Development of a Virtual Accelerator for Sirius

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Abstract

A virtual accelerator is being developed for Sirius, the new 4th generation synchrotron light source being built in Campinas, Brazil. The virtual accelerator is an on-line beam simulator which is integrated into EPICS control system. It consists of a command line interface server with a channel access (CA) layer and with an in-house developed tracking code library written in C++ for efficiency gain. The purpose of such server is to facilitate early development and testing of high level applications for the control system.

Virtual accelerator

On-line beam simulator composed of two parts: a back-end machine application implementing a simulated virtual accelerator with a channel access server layer (VACA) and a set of front-end virtual IOCs (vIOCS) with which other control system applications interact.

VACA - Virtual Accelerator with Channel Access

Implemented functionalities

- Parameter-dependent current decays
- Closed-orbit control with dipolar correctors
- Beam optics variations with quadrupoles
- Injection and ejection that depend on magnet and timing configurations.

Python programming language

- Allows for rapid development
- Binding layer between the CA server and a tracking code for simulations.
- The python package PCasPy is used as the CA server module.
- Trackcpp is a C++ library of beam dynamics and tracking routines developed at LNLS by the accelerator physics group. Trackcpp is converted to Python package with Swig3.0

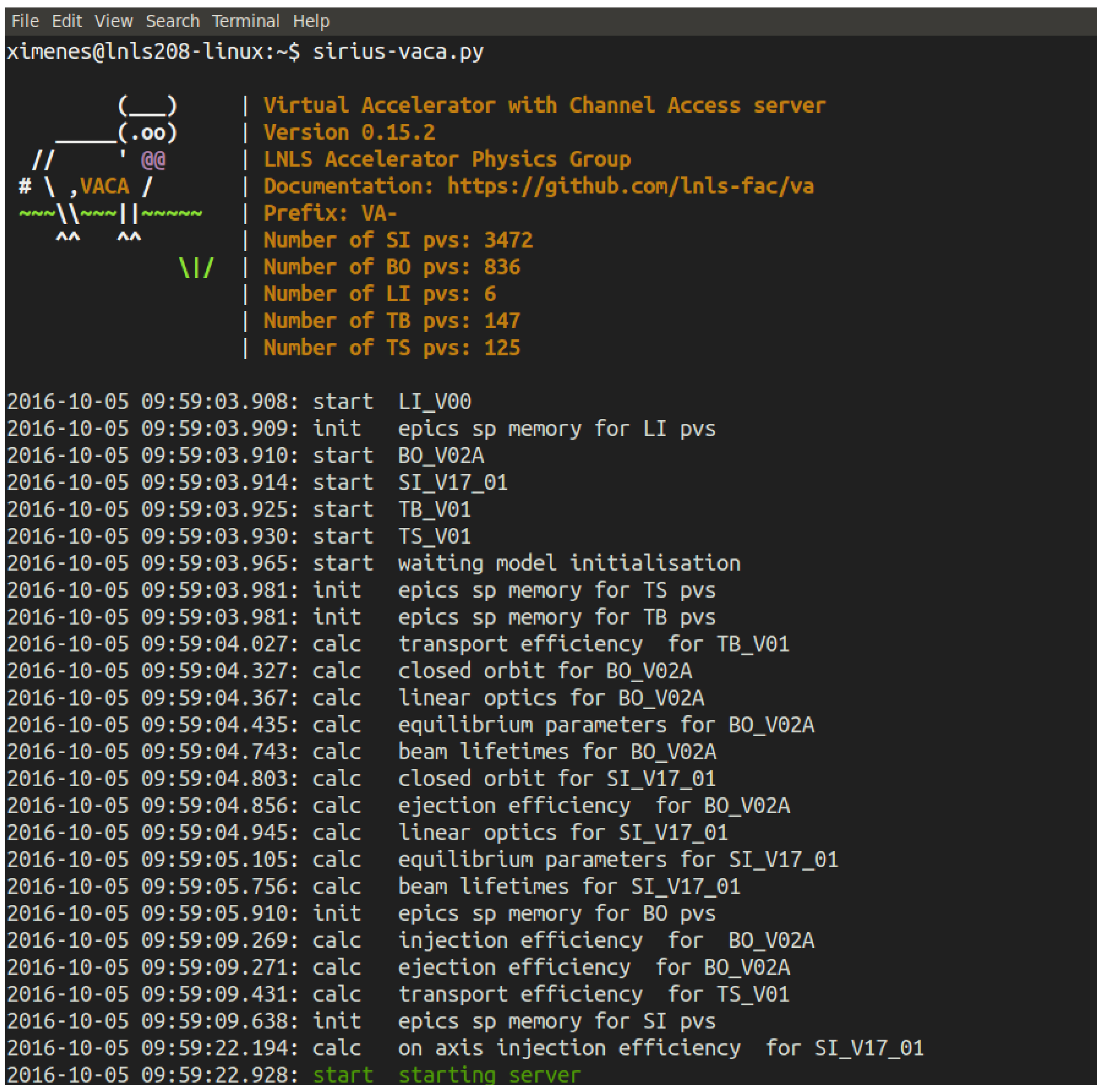

Figure 1 : Screen printout of a command line terminal showing a running instance of VACA.

Virtual IOCs

- **si_bpm, bo_bpm, ts_bpm, tb_bpm**: they serve BPM positions that are read from VACA, adding emulated measurement fluctuations.
- **si_current, bo_current**: they provide simulated beam currents with fluctuations.
- **si_ps, bo_ps, ts_ps, tb_ps**: provide read/write access to PVs that correspond to power supplies with associated magnet excitation curves.
- **si_rf, bo_rf**: implement radio frequency process variables.
- **si_tune**: emulation of the tune measurement IOC.
- **si_beamsize, bo_beamsize**: emulation of beam size measurement IOC.
- **si_lifetime**: emulation of lifetime calculation IOC.

Conclusions

- Facilitates the development of high level applications
- Enables commissioning training
- Can be use to serve model data during Sirius operations

Future improvements

- Details of the pulsed signals during injection and ejection processes need be considered.
- Approximate coupling expressions for beam size estimates should be substituted by Ohmi's envelop formalism in trackcpp.
- Considerations on moving from EPICS database to PCASPy for vIOCS developments.
- A major revision of PV names has taken place recently and VA should be updated to contemplate the new PV naming standard.

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