PMPGrant

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Subject: March APS in Boston

NB: Warning…this is a long e-mail and contains a number of clickable links…please use an html-enabled client. For videos, use of a good "streamer" is advised. Please tolerate its length…however, I think the subject deserves some deliberate reflection.

Subject: A Quarter-Century After Woodstock

The upcoming March Meeting in Boston will mark 25 years since the epic gathering in the Ballroom of the Hilton Hotel in New York to "celebrate" the then emerging era of high temperature superconductivity and the science and applications to hopefully follow. The purpose of this "Open E-Mail" is to inquire whether any plans are afoot to recognize the quarter-century anniversary of this landmark event when we convene three months from now in Back Bay.

The initial January, 1986, discovery by Bednorz and Mueller became generally known (and also first confirmed by them…not generally known or recognized!) by mid-September, and was quickly replicated in perhaps half a dozen labs in Japan and the US. One of these labs was Paul Chu's group in Houston, who by late November had obtained a sample revealing a broad transition beginning in the 70 K range. Today we recognize from its powder diffraction pattern, they had synthesized La-123!

Despite this initial flurry of activity and results, the March Meeting submission deadline in those days was ungodly early…I believe sometime in October…and only one abstract made it into the General Session (Trivia Question: which one and from whom? Don't know? Click here). However, by late December, a movement began by DCMP leadership (Neil Ashcroft and Brian Maple) to organize an "extraordinary session" apart from the General Program and not listed in the meeting BAPS. Given that all general "regular time" sessions by then had been scheduled, a special "rump" the evening of 18 March was organized.

The rest is history…The Woodstock of Physics. Arguably no other event sponsored by the American Physical Society captured so completely the attention and imagination of the public and press before or since. You can read all about it

on my webpage summarizing the 20th anniversary session Bill Evenson and I co-organized in 2007 at March-Denver. Click here. Evidence of such impact can be found in Reagan's July 1987 "White House Conference" (text and video) and the 1988 Nova "Race for the Superconductor" (video). This was set against the prevailing background of "Japan-phobia," the impression that "Japan was about to eat our economic lunch." Sound eerily relevant to certain fears today?

So what has transpired over the intervening years?

Truth be told, advances in high-temperature superconductivity since Woodstock have been bittersweet, both in science and application. It's probably way too late to suggest this, but a "public retrospection" session might be useful to organize at the last minute (in the spirit of Woodstock actually!) to address the following topics:

1) Science
    a. Materials:
        i. It is clear the advent of HTSC engendered a renaissance in the materials science of metal oxides leading to several improvements in synthesis techniques, especially growth of thin oxide epitaxial films.
        ii. Re-invigorated the search for new superconductors, arguably uncovering magnesium diboride, and certainly encouraged investigating the potential of other "Hubbard-like" complexes such as the iron pnictides and the "n-doped 2-1-4" copper oxide perovskites.
    b. Theory/Electronic Phase Diagram Development:
        i. An enormous advance in the understanding of the electronic phase diagram of "Mott-Hubbard, Charge-Transition" physics as a function of carrier concentration, magnetic field and temperature hosted by "natively pristine" Neel antiferromagnetic insulators has ensued. Much of the new knowledge derives from advances in ARPES and various "nano-scanners."
        ii. Such advances notwithstanding, it seems we are as far from a quantitative model of high-temperature superconductivity (like Migdal-Eliashberg-McMillan-BCS…"like"…only as an analogy, not a proposal! I could equally have said, "Maxwell's Equations") as we were at "t = 0" 25 years ago. I wrote about "where we are now" in a Nature N&V piece, "The Great Quantum Conundrum," published this past August (click here).
        iii. On two occasions this past summer, I had the pleasure of Alex Mueller's company for several days. BTW, he is in excellent spirits and appears essentially fully recovered from extensive spinal surgery he underwent three years ago. He maintains the rationale for his initial search for high-Tc in transition metal oxides remains sound…a Jahn-Teller-like instability driving bipolaron-mediated pairing…and continues to work on his model with a small circle of collaborators in Europe (click here). Yet his ideas and conclusions remain largely ignored by the "mainline" theoretical community engaged in HTSC. Ask yourself this question: Why doesn't Nature "make" cubic, rocksalt copper monoxide like She does for the lighter TMOs? Well, I can make it in a computer and in 2008 published a paper (click here) revealing such a structure would be extremely J-T (not t-J!) unstable, yet yielded a residual lattice-electron coupling which could sustain a transition temperature 40 – 60 K for non-spin polarized CuO. It would be quite fitting to invite Alex to Boston to participate in an appropriate "retrospective session" to defend his original model.
        iv. Room Temperature Superconductivity. It's clear…at least in my opinion…that "strong coupling has run its limit." In 2007, there was hosted in Loen, Norway, a NATO workshop, The Path to Room Temperature Superconductivity,"Road2RTS, RTSC07," the largest collection of super-egos under one roof on the planet that year. Mac Beasley and Alex Gurevitch, essentially "proved" any increase in BCS "strong" (emphasis "strong") fermion-(whatever) boson coupling would result in a pair coherence length less than a unit cell! BEC! Alternative…in my opinion…return to Bill Little's 1960-70 papers suggesting a much higher characteristic energy boson "glue"…excitons. Make sure you read my upcoming 2028 Phys. Rev. Letter.
2) Applications

a. Electronic
    i. Initially, there was hope, especially with respect to passive rf filters for cellular ground station applications. All demonstrations worked, yet today the technology most deployed uses variations of advances in semiconductor materials.
    ii. In 1987, in IBM, we conducted a task force to study opportunities for HTSC in back panel and on-chip interconnects. Conclusion: The progress in integration of Cu on chips would be "good enough." And that has proven correct. It almost seems as if the impending advent of a competitive superconductivity technology incentivizes advances in the "usual" solutions.
    iii. The one major remaining "electronics" company is STI. The company was bought a few years ago by a Chinese consortium, and currently is experiencing "negative" cash flow (click here). STI is now trying to exploit proprietary "coated conductor" technology, but the outcome may be problematic…see below.

b. Power and Energy
    i. To get to the current "bottom line," please visit my upcoming editorial, "Upbraiding the Utilities," to appear in the January issue of Power Magazine, subscribed to by all US senior utility executives, and based on an equivalent recent editorial in Cold Facts. Bottom line. HTSC power technology is here and works. When will it arrive in the countryside, on the street and under the sidewalks?
    ii. Note that the two major US manufacturers of HTSC wire are "in distress," despite there technical success and efforts to control cost (see "Upbraiding" above). American Superconductor is now AMSC. In recent quarters, less than 2% of its gross income comes from superconductivity. The cash flow of SuperPower is negative.
    iii. I'm quite aware of the power applications prospects in Europe, Russia, China, Japan and Korea. Aside from possibly government subsidized projects…possibly…well, we'll have to see.
    iv. Future prospects. I call these the "energy equivalents" to the next "large hadron collider…such as Bill Foster's Pipe-a-tron" LIke wheeling electricity (and possibly hydrogen) from remote and concentrated energy generation resources, be these fossil (methane, "clean" coal), "renewable" (solar) or nuclear. Go here to see only a few possibilities, SuperGrid, Hydricity, Extreme Energy Makeover, and The Solarpipe.

3) Military
Sorry. I am not allowed to post my consulting resume on these activities.

OK. As we native New Yorkers said as the sun was rising the early morning of March 19, 1987…"enough already."

Final Warning: I am NOT volunteering to organize the "suggested session." However, I would be more than willing to help.

Thanks for your patience…if you've read this far.

-Paul

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