

e-FISCAL Summer Workshop

Opportunities

A Realistic Study of ~~Costs~~ Associated
to Datacenter Installation and
Operation *in a Research Institute*

can we do EVEN better?



Samos, 3rd July 2012

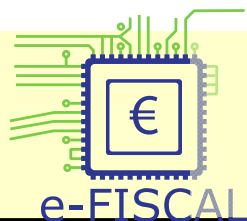


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thanks to: R.Marco, I.Cabrillo, P.Orviz, A.Lopez, L.Cabellos, M.A.Nuñez, I.Campos



Outlook

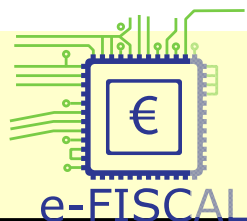
Where we do come from?

Where are we?

- ⊕ Computing in a Research Institute
- ⊕ Operating a Grid
- ⊕ HPC and Supercomputing
- ⊕ What about Cloud?

Where do we go?

- ⊕ **The real BUSINESS MODEL**



Where we do come from?

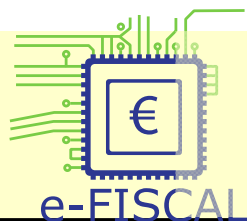
We have walked for long...

- ✦ >200.000 years Homo Sapiens
- ✦ >2.500 years *μάθημα*
- ✦ >500 years “modern” math/phys



We have also computed for long...but not so long...

✦ **Alan Turing Centennial!**



Computing in a Research Institute

Instituto de Física de Cantabria, Santander, SPAIN

Joint center CSIC (National Research Council)-University of Cantabria

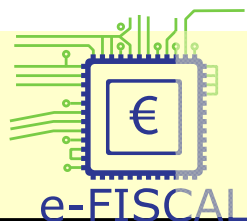
Around 100 researchers (25 senior staff + postdocs, contracts, fellows)

What are our research fields?

- ⊕ High Energy Physics (LEP, Tevatron, now mainly LHC)
- ⊕ Astrophysics (XMM, Planck, next EUCLID)
- ⊕ Statistical Physics and Meteorology

How do we compute?

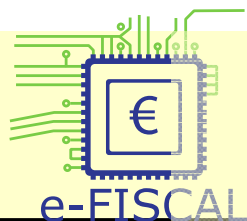
- ⊕ Individual workstations, small clusters
- ⊕ **Datacenter**
- ⊕ **Integrated in a e-Infrastructure**



Datacenter at IFCA

The “complete” experience

- ✦ Built from “scratch” in 2004 to host medium size clusters
 - Conditioning of around 120 m² in basement: floor, painting
 - Basic cooling (40KW), Basic UPS (15 KW)
 - Electrical boards (80 KW)
- ✦ Upgrade to host supercomputing node in 2006
 - Refrigeration Unit (+65kW), Second UPS (15 KW)
 - Technical floor , new electrical board (+ 80 KW)
 - Fire and alarm systems
- ✦ Upgrade to host large cluster (for Grid computing) in 2008
 - Second Refrigeration Unit (+65kW)
- ✦ Improvements to cooling “crisis”
 - Direct external air



GRID enabled clusters and storage

- ✦ CLUSTERS: ASTRO (6x48) + CMS (36x12) + GRID-CSIC (182x8) ~ 2200 cores
- ✦ STORAGE: CMS Tier-2 (1 Pb) + GRID-CSIC (300 Tb) + IFCA-CSIC (1 Pb) ~2,3 Pb
- ✦ NETWORK: 10Gb backbone+ with direct link to RedIris Nova (dark fiber)
- ✦ Cluster/Storage/Grid managers: Iban Cabrillo, Pablo Orviz, Alvaro López
- ✦ Funding: CSIC (50%), University (25%), HEP project Tier-2 CMS (25%)
- ✦ TIME SHARING: 25% local & institutional, 75% Ibergrid -EGI including LHC-CMS
- ✦ Important operational points:
 - ❖ Services virtualized (requiring around 10% extra servers, including login nodes)
 - ❖ Unified storage under GPFS
 - ❖ Single batch system using GridEngine, both for local cluster and Grid users

uCloud

Cluster
Tier-2 CMS

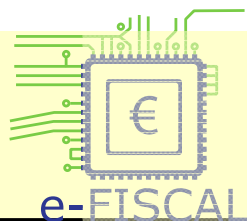
Storage
Tier-2 CMS

HPC/Grid
Storage

network
ifca.es

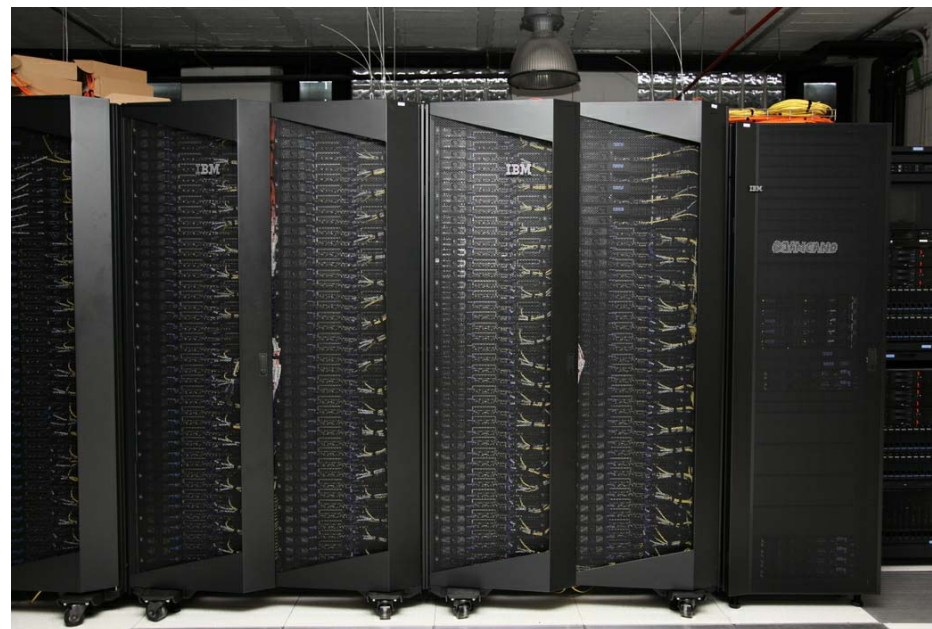
GRID-CSIC

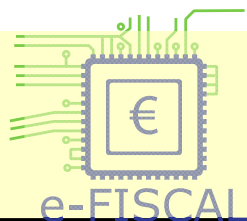




Supercomputing node at UC

- ✪ CLUSTER: INTEL SB (160x16) + POWER7 (11x16) + GPU (512x10) ~ 7800 cores
 - ✪ POWER >60 Teraflops (52 Tflop + 4 Tflop + 5 Tflop) (top500.org with IH)
 - ✪ NETWORK: Infiniband FDR10 (40Gbps) both for MPI and for GPFS
 - ✪ Cluster/Storage/SC managers: Luis Cabellos, Iban Cabrillo
 - ✪ Funding: University (100%) through national call for Campus of Excellence
 - ✪ TIME SHARING: 75% local & institutional, 25% Spanish Supercomputing Network (RES)
-
- ✪ REMARKS:
 - ❖ Unified Storage with GRID/Cluster
 - ❖ Flexibility to join GRID
 - ❖ NO HT nor Virtualization
 - ❖ **Supercomputing BIOS and Network**
 - ❖ Periodic call for proposals





Detailed Costs

✦ Datacenter conditioning (for 10 years)

✦ 120K€ + 100K€ + 80K€ ~ 300K€

✦ Datacenter energy (per year)

✦ 150K€ (150KW 24h 365 days)

✦ Clusters GRID (5-years life)

✦ 200K€+500K€+80K€+120K€ = 900K€

✦ Storage (7-10 years life)

✦ 320K€+ 250K€ + 150K€ = 720K€

✦ Supercomputer node(5-years life)

✦ 900K€ + 150K€ + 50K€ = 1100K€

✦ Network backbone(5-years life)

✦ 60 K€+30K€+ 120K€ = 210 K€

✦ GRID managers

✦ 130K€/year

✦ Storage manager

✦ 60K€/year

✦ Supercomputer manager

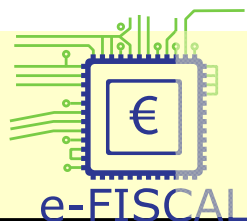
✦ 60K€ / year

✦ Datacenter support (2 people, part time)

✦ 100 K€

YEARLY COST: 600K€ + 350K€ = 950K€

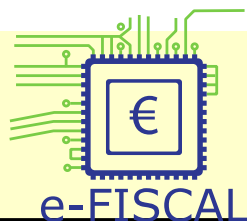
CORE COST PER HOUR @ 80% eff: **0,03 €**
(5000 cores, GPU not included, storage included)



What about Cloud

Not so “complete” experience...

- ✦ Account in AMAZON EC2 for experienced user
 - ❑ IaaS is not a solution for a final user
 - ❑ Learn what it offers, standards...
- ✦ Develop experience using OpenStack to setup own Cloud
 - ❑ Identify potential users
 - ❑ Dedicated hardware (“low cost”: supermicro blades)
 - ❑ LOTS of time for setup
 - ❑ Good replacement for workstations / small clusters ON DEMAND
 - Examples: Mathematica, ROOT, PROOF/PAF
- ✦ Challenge: integrate as e-Infrastructure
 - ❑ Ibercloud initiative
 - ❑ Collaboration with CNRS

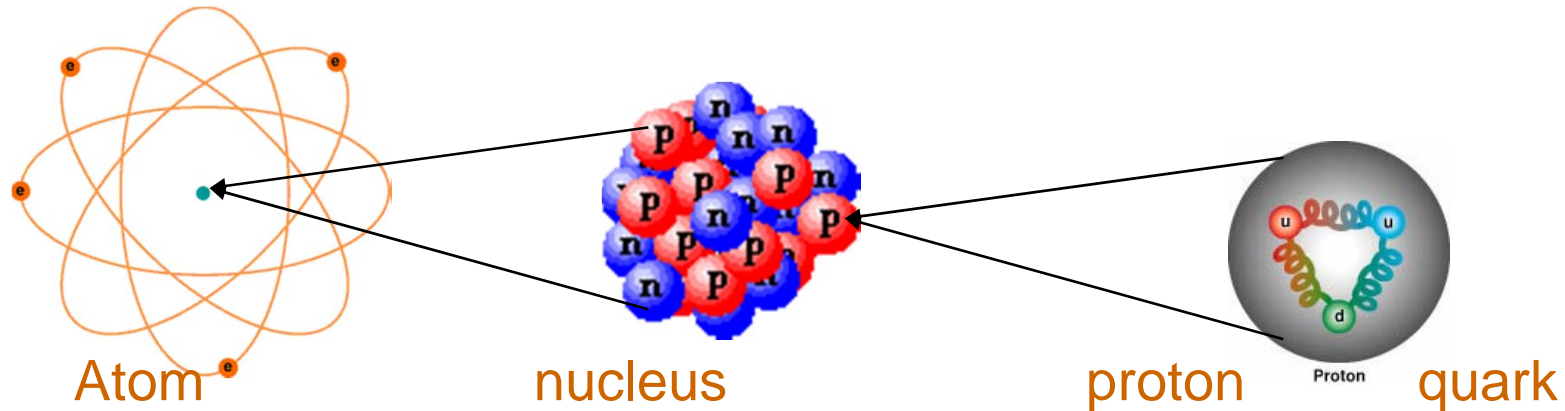


KEYS in our "business model"

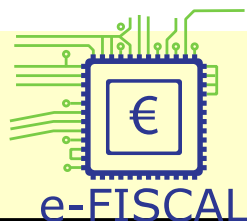
- ⊕ % use
- ⊕ % "effective" use
- ⊕ % use exploiting HPC/GRID
- ⊕ **IMPACT on RESEARCH**

Searches in Particle Physics

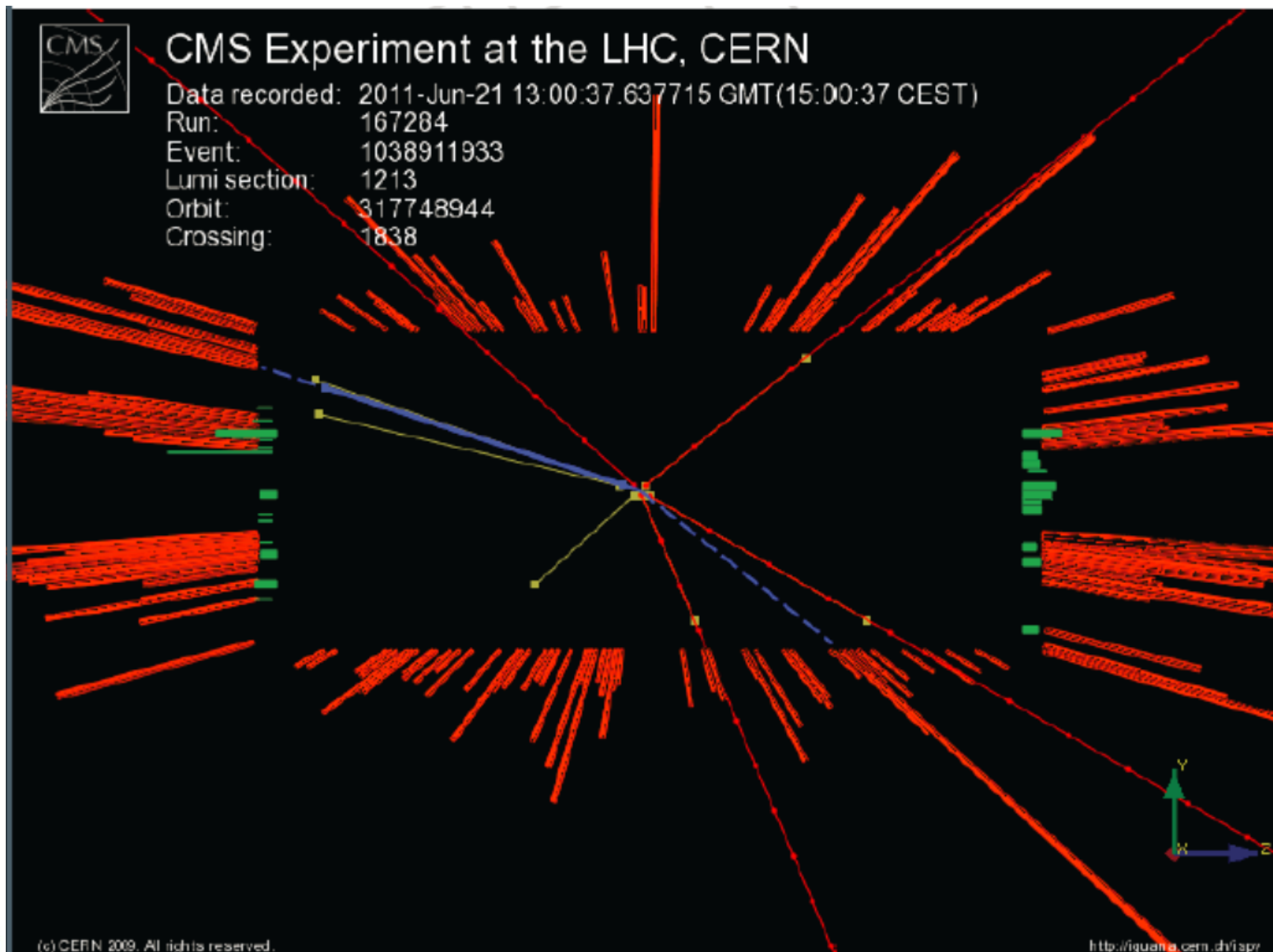
- Particle physics: studying the basic constituents of all matter around!



The origin of the “*mass*” of all particles is linked to a fundamental particle predicted but not yet discovered: **the Higgs boson**

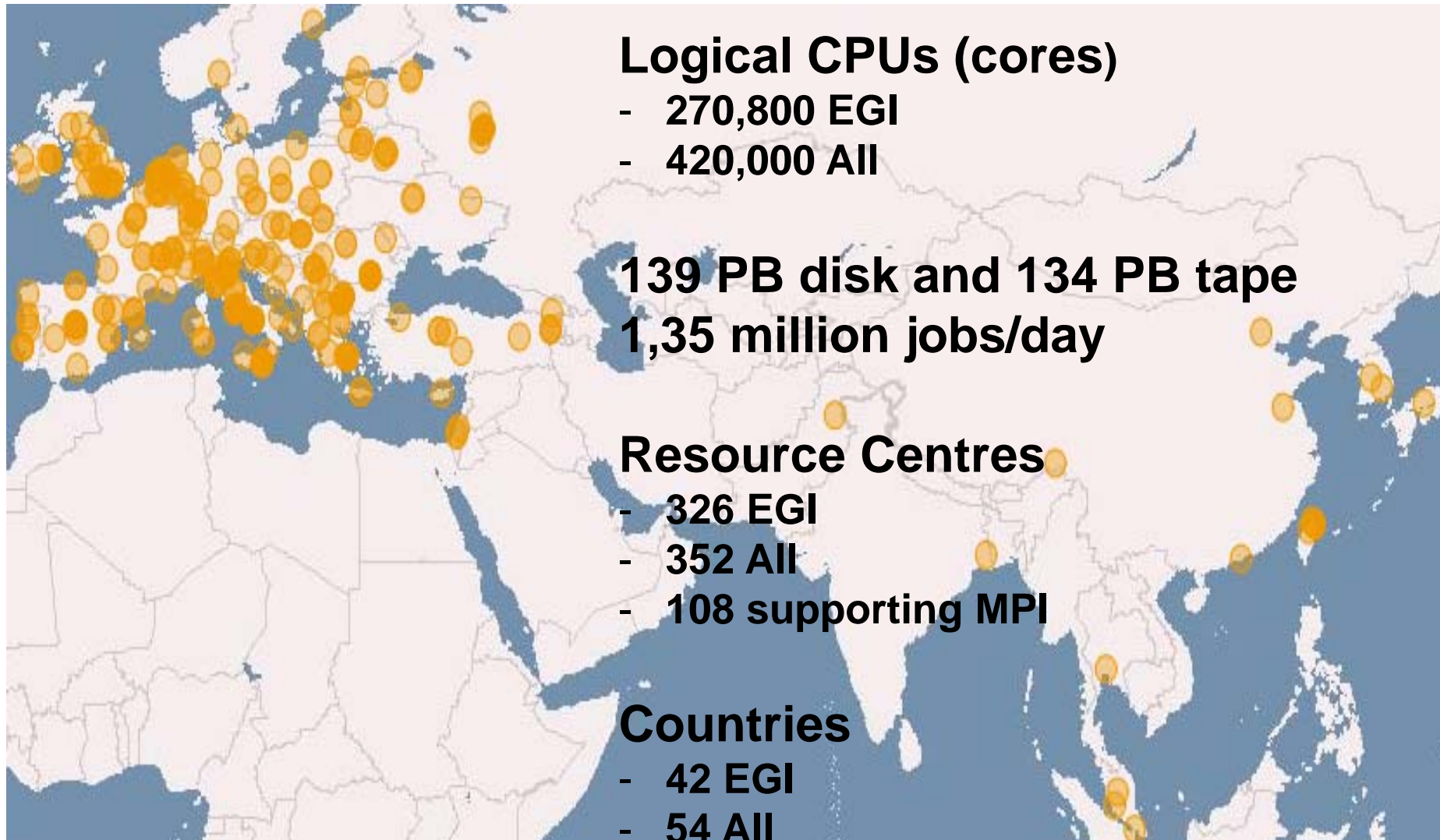


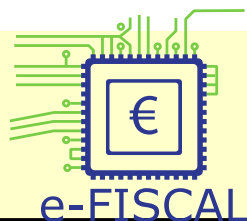
Higgs into 4 leptons



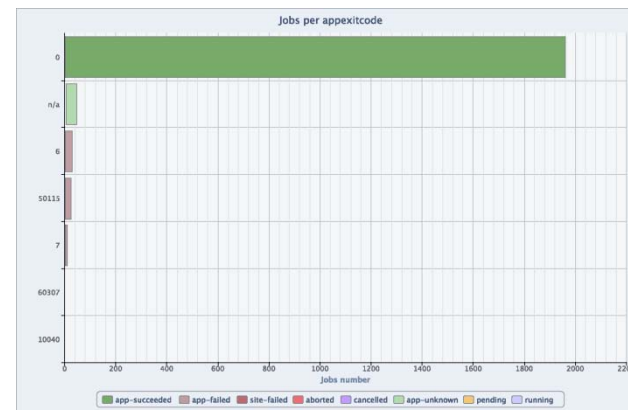
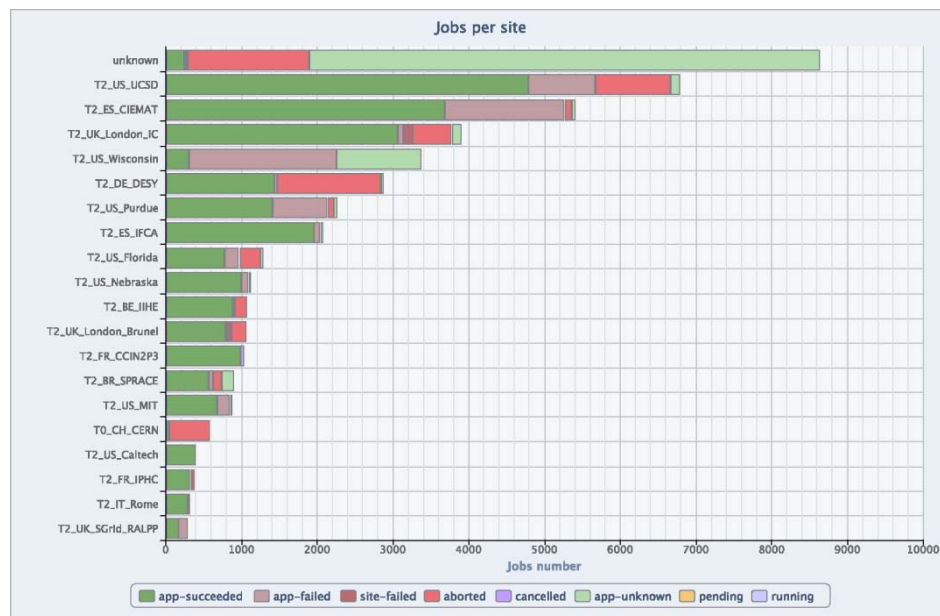
European Grid Infrastructure

(June 2012)





Processing CMS data looking for Higgs boson events!

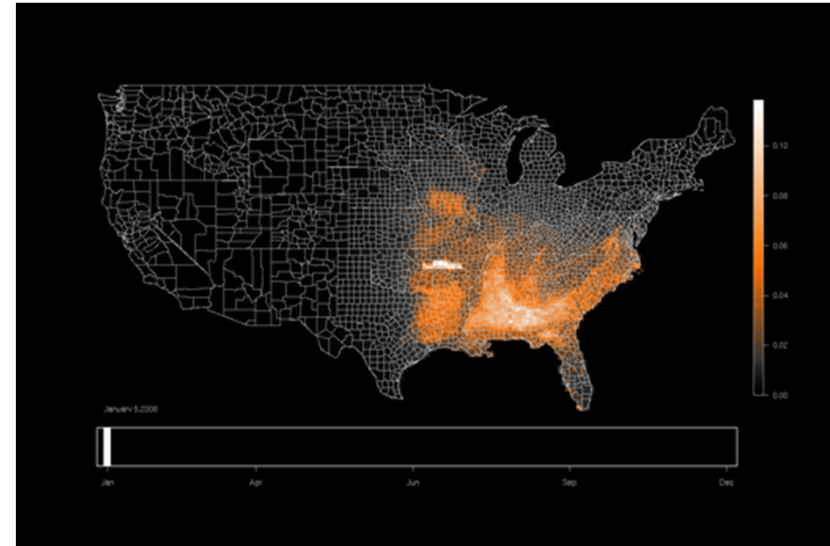
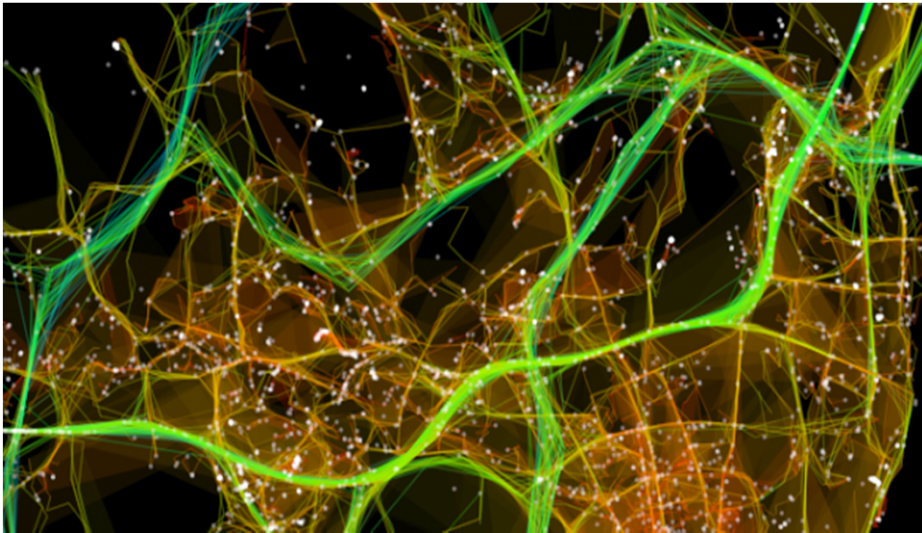


@IFCA: thousands of jobs last weeks (skimming+analysis)>99 % eff.
Executing on 60TB input, italian + spanish team

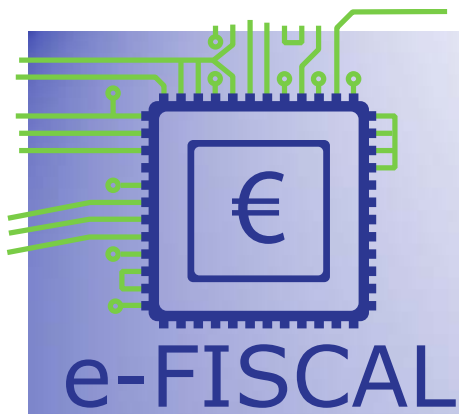
Key support to groups in the Higgs into WW channel

2012: DOUBLE luminosity: DOUBLE pressure on our systems!!!

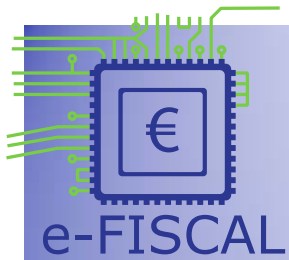
What next?



✚ Global objective:
pattern matching in a context

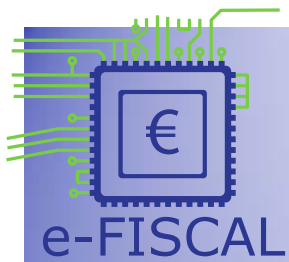


e-Infrastructure for research and science: owned, leased or hybrid approaches



Provocative Statements

- SETUP A GOOD TEAM TO SUPPORT YOUR e-INFRASTRUCTURE FOR **RESEARCH**
- **GET INVOLVED IN/ ORGANIZE KEY PROJECTS**
- FORGET EXTERNAL PRIVATE CLOUDS



Low Hanging Fruits

- MAKE IT SIMPLE (but I almost give up!)
- **MARKETING / TRAINING**
 - Did we include these “costs” in the analysis?
 - Oriented to the FINAL USERS: **RESEARCHERS!**