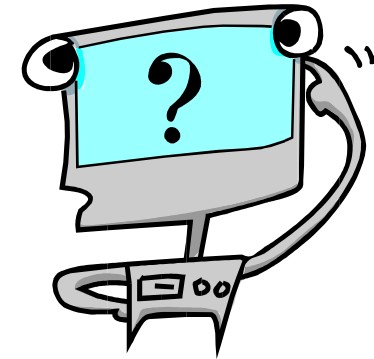
CONCLUSIONS

- **Other Challenges are running just now**
- **New Challenges open call**
- **Finis Terrae fits this kind of applications**
- **Decreasing time to solution on a wide spectrum problems**
- **More than 10 scientific papers**



THANK YOU!

QUESTIONS?



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