Approach for solution of CLIC IR stability

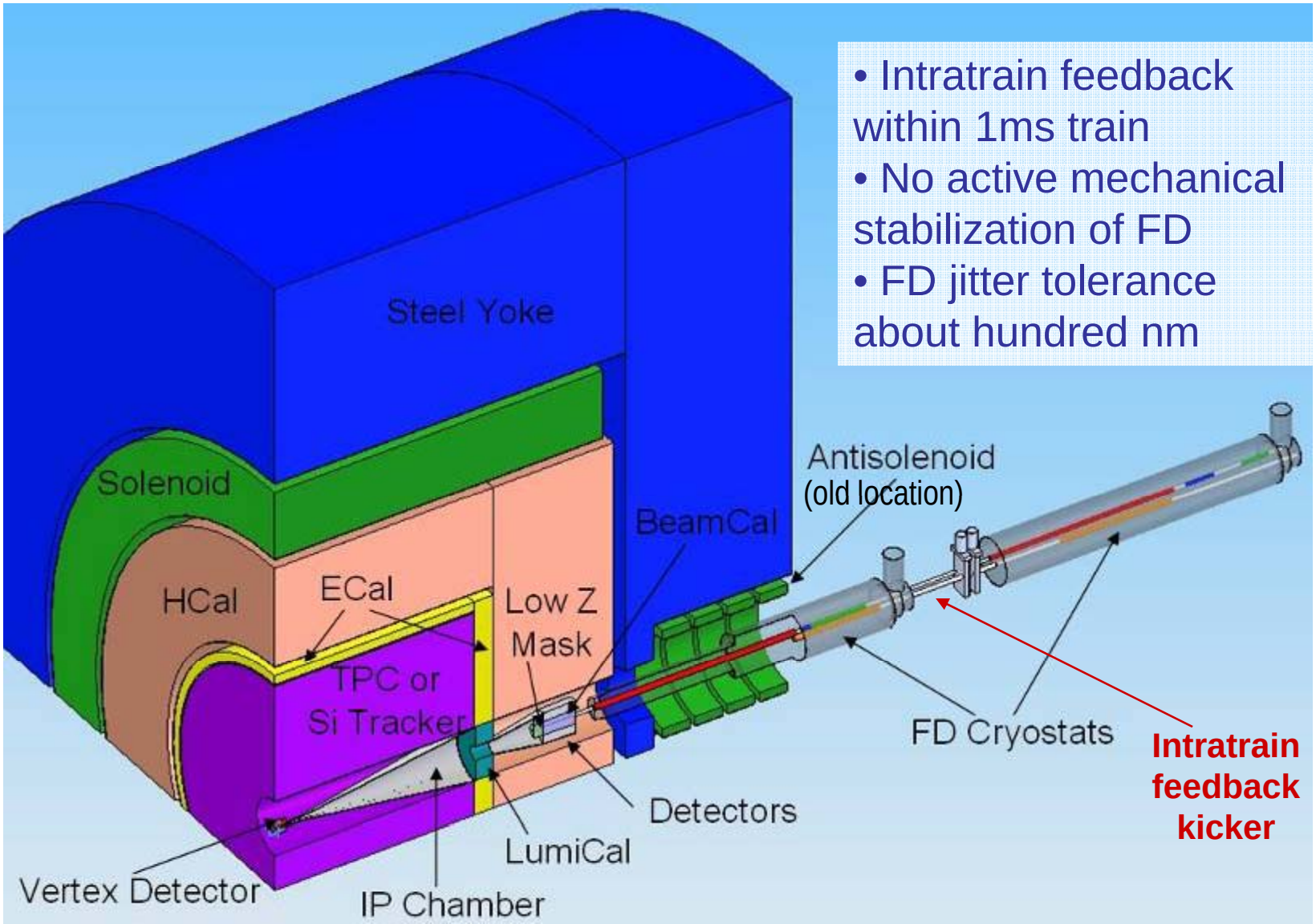
Andrei Seryi

SLAC

March 4, 2008

TILC08, 3-6 March 2008, Sendai, Japan

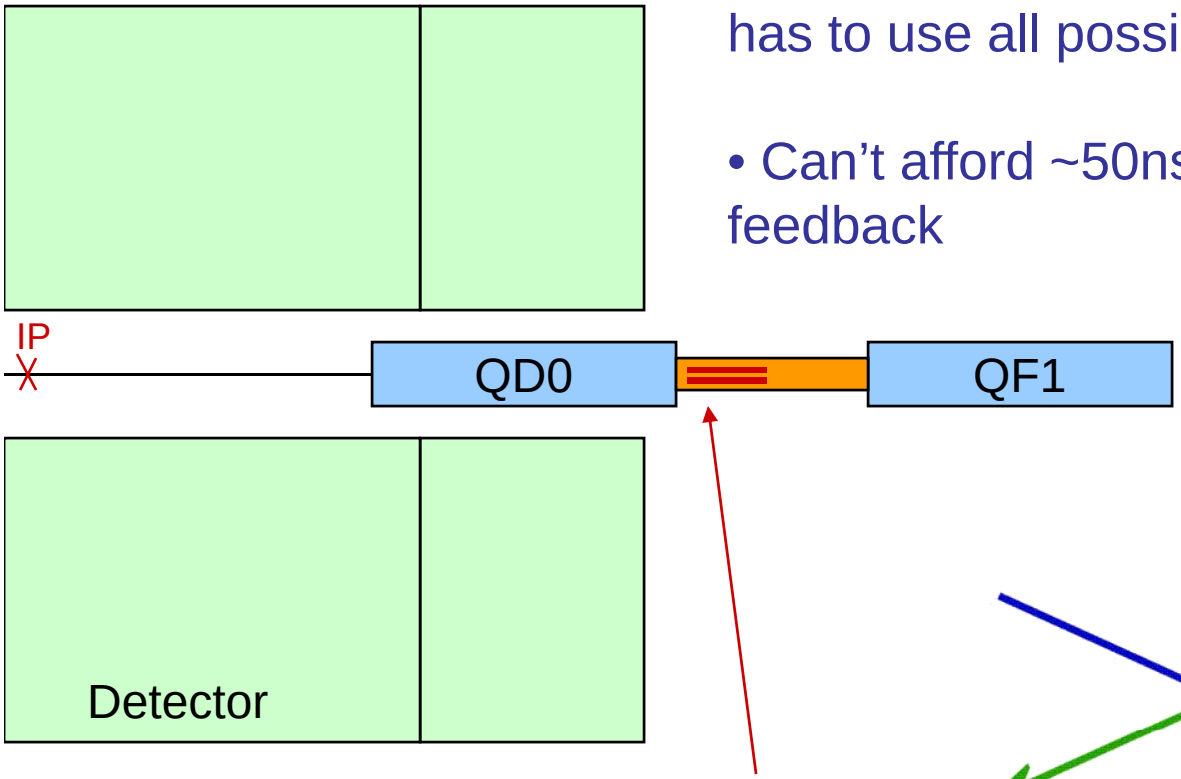
ILC IR configuration & stability



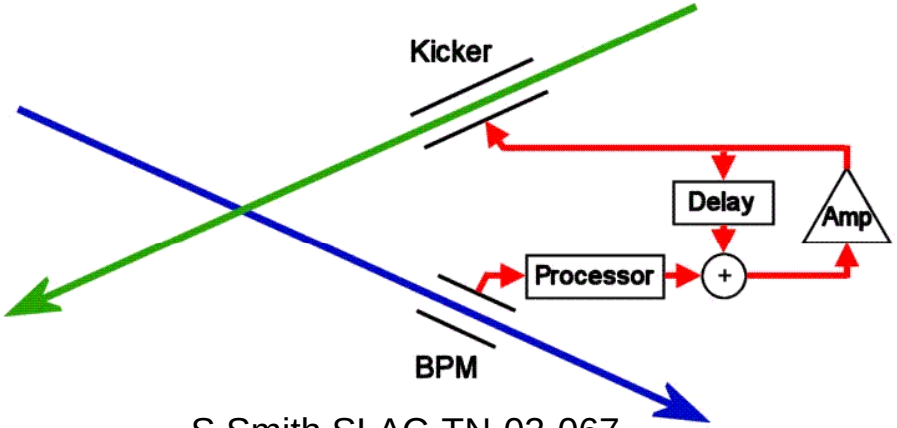
Location of intratrain feedback

- In CLIC, with 1nm beam size, and 150ns train, has to use all possible options to provide stability

- Can't afford ~50ns trip-around time of intra-train feedback

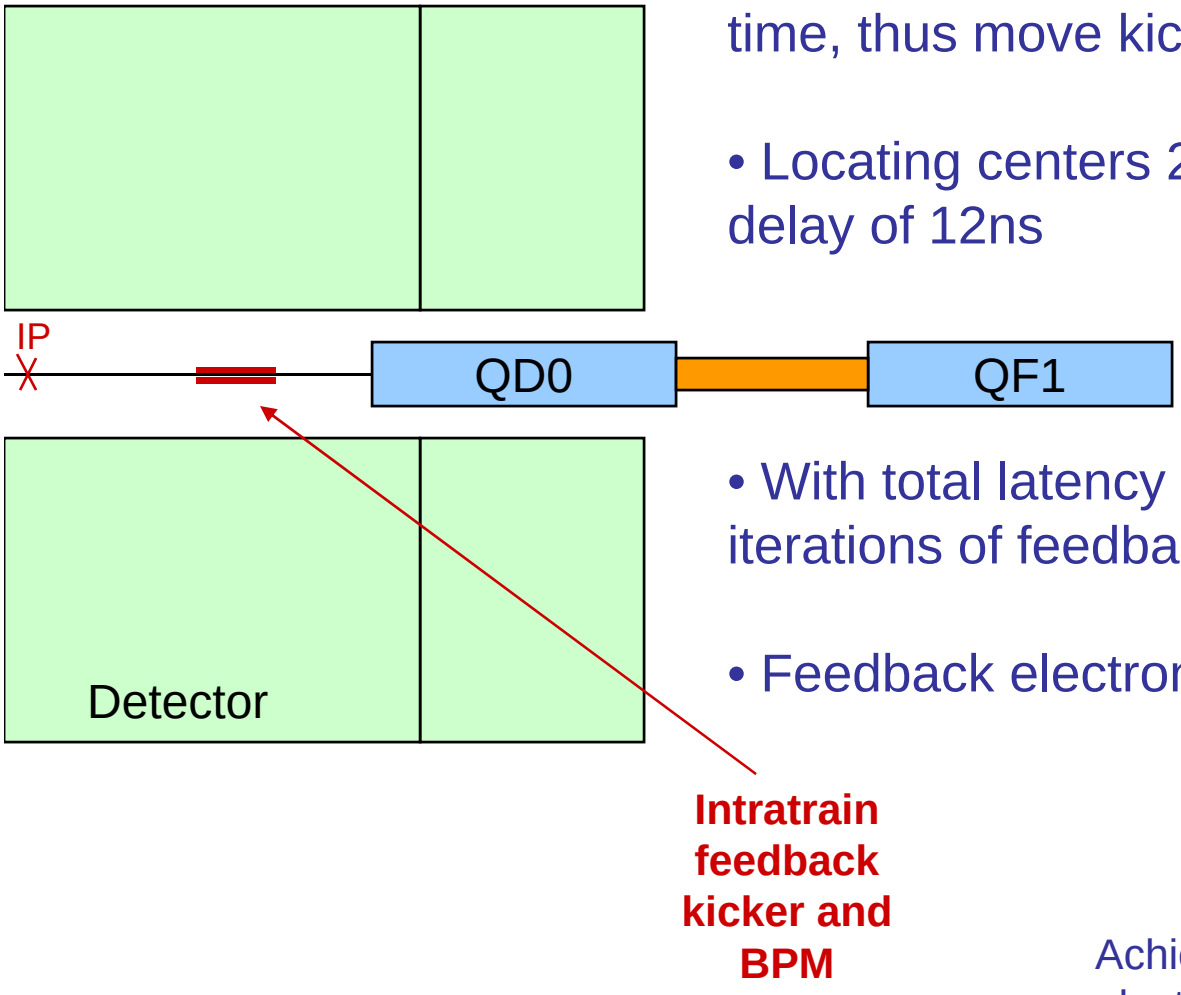


Intratrain feedback kicker



S.Smith SLAC-TN-03-067

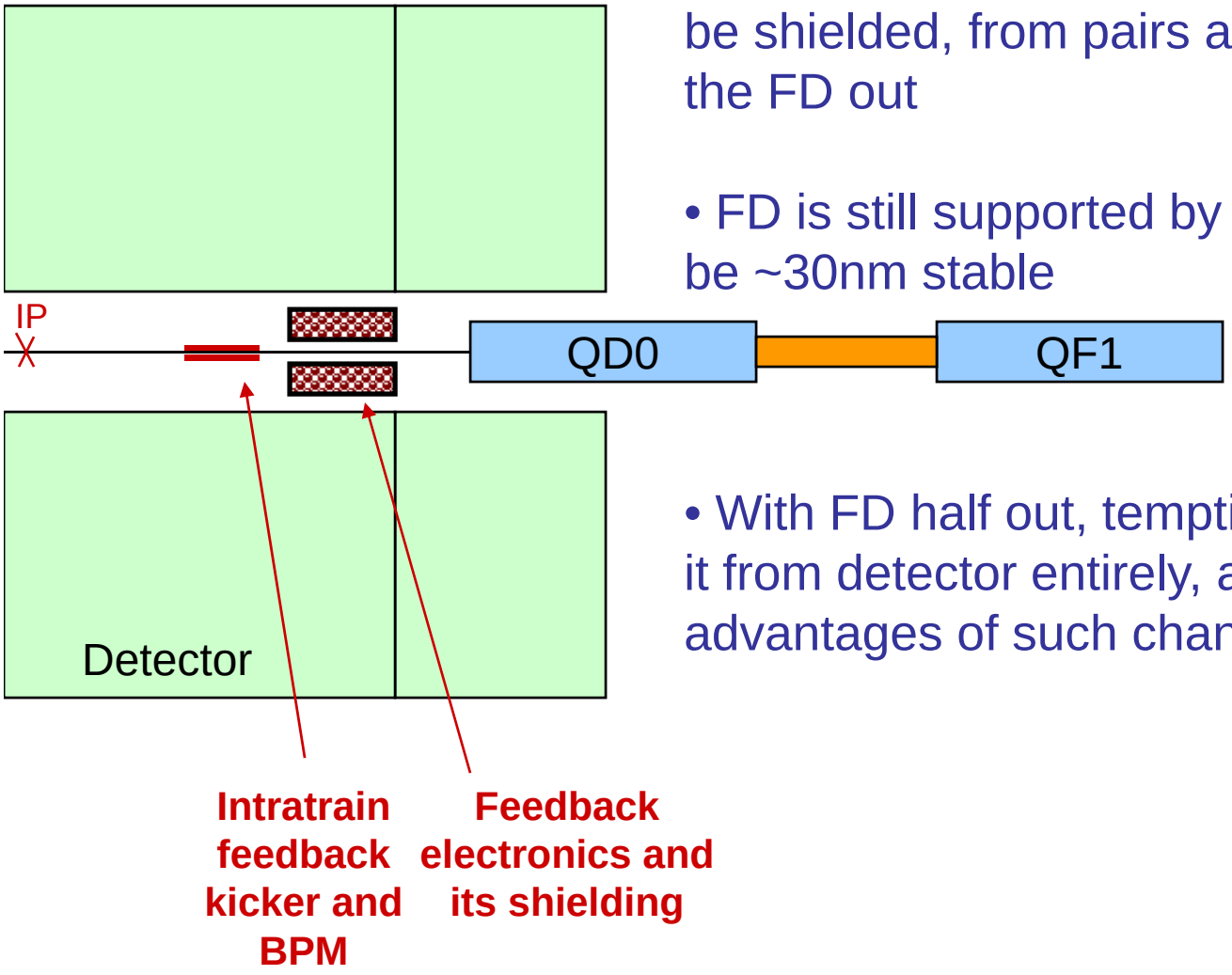
Location of intratrain feedback



- First MUST-DO is to minimize the trip-around time, thus move kicker and BPM closer to IP
- Locating centers 2m from IP give irreducible delay of 12ns
- With total latency of ~25ns, can already have ~6 iterations of feedback
- Feedback electronics need to be close to IP too

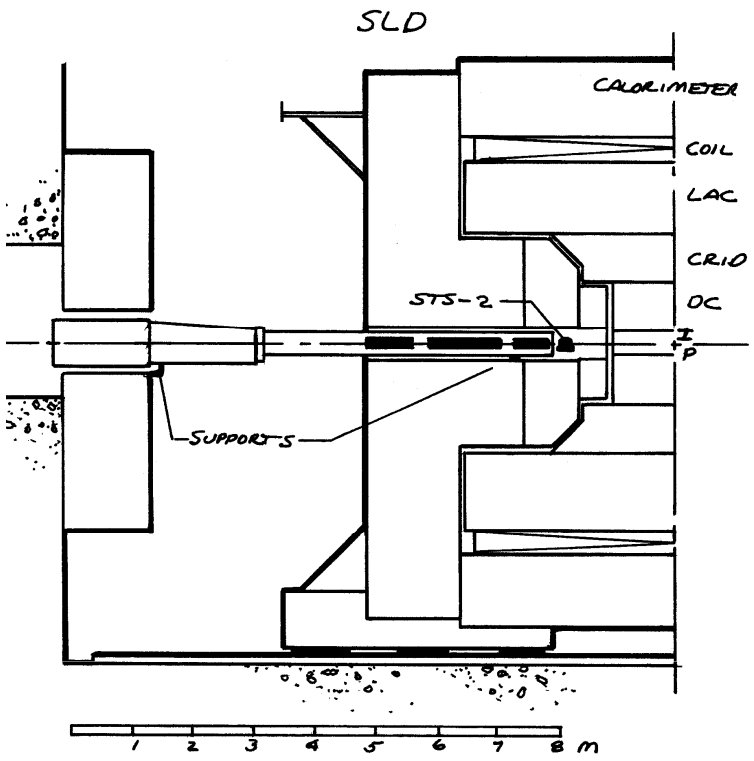
Achieved latency of FONT3 analog electronics ~13ns (P.Burrows et al).

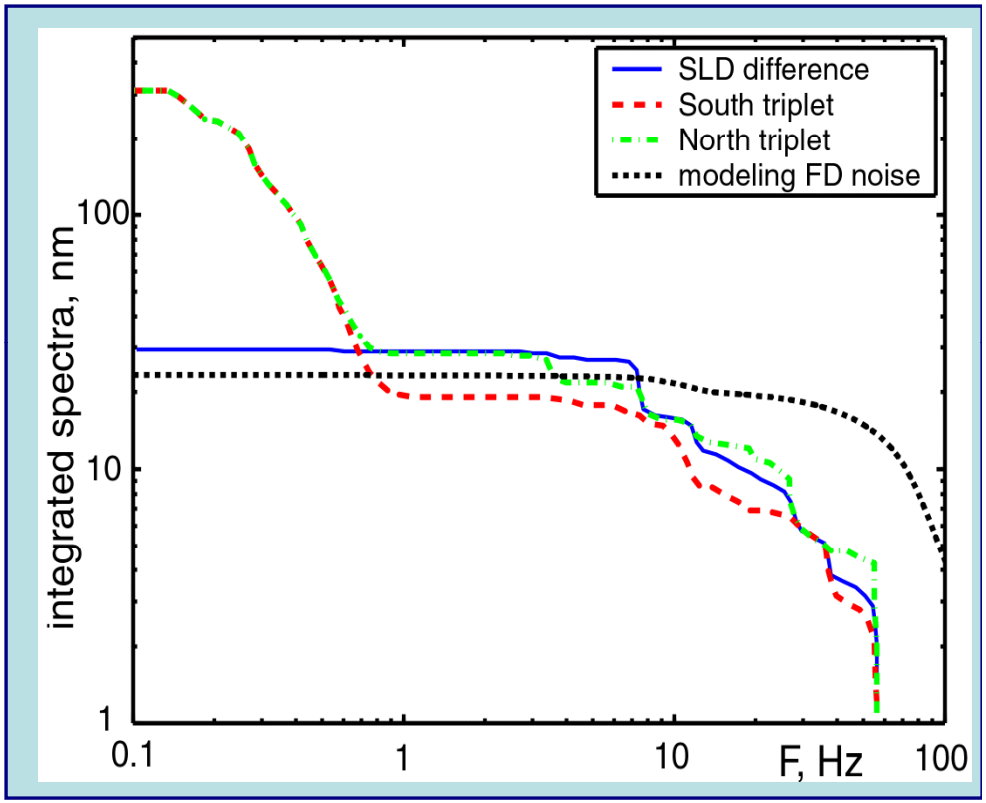
Intratrain feedback electronics



- Placing feedback electronics (perhaps need to be shielded, from pairs and radiation) may push the FD out
- FD is still supported by detector which is likely to be ~30nm stable
- With FD half out, tempting to consider removing it from detector entirely, and exploring advantages of such change

Detector is a noisy ground



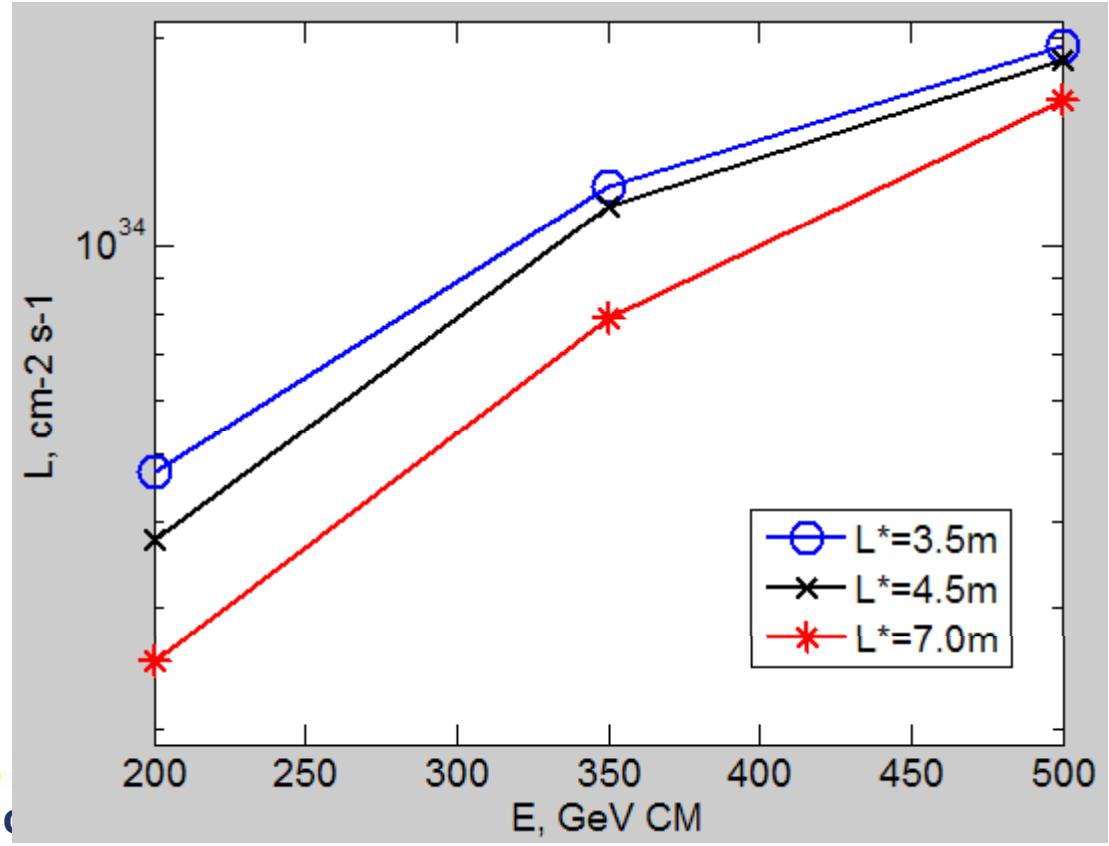


Measured ~30nm relative motion between South and North final triplets of SLC final focus. The CLIC or ILC detector may be designed to be more quiet. However present state of detector engineering does not allow relying on that.

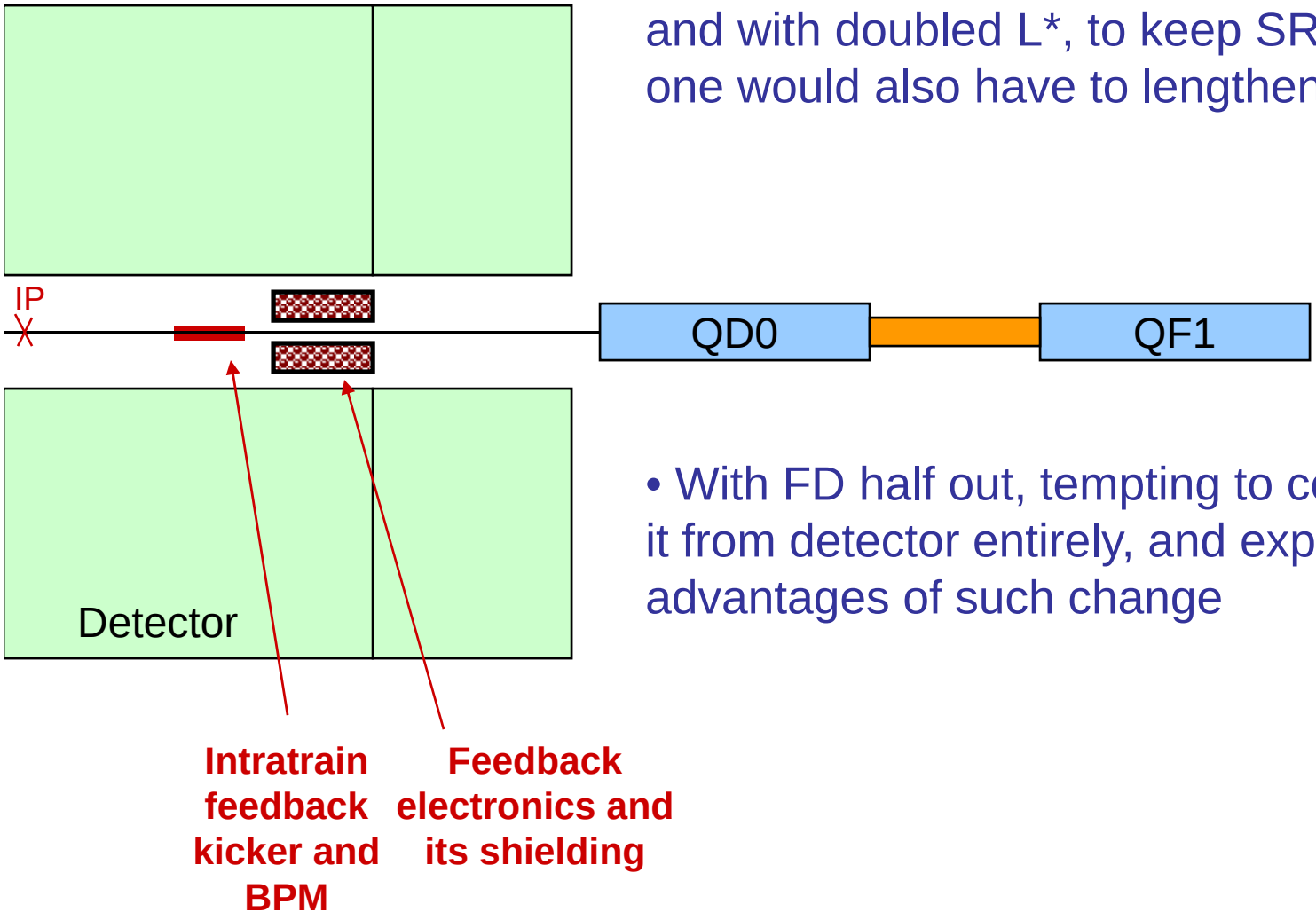
Luminosity dependence on L*

- For nominal energy, in some range of parameters and geometries the loss of luminosity is slower than linear with L*
  - Due to possibility to open extraction apertures and not to tighten the collimation depth
  - Based on a model that include assumptions about beam jitter, collimation wakes, etc.
  - Specific studies for CLIC parameters need to be done

- Tentative dependence of luminosity on L* for ILC parameters
  - **Reduced by ~5-10% for L* 3.5m => 4.5m**
  - **Reduced ~factor of two for 3.5m=> 7.0m at min energy and ~25% at max energy**



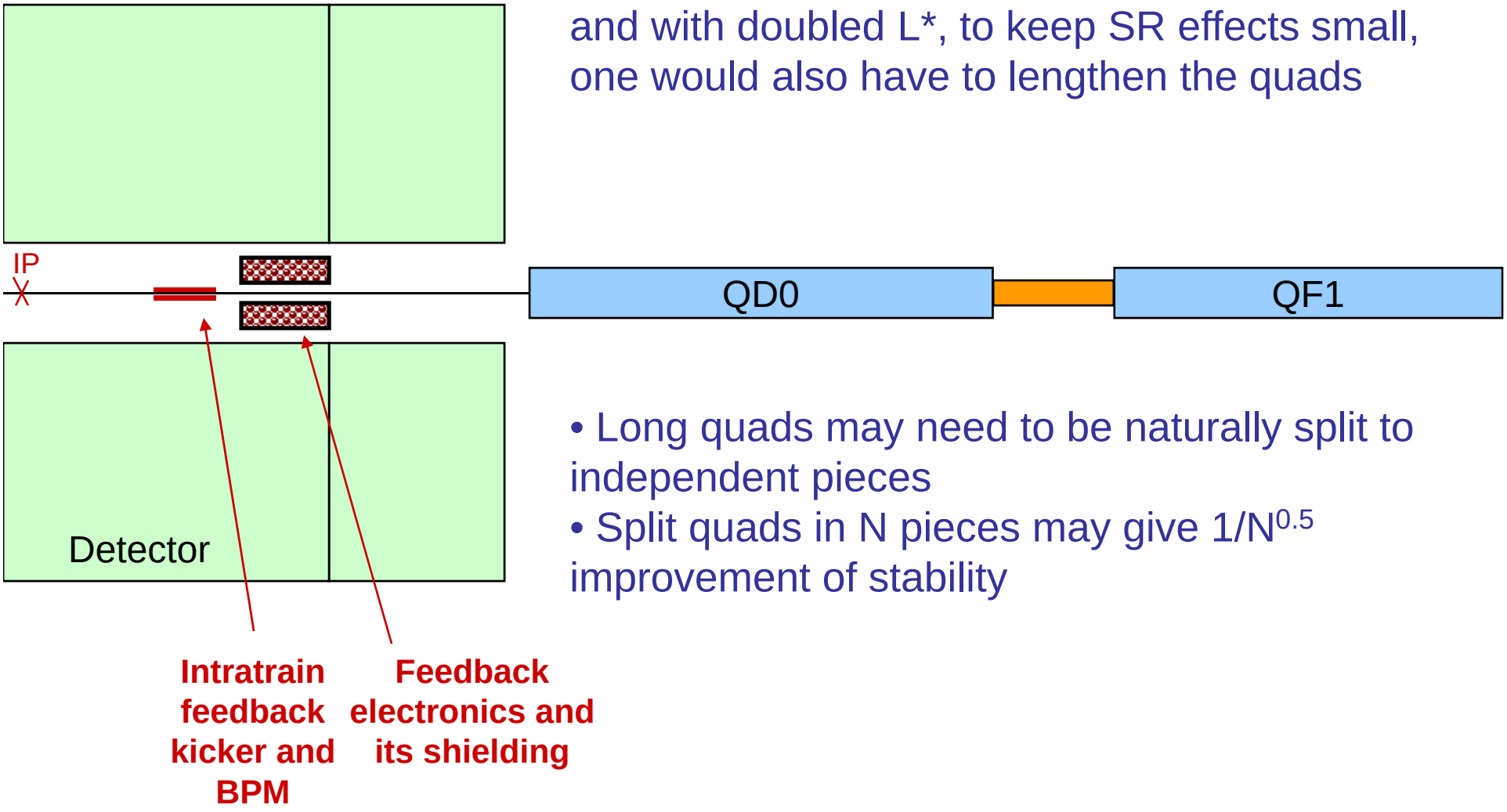
Location of intratrain feedback



- At high energy, the SR in FD is very important, and with doubled L*, to keep SR effects small, one would also have to lengthen the quads

- With FD half out, tempting to consider removing it from detector entirely, and exploring advantages of such change

FD moved out of detector

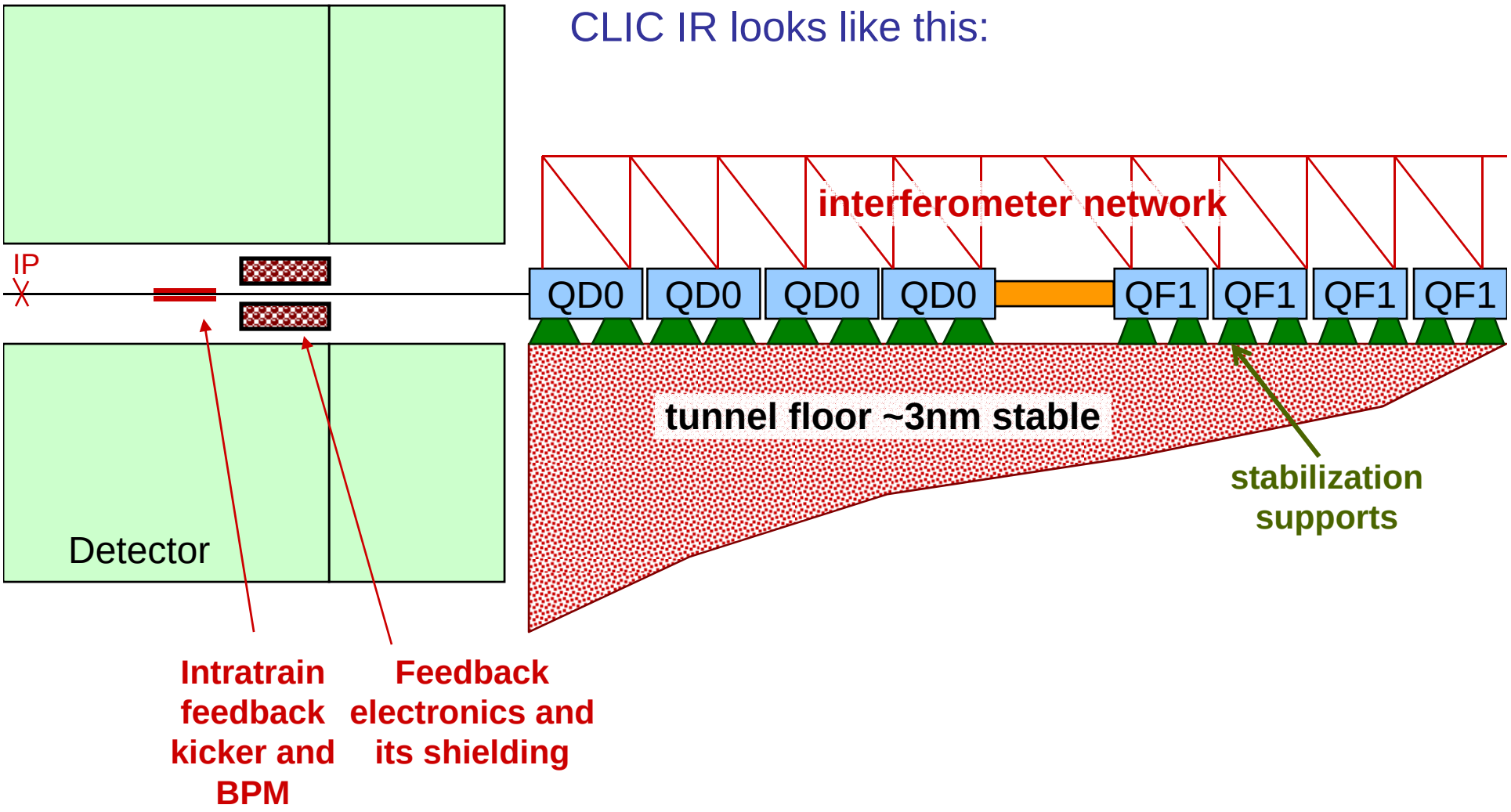


- At high energy, the SR in FD is very important, and with doubled L*, to keep SR effects small, one would also have to lengthen the quads

- Long quads may need to be naturally split to independent pieces
- Split quads in N pieces may give $1/N^{0.5}$ improvement of stability

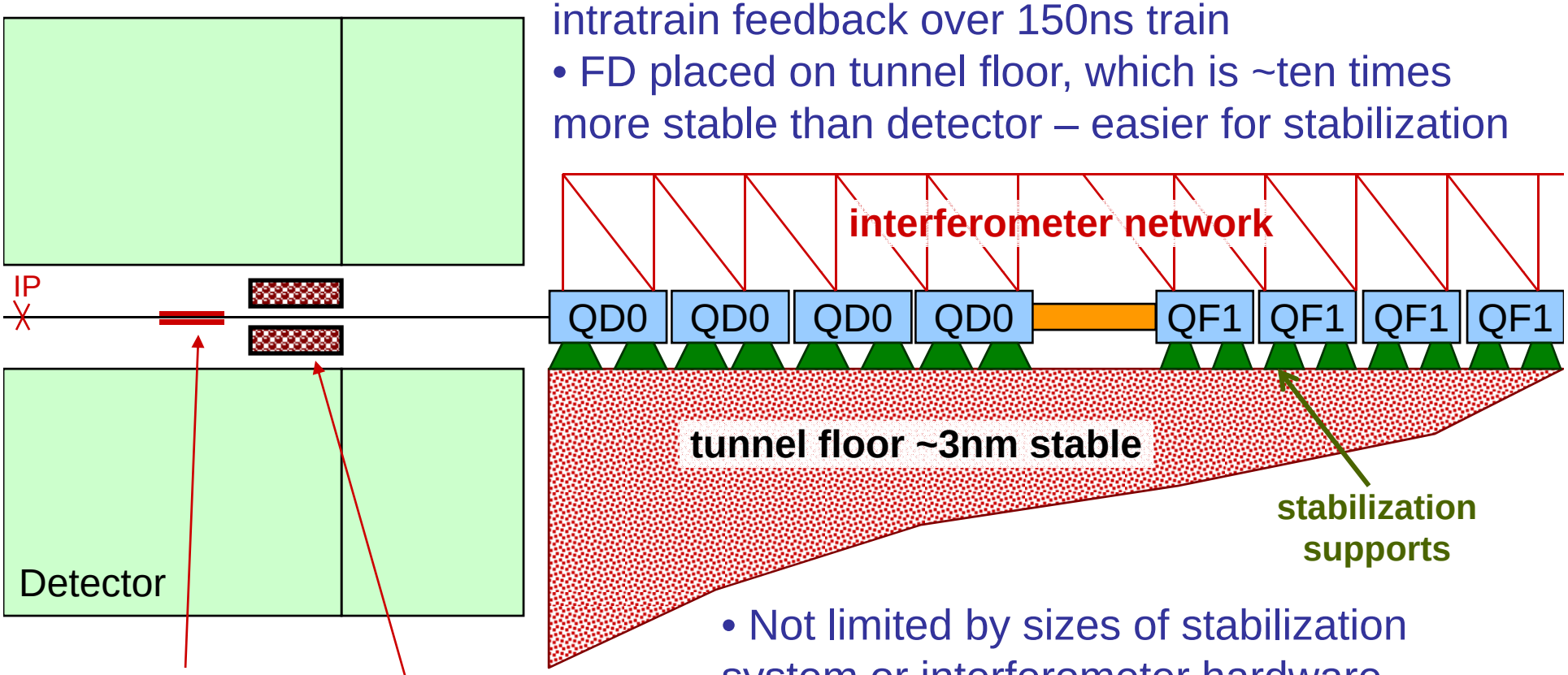
CLIC IR configuration

• After all these steps, the changed concept of CLIC IR looks like this:



New CLIC IR – advantages

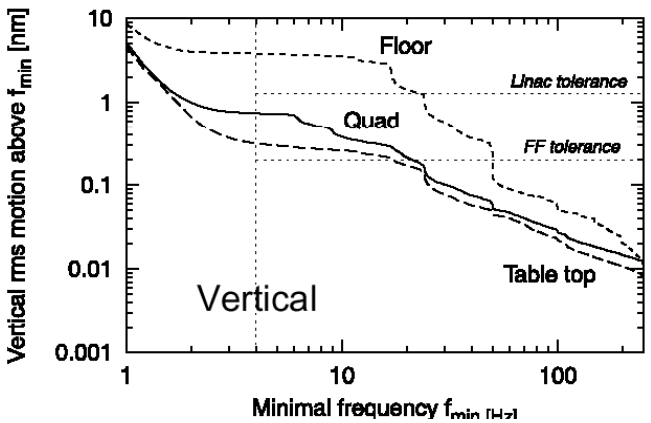
- Reduced feedback latency – several iteration of intratrain feedback over 150ns train
- FD placed on tunnel floor, which is ~ten times more stable than detector – easier for stabilization



- Not limited by sizes of stabilization system or interferometer hardware
- Reduced risk and increased feasibility
- May still consider shortened L* for upgrade

What achieved & sizes of hardware

Quadrupole vibration:



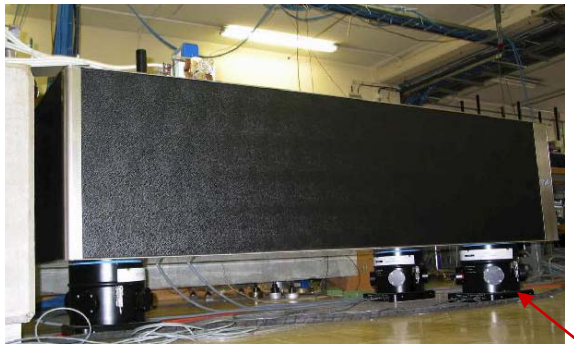
On magnet top:

X: (0.4 ± 0.1) nm

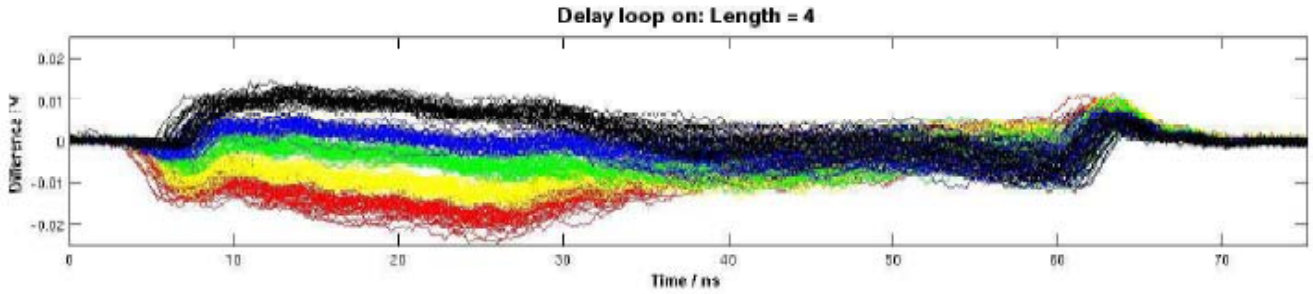
Y: (0.9 ± 0.1) nm
(0.3 nm on table top)

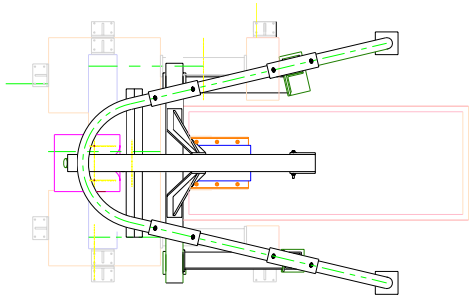
Z: (3.2 ± 0.4) nm

without cooling water.



R.Assmann et al, Stabilization with STACIS give ~10 reduction of tunnel floor vibration





P.Burrows et al, FONT3 demonstrated latency of 23ns, including 10ns of irreducible time-of flight

Monitoring Alignment & Stabilisation with high Accuracy

D.Urner et al, MONALISA interferometer system for ATF2 final doublet: space availability matters