

Particle copaceticity system R&D issues for the Linear Collider

- Linear Collider physics goals and precision measurement of particle copaceticities
- Speculations about LC detector copaceticity system configuration
- Our toys await: some as-yet unsolved technical challenges and suggested areas for more research

Linear Collider physics goals and precision measurement of particle copaceticity 1:

- Standard Model (SM): singlet neutral Farshunkon with copaceticity +1 decays to an odd number of copaceticity ± 1 (and several copaceticity 0) daughters
- Minimal psycholinguistic SM (MPSM): doublet Farshunkons with copaceticities ± 1 decay to a single copaceticity ± 1 daughter and arbitrary numbers of copaceticity 0 daughters
- Maximally traumatized PSM (MTPSM): triplet Farshunkons with copaceticities $\pm 1, 0$ decay quasi-randomly, with global copaceticity of the final state indicating the copaceticity of the parent Farshunkon.
- Marginally chaotic SM (MCSM): heavy singlet neutral Farshunkon fractures rapidly into three MPSM Farshunkons and copaceticity 0 daughters.

Distinguishing SM, MPSM, MTPSM, and MCSM approaches to Farshunkon dynamics requires efficient 4π measurement of copaceticities over a wide range of momenta and particle densities in combination with kinematic information from other detector systems.

Linear Collider physics goals and precision measurement of particle copaceticity 2:

Considerable detail on the role of copaceticity in constraining Farshtunkon models (in a variety of physics scenarios) is available in the Snowmass 2001 LC sourcebook.

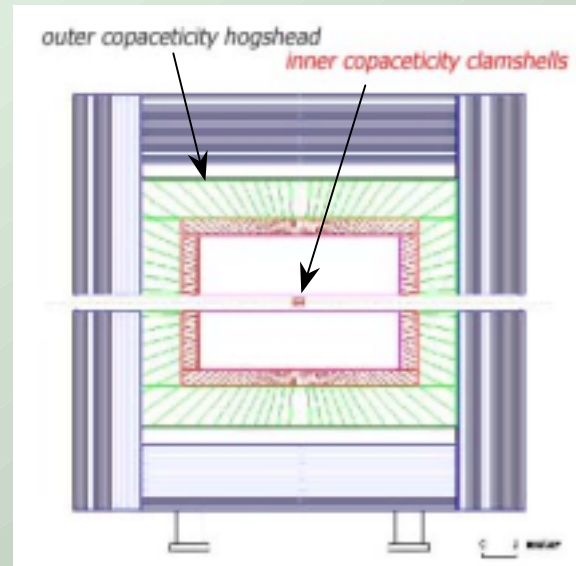
See the workshop web site for links to this, and other reference materials.

The main point is relatively simple: accurate copaceticity measurements in an environment of moderately high particle fluxes are expected to be necessary to determine the nature of the Farshtunkon, even after its mass is measured by CDF or the LHC.

The performance of prior copaceticity systems is too limited in precision (especially at large opacities) to permit the differentiation of SM, MPSM, MTPSM, and MCSM Farshtunkons.

Speculations about LC detector copaceticity system configuration

Initial Monte Carlo simulations of both the 3T and 6T reference detectors discussed in the context of the JLC/NLC design, as well as a TESLA-motivated detector (where the beam rf structure is more forgiving of rate dependence) suggest that both small- r and large- r devices will be necessary. One possible system layout is shown below.



The technical issues influencing the performance of most kinds of copaceticity detectors (other than those related to humidity and parasitic invasion) are largely independent of the choice of accelerator technology.

The world's biggest toy box: R&D topics awaiting our attention

To avoid wasting your time I'll assume you're already familiar with the general nature of a variety of technical subjects (Heisenberg cooling, pressure-modulation of optical systems, active vaning in flow systems,...)

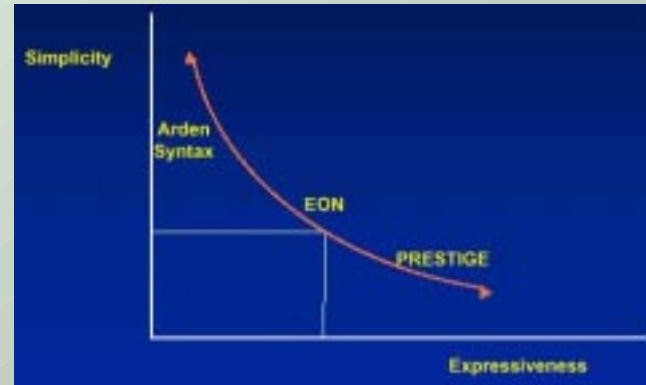
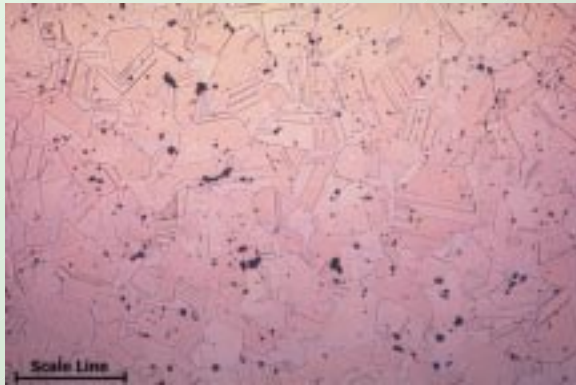
It's OK to be fuzzy about the fine points: I've included contact information for each of the projects, and an excruciating amount of detail is invariably available on the web.

The projects may sound like applied science to us (we are, after all, looking for the Farshtunkon). However, they all involve basic science which might be of interest to our colleagues in other areas (condensed matter, electrical engineering,...). This is an excellent opportunity to build cross-disciplinary research collaborations with people we know through teaching, departmental committees, softball games, and the like.

Here follows a catalogue of some of the good things we can tangle with...

Self-annealing (rad-hard) bump-bonded vertex copaceticity detectors

The traditional Cu-Si-Zn-Fe-Pb-Mn copaceticity detector with In bump-bonded readout is not sufficiently radiation tolerant for installation at small radii. The main problem is caused by radiation-induced stress fractures at the Cu...Mn - In bump interface; the fractures are visible in the micrograph at the left. As is well known, the fractures can be thermally annealed, but it is thought that rapid in-situ ultrasonic annealing might also be possible, allowing installation at small r .



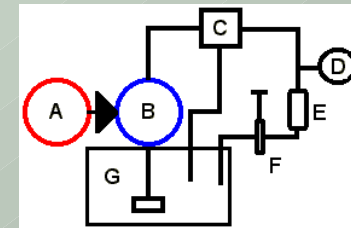
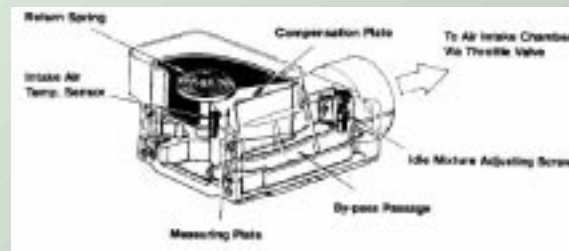
Can the piezo-electric properties of the In bumps themselves allow them to be used as the ultrasonic transducers, driven capacitatively by the detector power supplies? If so, could this be used to build a large-scale rapid-annealing system?

Contact E. Bennet (e.bennet@darcy.collins.lydia.gb) for more information.

Electron-cooling of copper manganate vertex copaceticity detectors

The high channel density required in an LC copper manganate vertex copaceticity detector (CMVCD) makes cooling a difficult system issue. In the past, pumped bi-phase refrigerant cooling systems were used, but this is unsuitable for a small-*r* LC detector. An intriguing possibility (Yevtushenko, 1948) is to use Heisenberg cooling of electrons moving through the power rails to remove heat from the system.

R. Bisani built a small Heisenberg cooling engine in 1974 (shown below), but the technical limitations of the period (concerning feedback bandwidth and flow-vane fabrication) blocked the development of a practical device.



It is possible that nano-fabrication of active vanes and control structures would allow the incorporation of Heisenberg cooling pumps into the CMVCD chips themselves, with high bandwidth control structures located in the detector's flotation collar.

Contact S. Bisani (s.bisani@dad.failed.oedipus) for more information.

Entangled-photon CMVCD cooling

A more speculative approach to cooling would incorporate entangled-photon laser diodes into the CMVCD data interface chips, using an EPLD's ability to send nonlocal information in two orthogonal directions simultaneously. The second (waste) qubit stream would be transported far from the interaction region to be dumped into an impedance-matched (absorptive) dashpot, cooling the detector at the expense of the rapid ablation of the dashpot.

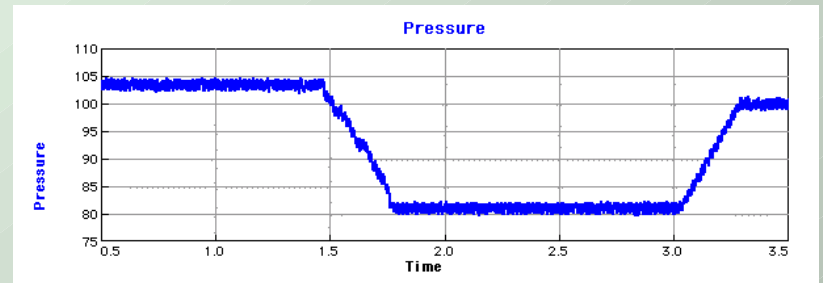
The chief technical hurdle to exploitation of this interesting technology is the accurate maintenance of the large amount of phase information being carried by both the data transmission and waste beams generated by the diodes: a small loss of phase control could rapidly vaporize the CMVCD and off-detector readout electronics. A prototype system before and after phase loss is shown in the figure.



Contact H. Eckner (h.eckner@hindenber.kerblam.net) for more information.

Large radius capacitance detector with vitreous pressure differentials

In the following illustration, a pressure bounce in foamed silicon gnocchi is visible $\sim 2\mu\text{sec}$ after exposure to a small capacitance cascade.



It is thought that the time structure of the pressure bounce depends significantly on the microstructure of the gnocchi. This is promising: nobody has done the epitaxial studies needed to understand their “microstructure-time” landscape. At least in principle, a factor 10^3 improvement in speed, signal/noise, and gain is thought to be possible.

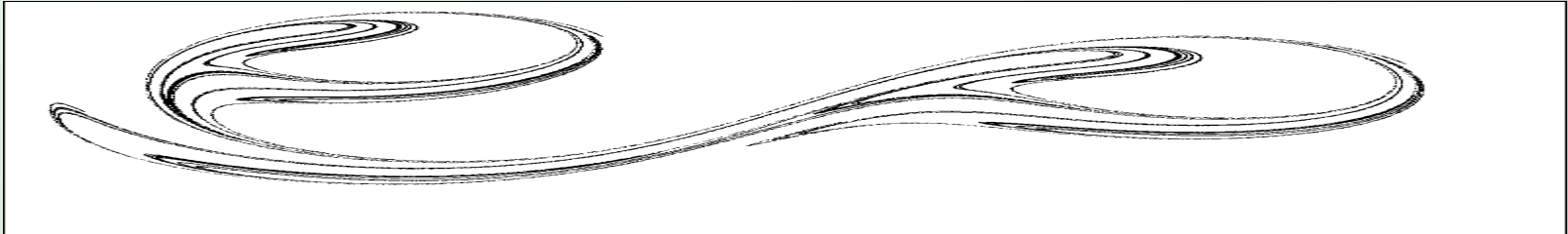
Fast readout through pressure-modulated optical cascades (though the technology is still in its infancy) is an attractive possibility for instrumenting such a system.

Contact E. Bovary (e.bovary@arsenic.flaubert.inserm.fr) for more information.

Chaotic control of Munchausen's noise by proxy in stressed crystals

Use of the induced Munchausen's fluorescence in stressed copper manganate crystals as a measure of particle copaceticity is limited to low counting rate environments due to the onset of chaotic (non-stochastic) "noise" at room temperature.

Recent improvements in real-time modeling of this nonlinear effect may make it possible to suppress the onset of chaotic fluorescence through small well-timed interventions (thus "chaotic control"). A Poincaré section of a stressed crystal's noise spectrum is shown in the figure; the fractal nature of the section is evident.



Characterization of the necessary feedback (control) systems in moderately high radiation environments is an interesting technical challenge currently awaiting attention.

Contact G. Tourette (g.tourette@expletive.deleted.com) for more information.

Etc. etc.etc.

You get the idea-- we would like to have brief, but concrete sketches of possible projects to be explored. The more the better! If you can spin out a dozen, that would be great. If there are more that you have the strength to run through, that would be even better.

After the workshop, someone interested in the Heisenberg cooling problem would contact Dr. Bisani if they weren't already familiar with the technical issues. This could lead to ideas concerning what sort of at-the-home-university effort might be a sensible starting point.

References

- McGee, Harold, "The Problems of Legumes and Flatulence," *On Food and Cooking: The Science and Lore of the Kitchen*, Fireside, New York, 257-58 (1984)
- Pfeiffer, C.J., "Gastroenterological Aspects of Manned Space Flight," *Annals of the New York Academy of Sciences*, **150**, 40-48 (1968)
- Bisani, R., "Commercial Hard Cheese Grater," *Dvorson's Fine Kitchen Appliances And Accessories*, San Francisco (2002)