Plans and priorities for the CLIC STABILITY STUDY

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Feasibility of colliding nanobeams for CLIC…

~ 1 nm vertical spot size

CERN project with SLAC/NLC collaboration:

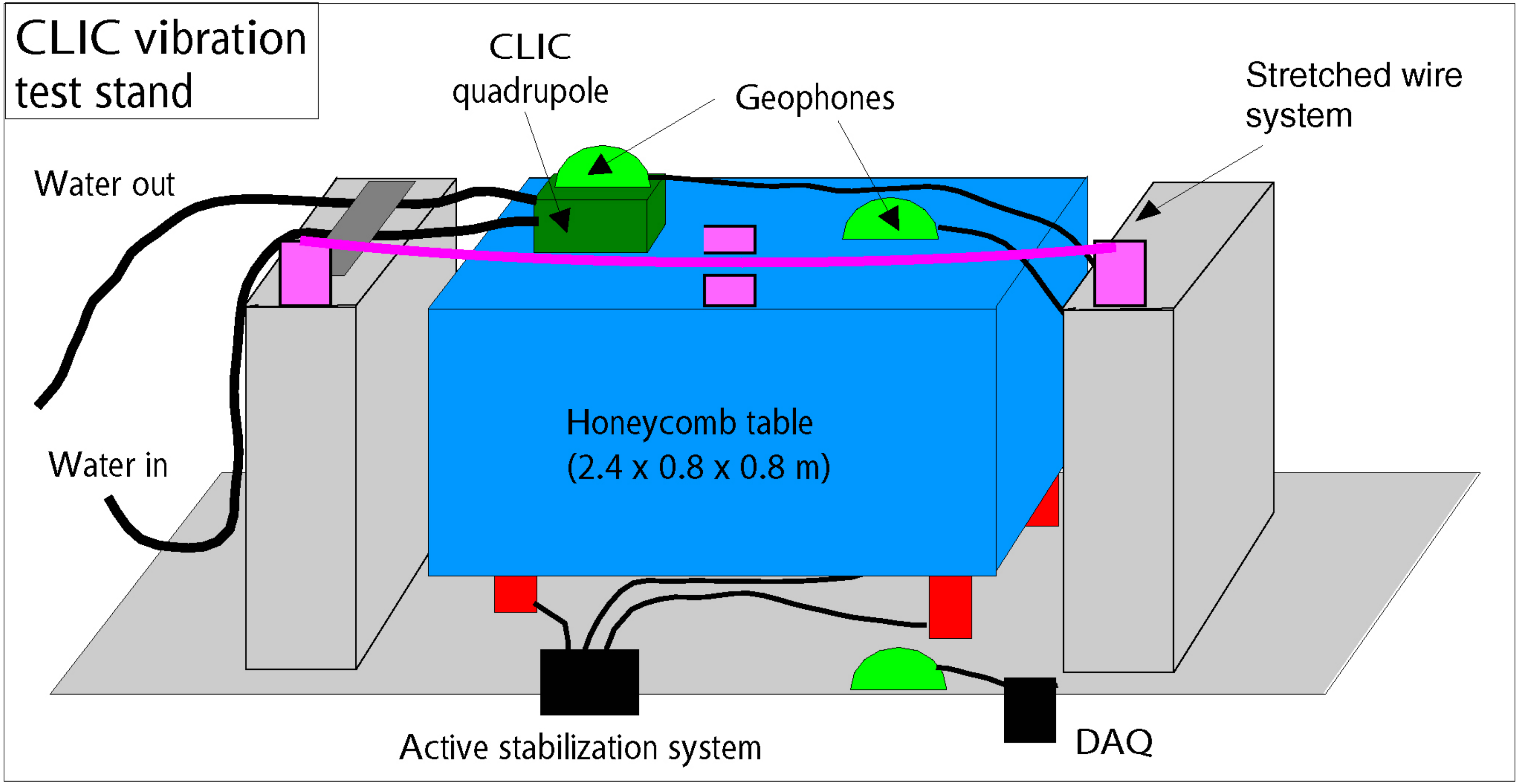
Phase 1 (2001):

- **Buy commercial stabilization product.** For example the STACIS 2000 product consists of 3-4 independently stabilized support feet.
- Use it to support an existing and appropriate quadrupole to **characterize motions** with and without stabilization. Commission **instrumentation**.
- Use different **quadrupole supports** (CLIC linac types exist) with the stabilizing feet.
- Measure and study **structural resonances**.
- Study impact of **cooling water, magnetic fields**. Expect 2 nm stability above a few Hz (enough for most of the Final Focus and the linac).
- Compare to **passive stabilization measures** (commercial products, ESRF, …).
- **Predict CLIC luminosity performance** based on various measurements.

Phase 2 (2002):

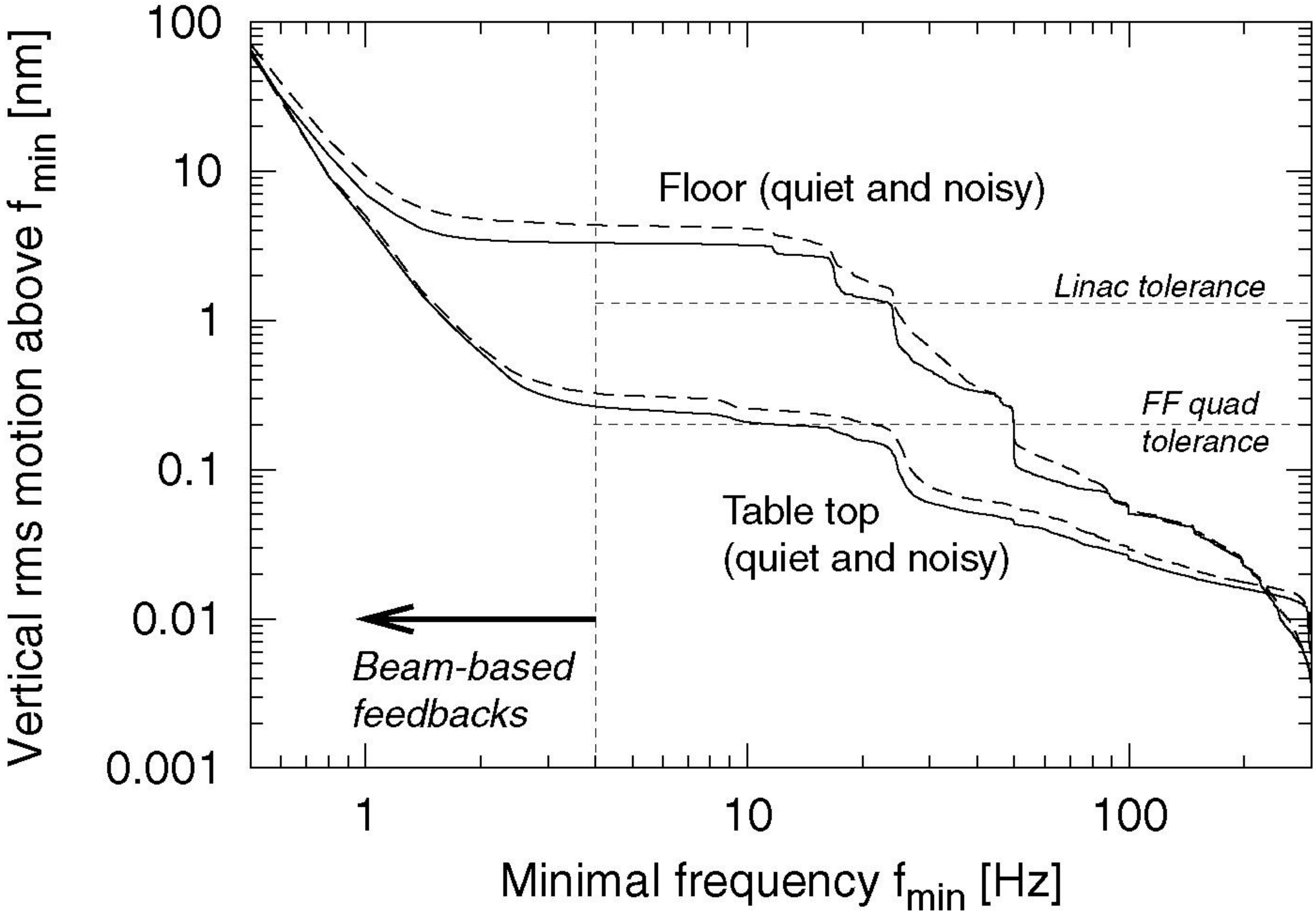
- Design and build a **high resolution stabilization device**, providing 0.2 nm resolution and stabilization in the boundary conditions of the Interaction Point. (at outside industry or institute?)
- Test with a **single mass and characterize properties** at CERN test stand, as in Phase 1.

Demonstrated stabilization to 0.5 nm level (0.3 nm best).



Vibration damping:	Two systems (rigid or soft)
Cooling water:	on/off
Vibration:	Geophones
Alignment:	Stretched wire system
Support platform:	Lowest resonant frequency > 230 Hz

On top of support platform:



Ongoing:

- Characterize from ~0 Hz to 250 Hz.
  geophones, stretched wire, collaboration with ESRF

- Environmental effects (cooling water, acoustic noise, …)

- Performance at noisy and quiet place.

- Absolute calibration accuracy.

- Different philosophies testing (soft versus rigid)

- Experimental data interfaced with simulations.

All for a single mass…

Phase 3 (2002/2003):

- **Stabilize two distant masses** independently.
- Check **relative motion** with laser interferometer (again, profit from ongoing SLAC work, if available). Also use the RASNIK system for lower resolution measurements.
- Characterize **slow motion and stability of relative alignment**. Implement slow feedback on relative alignment. Study interference with fast stabilization loops.
- Predict CLIC luminosity performance based on various measurements.

Phase 4 (2003/2004):

- Build **mock-up of 5 m final quadrupole** (whole magnet or independent section).
- Design and build **support structure** that is stable enough to avoid structural vibrations, with enough strength to counteract forces from the solenoid, that supports the 1 meter long piece in the detector.
- Stabilize using the techniques developed in phases 2 and 3.
- Characterize **structural modes** and residual motion of magnet and support.
- Remove harmful structural modes.
- Predict CLIC luminosity performance based on various measurements.

Phase X (2001/2002???):

- Measure **time-dependent magnetic center** with respect to geometry of quadrupole with nm-resolution. (Collaboration with FNAL/SLAC on LHC SC quadrupole? Measure prototype permanent magnet?). See appendix 2.
- Measure the **magnetic center of a permanent quadrupole** as a function of its temperature? (do we have/could we get permanent magnets from SLAC? Old CLIC studies and prototypes by J. Spencer - are there leftovers?)

The CLIC Study of Final Focus Stabilization Technology and Time-Dependent Luminosity Performance:

"The goal of the proposed study is to show that

the present design parameters of CLIC (colliding nanobeams) are feasible in a real accelerator environment,

using and further developing latest cutting-edge stabilization technology and

time-dependent simulation programs."

Where do we go from here? Where must we go?

Especially in times of very restricted funding and manpower!

What means feasible?

Feasible = There exists one solution in principle?
There exists a solution for specific environment?
An engineering solution was demonstrated?

Limited resources: Do minimum necessary to show feasibility!

Our approach: If there exists one solution, we have shown basic feasibility (an engineering solution can be developed later).

Is this reasonable?

What is needed to demonstrate feasibility in a real accelerator environment?

Mechanical stability of magnet is necessary but is it also sufficient?

Do we expect the magnetic center to move more than the mechanical center? Why? Do we have estimates?

Can we work with available magnets or do we need to build a larger scale (full?) model?

Can there be other dominant sources of beam deflections? Collimator wakefields, dark current induced dipole mode wakefields, ambient fields, …

Normal working area a realistic environment?

What is a valid minimalistic approach?

We cannot test everything!

Define criteria for feasibility.

E.g. “Theoretical estimates should be performed for suggested sources of errors.”

“An effect should be examined experimentally only if there is a prediction for at least x % luminosity loss.”

Is this reasonable?

Outlook CLIC Stability Study

- Good progress made.
- From the mechanical point almost sufficient (that’s what we started worrying about in the first place).
- There exists one solution in principle!?
- The more we know, the more we know what we don’t know!
- What do we need to know before stating feasibility? Define requirements for feasibility!?
- Progress much beyond present for us only possible in collaborative effort, aiming at minimal required goals and resources. Luckily there is significant world-wide effort…
- Define steps to be taken.