Tune Feedback at the Canadian Light Source

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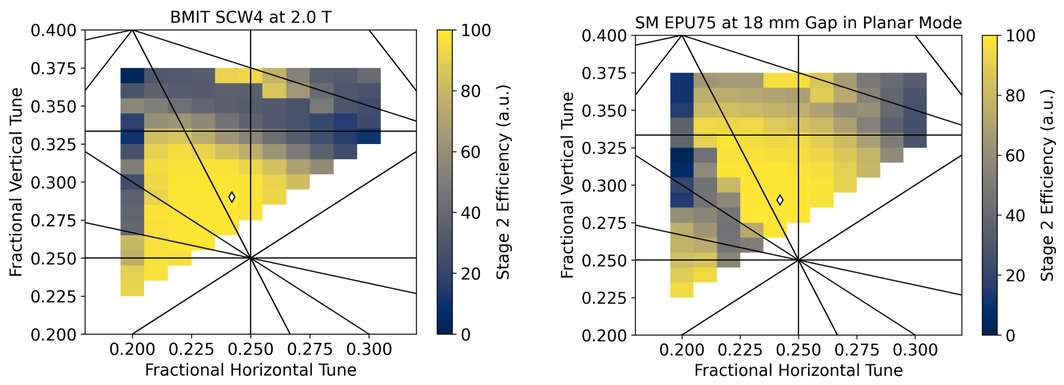
Abstract

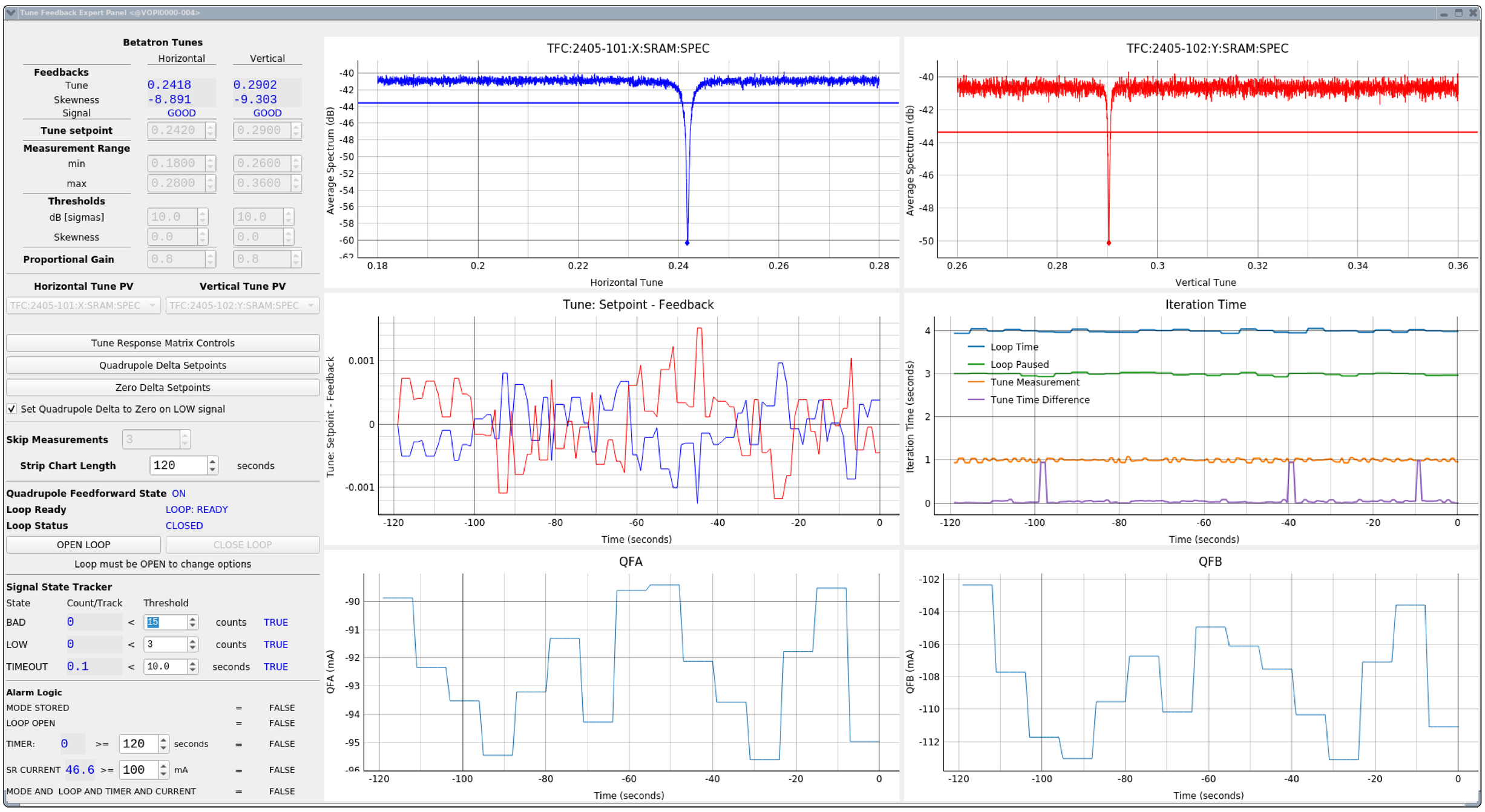
In order to maintain good injection efficiency for top-up operation at the Canadian Light Source, we must keep the betatron tunes constant even as changes in insertion device fields cause the tunes to vary. To meet this requirement, we implemented a tune feedback system. We measure the tunes at a rate of 1 Hz using Dimtel bunch-by-bunch systems. The transverse feedback function of the bunch-by-bunch systems provides tune measurements without disturbing the electron beam. We adjust two quadrupole families at a rate of 0.25 Hz to control the horizontal and vertical tunes. In this article we describe the tune feedback system, its development and its performance. The system has proven to be very robust, enabling reliable top-up operation.

Tune and Injection

- The betatron tunes must be held constant in order to maintain acceptable injection efficiency
- Insertion device field changes cause the tunes to change



Diamonds mark the nominal fractional tunes



Tune Measurement

- Dimtel iGp12 bunch-by-bunch systems provide non-invasive tune measurements once per second
- LOW means signal is weak (tune signals are negative going)
- BAD means signal is positively skewed
- TIMEOUT means signal is not updating
- If none of the these, then signal is GOOD and we can use the measured tune as an input to the feedback algorithm
- If tune feedback is not running when it should be, then generate an alarm for the operators

Feedback

- Use two families of quadrupoles to control the tunes
- Use an inverse response matrix to calculate the required quadrupole changes to correct the tunes
- Output new quadrupole setpoints every four seconds

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