Phase Feed-Forward

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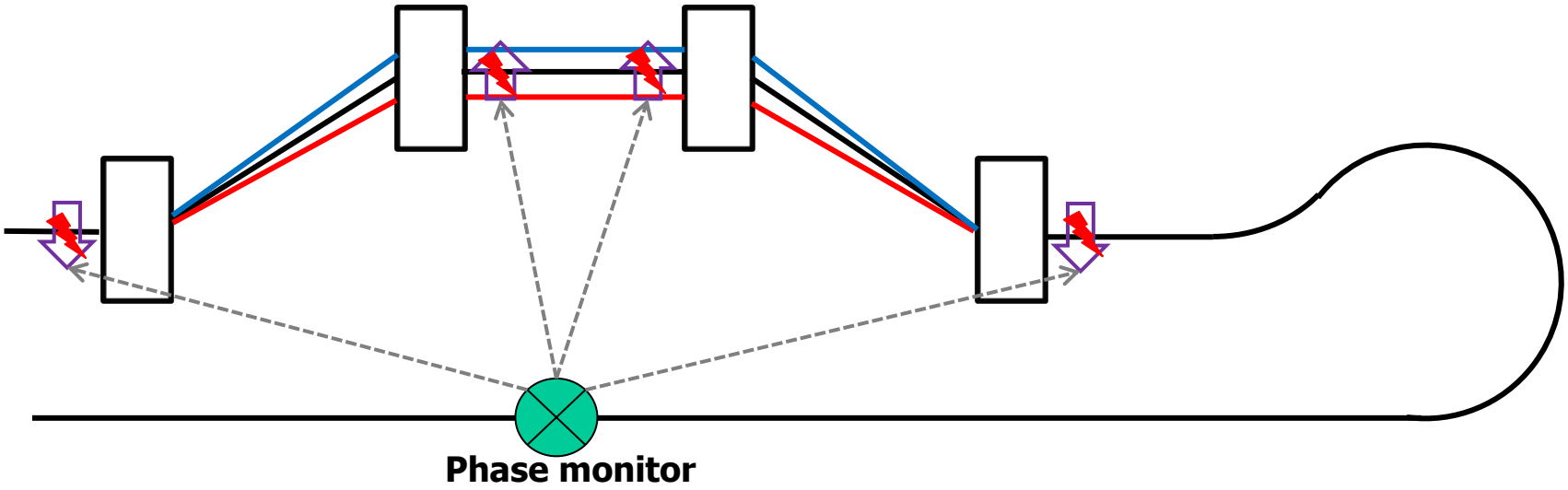
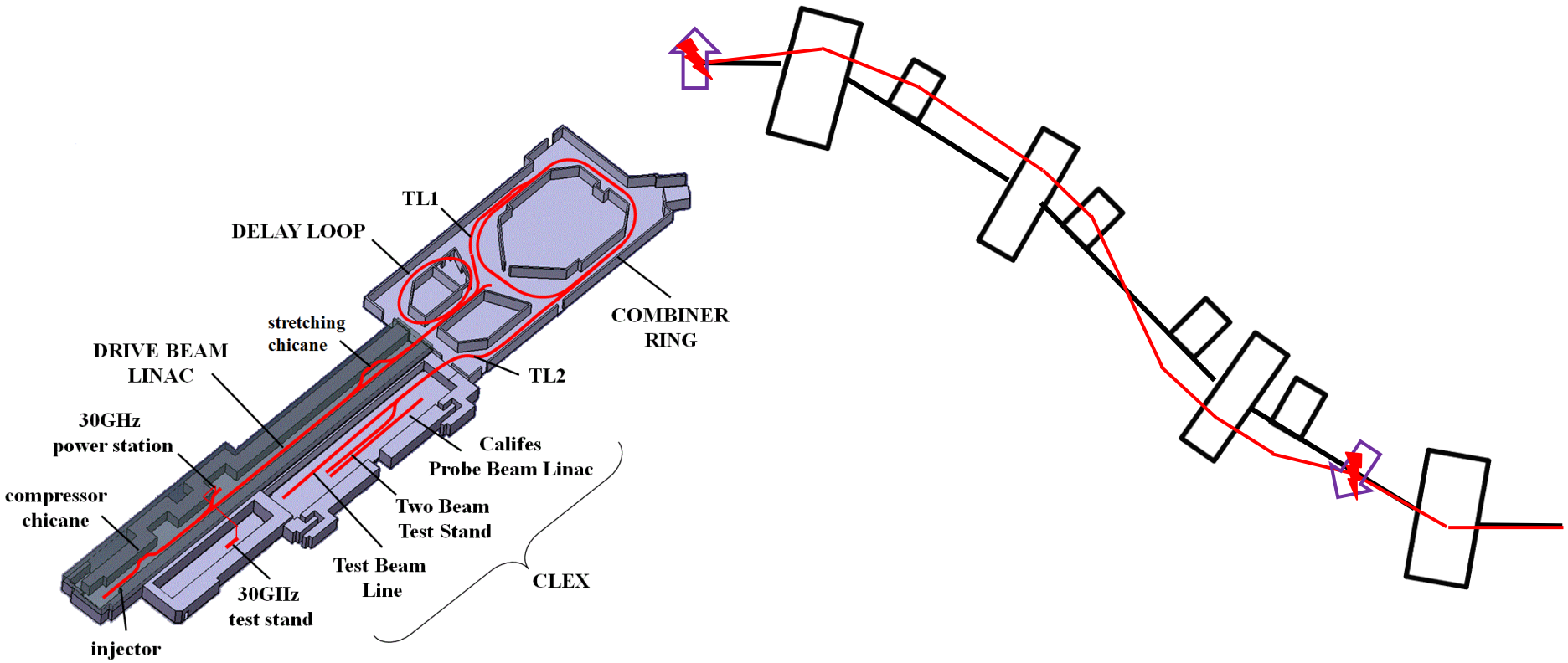
CLIC Phase Feed-Forward System

- Phase Feed-Forward system will increase the drive beam stability and correct phase variation along pulse from 10° (max) to the required 0.1° at 12GHz
  - Measure phase offset before turn around
  - Correct it after turn around
- The current CLIC design based on a 4-bend chicane, each bend equipped with a fast kicker so the "height" of the chicane is changing, and thus TOF together with it



Setup in CTF3

- A prototype system will be implemented in CTF3
- Phase will be measured just before DL
- Correction will be done in the dog-leg chicane of TL2 using 2 kickers



First-stage system design specifications

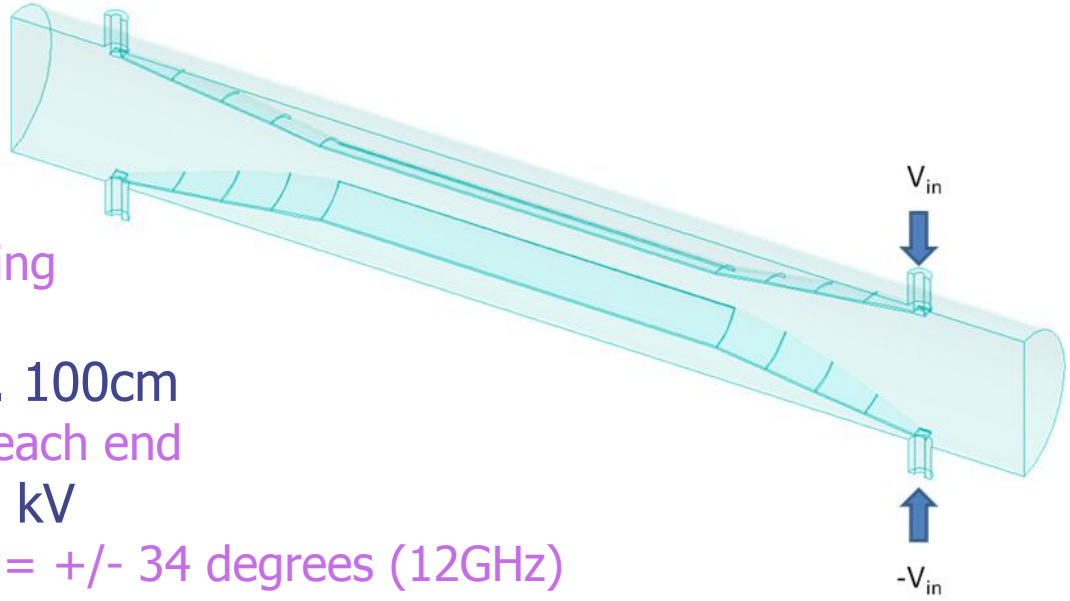
- Uncombined beam: 3 GHz bunch spacing
  - Correction for combined beam may be possible too, if phase errors are small
- Train length: 280ns
  - System useable also up to 420ns
- Pulse to pulse 'slow' feed-back correction of mean phase sag with wide phase correction range
- Feed-forward correction of higher-frequency components
  - With smaller range in phase correction (few degrees) and bandwidth (30MHz)
    - Defined by the amplifier performance that could be delivered within 1 – 1.5 years
  - R&D on amplifier with the CLIC specs starting now, to be installed in the second-stage

Phase monitor

- Phase measurement at 12 GHz using monopole mode of custom resonant cavity
- Three monitors will be made
  - the first will be available around October 2011 for testing
- 2 or 3 monitors will be tested in series with beam in 2012
- Electronics will output baseband analogue signals
  - Amplitude
  - Phase
  - Amplitude/Phase
- Output signal bandwidth 50-100 MHz, with latency about 5ns
- First version of electronics available soon for testing

Kicker

- Longitudinal space available in the beam line max 120cm
- Radial space:
  - Flanges max 18cm
  - Connectors max 25cm diameter
  - Determined by surrounding quadrupole aperture



- Total kicker strip length c. 100cm
  - 80cm + 10cm tapers at each end
- Kicker sensitivity: +/-1.35 kV
  - equivalent to +/- 1mrad = +/- 34 degrees (12GHz)
- Alignment not very critical:
  - mm transverse
  - few degrees azimuth ok, but will put a rotatable flange on one end, and fiducial marks near feed-throughs
- Kicker fabrication possible by Spring 2012
- Possibly use an external dipole corrector for the 'slow correction', if required

Kicker amplifier

- Bandwidth ~ 30MHz (eventual target: 70MHz)
- To be located in CLEX gallery extension
  - Roughly '6u' sub-rack size
- Cable run from amplifier to kicker about 15m
- Feedback board will digitise phase monitor signals using FONT approach
  - details will be decided later
- Latency considerations:
  - Design for total latency c. 380ns
  - If required, can add latency by circulating beam in the combiner ring

Summary

- Phase monitors – LNF Frascati
- Phase monitor read-out system – CERN
- Amplifiers – Oxford University
- Kickers – LNF Frascati
- Tentative Schedule
  - 1st monitor ready in October 2011
    - Tests with the readout electronics in the lab and later with the beam
  - Remaining monitors installed during 1st half of 2012
  - 3 monitors installed in chain for performance checks
  - Kickers ready mid 2012
  - Installation during winter shutdown 2013
- Oxford team will work on amplifier with CLIC specs
  - When ready to be installed in CTF3
    - It will provide feed-forward correction over the full range and with the full bandwidth