

A SYSTEM FOR AUTOMATIC LOCKING OF RESONATORS OF LINAC AT IUAC

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ABSTRACT The superconducting LINAC booster of IUAC^[1] consists of five cryostats housing a total of 27 Nb quarter wave resonators (QWRs)^[6]. The QWRs are phase locked against the master oscillator at a frequency of 97 MHz. Cavity frequency tuning is done by a Helium gas based mechanical tuner (slow tuner) prior to phase locking. The frequency tuning and phase locking is done from the control room consoles [7]. To automate the LINAC operation, automation of phase locking has been implemented by automatically controlling the slow tuner gas pressure in response to the frequency error. When the frequency error is low, the phase lock PLL is automatically closed. The system has been implemented successfully. High stability and reliability has been observed.

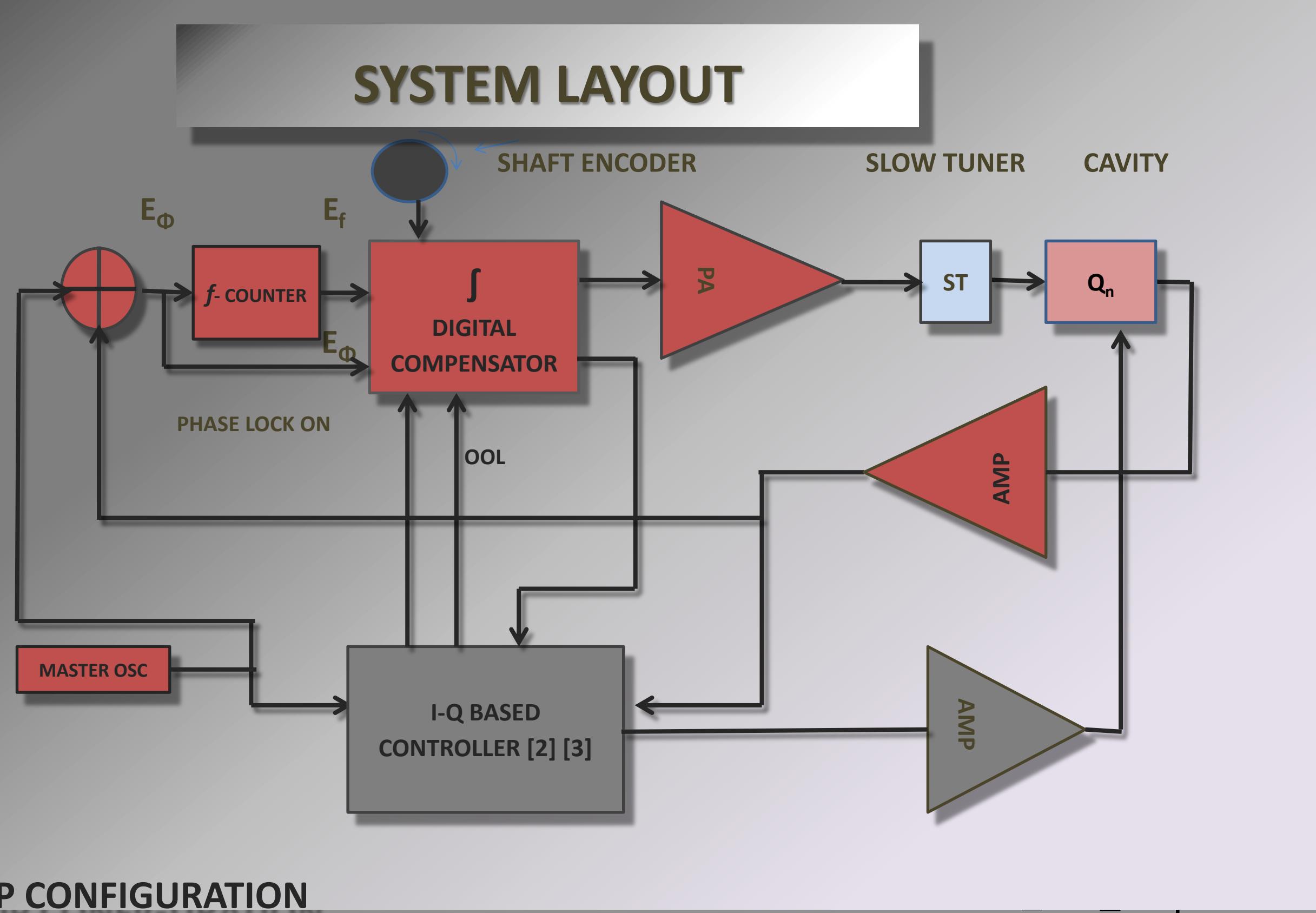


FIG: LOOP CONFIGURATION

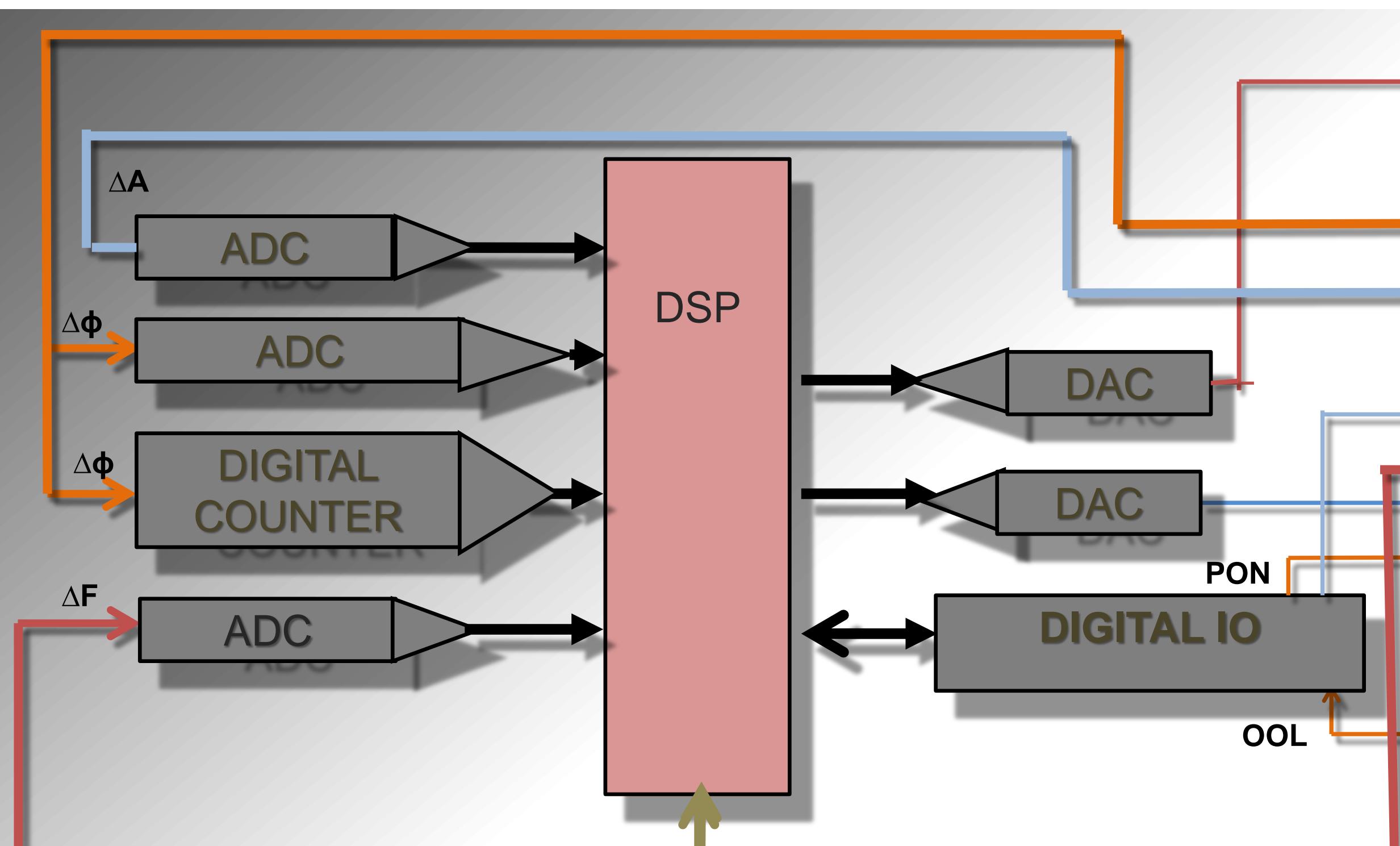


FIG: LOOP IMPLEMENTATION

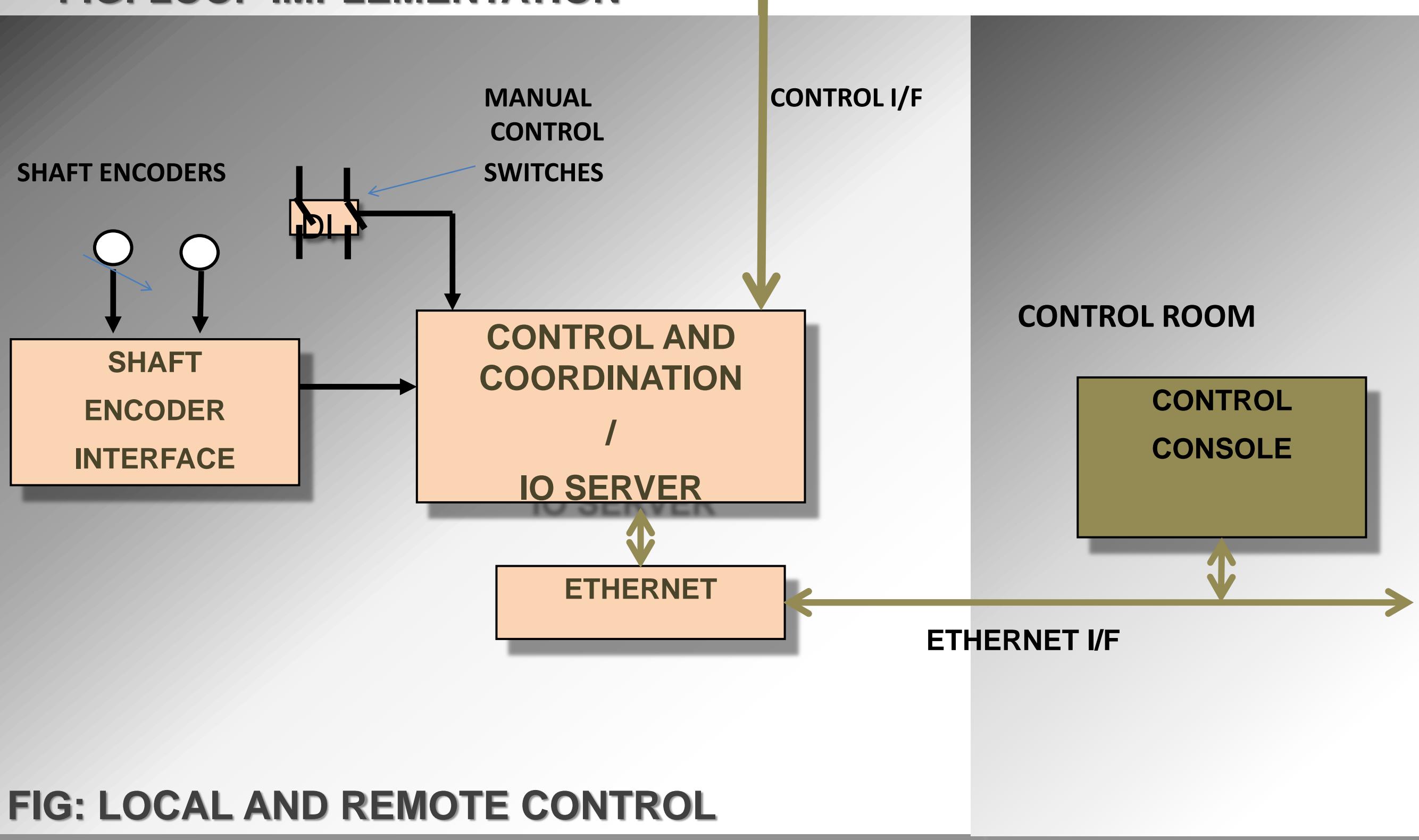


FIG: LOCAL AND REMOTE CONTROL

ALGORITHM

1. Look at the amplitude error and adjust IG until it is minimum.
2. Switch on amplitude locking on main controller.
3. Drive pneumatic valves V1 and V2 to Minimize ΔF .
4. When the ΔF is very small, switch on the main and change the feedback mode to phase mode. The PID gains change accordingly.
5. Watch OOL signal regularly. If it fails, unlock the phase lock PLL and go back to frequency mode.

FEATURES

- AUTOMATIC FREQUENCY TUNING.
- AUTOMATIC ENABLING OF THE MAIN PHASE LOCK LOOP.
- DIGITAL IMPLEMENTATION OF SLOW PHASE LOOP.
- CONSTANT MONITORING OF LOCK FAILURES FROM THE MAIN IQ BASED PLL CIRCUIT.
- AUTOMATIC ADJUSTMENT OF THE RESONATOR INPUT GAIN TO MINIMIZE AMPLITUDE ERROR.
- AUTOMATIC ENABLING OF AMPLITUDE LOCK SWITCH.
- LOCAL AND REMOTE INTERFACE

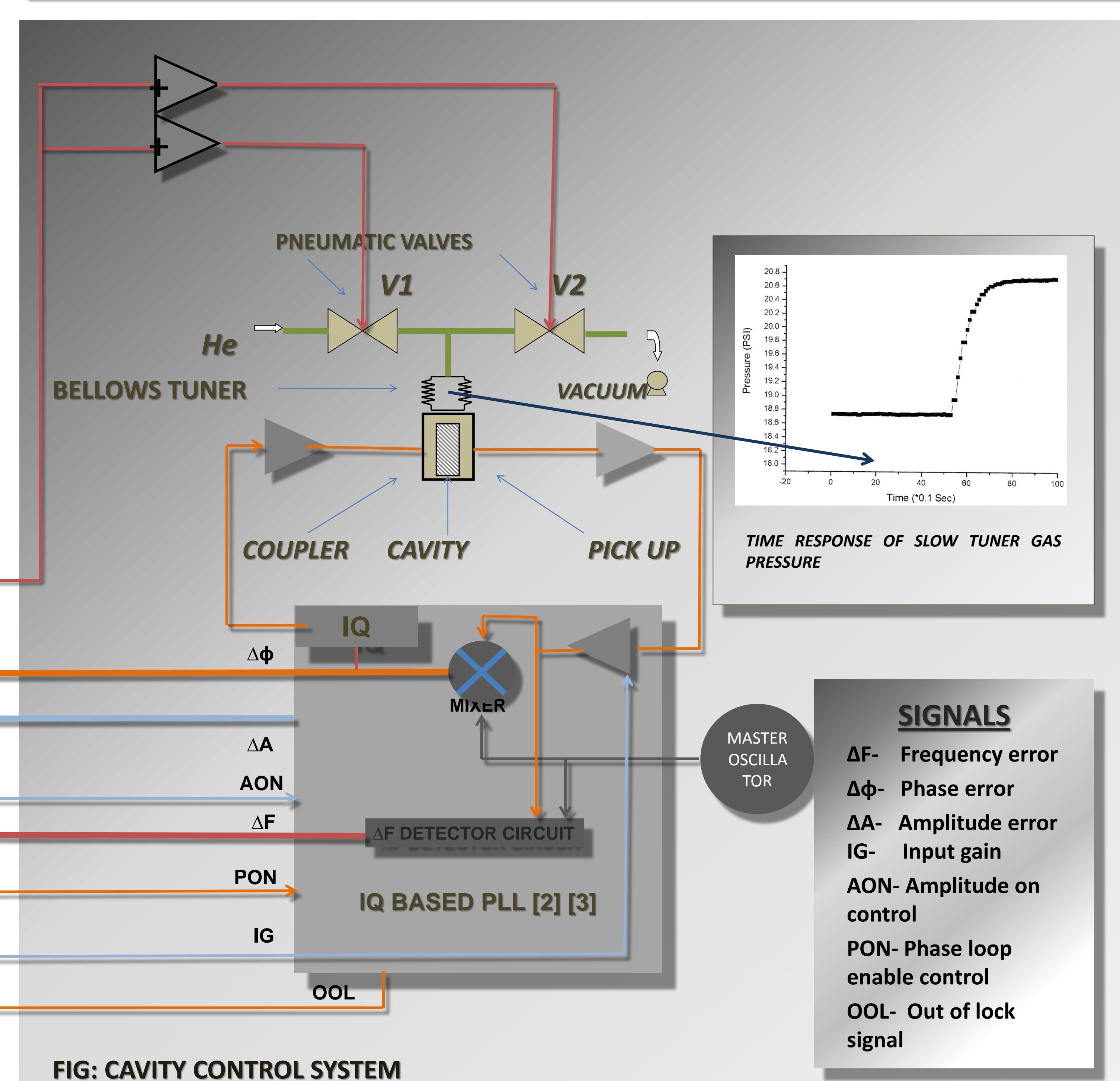


FIG: CAVITY CONTROL SYSTEM

SIGNALS

- | | |
|----------------|---------------------------|
| ΔF - | Frequency error |
| $\Delta\phi$ - | Phase error |
| ΔA - | Amplitude error |
| IG- | Input gain |
| AON- | Amplitude on control |
| PON- | Phase loop enable control |
| OOL- | Out of lock signal |

PERFORMANCE

Automatic locking of cavities has been done successfully upto the highest cavity fields available at IUAC. Lock stability is excellent with a Ph error of < 0.5 Deg at a field of 4.5 MV/m. Typical locking time is of the order of 30 seconds. High stability and reliability has been observed.

FUTURE PLANS

Implementation of the system is underway for all remaining cavities of linac cryostats. Support for the piezo electric mechanical frequency tuners recently installed at IUAC [5] is to be added. High voltage electronics is planned for the purpose.

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