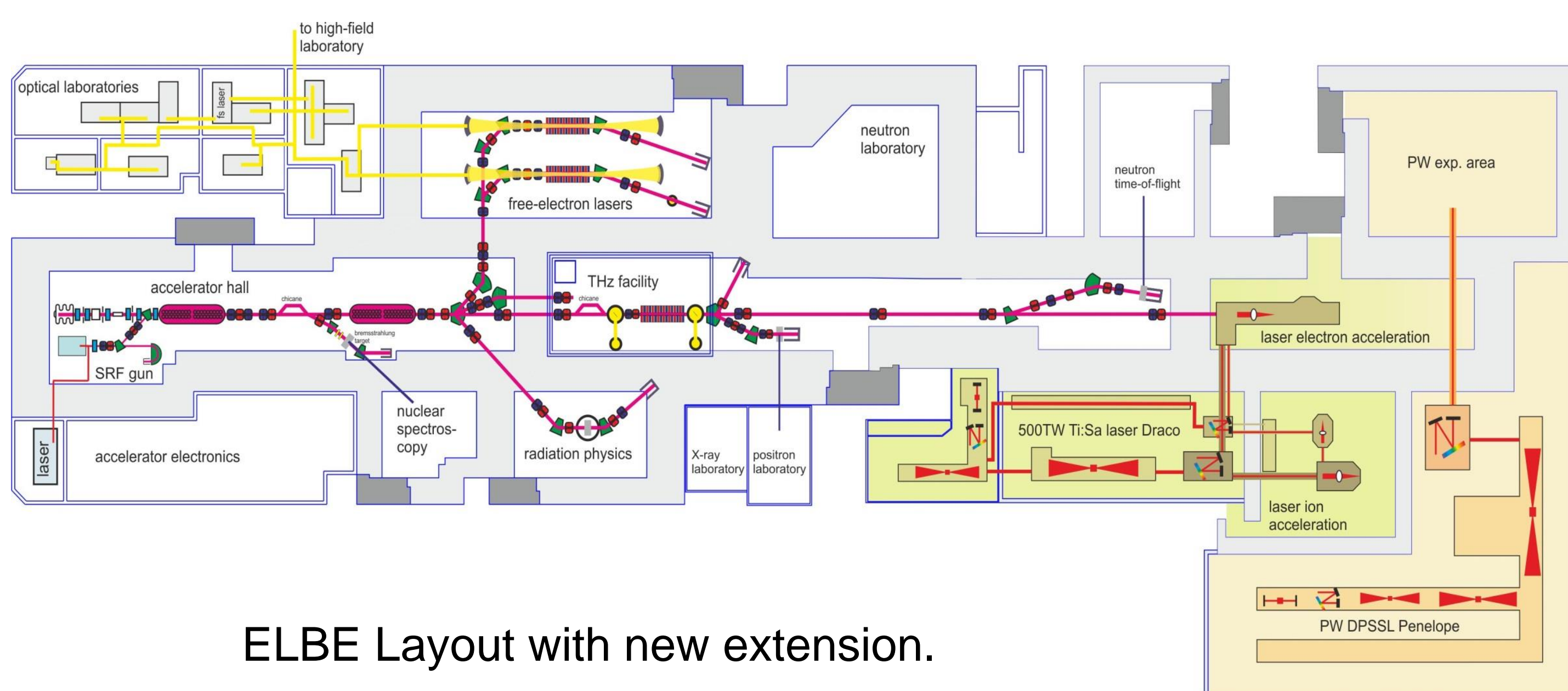


# A NEW HIGH-DYNAMIC RANGE BPM FOR ELBE WITH INTEGRATED DIFFERENTIAL CURRENT MONITOR (DCM)

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## ELBE Upgrade

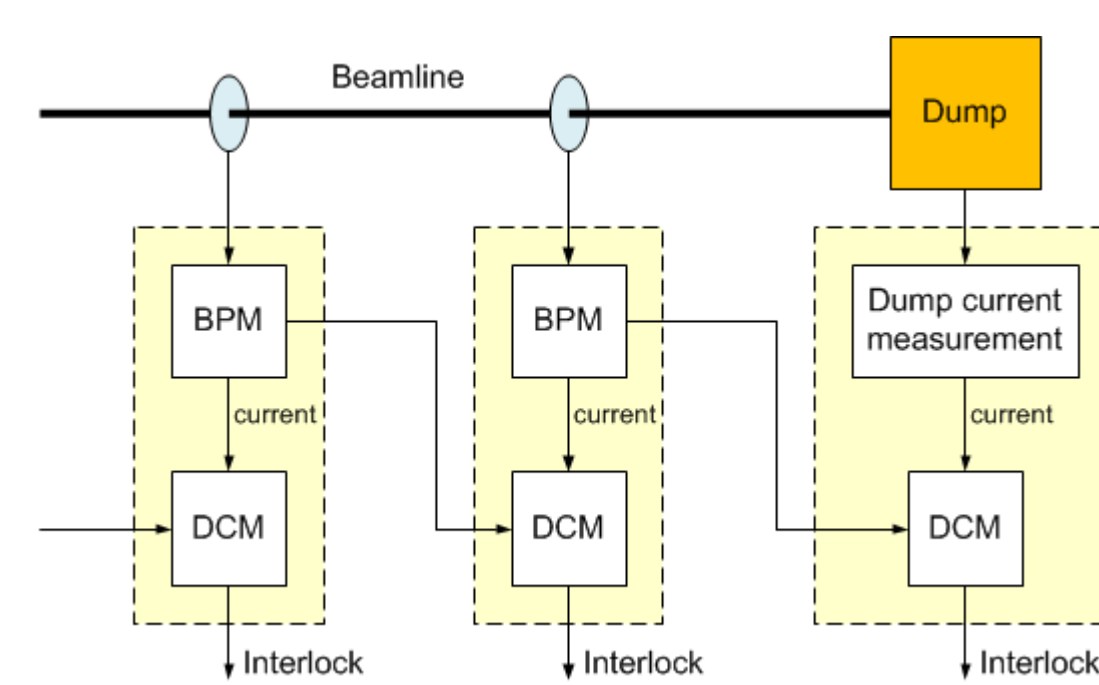
ELBE is a LINAC electron accelerator for small energies (12 to 50 MeV) [1]. The ELBE upgrade allows electron beams with bunches ranging from single electrons to 1 nC in the future. The maximum possible beam current is now 1.6 mA CW and the repetition rates covering the range from one shot single bunch pulses to 26 MHz CW. This requires an increase in the dynamic range of the BPMs / DCMs.



ELBE Layout with new extension.

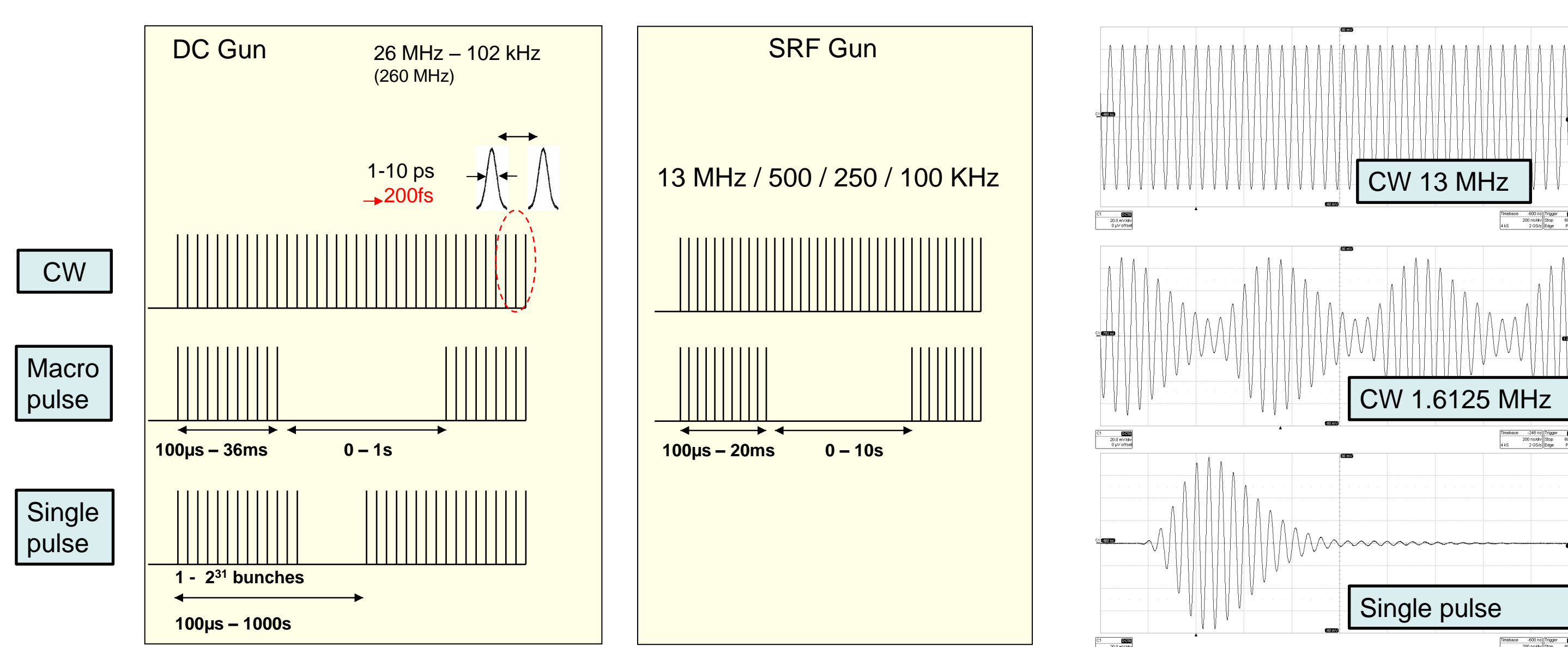
## DCM working principle

DCMs watch the beam current difference between two stripline sensors. A beam loss greater than 10  $\mu$ A produces an interlock. For the beam dump exist special DCMs.



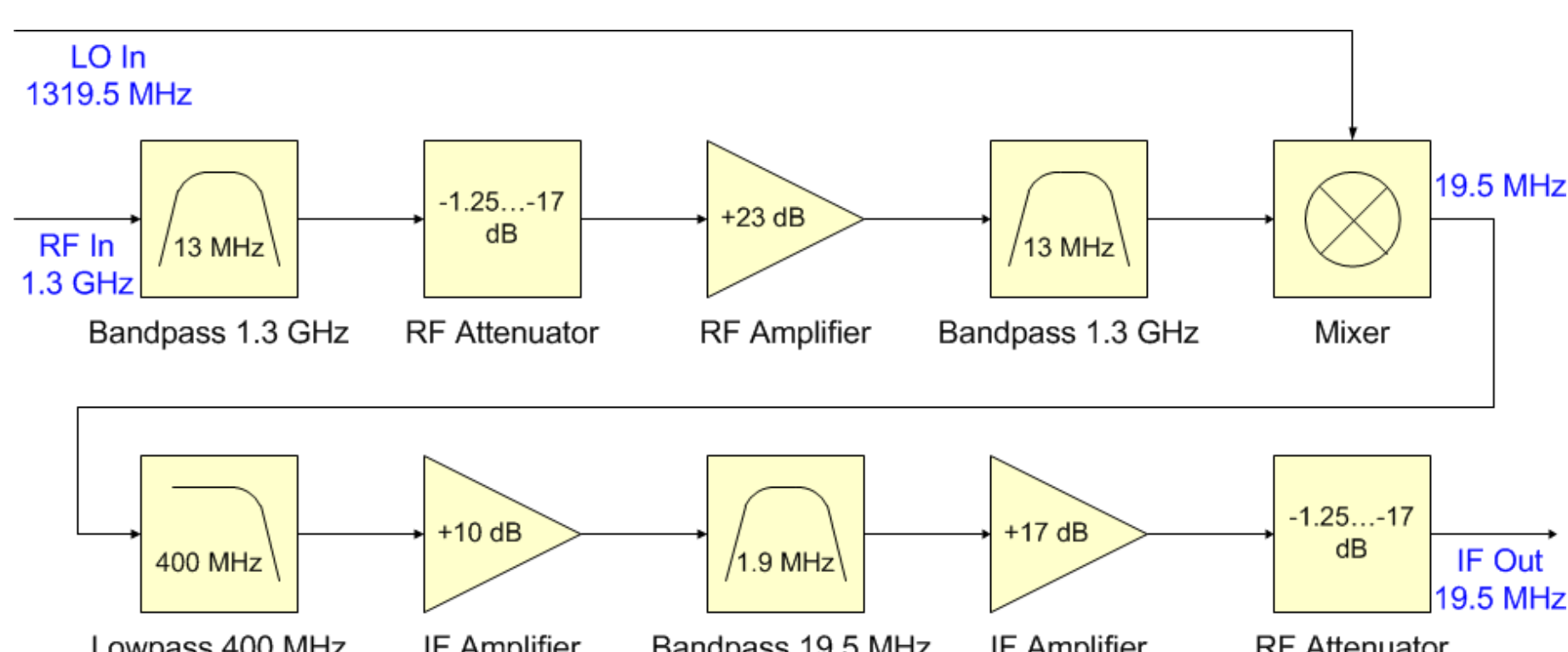
## ELBE beam modes

ELBE has a great variety of beam modes. CW with different micro pulse rates, macro pulses and single pulse counts may be combined. This gives different signals in the BPM RF frontend:

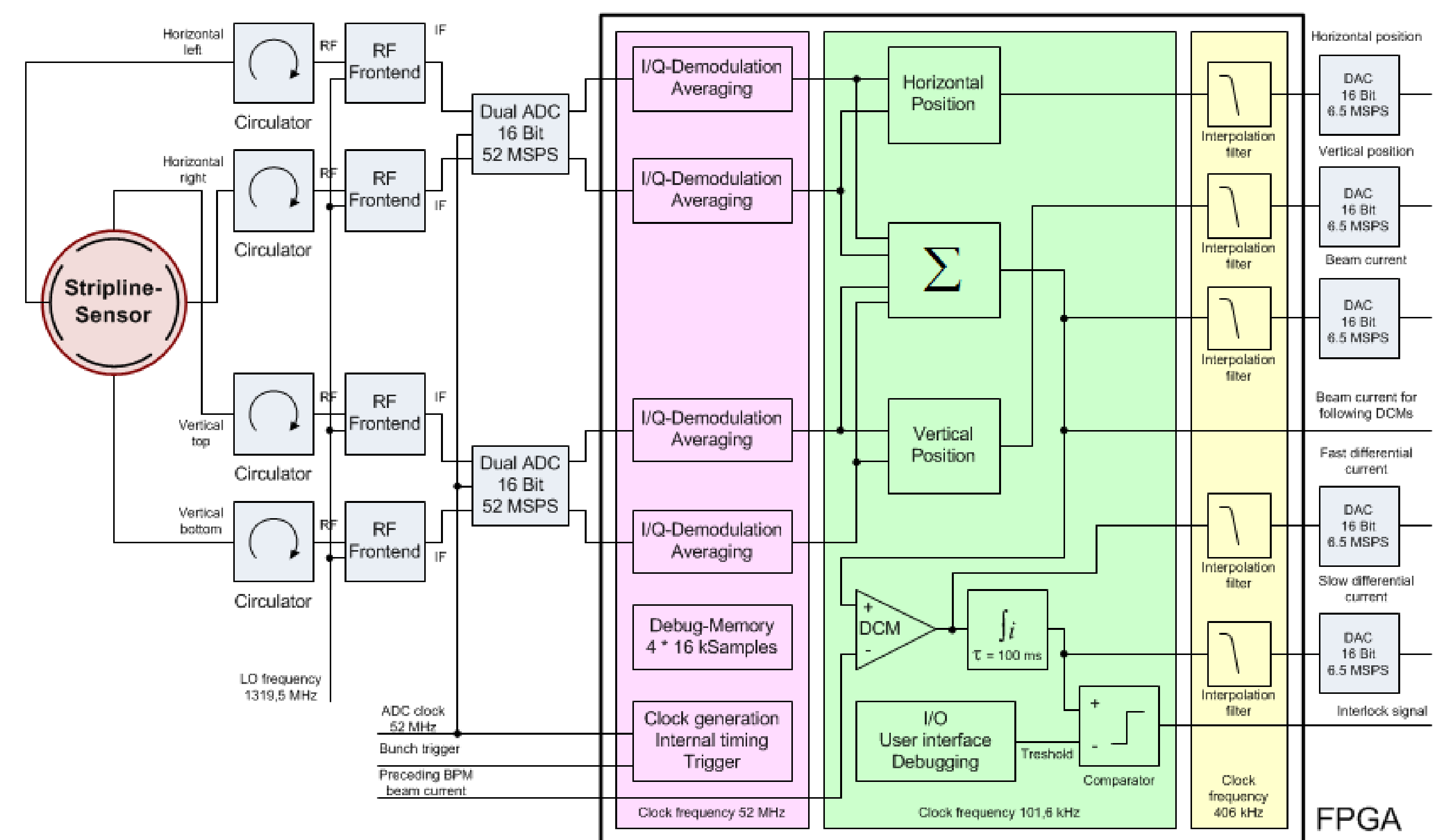


By a completely synchronized operation with true RMS calculation the bunch mode dependency problem could be solved.

## RF Frontend



The new RF Frontend together with I/Q signal processing and averaging in the FPGA increases the dynamic range significant.



## New BPM with integrated DCM

Main parts of the new BPM are:

- The RF Frontend
- The two dual ADCs
- The FPGA with the signal processing:
  - I/Q-Demodulation and averaging
  - Position and beam current calculation
  - DCM functionality
  - Interpolation filter
- The DACs

The following interfaces are implemented: ProfiNET (SCADA), SFP high speed I/O, Machine interlock system and USB. The FPGA firmware realizes functions for control, communication, maintenance and debugging.

## Summary

The new BPM for the ELBE accelerator solves the bunch mode dependency problem inherent in the old BPMs and DCMs and gives a huge improvement in dynamic range.



## References

- [1] F. Gabriel, P. Gippner, E. Grosse, D. Janssen, P. Michel, H. Prade, A. Schamlott, W. Seidel, A. Wolf, R. Wunsch, "The Rossendorf radiation source ELBE and its FEL projects", Nucl. Instr. Meth. B 161, p. 1143 (2000).
- [2] H. Büttig, "Design and Performance of the upgraded ELBE RF-System based on Solid State Power Amplifiers", TIARA Workshop on RF Power Generation for Accelerators, Uppsala, 2013
- [3] M. Kuntzsch, "Electron Bunch Diagnostic at the Upgraded ELBE Accelerator: Status and Challenges", MOBL3, these proceedings.

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