F. Grey*, Tsinghua University, Beijing, China
P. Buncic, A. Harutyunyan, N. Høimyr, P. L. Jones, A. Karneyeu, B. Segal*, P.Skands, **Miguel Angel Marquina, CERN, Switzerland**
D. Lombraña González*, Citizen Cyberscience Centre, Switzerland
B. Chopard, N. Maisonneuve*, C. Pellegrini*, University of Geneva, Switzerland
L. Bromley, UNOSAT, UN Institute of Training and Research, Switzerland
* working on projects actively financed by the Citizen Cyberscience Centre sponsors

The rise of citizen cyberscience and its impact on professional research

Abstract: *Thanks to internet-based participatory science projects, the distinctions between amateur and professional scientists are beginning to blur. In this article, we review some of the ways that volunteers and professional scientists collaborate, and chart out how this trend may evolve in the future. We focus on projects that the Citizen Cyberscience Centre (CCC) — a partnership between CERN, the UN Institute for Training and Research (UNITAR), and the University of Geneva — are actively involved in, including geotagging Web-based images of crisis-stricken regions, or simulating particle collisions in CERN's Large Hadron Collider.*
Keywords: *Internet, scientific researches, citizen cyberscience, volunteers, social web services*

Introduction

The world of journalism has been turned upside-down in recent years by social media technologies that allow a wider range of people to take part in gathering, filtering and distributing news. Although some professional journalists resisted this trend at first, most now appreciate the likes of Facebook, Twitter and blogs in expanding the sources of news and opinion and accelerating dissemination: the audience has become part of the show.

Could the internet one day wreak the same sort of social change on the world of science, breaking down the distinction between amateur and professional? In the field of high-energy physics, that might seem unlikely. What amateur can really contribute something substantial to, say the analysis of LHC data? Yet in many fields of science, the scope for such contributions is growing fast.

Crowdsourcing research

Modern astronomy, for instance, has a long tradition of inspired amateur contributions, such as spotting comets or supernovae. Now, the internet has broadened the range of tasks that amateurs can tackle. For example, the project GalaxyZoo[1], led by researchers at the University of Oxford, invites volunteers to participate in web-based classification of galaxy images. Such pattern recognition is a task where the human mind still tends to outperform computer algorithms.

[1] *Galaxy Zoo* [on-line]. [Cited 20.02.2012]. Available from Internet: http://www.galaxyzoo.org.

Not only can astronomers attract hundreds of thousands of free and eager assistants this way, but occasionally those helpers can themselves make interesting discoveries. This was the case for a Dutch school teacher, Hanny van Arkel, who spotted a strange object in one of the GalaxyZoo images that had stumped even the professional astronomers. It now bears the name "Hanny's Voorwerp", the second word meaning "object" in Dutch.

GalaxyZoo is just one of many volunteer-based projects making waves in astronomy. Projects such as Stardust@home, Planet Hunters, Solar Watch and MilkyWay@home all contribute to cutting-edge research.

Einstein@home[2] uses volunteer computing power to search for — among other things — pulsar signals in radio-astronomy data. Run by researchers at the Max-Planck Institute for Gravitational Research, the project published its first findings in "Science" in 2010[3,4], acknowledging the names of the volunteers whose computers had made each discovery.

However, it is in fields outside those traditionally accessible to amateurs where some of the most impressive results of citizen-powered science are beginning to be felt. Consider the project Foldit[5], shaped as a computer game where players compete to fold protein molecules into their lowest energy configuration. Humans routinely outperform computers at this task, because the human mind is uniquely apt at such spatial puzzles; and teenagers typically out-compete trained biochemists. What the scientists behind the project, based at the University of Washington, have also discovered is that the players were spontaneously collaborating to explore new folding strategies — a possibility the researchers had not anticipated. In other words, the amateur protein folders were initiating their own research programme.

In the world of infinitely small

Could high-energy physics also benefit from this type of approach? Peter Skands, a theorist at CERN, thinks so. He has been working with colleagues on a Monte Carlo QCD event generation project, MCPLOTS[6], about fitting models to LHC data, where delicate tuning of the model parameters by eye can help the physicists achieve the best overall fit. Experience with a high-school intern convinced Skands

[2] *Einstein@Home* [on-line]. [Cited 20.02.2012]. Available from Internet: http://einstein.phys.uwm.edu/.
[3] REED, S. Astronomical find by three average joes. *ScienceNOW* [on-line]. August 12, 2010 [Cited 20.02.2012]. Available from Internet: http://news.sciencemag.org/sciencenow/2010/08/astronomical-find-by-three-avera.html.
[4] KNISPEL, B. Pulsar discovery by global volunteer computing. *Science* [on-line]. 2010, Vol. 329, no. 5997, p. 1305 [Cited 20.02.2012]. Available from Internet: http://www.sciencemag.org/content/329/5997/1305.
[5] *Foldit: solve puzzles for science* [on-line]. [Cited 20.02.2012]. Available from Internet: http://fold.it/portal.
[6] *MCPLOTS.cern.ch* [on-line]. [Cited 20.02.2012]. Available from Internet: http://mcplots.cern.ch/.

that even people not versed in the gory details of LHC physics could solve this highly visual problem efficiently.

Volunteers can already contribute their processor time to it by simulating collisions in the LHC for the recently launched LHC@home project Test4Theory[7], where more than 4400 volunteers have already generated almost 200 billion events.

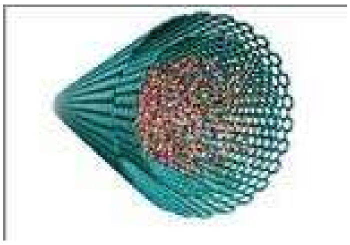

Figure 1. Simulations

Such volunteer computing projects are not as passive as they might appear. Message boards and a credit system for the amount of processing completed — features provided by an open-source platform called BOINC[8] — add elements of social networking and gaming to them.

The community in this type of project plays a key role. The message boards are the meeting points, where volunteers, researchers and developers share their knowledge, opinions, questions, answers, etc.

From all the posted and interchanged messages, the following parts of Test4Theory have been improved thanks to the collaboration of the volunteers:

- Finding and solving errors. The community surveys most of the experiments that are run in their machines. This surveillance mode has helped the researchers to fix bugs in the experiments[9,10], the distribution software[11,12], code styling[13,14], etc.

---

[7] *LHC@home* [on-line]. [Cited 20.02.2012]. Available from Internet: http://cern.ch/LHCathome.
[8] *BOINC: open-source software for volunteer computing and grid computing* [on-line]. [Cited 20.02.2012]. Available from Internet: http://boinc.berkeley.edu/.
[9] Feedback about an error in the experiments. Fail to compile pythia8. In: *Test4Theory a virtual atom smasher!* [on-line]. August 22, 2011 [Cited 20.02.2012]. Available from Internet: http://goo.gl/LIlpYhttp://goo.gl/LIlpY.
[10] Feedback about an error in the experiments. GSL error. In: *Test4Theory a virtual atom smasher!* [on-line]. December 1, 2011 [Cited 20.02.2012]. Available from Internet: http://goo.gl/nCy2z.
[11] Viewing the simulation output of your virtual machine. In: *Test4Theory a virtual atom smasher!* [on-line]. January 13, 2012 [Cited 20.02.2012]. Available from Internet: http://goo.gl/fsXk5.
[12] Reports about CPU performance. In: *Test4Theory a virtual atom smasher!* [on-line]. January 13, 2012 [Cited 13.01.2012]. Available from Internet: http://goo.gl/BmmEz.
[13] Fix buggy if-else. In: *CernVMwrapper GitHub Repository* [on-line]. 2012 [Cited 20.02.2012]. Available from Internet: http://git.io/_WFt9Q.

- Requesting new features. The project is evolving thanks to new ideas from discussions with the volunteers. In general, when they have the chance to actively participate, they may propose interesting ideas (i.e. an acknowledgement scheme alternative to the official credit of BOINC[15]).
- Improving user experience. When new features have been deployed, some users have reported their bad user experience but also how this situation could be improved. This feedback has been very important to the project, giving volunteers more control about how they participate. For instance, they requested a user preference to throttle the CPU performance via a web preference[16] and the developers accepted implementing it[17].
- Documentation. Even though the project has seeded most of the documentation, the volunteers have created specific threads in the forum that are very valuable for new users, becoming "sticky" or promoted to the top of every section. Additionally, a FAQ section has been built[18,19] based on the questions and answers provided at the message boards.
- Managing the forums. Some volunteers are invited to become moderators of the forums due to their expertise and help already provided at the message boards. They become more and more valuable as they grow their expertise, by answering most of the standard questions in the forums while channelling the more complex ones to the right developers and researchers.

In summary, the community powers the project not only by donating CPU cycles of their computers, but also by actively taking part in its evolution (documentation, experiments, suggestions, etc.).

LHC@home and the volunteer cloud

Test4Theory is the first of a class of projects which relies on CernVM[20], a virtual machine technology developed at CERN that enables complex simulation code to run

---

[14] Fixed style issues via cppcheck thanks to Julien. In: *CernVMwrapper GitHub Repository* [on-line]. 2012 [Cited 20.02.2012]. Available from Internet: http://git.io/rjiEFw.

[15] Cheating: general discussion. In: *Test4Theory a virtual atom smasher!* [on-line]. January 5, 2012 [Cited 20.02.2012]. Available from Internet: http://goo.gl/VfVx0.

[16] Help testing VirtualBox 4.1. In: *Test4Theory a virtual atom smasher!* [on-line]. August 8, 2011. [Cited 20.02.2012]. Available from Internet: http://goo.gl/W2rfA.

[17] VM CPU throttling enabled. In: *CernVMwrapper GitHub Repository* [on-line]. 2012 [Cited 20.02.2012]. Available from Internet: http://git.io/OuX-UQ.

[18] Frequently Asked Questions. In: *LHC@Home 2.0* [on-line]. 2011 [Cited 20.02.2012]. Available from Internet: http://lhcathome2.cern.ch/faq.

[19] Over Daily Quota. In: *Test4Theory a virtual atom smasher!* [on-line]. July 20, 2011. [Cited 20.02.2012]. Available from Internet: http://goo.gl/BMMMA.

[20] BUNCIC, P. et al. CernVM: minimal maintenance approach to the virtualization. *Journal of Physics: Conference Series* [on-line]. 2011, no. 331, p.1–7 [Cited 20.02.2012]. Available from Internet: http://iopscience.iop.org/1742-6596/331/5/052004/pdf/1742-6596_331_5_052004.pdf. (International Conference on Computing in High Energy and Nuclear Physics, CHEP 2010).

easily on the diverse platforms provided by volunteers. Running fully fledged physics simulations for the LHC on home computers — a prospect that seemed technically impossible when the first LHC@home project was introduced in 2004 to simulate proton-beam stability in the LHC ring — now has the potential to expand significantly the computing resources for the LHC experiments. Projects like this typically draw tens of thousands of volunteers and their computers, a significant fraction of the estimated 250 000 processor cores currently supporting the four LHC experiments.

However, this existing power is currently being delivered primarily via the Grid, a complex and expensive infrastructure difficult to combine with volunteer computers. A recent change this model has seen is the emergence of computing clouds. These leverage the installed capacity of very large computing centers by offering attractive rented chunks of processor power and storage to consumers over the Internet. Using CernVM's facilities, the LHC experiments have been able to connect to such clouds, e.g. the Amazon EC2. Our present approach connects volunteer computers using this new paradigm.

In effect we have been able to set up a BOINC system where the volunteer PCs simply appear as an additional cloud resource for the LHC experiments, in exactly the same way as EC2 and other clouds have been interfaced to them. All the code to support this is included in the CernVM images that we use. No major changes are needed to BOINC client or server code, or to any LHC experiment code or procedures as long as they use CernVM. This resulting "Volunteer Cloud" for LHC computing is now in production, initially for MCPLOTS.
Soon the LHC experiment collaborations will be able to run simulation, event generation, and perhaps some reconstruction, with an emphasis on CPU intensive rather than data intensive problems.

It is clear that other scientific communities could benefit from the same approach we have used in the LHC context. Many of them may have less demanding requirements than the LHC physicists, so they will perhaps not need all the power of the CernVM approach but still be able to enjoy access to volunteer cloud computing.

Looking beyond raw computing power, we may ask whether there is a role for volunteers in actual data analysis, similar to the highly sophisticated involvement of volunteers in the Folding@home project[21].

In April 2010, Skands' CERN team conducted proof-of-principle tests in which a 14-year old middle-school intern was given a brand new state-of-the-art high-energy simulation package (called VINCIA[22]) and instructed to tune it to a set of 10 different

---

[21] Our goal: to understand protein folding, misfolding, and related diseases. In: *Folding@home* [on-line]. 2000-2010 [Cited 20.02.2012]. Available from Internet: http://folding.stanford.edu/.
[22] GIELE. W.T. et al. *Vincia* [on-line]. [Cited 20.02.2012]. Available from Internet: http://projects.hepforge.org/vincia/.

sets of experimental data from older experiments at the Large Electron Positron collider (LEP). The student was given control of about 10 different simulation parameters, which he could adjust by editing simple text files. The simulation itself used a runtime display, which provided a live simulation-to-data comparison on the 10 distributions.

During the process, the intern asked many questions about what each distribution really measured (like the 'shapes' of the events, the energy spectra of individual species of particles, etc.) and, correspondingly, what each parameter in the simulation really controlled (like the strength of the strong nuclear force, or the probability for a particle to fragment). At the end of just one week of training and tuning, the parameter set he settled on was so good that it was used as the default parameter set in the next public release of VINCIA.

The lessons from this proof-of-concept study were, firstly, that it is possible for a person without expert training to take over certain tasks from the simulation developers, making a genuine contribution to science, provided that the problem can be phrased in a suitably visual and interactive way. Secondly, since the simulations attempt to describe real measurements, each parameter controlling a specific physical aspect, there is a huge potential for learning about very exciting high-level fundamental physics, provided pedagogical explanations and visualizations are provided.

A humanitarian angle

LHC@home is an example of a project that has benefited from the support of the Citizen Cyberscience Centre (CCC), which was set up in 2009 in partnership between CERN, the UN Institute of Training and Research and the University of Geneva. A major objective of the CCC is to promote volunteer computing and volunteer thinking for researchers in developing regions, because this approach effectively provides huge resources to scientists at next to no cost. Such resources can also be used to tackle pressing humanitarian and development challenges.

One example is the project Computing for Clean Water (C4CW) [23,24], led by researchers at Tsinghua University in Beijing. The project was initiated by the CCC with the sponsorship of a philanthropic programme run by IBM, called World Community Grid[25]. The goal is to simulate how water flows through carbon nanotubes and explore the use of arrays of them for low-cost water filtration and

[23] The computing for clean water project (C4CW). In: *Projects: Flow and Healthy* [on-line]. Beijing: CNMM, 2010 [Cited 20.02.2012]. Available from Internet: http://cnmm.tsinghua.edu.cn/contents/51/263.html.
[24] Computing for clean water. In: *World Community Grid: technology solving problems* [on-line]. [Cited 20.02.2012]. Available from Internet: http://www.worldcommunitygrid.org/research/c4cw/overview.do.
[25] *World Community Grid: technology solving problems* [on-line]. [Cited 20.02.2012]. Available from Internet: http://www.worldcommunitygrid.org/.

desalination. The simulations would require thousands of years on a typical university computing cluster but can be done in just months using volunteer-computing resources aggregated through World Community Grid.

The specific challenge that C4CW tackles is to extend existing simulations, which are only accurate for very high flow rates — much higher than ever achieved in real filtration systems — to a range of flow velocity that is comparable with experiment. This requires averaging over much larger sets of simulations, in order to get statistically accurate results at slow flow rates. With this project, it has been possible to explore flow rates down to below 0.5 m/s, whereas previous simulations only provided accurate results above 10 m/s.

Another example is volunteer mapping for UNOSAT, the operational satellite-applications programme for UNITAR, based at CERN[26]. Although a range of crowd-based mapping techniques are available these days, the use of satellite images to assess accurately the extent of damage in regions devastated by war or natural disasters is not trivial, even for experts. However, rapid and accurate assessment is vital for humanitarian purposes in estimating reconstruction costs and rapid mobilization of the international community and NGOs.

Figure 2. Humanitarian response

With the help of researchers at the University of Geneva and HP Labs in Palo Alto, UNOSAT is testing new approaches in crowdsourcing damage assessment by volunteers. These involve using statistical approaches to improve accuracy, as well as models inspired by economics where volunteers can vote on the quality of others' results.

The platform for this research is called Cybermappr[27] and in an initial phase focuses on geotagging web-based images of damage from the Libya conflict. It has been designed to be task-centric with a notion of task completeness.

Such task-based service enables any new volunteer to quickly be guided and know how to contribute to support this initiative. It is currently based on four main photo

[26] PISANO, F. Working for the world: UNOSAT and CERN. *CERN Courier* [on-line]. September 30, 2009 [Cited 20.02.2012]. Available from Internet: http://cerncourier.com/cws/article/cern/40423.
[27] Geotag Libya. In: *Citizen Cyberscience Centre* [on-line]. [Cited 20.02.2012]. Available from Internet: http://cybermappr.unige.ch/.

management tasks integrated into a work flow:

1. Gathering: submitting web page (URLs) publishing photos about the damage caused by the war.
2. Filtering: deciding and voting whether the submitted photos are relevant for damage assessment.
3. Linking: connecting photos sharing visual landmarks to support accurate geotagging.
4. Geotagging: marking the area where a relevant photo was taken on a map, or reviewing previous geotagging.

Social web services provide generally mechanisms enabling people to vote and comment on user-generated information. But unlike those services, the purpose of the voting system in Cybermappr is not to rank information but to collectively improve its reliability. Voting is thus used for information that has not been verified, for example in filtering to review submitted photos, linking to review recommended links between photos and geotagging to review recommended areas.

While geotagging damage in Libya is a starting point for the Cybermappr platform, the intention is to develop it for other applications, such as gathering and accurately geotagging web-based imagery related to natural disasters or human-rights abuses.

Reaching out to othercommunities

There are hundreds of citizen-cyberscience projects engaging millions of volunteers but the vast majority supports researchers in industrialized countries. A large part of the CCC activities involve raising awareness in developing regions. With the support of the Shuttleworth Foundation in South Africa, the CCC has been organizing a series of "hackfests": two-day events where scientists, software developers and citizen enthusiasts meet to build prototypes of new citizen-based projects, which the scientists can then go on to refine. Hackfests have already taken place in Beijing, Taipei, Rio de Janeiro and Berlin, with more planned this year in South Africa and India.

The topics covered to date include: using mobile-phone Bluetooth signals as a proxy for bacteria, tracking how air-borne bacterial diseases such as tuberculosis spread in buildings, monitoring earthquakes using the motion sensors built in to laptop computers and digitizing tables of economics data from government archives. Because the "end-users" — the citizen volunteers themselves — participate in the events, there is a healthy focus on making projects as accessible and attractive as possible, so that even more volunteers sign up and stay active.

Conclusions

When asked what sort of rewards the most engaged volunteers might appreciate for their on-line efforts, one striking response — echoed on several occasions — is the opportunity to make a suggestion to the scientists for the course of their future research. In other words, there is a desire on behalf of volunteers to be involved more actively in the process that defines what science gets done. The volunteers who propose this are quite humble in their expectations — they understand that not every idea they have will be useful or feasible. Whether scientists will reject this sort of offer of advice as unwanted interference, or embrace the potentially much larger brainpower that informed amateurs could provide, remains to be seen. But the sentiment is clear: in science, as in journalism, the audience wants to be part of the show.

Acknowledgements

Besides the founding CCC partners (CERN, University of Geneva and UNOSAT), the work described in this article was sponsored by the Shuttleworth Foundation, the IBM World Community Grid, the HP Innovation Research Programme award and the LHC Physics Centre at CERN (LPCC).

References:

1. *BOINC: open-source software for volunteer computing and grid computing* [on-line]. [Cited 20.02.2012]. Available from Internet: http://boinc.berkeley.edu/.
2. BUNCIC, P. et al. CernVM: minimal maintenance approach to the virtualization. *Journal of Physics: Conference Series* [on-line]. 2011, no. 331, p.1–7 [Cited 20.02.2012]. Available from Internet: http://iopscience.iop.org/1742-6596/331/5/052004/pdf/1742-6596_331_5_052004.pdf. (International Conference on Computing in High Energy and Nuclear Physics, CHEP 2010). ISSN 1742-6596.
3. Cheating: general discussion. In: *Test4Theory a virtual atom smasher!* [on-line]. January 5, 2012 [Cited 20.02.2012]. Available from Internet: http://goo.gl/VfVx0.
4. Computing for clean water. In: *World Community Grid: technology solving problems* [on-line]. [Cited 20.02.2012]. Available from Internet: http://www.worldcommunitygrid.org/research/c4cw/overview.do.
5. *Einstein@Home* [on-line]. [Cited 20.02.2012]. Available from Internet: http://einstein.phys.uwm.edu/.
6. Feedback about an error in the experiments. Fail to compile pythia8. In: *Test4Theory a virtual atom smasher!* [on-line]. August 22, 2011 [Cited 20.02.2012]. Available from Internet: http://goo.gl/LIlpYhttp://goo.gl/LIlpY.
7. Feedback about an error in the experiments. GSL error. In: *Test4Theory a virtual atom smasher!* [on-line]. December 1, 2011 [Cited 20.02.2012]. Available from Internet: http://goo.gl/nCy2z.
8. Fix buggy if-else. In: *CernVMwrapper GitHub Repository* [on-line]. 2012 [Cited 20.02.2012]. Available from Internet: http://git.io/_WFt9Q.
9. Fixed style issues via cppcheck thanks to Julien. In: *CernVMwrapper GitHub Repository* [on-line]. 2012 [Cited 20.02.2012]. Available from Internet: http://git.io/rjiEFw.
10. *Foldit: solve puzzles for science* [on-line]. [Cited 20.02.2012]. Available from Internet: http://fold.it/portal.
11. Frequently Asked Questions. In: *LHC@Home 2.0* [on-line]. 2011 [Cited 20.02.2012]. Available from Internet: http://lhcathome2.cern.ch/faq.
12. *Galaxy Zoo* [on-line]. [Cited 20.02.2012]. Available from Internet: http://www.galaxyzoo.org.
13. Geotag Libya. In: *Citizen Cyberscience Centre* [on-line]. [Cited 20.02.2012]. Available from Internet: http://cybermappr.unige.ch/.

14. GIELE. W.T. et al. *Vincia* [on-line]. [Cited 20.02.2012]. Available from Internet: http://projects.hepforge.org/vincia/.
15. Help testing VirtualBox 4.1. In: *Test4Theory a virtual atom smasher!* [on-line]. August 8, 2011. [Cited 20.02.2012]. Available from Internet: http://goo.gl/W2rfA.
16. KNISPEL, B. Pulsar discovery by global volunteer computing. *Science* [on-line]. 2010, Vol. 329, no. 5997, p. 1305 [Cited 20.02.2012]. Available from Internet: http://www.sciencemag.org/content/329/5997/1305. ISSN 1095-9203.
17. *LHC@home* [on-line]. [Cited 20.02.2012]. Available from Internet: http://cern.ch/LHCathome.
18. *MCPLOTS.cern.ch* [on-line]. [Cited 20.02.2012]. Available from Internet: http://mcplots.cern.ch/.
19. Our goal: to understand protein folding, misfolding, and related diseases In: *Folding@home* [on-line]. 2000-2010 [Cited 20.02.2012]. Available from Internet: http://folding.stanford.edu/.
20. Over Daily Quota. In: *Test4Theory a virtual atom smasher!* [on-line]. July 20, 2011. [Cited 20.02.2012]. Available from Internet: http://goo.gl/BMMMA.
21. PISANO, F. Working for the world: UNOSAT and CERN. *CERN Courier* [on-line]. September 30, 2009 [Cited 20.02.2012]. Available from Internet: http://cerncourier.com/cws/article/cern/40423. ISSN 2077-9550.
22. REED, S. Astronomical find by three average joes. *ScienceNOW* [on-line]. August 12, 2010 [Cited 20.02.2012]. Available from Internet: http://news.sciencemag.org/sciencenow/2010/08/astronomical-find-by-three-avera.html. ISSN 1947-8062.
23. Reports about CPU performance. In: *Test4Theory a virtual atom smasher!* [on-line]. January 13, 2012 [Cited 13.01.2012]. Available from Internet: http://goo.gl/BmmEz.
24. The computing for clean water project (C4CW). In: *Projects: Flow and Healthy* [on-line]. Beijing: CNMM, 2010 [Cited 20.02.2012]. Available from Internet: http://cnmm.tsinghua.edu.cn/contents/51/263.html.
25. Viewing the simulation output of your virtual machine. In: *Test4Theory a virtual atom smasher!* [on-line]. January 13, 2012 [Cited 20.02.2012]. Available from Internet: http://goo.gl/fsXk5.
26. VM CPU throttling enabled. In: *CernVMwrapper GitHub Repository* [on-line]. 2012 [Cited 20.02.2012]. Available from Internet: http://git.io/OuX-UQ.
27. *World Community Grid: technology solving problems* [on-line]. [Cited 20.02.2012]. Available from Internet: http://www.worldcommunitygrid.org/.

Biography

Miguel Angel Marquina is CERN staff member since 1988. Before joining the Information Technology Department, he collaborated as particle physicist at various experiments, both at DESY (Mark-J) and CERN (NA23, NA27 and UA1). His activities during the IT phase have been diverse, ranging from heading the CERNlib Software Library unit (5 years), through the coordination of the User Support group (7 years) to being the first resource manager of the LHC Computing Grid (LCG) project.

He is currently the CERN/IT linkperson to the Citizen Cyberscience Centre project, a partnership set up in 2009 between CERN, the UN Institute of Training and Research and the University of Geneva on the subjects of Volunteer Computing and Volunteer Thinking.