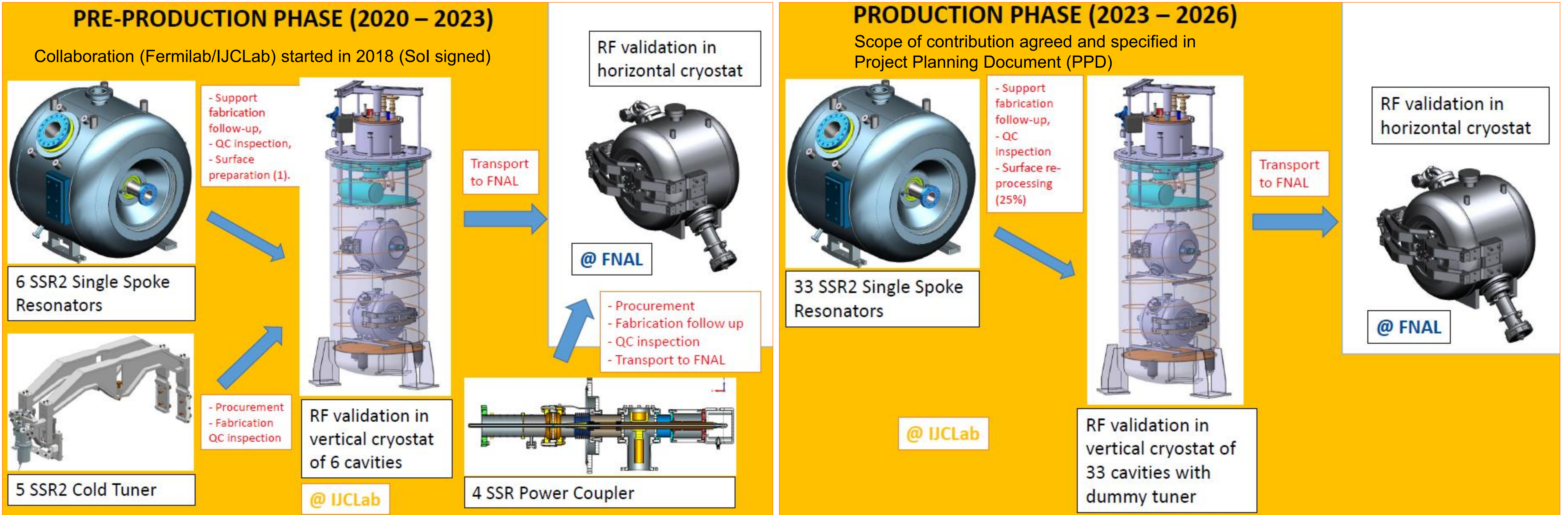


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ABSTRACT :

IJCLab is one of the labs of IN2P3 (National institute of nuclear and particle physics), one of the ten research institutes composing the French National Center for Scientific Research (CNRS). Since 2018, IJCLab has been involved in the PIP-II project [1], assisting with the design, development, and qualification of accelerator components for the SSR2 (Single Spoke Resonator type 2) section of the superconducting linac. The first pre-production components (cavity, coupler, and tuner) have been fabricated, and some of the first qualification tests have been performed at IJCLab. This paper will summarize the complete scope of IJCLab contributions to PIP-II and give updates on the performances of the first pre-production components.



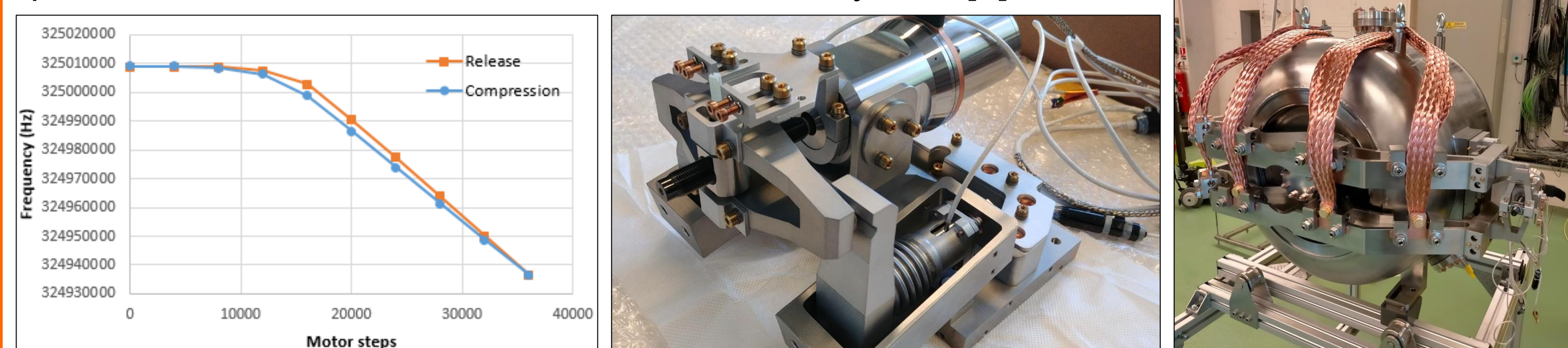
Progress on SSR POWER COUPLER :

- 4 prototype couplers fabricated at PMB [2] (France) based on Fermilab design procured by IN2P3.
- Lessons learned during manufacturing captured in [3].
- 2 vacuum side assemblies delivered at Fermilab for power test
- 1 vacuum side (with TiN coating) assembly successfully power processed to nominal power (12 kW CW) at Fermilab with and without bias [4].
- 2 couplers fully assembled at PMB to check interfaces.
- Copper coating of warm ends done and qualified (inner and outer conductor both with bellow).
- Shipping of all remaining parts to Fermilab planned in June for final power test.



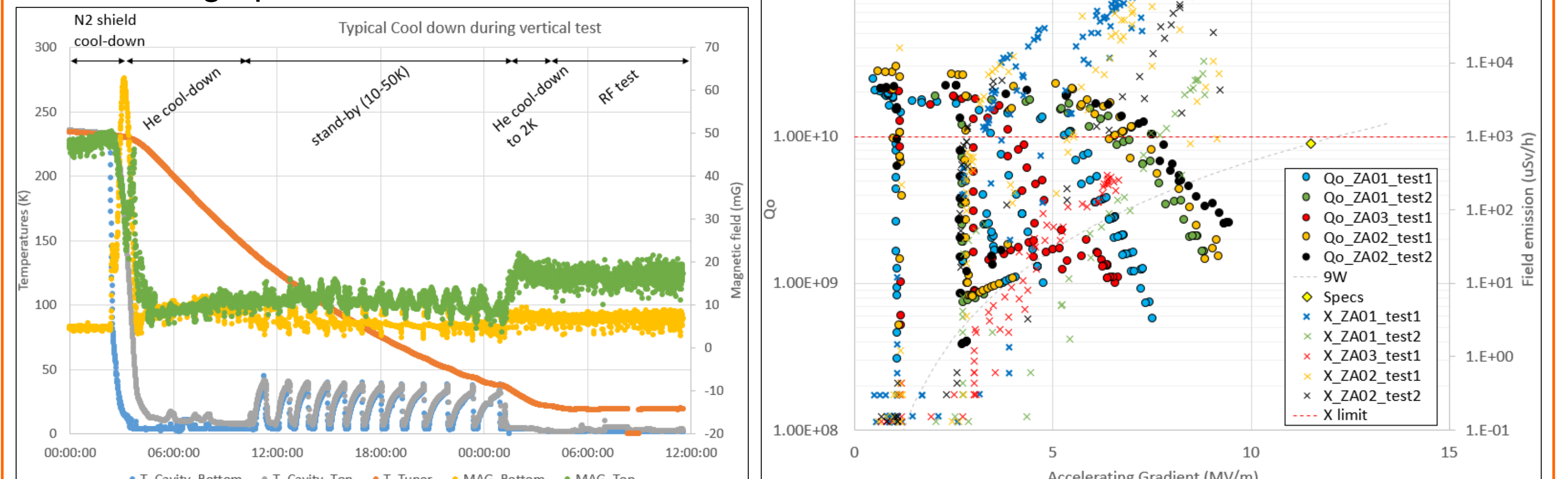
Progress on SSR2 TUNER :

- 5 tuner mechanical parts procured by IN2P3 to French company PSI [5] and delivered at IJCLab. Stepper motors and piezo procured by Fermilab.
- Dedicated thermal straps for fast thermalization (<20K within 24h)
- 4 tuners validated in vertical cryostat [6].
- Very robust, good repeatability and reliability confirmed during specific accelerated lifetime test in a dedicated cryostat [6].



Progress on SINGLE SPOKE RESONATOR :

- RF design based on SSR1 and optimized at Fermilab (multipacting) [7].
- Mechanical design jointly optimized based on lessons learned from SSR1 (Fermilab) and ESS (IJCLab) [8].
- A first set of 3 prototypes procured by Fermilab and built by Zanon Research & Innovation (ZRI) [9]. 2 cavities delivered « ready for test ».
- 1 cavity fully processed on Supratech platform [10].
- Development of rotational BCP capability [11] and all tooling required (tuning, HPR, baking).
- All cavities show very sound mechanical behaviour and were successfully cooled at 2K.
- Frequency goal was successfully achieved at room temperature (324.609 MHz ± 65 kHz).
- Pressure sensitivities below 5 Hz/mbar
- Lorentz factor at -7.5 Hz/(MV/m)² and down to -4.8 Hz/(MV/m)² with tuner engaged (simulated -4.75 Hz/(MV/m)²).
- Base Q₀ ~ 2 · 10¹⁰ range (R_s ~ 5nΩ).
- 2 major multipacting bands around 1 and 3 MV/m in agreement with simulations [7].
- Cavities limited by field emission. HPR nozzle being optimized.



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CONCLUSION:

- Very fruitful PIP2 collaboration between Fermilab and IJCLab since 2018.
- Successful joint design of cavity thanks to previous experience (SSR1, ESS)
- Prototype ancillaries (5 tuners and 4 couplers) procured by IJCLab to qualify vendors.
- Supratech facility upgraded (rotational BCP) and dedicated tooling developed.
- Sound mechanical behaviour of cavities during vertical testing. Frequency goal reached.
- Cavities limited by field emission. HPR configuration and procedure being optimized.

