

AUTOMATIC DELTATAU PROJECT AND CODE GENERATION FOR GRANITE BENCHES AT SIRIUS

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T. R. S. Soares
J. V. E. Matoso
J. P. S. Furtado

Brazilian Synchrotron Light Laboratory (LNLS), Brazil.

telles.soares@lnls.br
joao.matoso@lnls.br

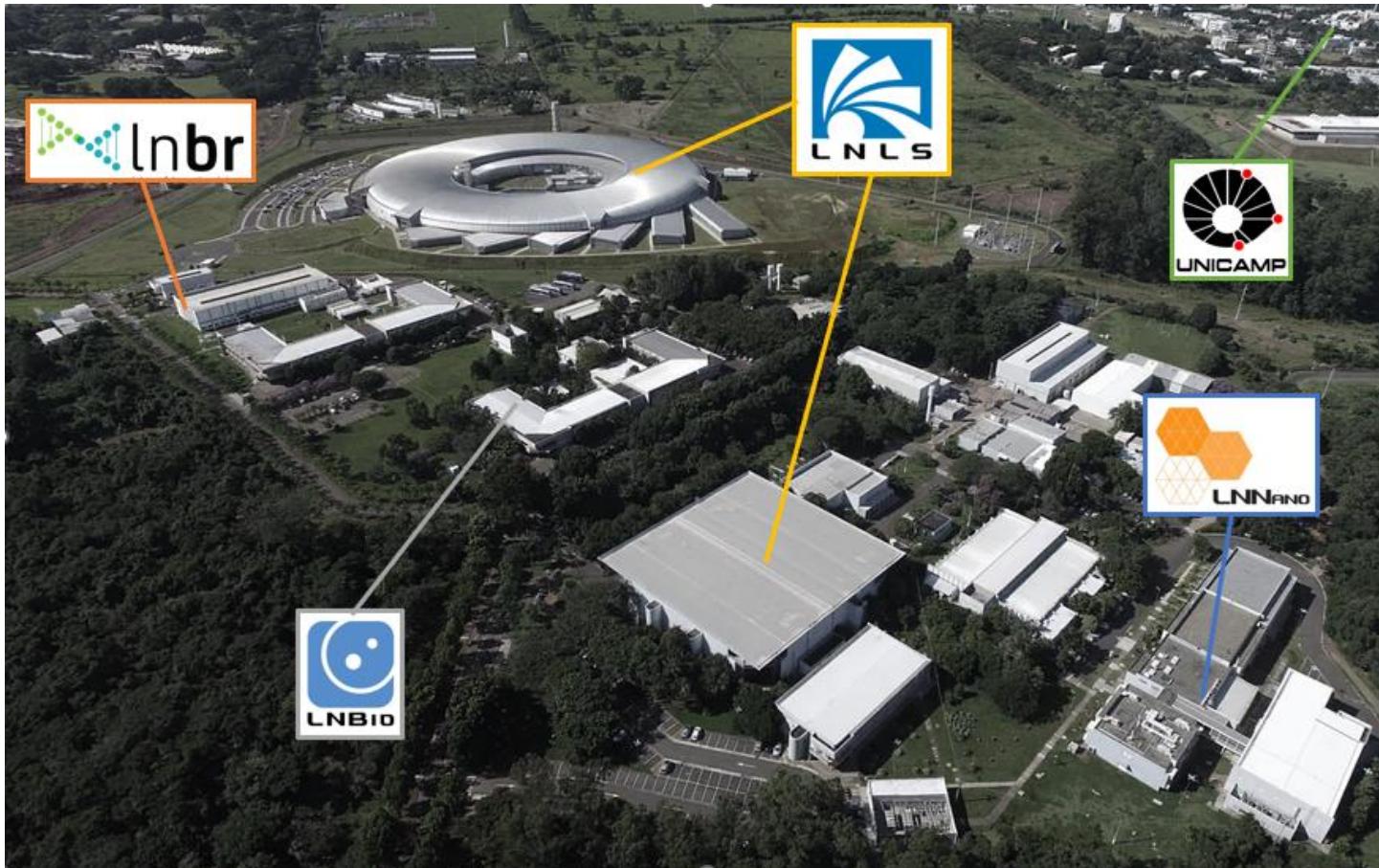


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AND INNOVATION

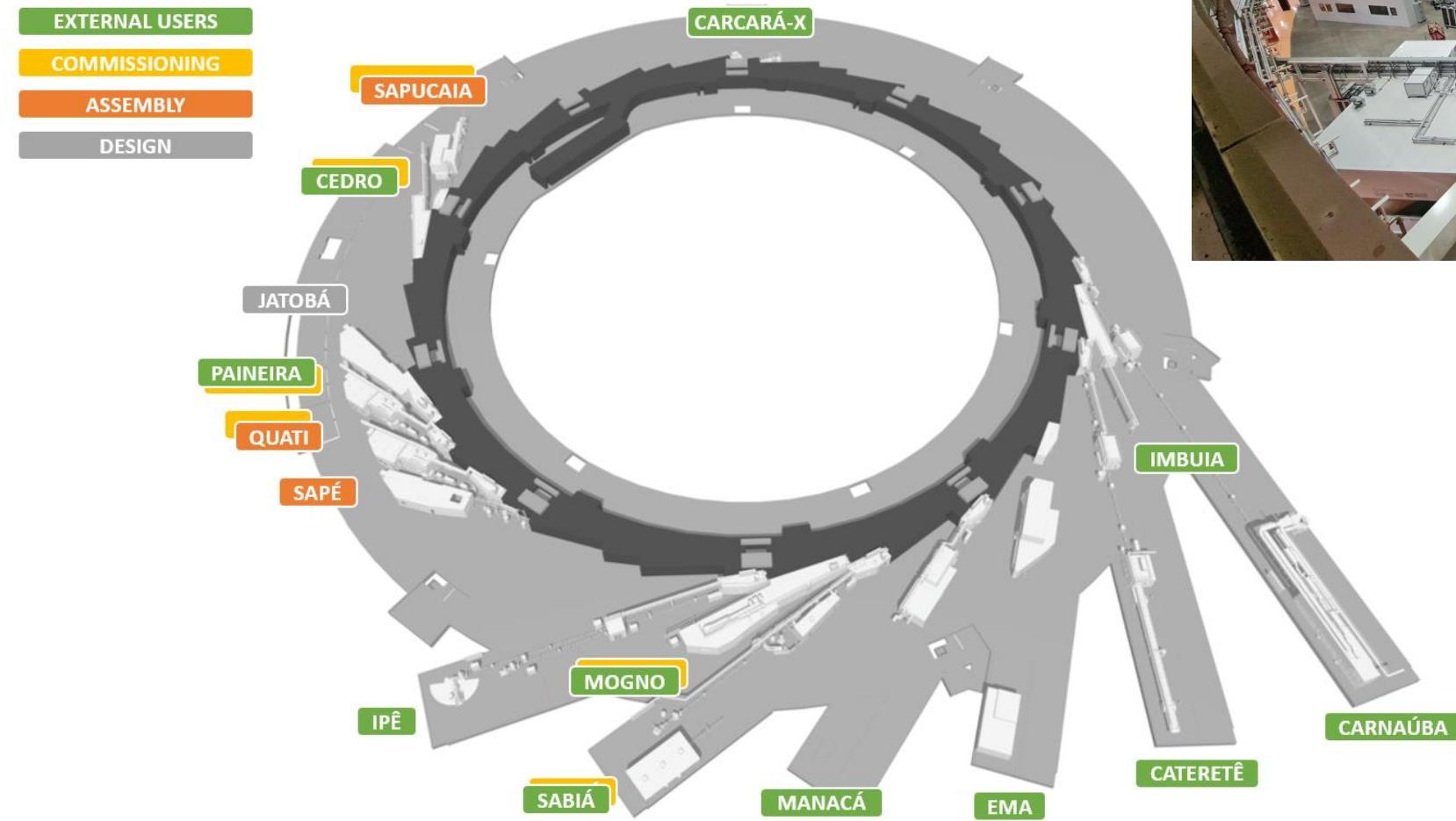


Introduction

- LNLS – Brazilian Synchrotron Light Source
- Sirius - 4th generation storage ring

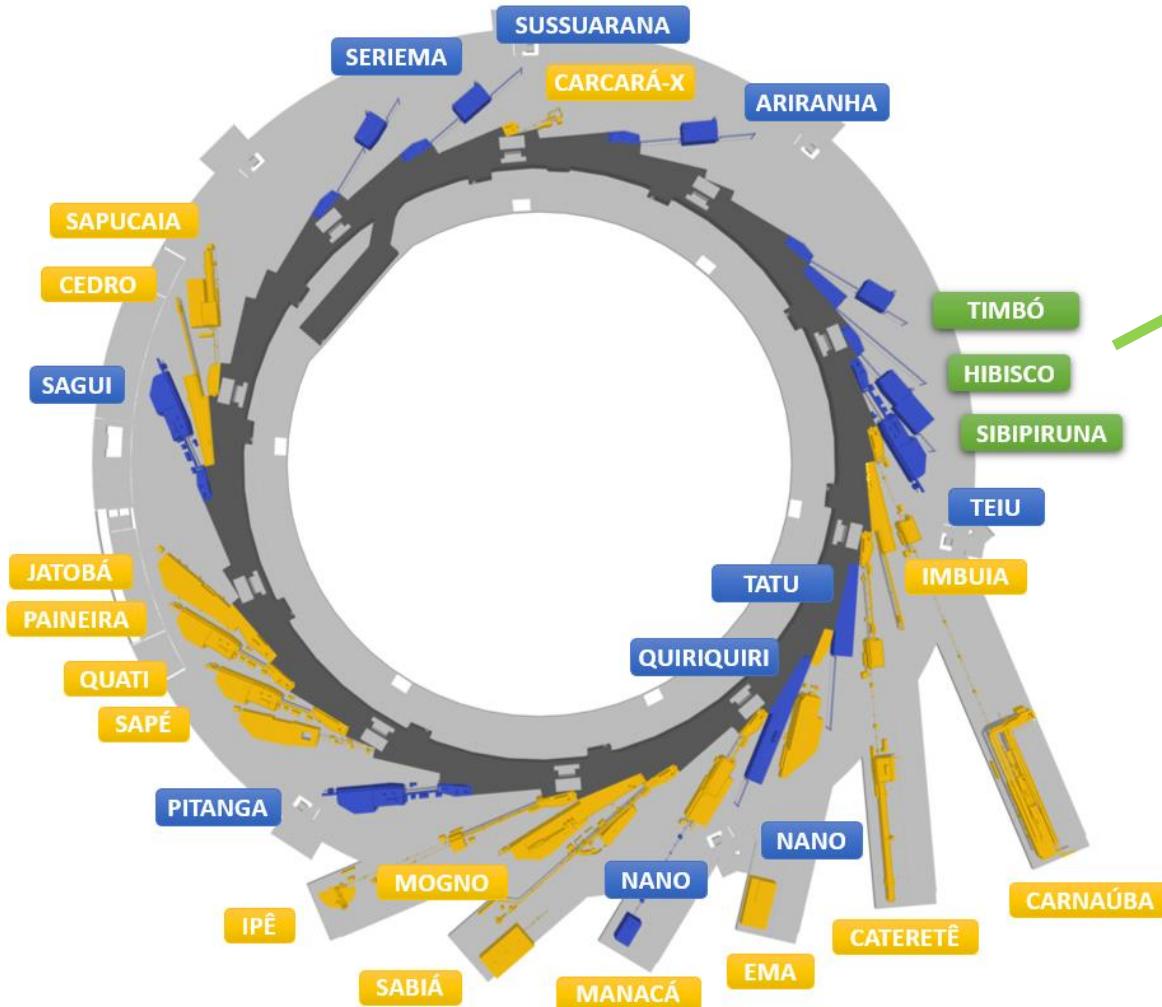


Sirius Status – Phase 1

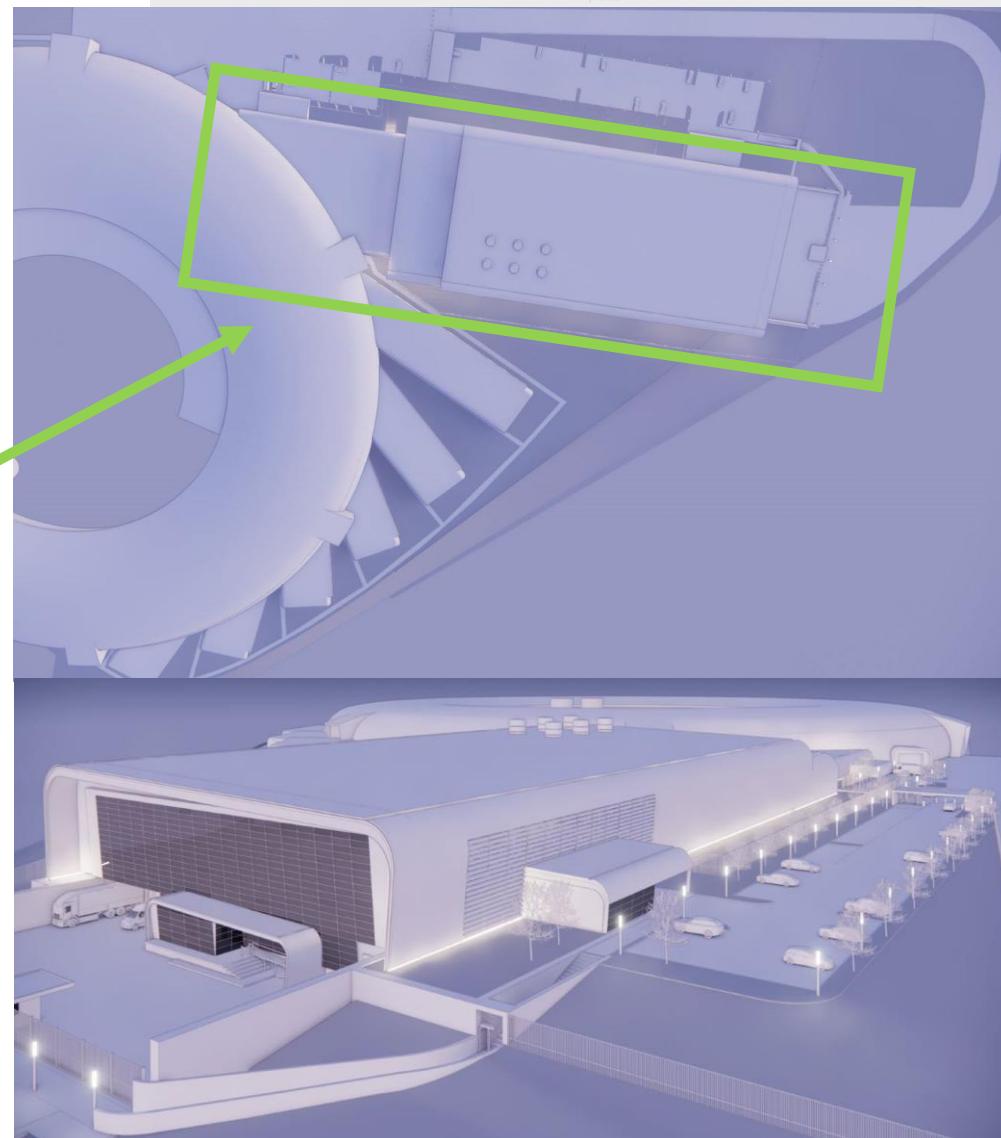


Sirius Status

PHASE I
PHASE II
ORION

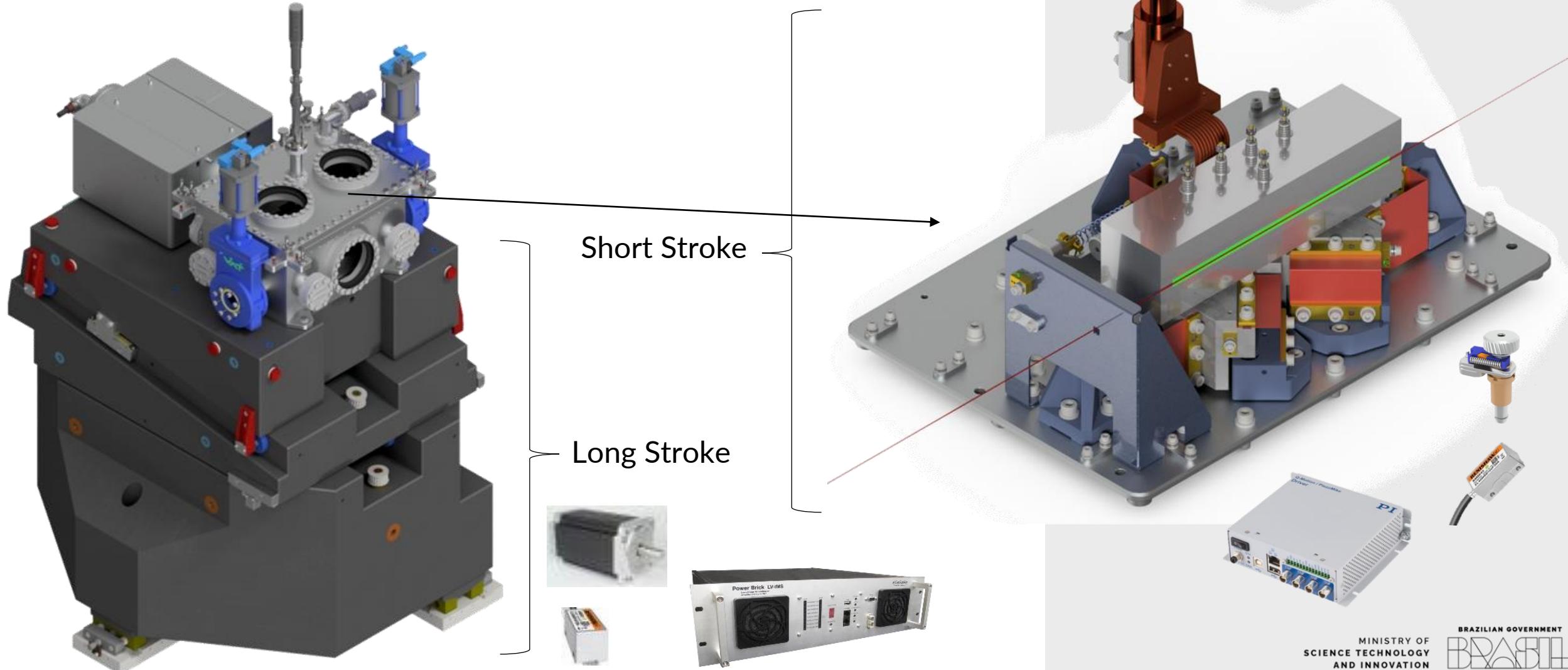


Orion (NB4)



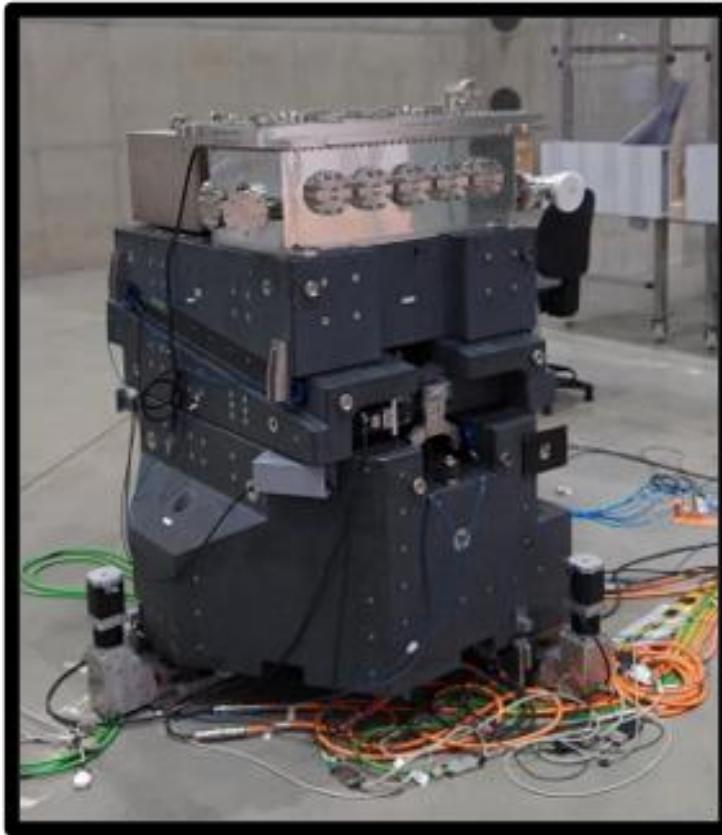
Granite Bench Overview

- High coupling stiffness to the ground and position control



Granite Bench Implementation

Assembly validation



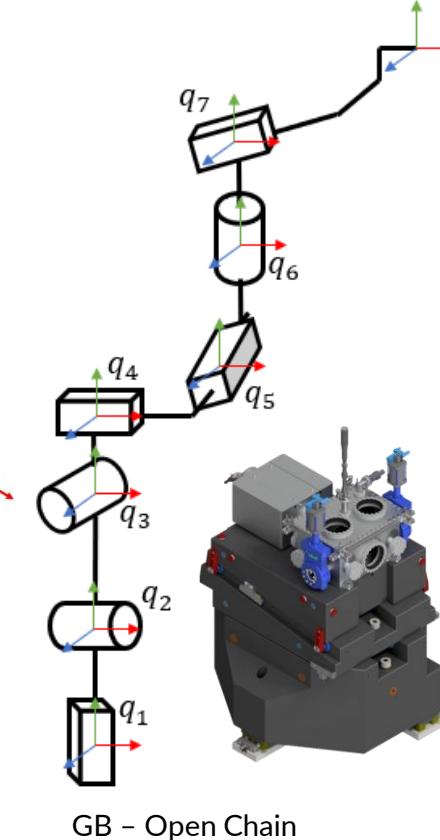
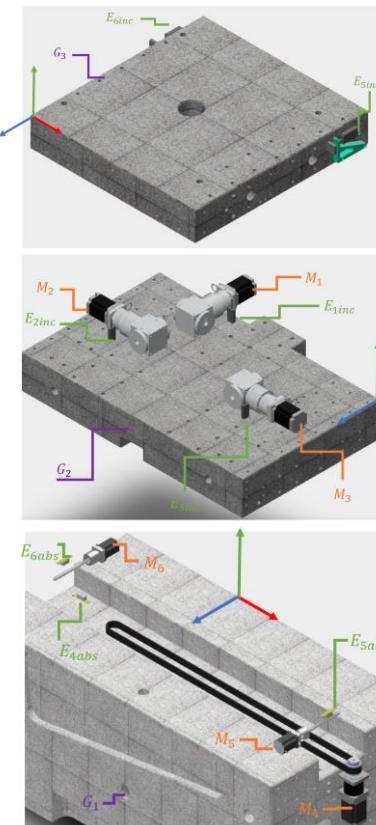
Granite bench (GB)

4 stepper motors with abs. feedback
Air-bearing system for movement

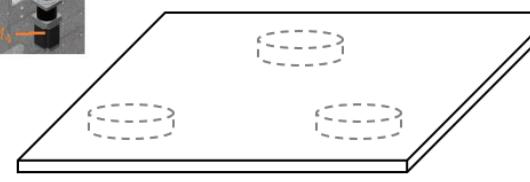
Levelers - Tripod

3 stepper motors with inc. feedback

Kinematics Modeling



GB - Open Chain



Numerical Method to solve Kinematics Equations

$$e_i = \begin{bmatrix} T_{y',i} \\ \theta_{x',i} \\ \theta_{z',i} \end{bmatrix}$$

$$J(e_i) = \begin{bmatrix} \frac{\partial p_1}{\partial T_{y'}}(e_i) & \frac{\partial p_1}{\partial \theta_{x'}}(e_i) & \frac{\partial p_1}{\partial \theta_{z'}}(e_i) \\ \frac{\partial p_2}{\partial T_{y'}}(e_i) & \frac{\partial p_2}{\partial \theta_{x'}}(e_i) & \frac{\partial p_2}{\partial \theta_{z'}}(e_i) \\ \frac{\partial p_3}{\partial T_{y'}}(e_i) & \frac{\partial p_3}{\partial \theta_{x'}}(e_i) & \frac{\partial p_3}{\partial \theta_{z'}}(e_i) \end{bmatrix}$$

Iteration Vector

Jacobian Matrix

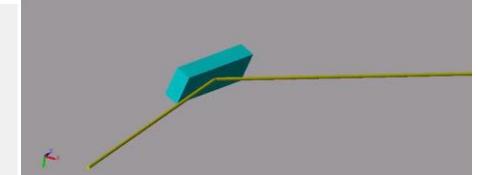
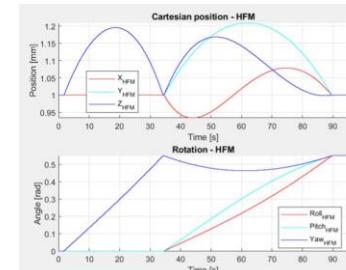
$$G(p_{1,raw}, p_{2,raw}, p_{3,raw}) = \begin{bmatrix} p_{1,raw} - p_1(e_i) \\ p_{2,raw} - p_2(e_i) \\ p_{3,raw} - p_3(e_i) \end{bmatrix}$$

Minimization Vector

$$e_{i+1} = e_i + J^{-1}(e_i)G(p_{raw}, e_i)$$

Iteration Algorithm

Simulation



C Code



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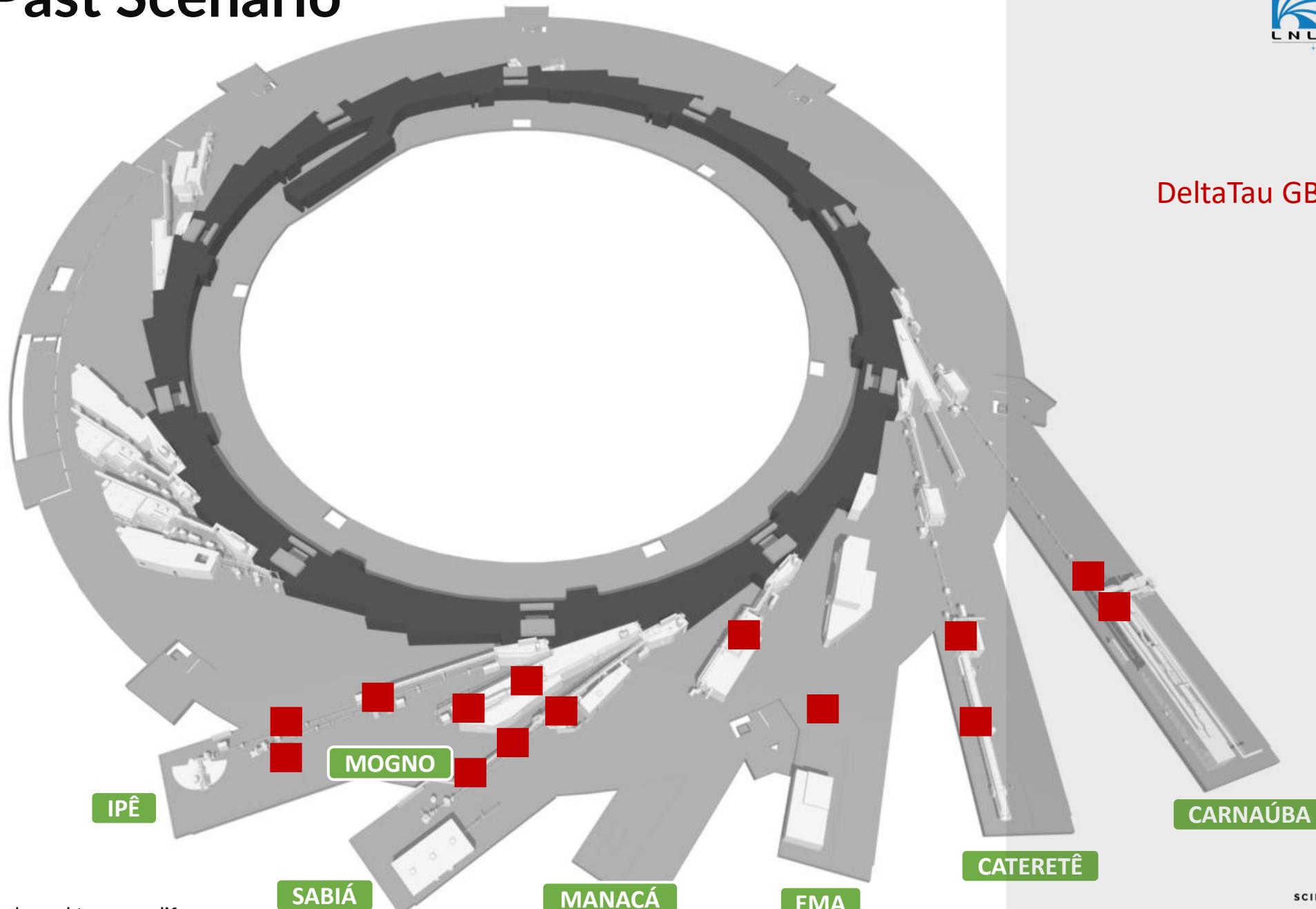
GBs Past Scenario



DeltaTau GB Project and code:

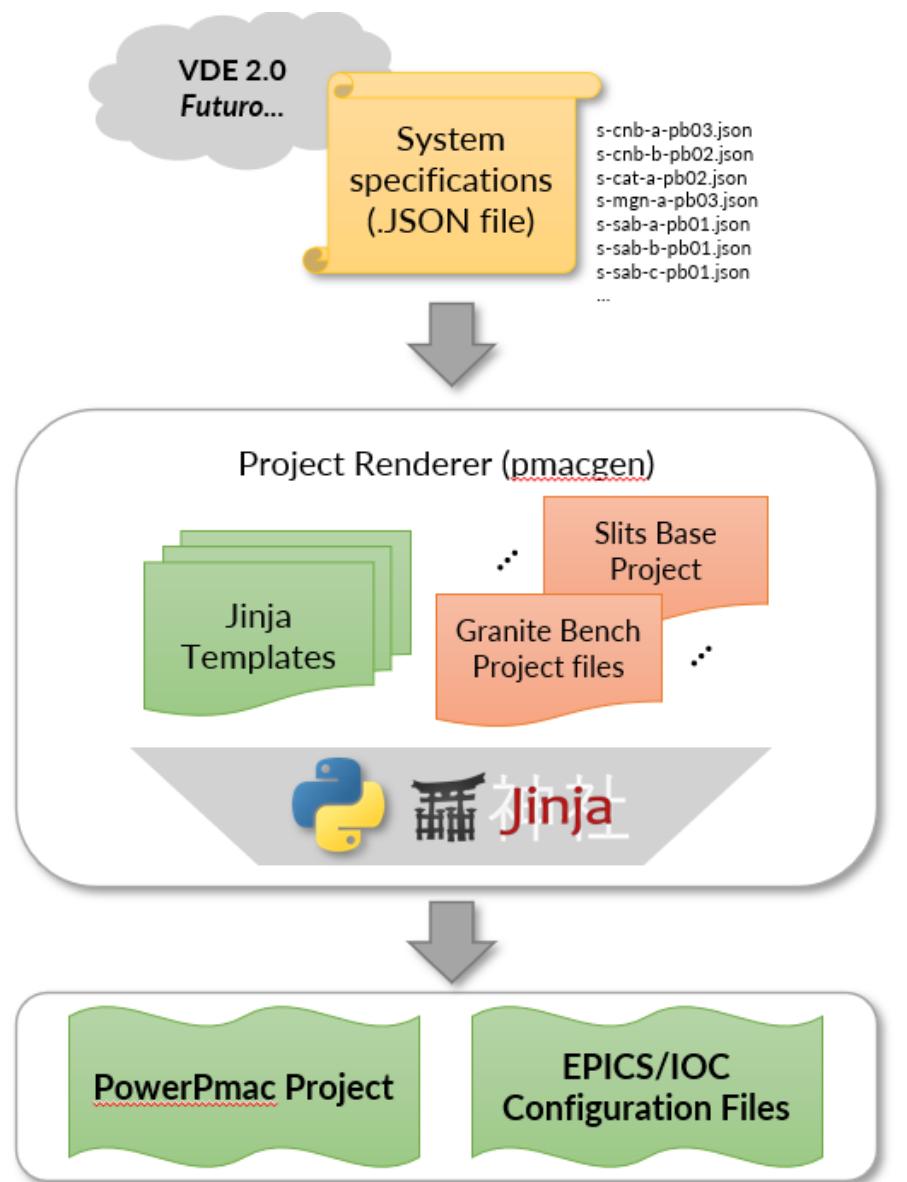
s-cnb-gb01
s-cnb-gb02
s-cat-gb01
s-cat-gb02
s-ema-gb01
s-mnc-gb01
s-sab-gb01
s-sab-gb02
s-sab-gb03
s-mgn-gb01
s-mgn-gb02
s-ipe-gb01
s-ipe-gb02
s-ipe-gb03

N



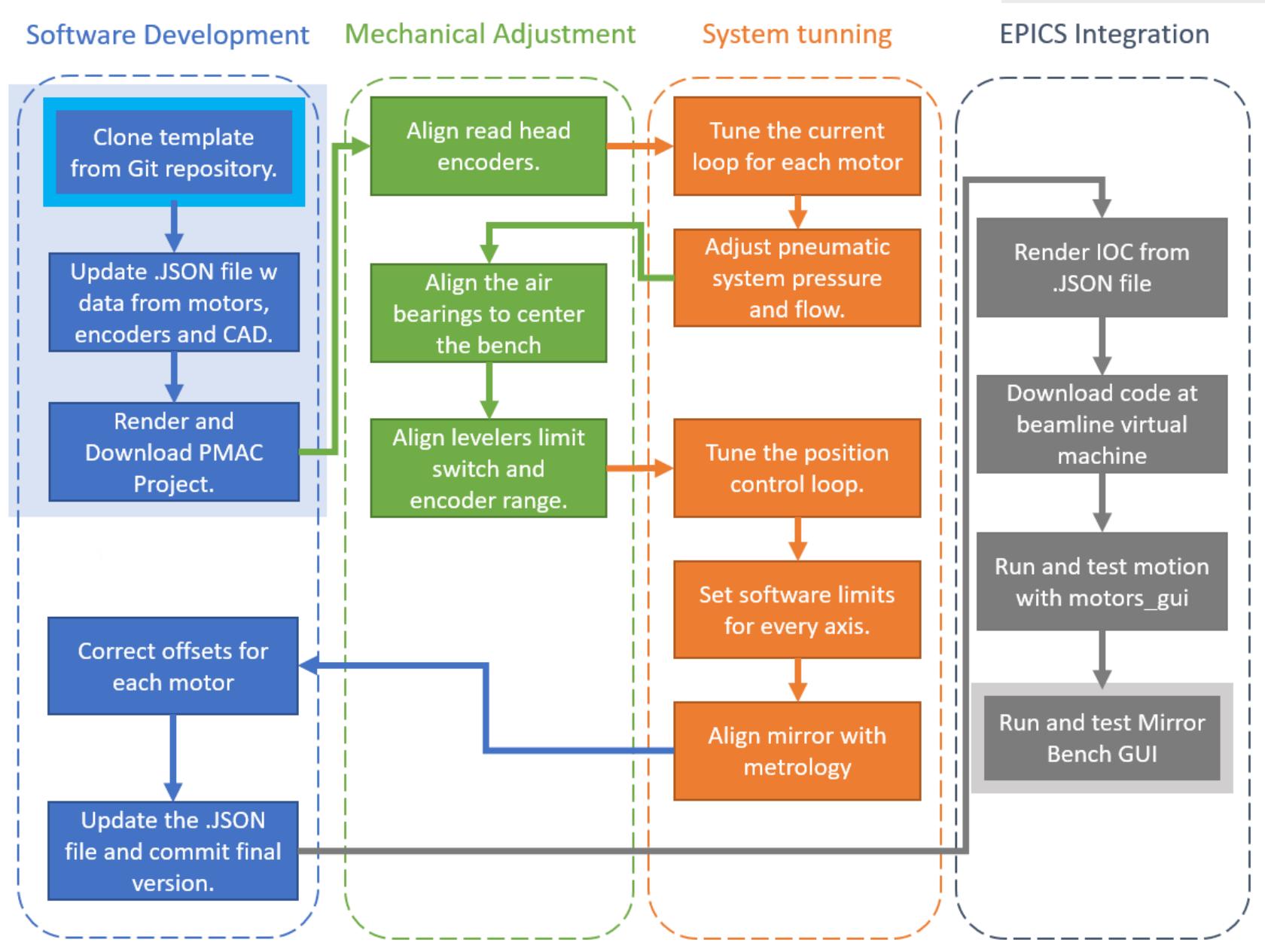
Not fully updated, used to exemplify

Power Pmac Project Generation

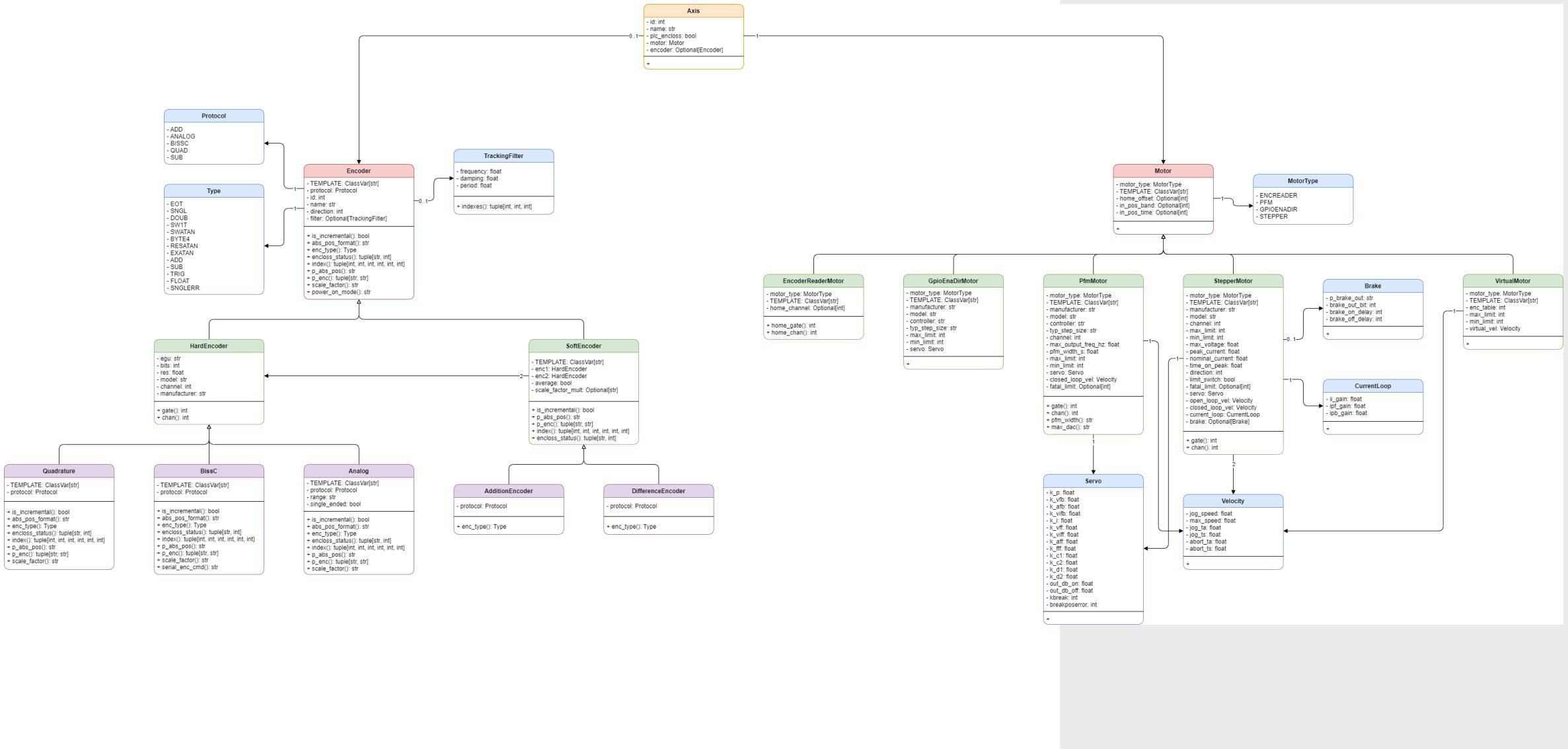


□ s-sab-a-pb01
▷ System
▷ Tools
▷ C Language
▷ Configuration
▷ Documentation
▷ Log
◀ PMAC Script Language
◀ Global Includes
□ 0_1-Global_Definitions.pmh
□ 0_2-Variables_Definitions.pmh
□ 0_3-User_Input.pmh
□ 0_4-SharedCCodeDefinitions.pmh
□ 1_1-E1_Leveler_X+.pmh
□ 1_2-E2_Leveler_X-.pmh
□ 1_3-E3_Leveler_Z+.pmh
□ 1_4-E4_Base_AX.pmh
□ 1_5-E5_Base_WE.pmh
□ 1_6-E6_Base_UP.pmh
□ 1_7-E7_Base_LO.pmh
□ 1_9-E9_Piezo_Ry.pmh
□ 2_1-M1_Leveler_X+.pmh
□ 2_2-M2_Leveler_X-.pmh
□ 2_3-M3_Leveler_Z+.pmh
□ 2_4-M4_Base_AX.pmh
□ 2_5-M5_Base_WE.pmh
□ 2_6-M6_Base_UP.pmh
□ 2_7-M7_Base_LO.pmh
□ 2_9-M9_Piezo_Ry.pmh
□ 3_1-Epics.pmh
▷ Kinematic Routines
▷ Libraries
◀ Motion Programs
□ EpicsSetpoints_CS1.pmc
□ EpicsSetpoints_CS2.pmc
◀ PLC Programs
□ 01-IOCSstop.plc
□ 02-ValvesSynchronizer.plc
□ 03-EncLossRecognition.plc
□ 04-Readback.plc
□ 11-PowerOnMotor.plc
□ 12-HomingLeveler.plc
□ 13-BaseTimer.plc
□ 14-LevelerTimer.plc
□ 15-ACK_M1.plc

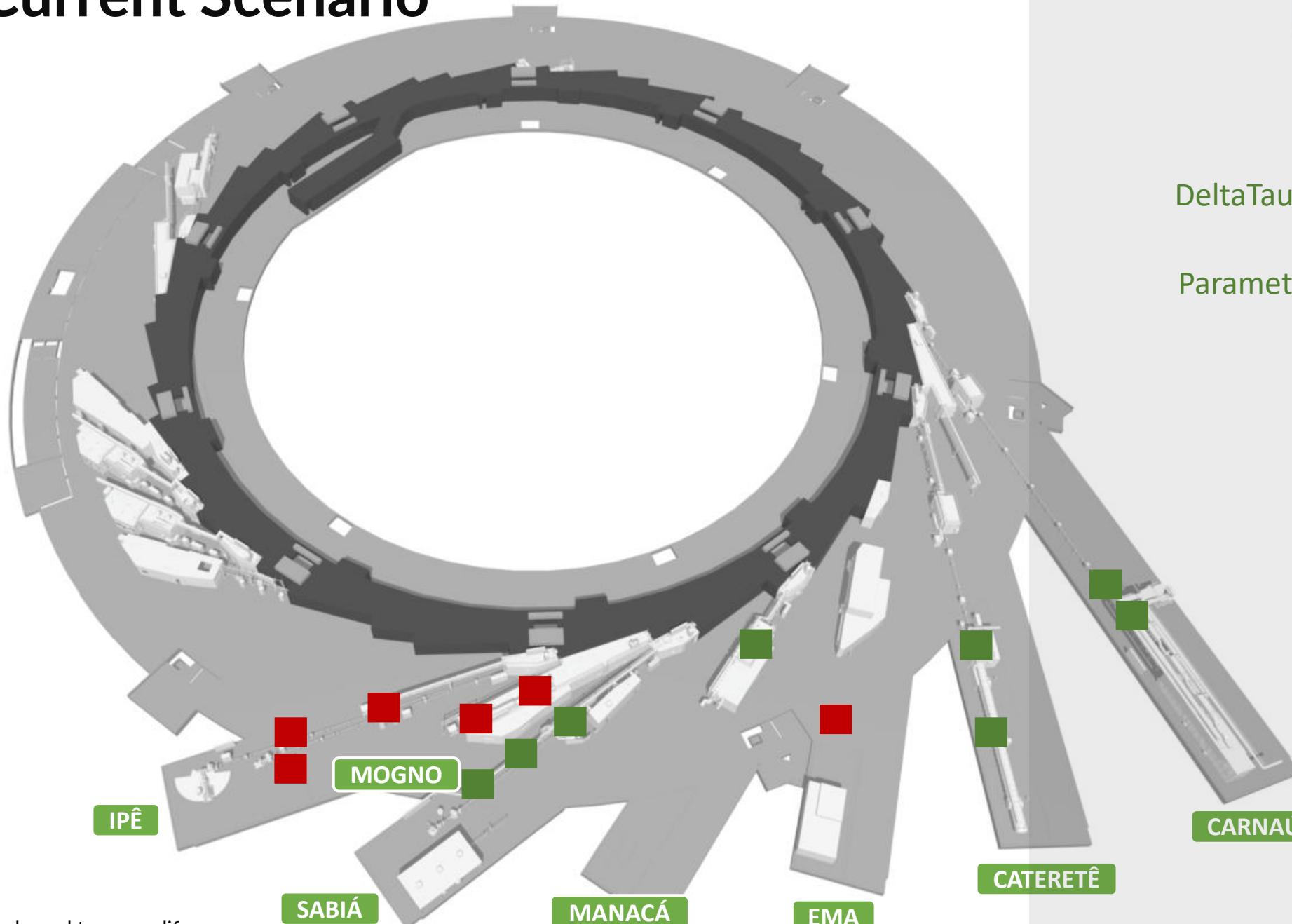
Power Pmac Project Generation



Class Diagram of PMACGEN Library



GBs Current Scenario



Not fully updated, used to exemplify



DeltaTau GB Project and code:
s-gbx

Parameters and deployed code
s-cnb-gb01
s-cnb-gb02
s-cat-gb01
s-cat-gb02
s-mnc-gb01
s-sab-gb01
s-sab-gb02
s-sab-gb03
s-ipe-gb01
s-ipe-gb02
s-ipe-gb03

Summary

Advantages of rendering projects from data files:

- Maintain only one repository, single source of truth
- Increase standardization among mirror granite benches
- Reduce maintenance cost by speeding upgrade to future versions
- Concentrate the parameters of each system in one database

THANK YOU

cnpem.br



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