SRF Cavity Instability Detection

Problem:

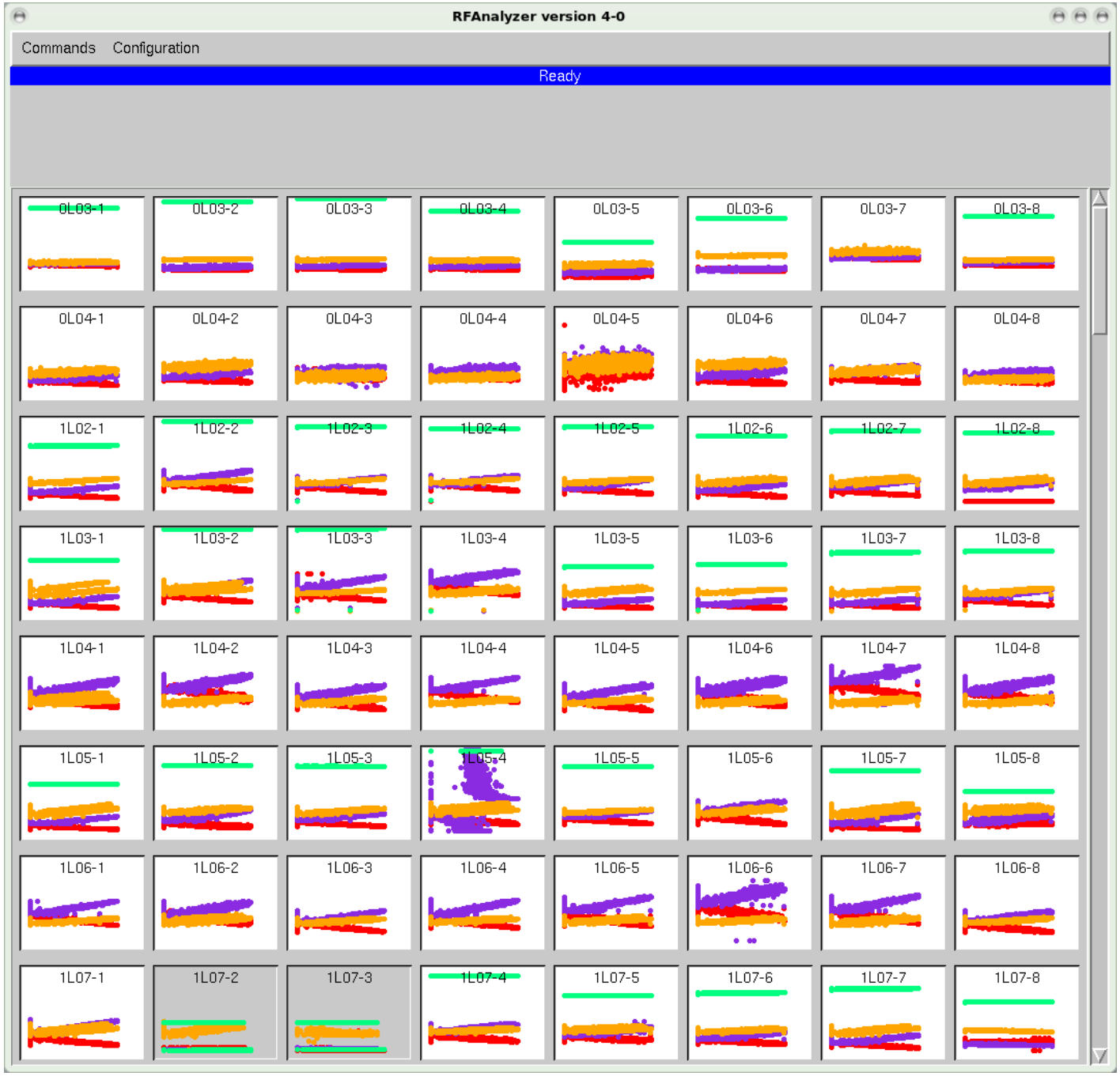
- SRF cavities can become unstable without presenting faults.
- Cavity instability causes beam energy instability, which can lead to beam loss and limited availability of beam for experiments.
- Identifying an unstable SRF cavity with the present diagnostics at CEBAF is difficult and time-consuming (*Needle in a haystack*).
- Present SRF diagnostics hardware and software for the legacy cavities are not fast enough to record fast transient instabilities.

SRF Cavity Instability Detection

Proposed Solution:

- Develop and install a new fast DAQ system for the legacy SRF cavities.
- Apply AI to the data acquired by the new DAQ to identify unstable cavities.
- Also apply AI to the existing slow archived data to identify unstable cavities.
- The goal is to quickly identify misbehaving cavities and therefore improve beam quality and availability.

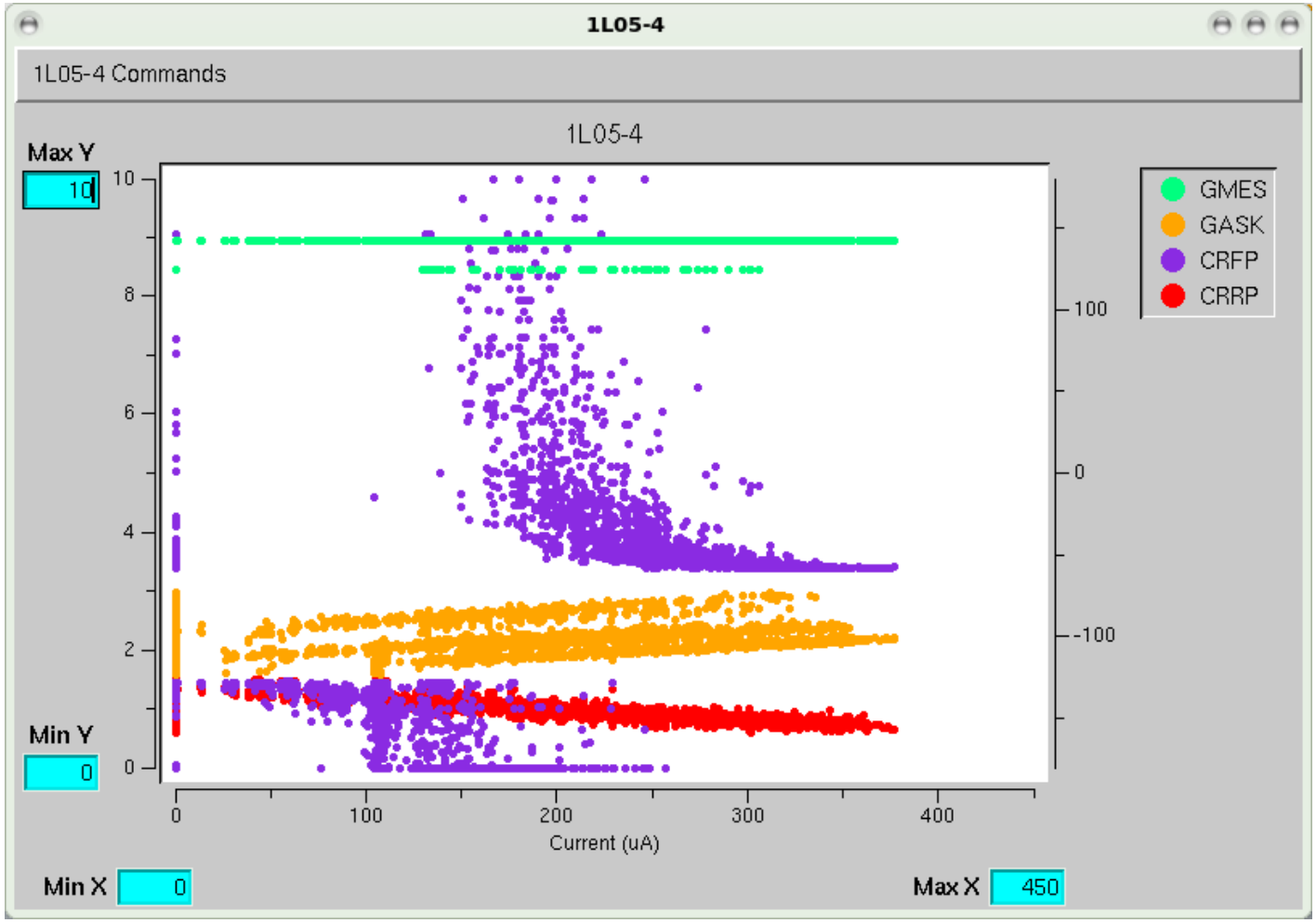
Existing RF Analyzer tool



Existing RF Analyzer tool

- Existing tool uses archived data from EPICS; sampling rate 1Hz (slow)
- Operators and technicians must examine all 400 cavities in CEBAF visually to find an offending cavity
- Pattern recognition or anomaly detection could be applied to the data to identify unstable cavities
- Other RF software tools exist with similar limitations

Example of Unstable Cavity



Blatant example; cavity instability is often more subtle.