

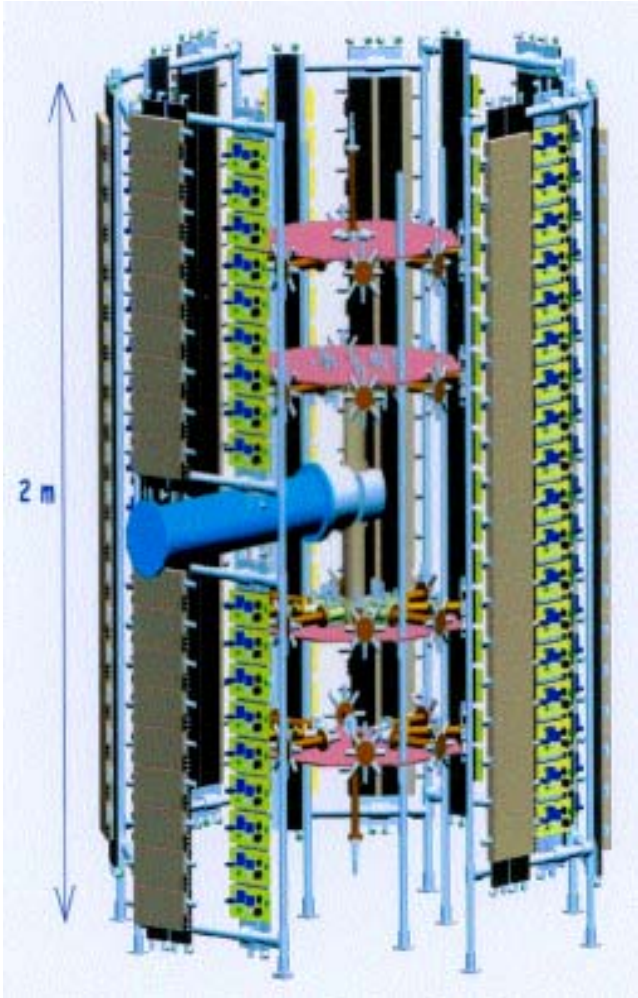
REGULATION LOOPS AND RF CONTROL SYSTEM FOR SOLEIL

8th ESLS RF meeting

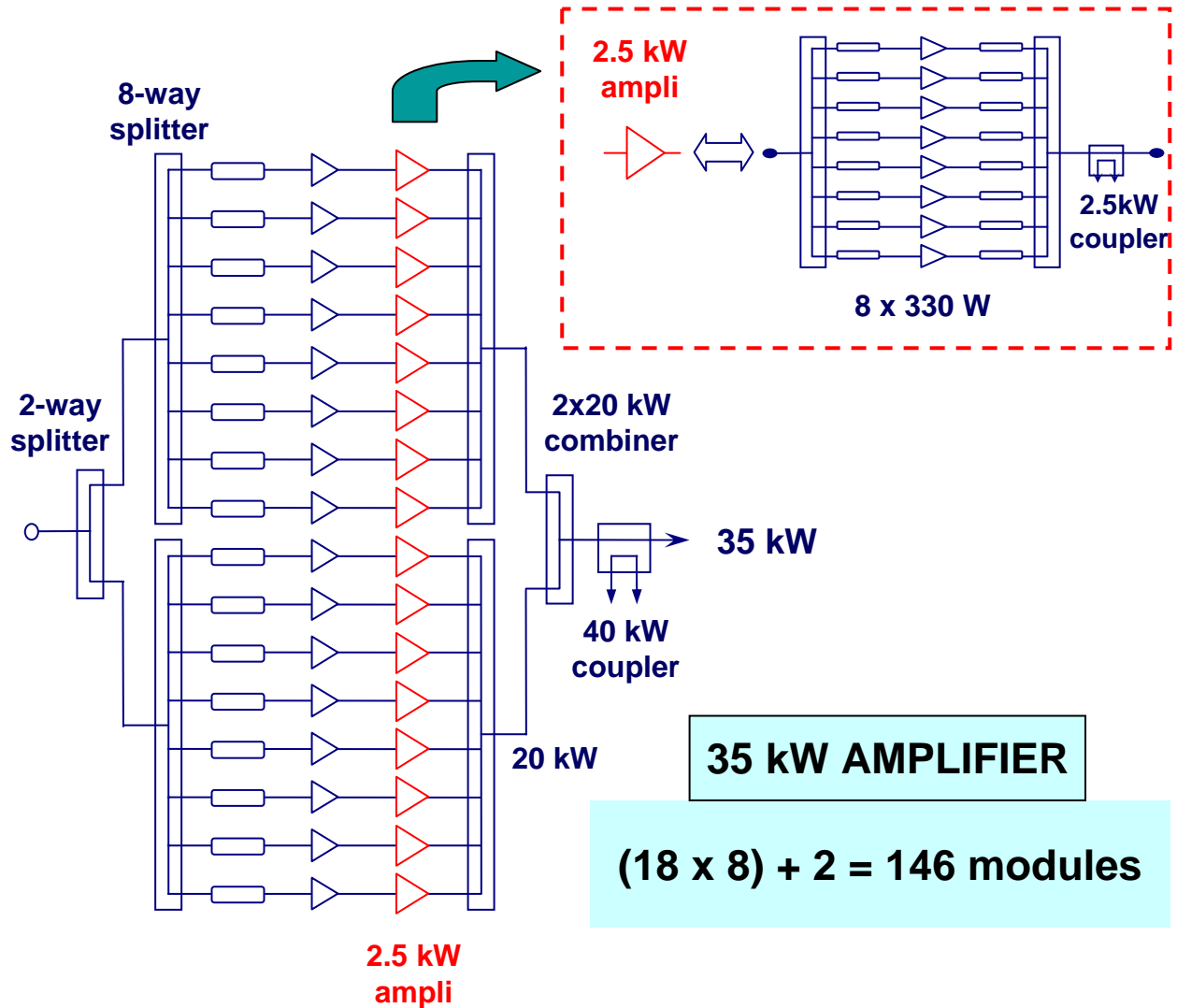
Daresbury, September 29th - 30th, 2004

M. DIOP

BOOSTER 35 KW AMPLIFIER

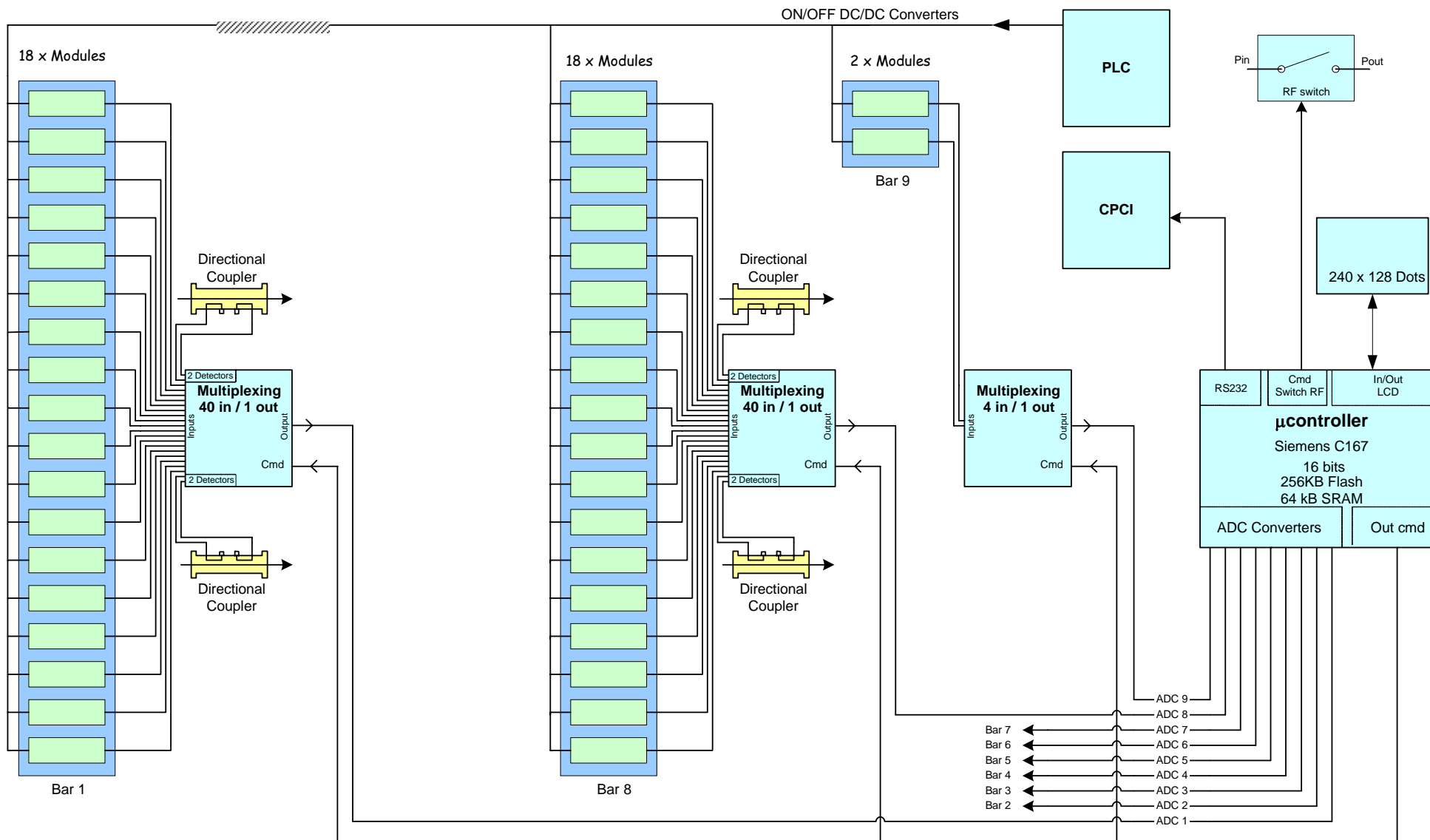


146 modules of 330 W

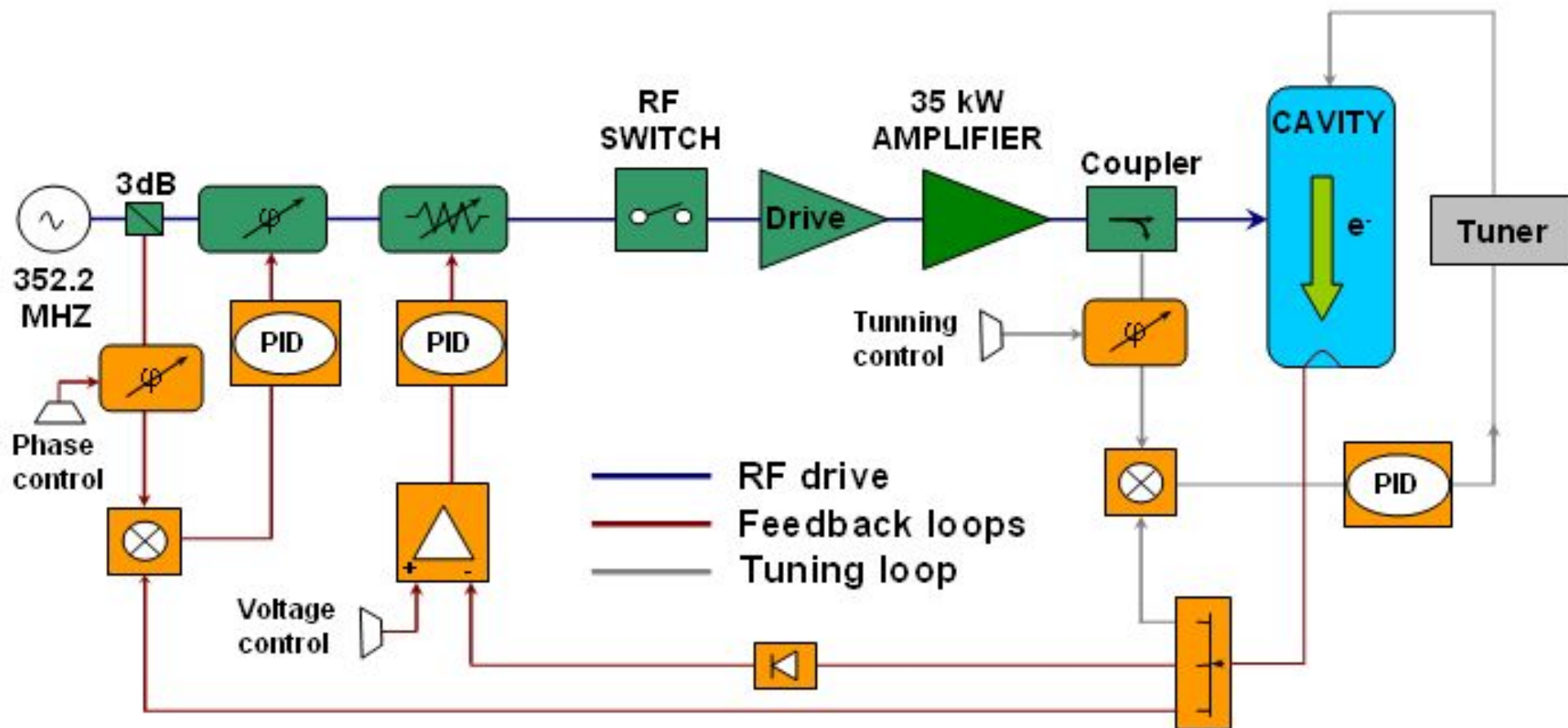


AMPLIFIER SUPERVISION

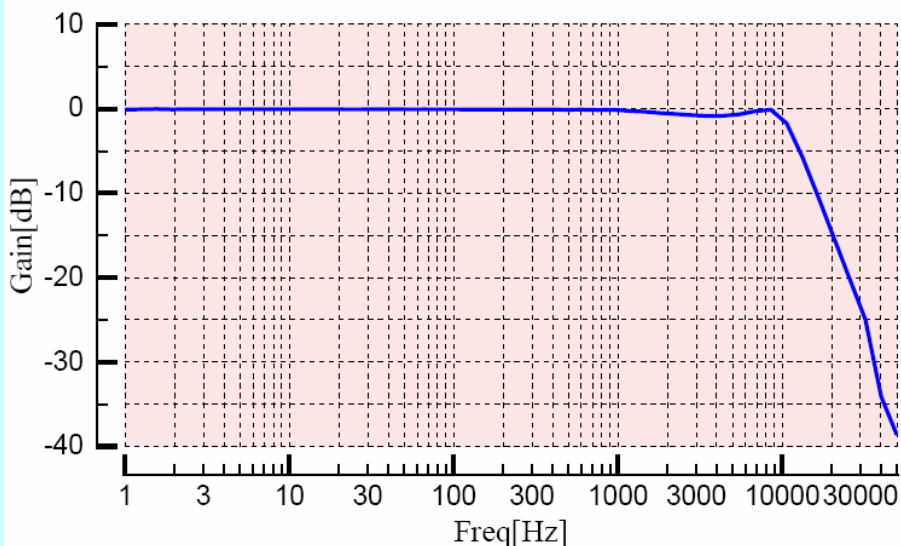
◆ Microcontroller and multiplexing system



- 3 « slow » loops (frequency, amplitude and phase)
Adapted version of the LURE system



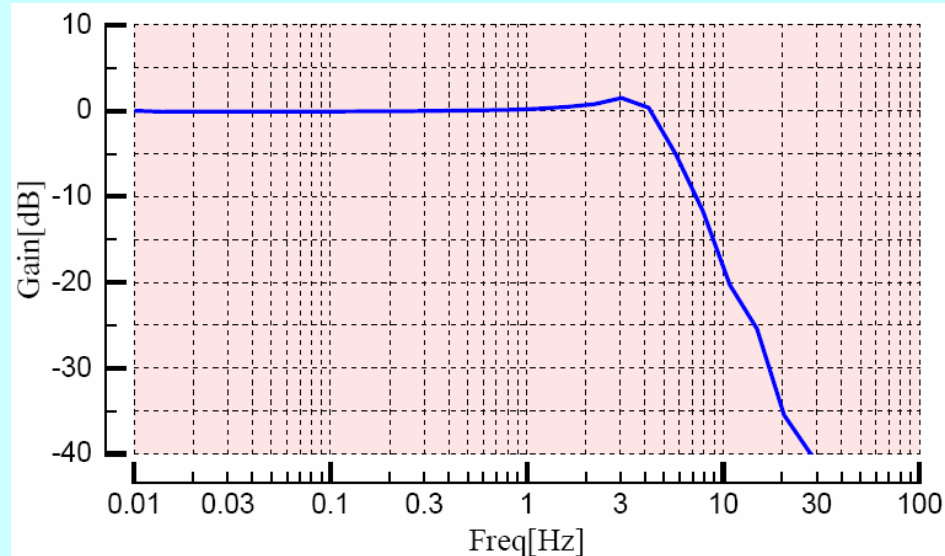
◆ Characterization of the regulation loops



Voltage loop transfer function

Result:
BP = 10 kHz for a 200 mV modulation

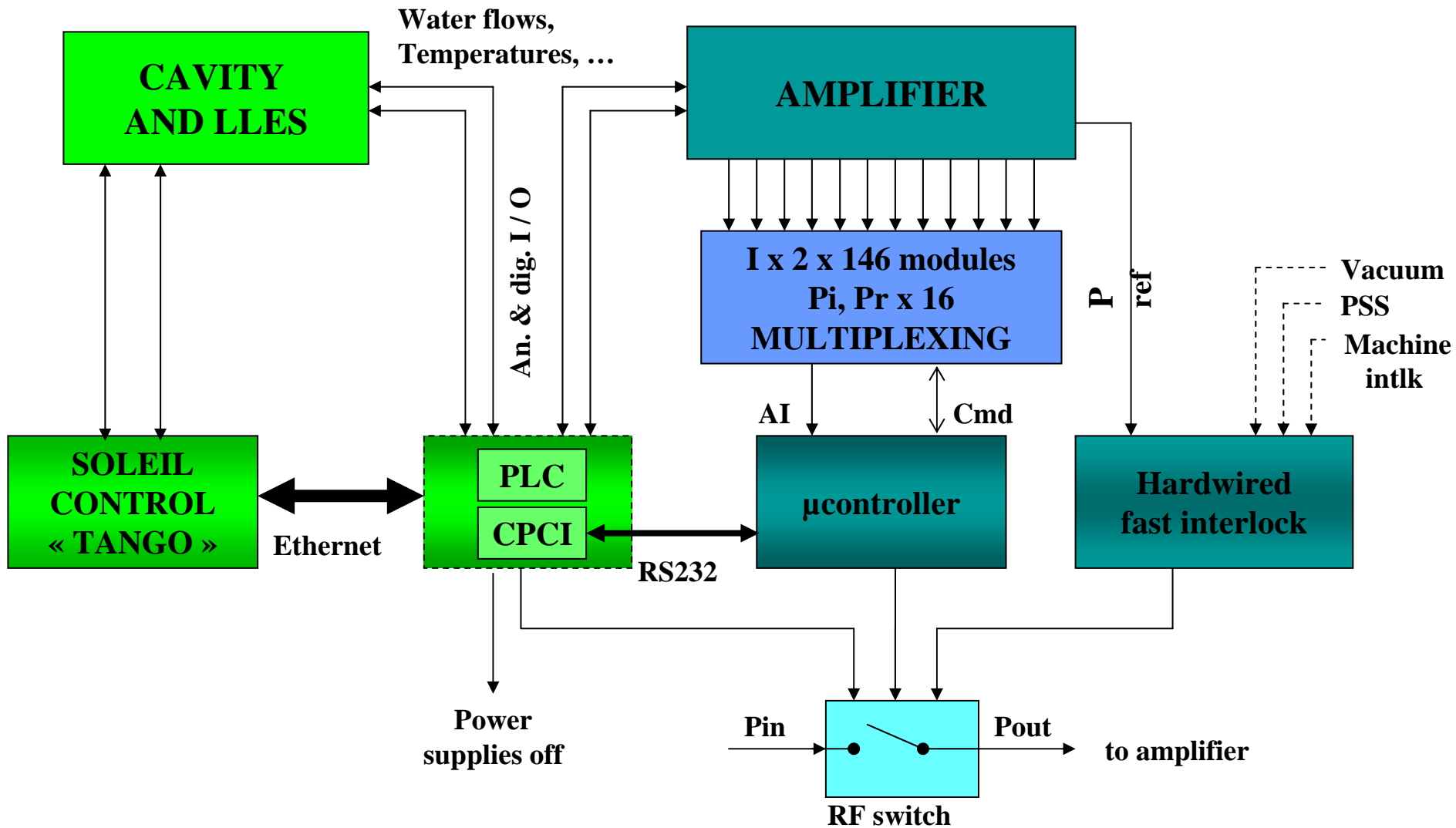
P = 10 KW



Frequency loop transfer function

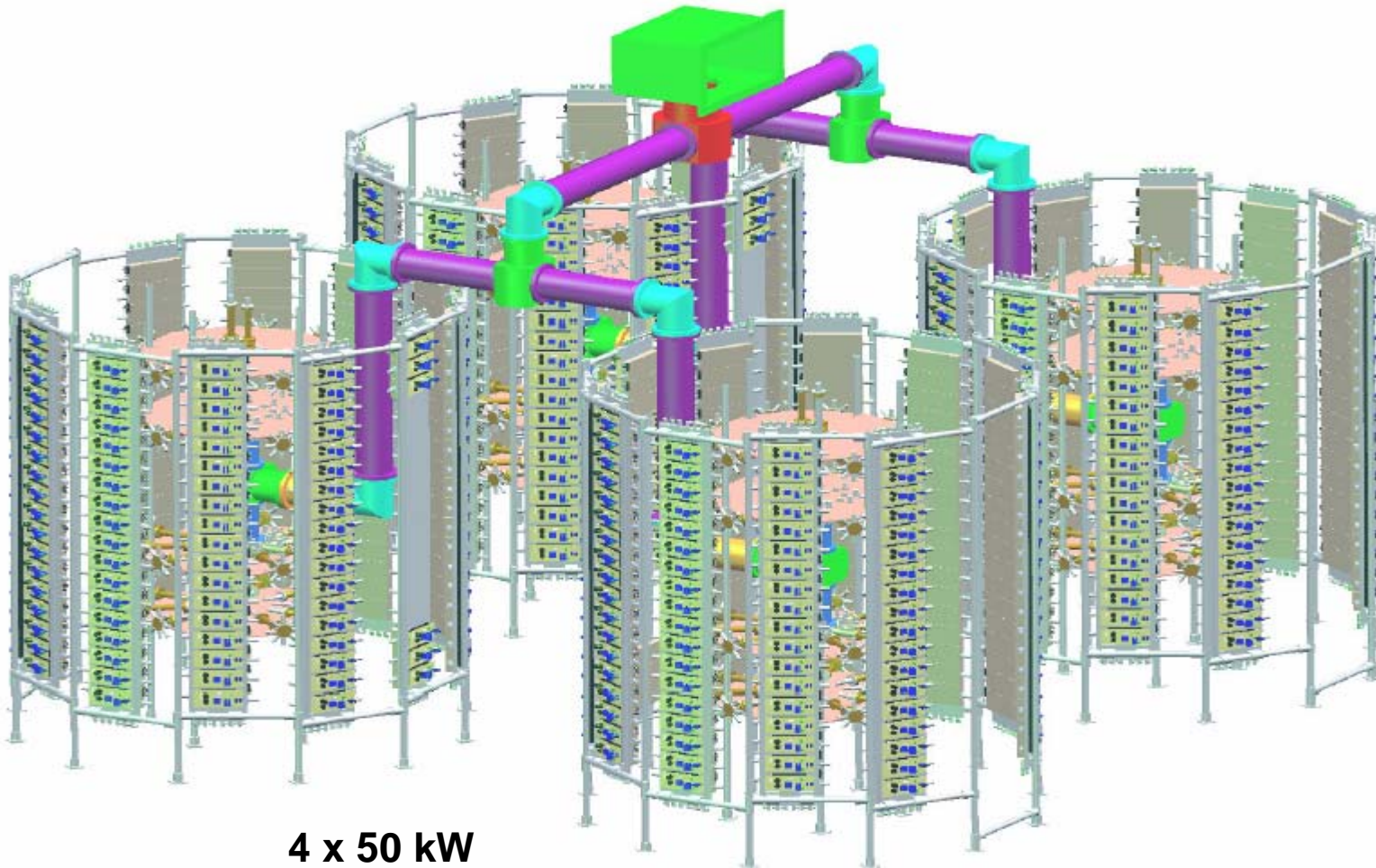
Result:
BP = 5 Hz for a 50 mV modulation

BOOSTER CONTROL SYSTEM



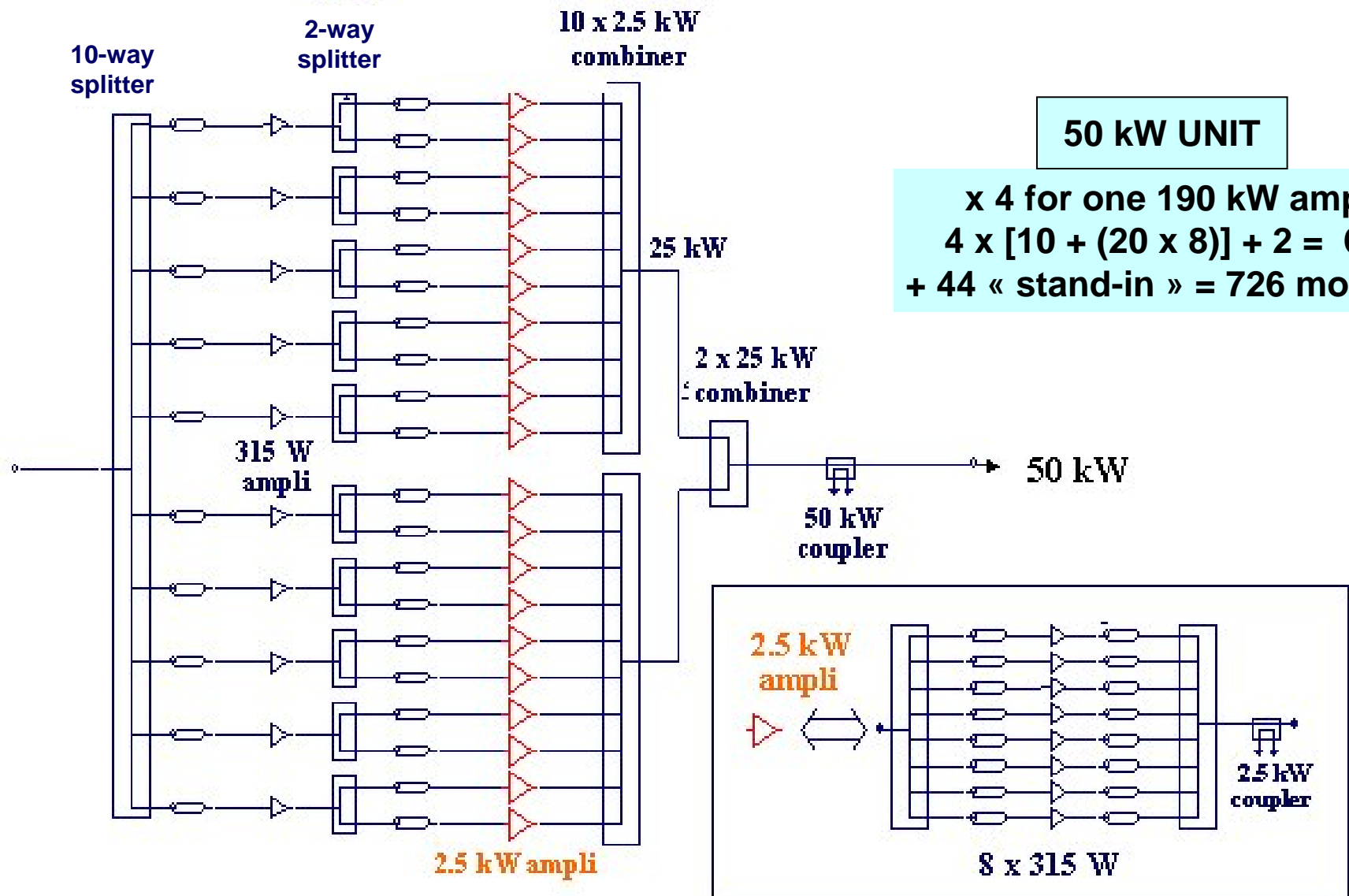
LLES: Low Level Electronic systems

◆ 190 kW Amplifier (1 per cavity)



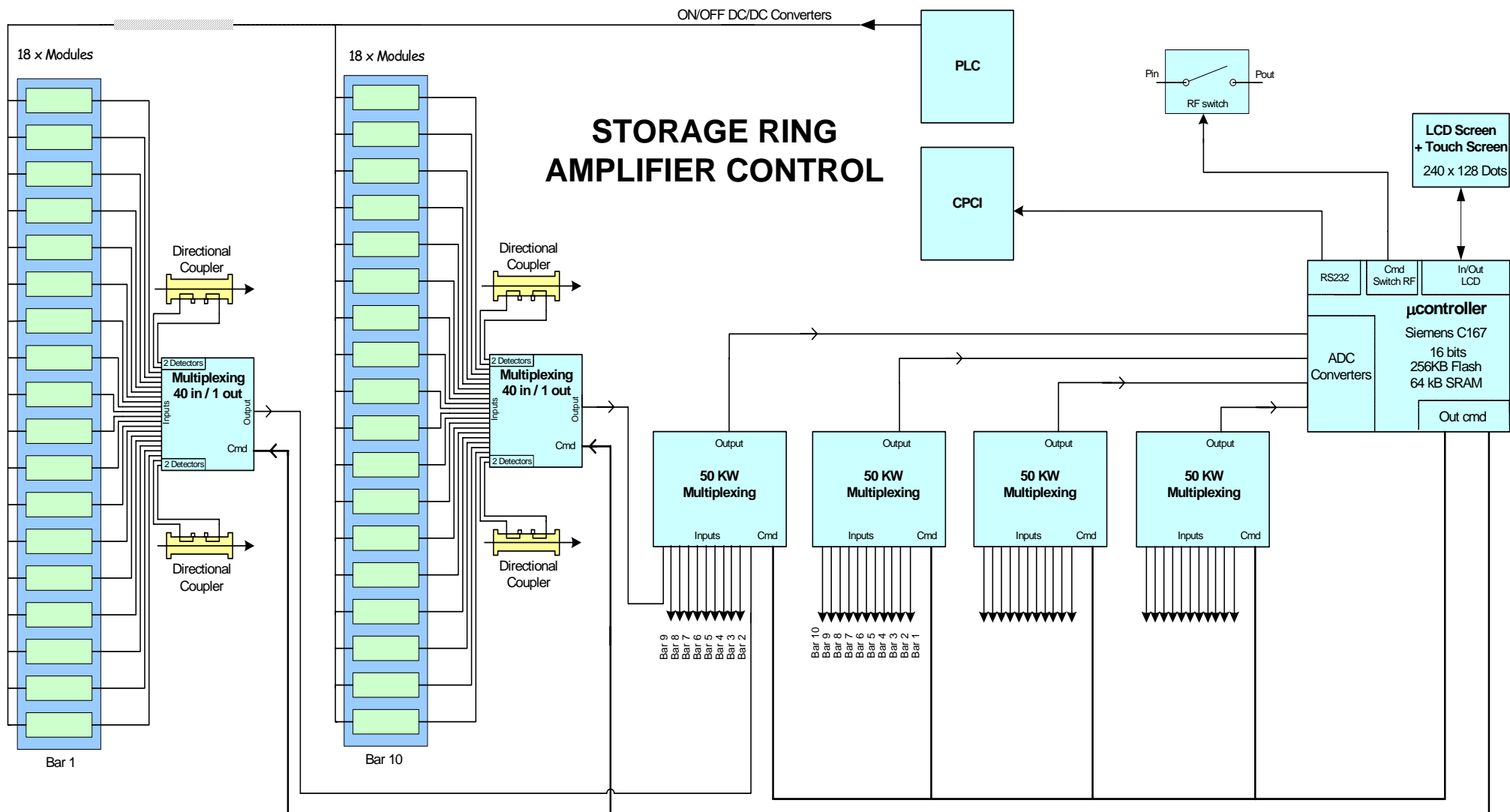
4 x 50 kW
726 modules of 315 W

50 KW UNIT PRINCIPLE



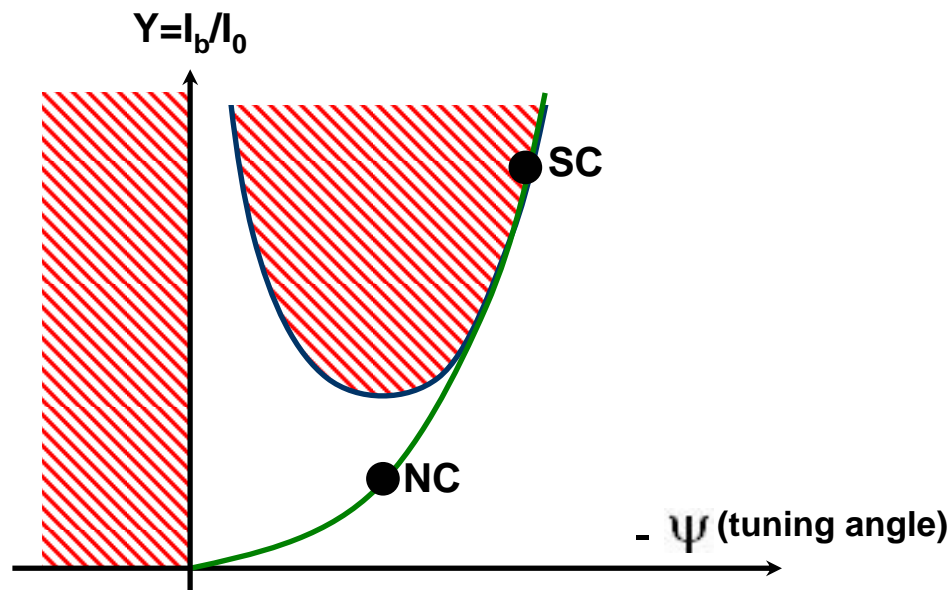
AMPLIFIER SUPERVISION

◆ Microcontroller and multiplexing system



◆ **STORAGE RING : 4 Superconducting 352 MHz cavities,
housed per pair in 2 cryomodules**

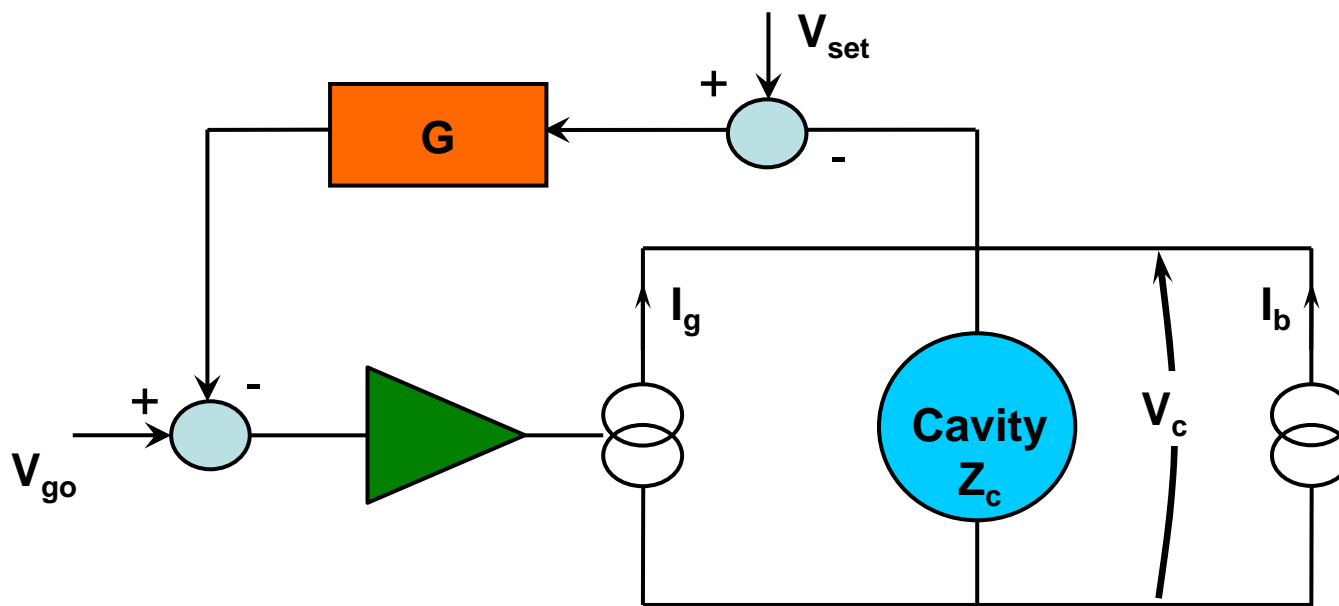
- **Very high beam loading ($Y_{sc} \sim 10 Y_{nc}$)** → **limit of Robinson instability
(zero margin)**



**Robinson stability diagram
(matched condition, $P_{ref} = 0$ at max I_b)**

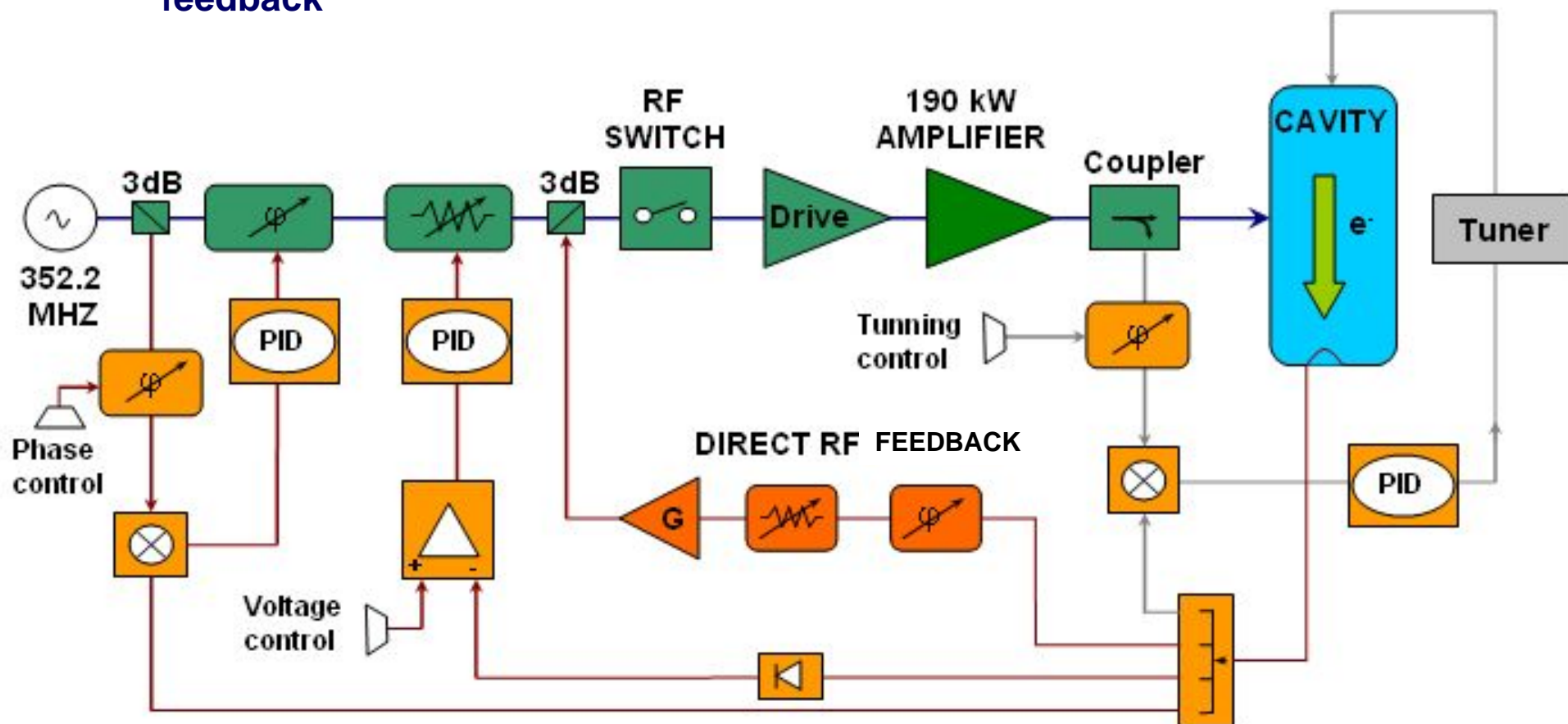
◆ Cure : direct RF feedback loop

- RF signal coming from the cavity pick-up re-injected into the power amplifier to reduce the impedance seen by the beam

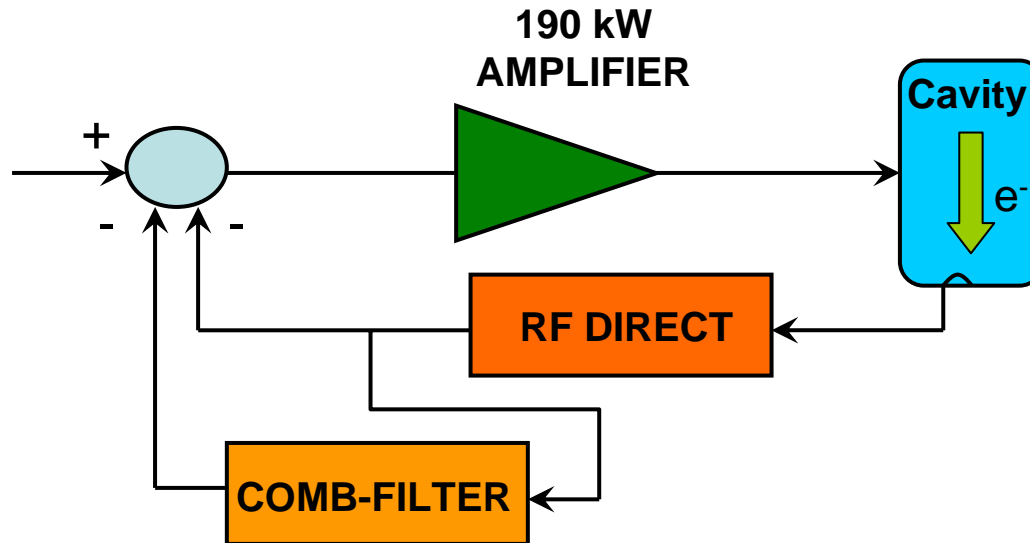


◆ STORAGE RING PHASE 1:

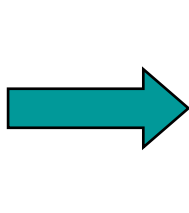
- **Booster - like « slow » frequency, amplitude and phase loops + direct RF feedback**



Gain limited by direct RF feedback delay → Optimization: comb-filter in parallel



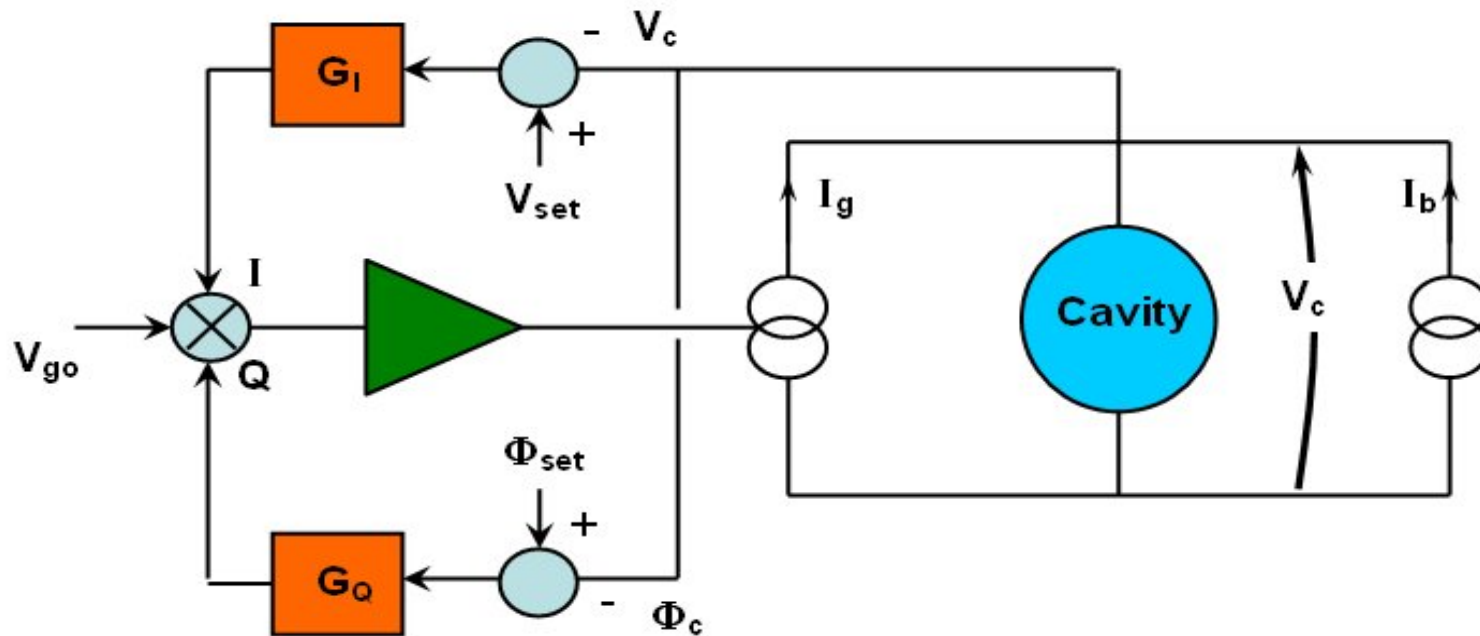
- This filter enables us to adjust the feedback phase at sideband frequencies



Possibility to reduce selectively the cavity impedance at the synchrotron sidebands of the revolution harmonics to cope with longitudinal coupled-bunch instabilities

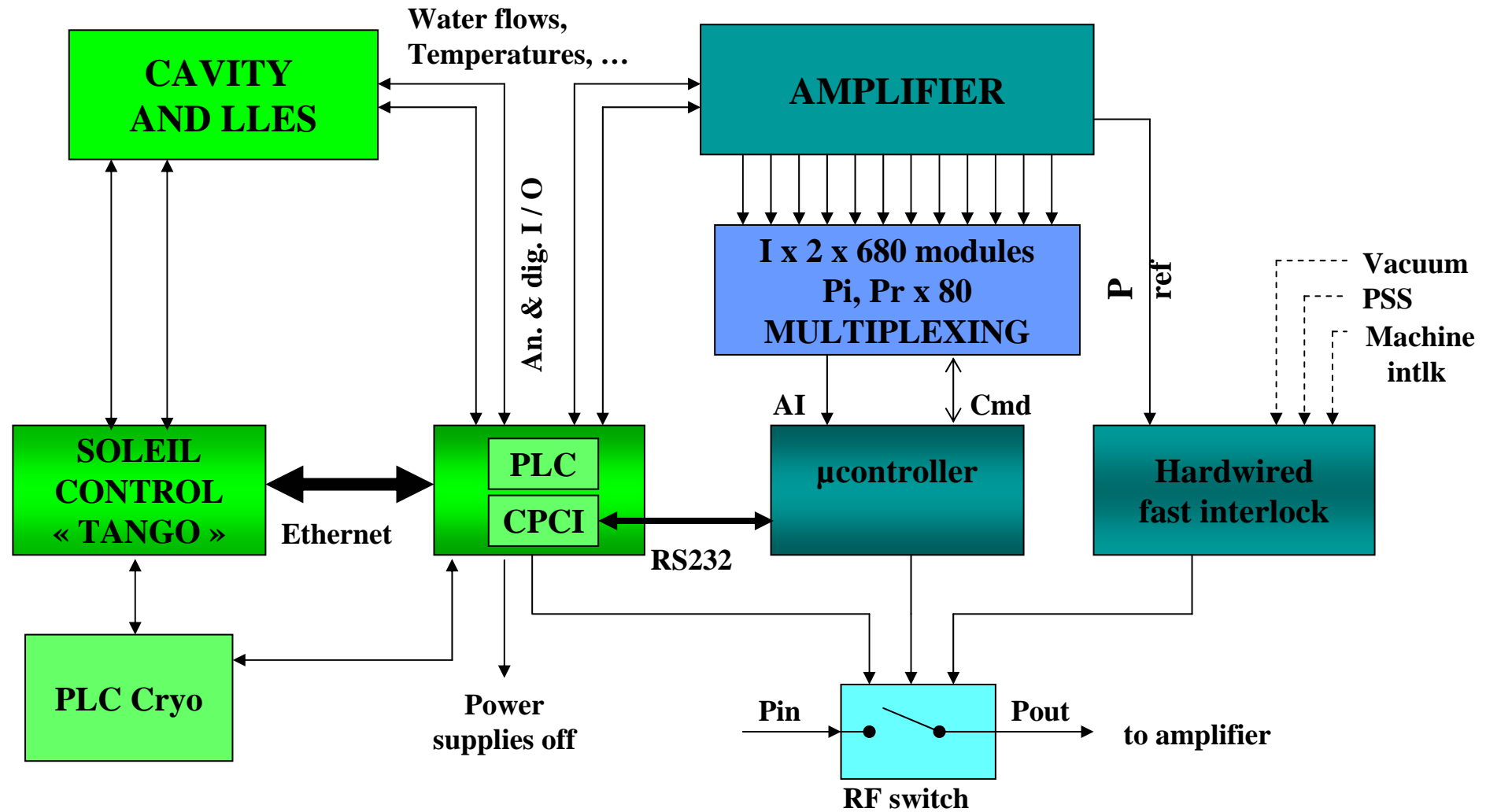
◆ STORAGE RING PHASE 2:

Design of fast digital amplitude and phase loops
(collaboration with CEA)



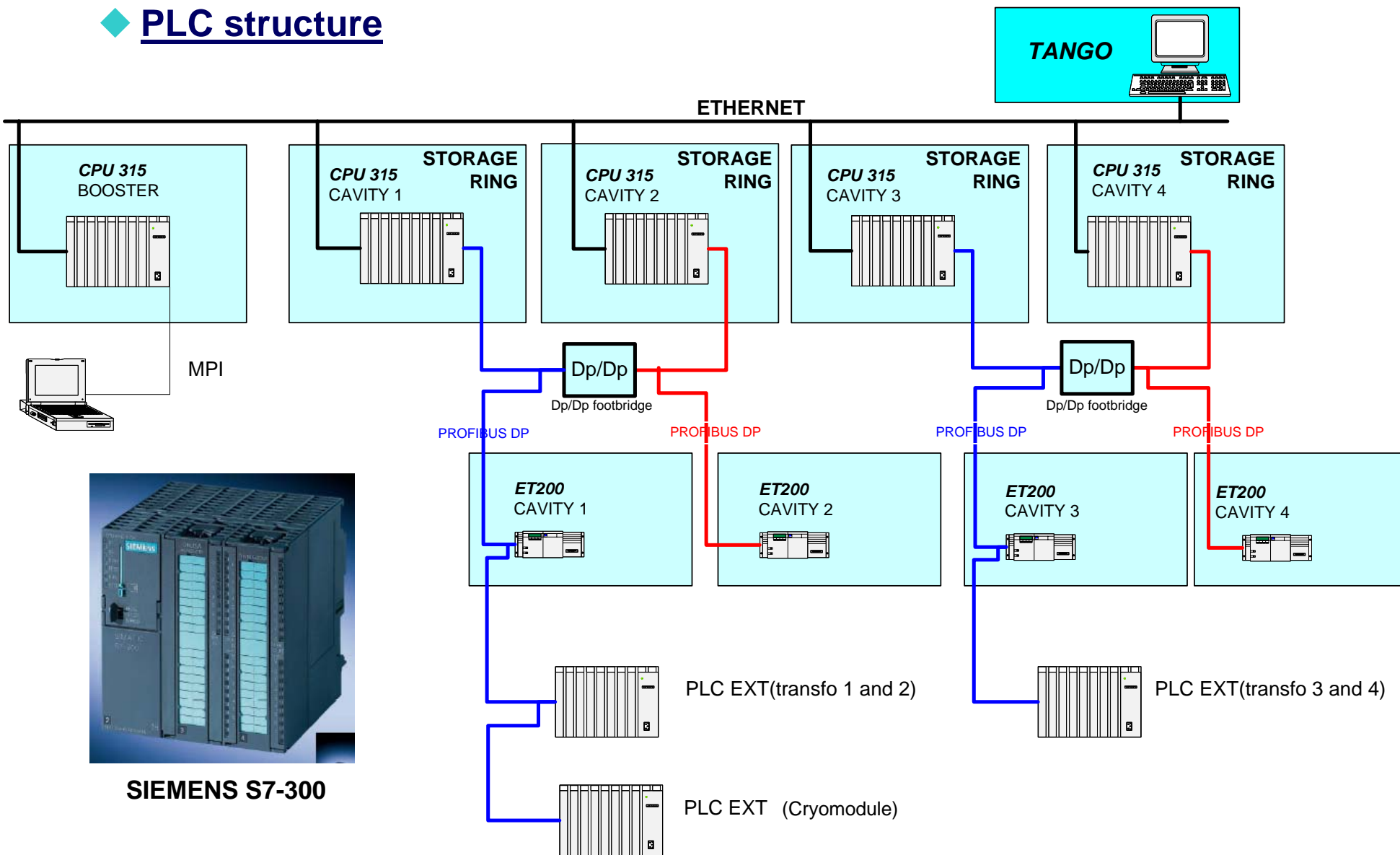
➤ **Fast, Modular, Reliable, Flexible**

STORAGE RING CONTROL SYSTEM



LLES: Low Level Electronic systems

◆ PLC structure



✓ Regulation loops

- **BOOSTER:** Use of « slow » analogic amplitude, phase and frequency loops
- **STORAGE RING:**
 - **Phase 1:** booster like system + direct RF feedback loop
 - **Phase 2:** replacement of the analogic system with a digital one using fast amplitude and phase loops

✓ RF control systems

- **CPCI => RF diagnostics**
- **PLC => cavities and amplifier interlocks**
- **Hardwired fast interlocks**
- **Dedicated PLC for cryo-plant (storage ring)**