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TANGO AT LULI

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Abstract

Apollon, LULI2000 and HERA are three Research Infrastructures of the Centre national de la recherche scientifique (CNRS), École polytechnique (X), Commissariat à l'Énergie Atomique et aux Energies Alternatives (CEA) and Sorbonne University (SU). Now in past-commissioning phase, Apollon is a four beam laser, multi-petawatt laser facility fitted with instrumentation technologies on the cutting edge with two experimental areas (short—up to 1m—and long focal—up to 20m, 32m in the future). To monitor the laser beam characteristics through the interaction chambers, more than 300 devices are distributed in the facility and controlled through a Tango bus. This poster presents primarily a synthetic view of the Apollon facility, from network to hardware and from virtual machines to software under Tango architecture. We can here have an overview of the different types of devices which are running on the facility and some GUIs developed with the exploitation team to insure the best possible way of running the lasers. While developments are still currently under work for this facility, upgrading the systems of LULI2000 from one side and HERA from the other side are underway by the Control-Command & Supervision team and would follow the same specifications to offer shared protocols and knowledge.

MULTI-PETAWATT APOLLON LASER FACILITY

In this section are presented some key figures of the building, and some photos for a better comprehension of the areas of the facility. For the context, the Laboratoire pour l'Utilisation des Lasers Intenses (thereafter LULI) runs three facilities: historically LULI2000, Apollon and HERA. Apollo is the first of the three which was implemented with Tango control system.

- The Facility covers about 4,500m²

LASER hall: ISO8 cleanroom

- Experimental rooms cover surfaces of 280m² and 490m² (focal lengths of 10+m)
- 5 m-thick concrete walls provide full radio protection

With more than 500 devices running in the facility, a distributed control system was obviously needed. Tango [1] was not so obvious ten years ago. Looking back, it was a good choice as the community is very helpful; larger and larger with new projects every year, and the system runs smoothly. Some photos inside the facility, for the different rooms.

Figure 1: Supervision control room.

Figure 2: Long Focal Area (420m²).

Figure 3: Compression and switchyard laser subsystem.

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Figure 4: Short Focal Area (210m^2).

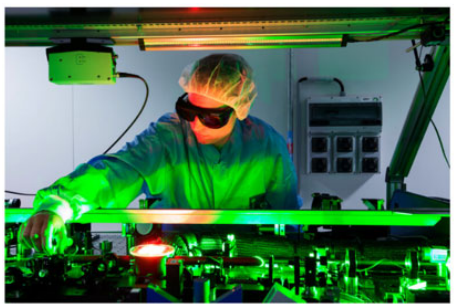

Figure 5: A laser expert during alignment protocol.

VERSIONS CURRENTLY USED

In this section and on the (Figure 6) is presented the different versions of Operating Systems (OS) and virtualized [2] applications (Tango, HDB++ [3], databases, Python, PytTango, PyQt, LabView) which are currently running on the installation.

C2S Devices	Vacuum Devices (Soleil)
64-bit Windows 10 Python 3.8 Tango 9 PyTango 9 NI LabView 2022 Currently updating to 64-bit Windows Server 2022 Datacenter on vSphere web client	64-bit Linux Ubuntu 14.04 LTS 6 Tango 9 NI LabView 2016
Archiving	**GUI**
Linux Ubuntu 20.04 LTS Tango 9.3.4 HDB++: Devices version 2.0.0, GUI Configurator version 3.1.1 BDD: MySQL	Windows 10 64-bit Python 3.8 Tango 9.3 PyTango 9.3 PyQt5

Figure 6: Short Focal Area (210m^2).

DEDICATED WEBSITE FOR FINAL USERS

The third section focuses on the results webpage we provide to the users (operators, laser experts or scientists) with a pseudo-real time display. “Pseudo” as the display lie on several processes which are not synchronized. The (Figure 7) presents a cropped screenshot of an example. We are currently upgrading the PHP webpage to a page based on Django.

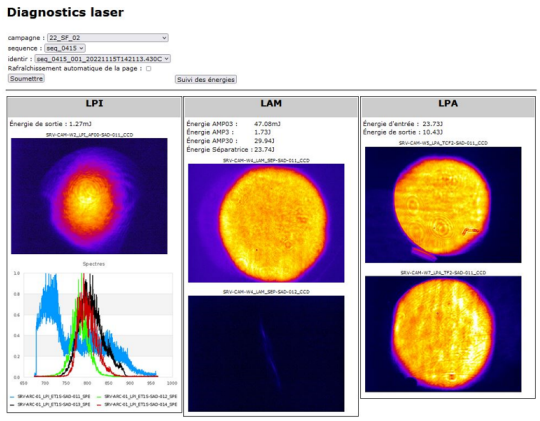

Figure 7: Example of results display.

KEY FIGURES

In this section are presented the number of hosts, Virtual Machines, control stations and some devices to have a better comprehension of the size of the installation’s network infrastructures (Figure 8).

Devices in operation	April 2019	April 2021	December 2022	Updated Estimation
Hypervisors	7	7	6	*<8*
Virtual Machines	33	49	54	*60*
Control stations	18	41	43	*~50*
CCD: laser beam CCD: plasma diag CCD: live exp. setup	42	59 12 8	62 12 8	*~80* *12(*)* *8(*)*
Calorimeters	16	18	19	*>20*
Motor channels: laser Motor interaction chamber Motor: diagnostics	66	93 25 ~15	100 ~50(*) 20	*120* *~60(*)* *30*
Delay generators	10	12	12	*~14*

* : Depending on campaigns

Figure 8: Network and devices numbers.

GUIS

In this section are presented a few Graphical User Interface—also called Human Machine Interface, HMI. They are mostly developed in Python and PyQt5, except note. Starting with images visualization (Figure 9), motorization (Figure 10), synoptic (Figure 11), vacuum (LabView) (Figure 12), and synchronization (Figure 13), and spectrometer (ATKPanel, monitoring and testing tool integrated within the Tango package) (Figure 14). On the image acquisition topic, you can refer of the TUMBCMO32 paper in these proceedings.

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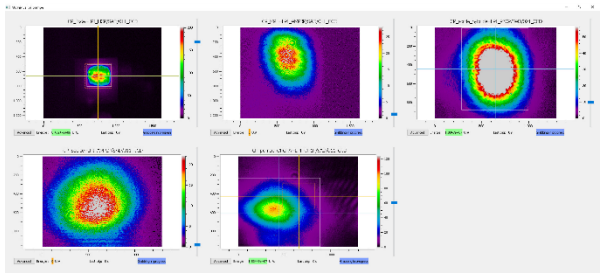

Figure 9: Images visualization.

Figure 10: Motorization.

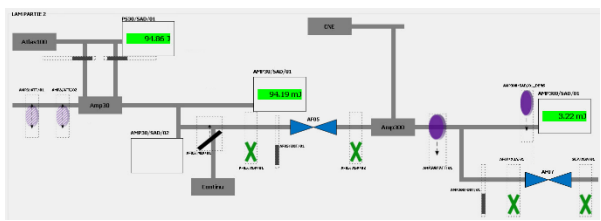

Figure 11: Synoptic.

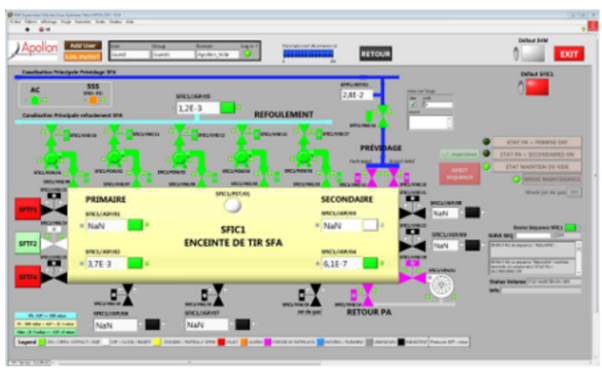

Figure 12: Part of the vacuum system.

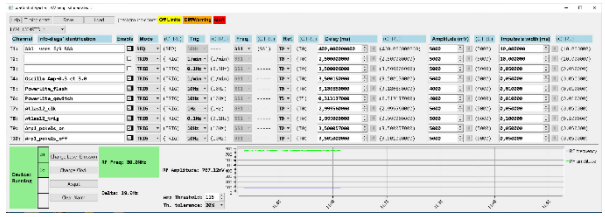

Figure 13: Synchronization.

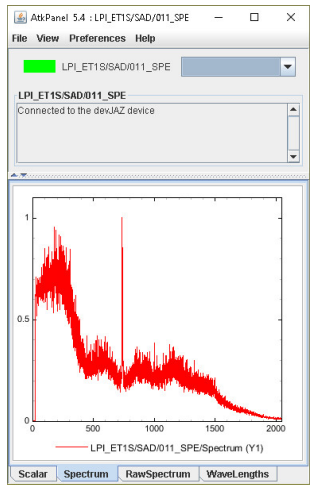

Figure 14: Spectrometer monitoring and testing.

MONITORING & ISSUES TRACKING

We have developed a basic supervision GUI which allows us to easily check if a device server is in a bad state. This application show a selection of devices servers based on classes filtering listed in a configuration file. We also use the application trac [4] for debugging.

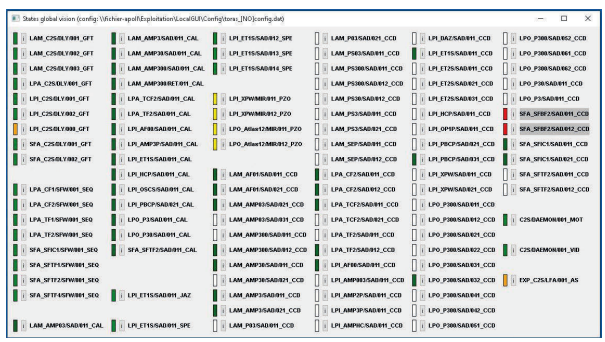

Figure 15: State of monitored devices servers.

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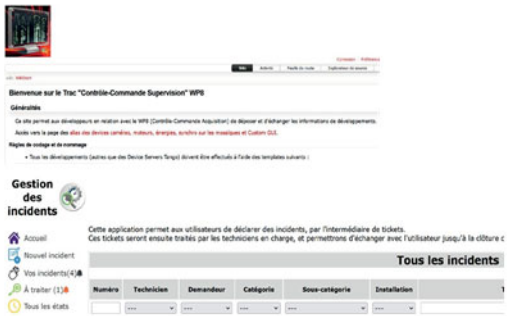

Figure 16: The Trac service to tracking issues.

ARCHIVING

The next and last section focuses on our archiving system. Based on HDB++ fully integrated to Tango, MariaDB databases and Virtual Machine VMWare. The (Figure 17) presents the architecture of our system which can currently recording mostly of all vacuum devices servers' attributes at a 1Hz rate on 24/7 routine, also called continuous mode. A sequence mode (corresponding of a sequence of shots) is under test with a 1-shot per minute and likely daily routine. There will be a third mode very soon, triggered, which will then follow the hardware trigger of the installation to record attributes at different rates available (at term, 10Hz, 1Hz, 0.1Hz and 1 shot per minute), on demand.

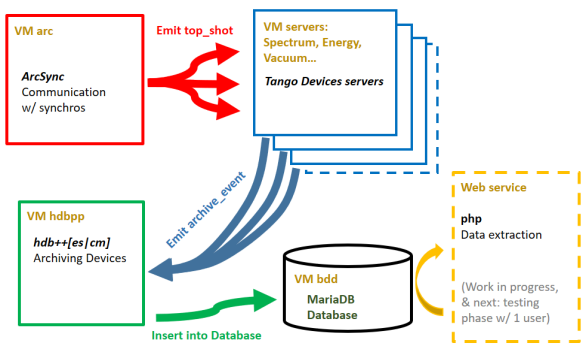

Figure 17: The archiving infrastructure.

CONTACT AND LINKS

The main contact us is an Email address: c2s@bureau.luli.polytechnique.edu. The scripts are available to download via our LULI GitLab repository [5] and via the Tango classes catalogue web page [6]. A 3-D visit of the Apollon installation is also available on the Internet [7].

REFERENCES

[1] Tango, https://www.tango-controls.org

[2] VMWare, https://www.vmware.com

[3] HDB++, https://tango-controls.readthedocs.io/en/latest/administration/overview.html

[4] Trac Open Source Project for issue tracking service, https://trac.edgewall.org/

[5] LULI_Tango GitLab, https://gitlab.in2p3.fr/stephane.marchand1/LULI_tango/-/tree/master?ref_type=heads

[6] Tango-control classes catalogue website, https://www.tango-controls.org/developers/dsc/

[7] 3-D visit of Apollon facility, https://my.matterport.com/show/?m=WzYCqomWH4o