

Memoriam Talk by Guy Ron

I'd always thought I'd end up talking at Stuart's 70th, or 80th, or 90th, as all of you who knew him were well aware, Stuart gave the impression of being perpetual, of knowing everything, and having done everything, you just knew he'd be doing physics till the end of time, or at least till the day he dropped (which he did, and for that at least, I think he would be grateful).

You all knew Stuart as a scientist, as did I, but I had the good fortune to know him as a mentor, for which I'm very grateful and that's something I'll also tell you about in a few minutes. But first and foremost, Stuart was a brilliant researcher and my comments cannot start with anything but a short survey of his accomplishments.

Stuart started out as a theorist, but quickly went into experimental physics. In 1972, as a graduate student at Berkeley, he performed the first test of hidden variable theories, in fact, the first test of the Bell inequality [2]. Unfortunately, Stuart isn't as renowned as he should have been for this work, his collaborators have been credited far more than he has for this work, although it truly was **his** experiment, and his design. One of the products of this work was a new inequality, which tellingly is now called the Freedman Inequality. Stuart himself, did not concern himself with recognition of fame, I'd like to show you some words he himself said about the experiment. [Clip1 - 3]

[4]

The first time I met Stuart was at the 2008 PANIC workshop at Eilat, I was just about wrapping up my PhD, and Marek Karliner, who I'm forever grateful to, suggested that I meet with Stuart to talk about a possible postdoc. Stuart had just given a talk about searching for oscillations in beta decay of ^{142}Pm (and a literature survey of Eu decays) which he performed with Paul Vetter and Rod Clark after the GSI results were published. This was a back to back talk with Litvinov, and I remember being struck by the elegance of the experiment, even if not so much by the null result. I later learned that Stuart had a penchant for measuring null results, as he himself put it when giving a talk at a symposium for John Schiffer [5].

[6] Of course, probably Stuart's most famous null result was the 17 keV neutrino. As you all likely know, around the mid-eighties, some experiments showed possible indications of a neutrino with a mass of around 17 keV. Soon, other experiments followed with positive results. [7] Stuart, together with a small collaboration, designed and ran an experiment which did not find any indications of this alleged neutrino [8]. Not content with this, Stuart ingeniously showed that by contaminating the sample they were measuring with ^{14}C , he was able to fake the massive neutrino signal [9,10].

I guess this must have started Stuart's life long love of neutrinos. One of his favorite slides, which I show here [11], is of the first proposal to measure the neutrino, by detonating a nuclear bomb and dropping the detector as it detonates, in order to avoid the shock wave. I think the idea was so crazy it made him happy. [12] Of course, what Stuart is extremely famous for now, is

running the KamLAND collaboration which conclusively showed neutrino oscillations, thus proving or re-proving, that neutrinos have mass. So I guess you could say that Stuart is one of the only people to both remove the neutrino mass and give it back.

Stuart, being Stuart, was not content with just measuring what the experiment was designed for, so KamLAND ended up with a slew of other important results, such as, for example, the first measurement of geo-neutrinos. [13] A measurement of ^8B flux, and many others.

Other famous results [14-16] were a search for axions, a measurement looking for the GSI electron-positron lines, a free-quark search, and the list goes on and on. But Stuart wasn't in it for the results, he was in it for the physics, for the pure joy of research. I think he said it best, in a talk he gave in a symposium for Luis Alvarez, and talking about Alvarez, but he may as well have been describing himself. [Clip2 - 17]

Stuart loved innovation, he loved the elegance of the experiments, and you can see that reflected in all of his endeavors. CUORE, the neutrino-less double beta decay search [18], which will measure the heating of a crystal from the energy deposit of 2 electrons (and for which there's still an outstanding bet between him and Jonathan Rosner[19]). KamLAND, which was designed with a marvelous prompt+delayed trigger scheme.

Fittingly, Stuart was one of the first people, if not the first, to realize that it's possible to use atomic traps to look at beta decay [20], less than 10 years after atomic traps **were** invented!

He also worked on other optics experiments [21], looking for PNC effects. Another idea, which I'm compelled to note here, was the electrostatic trap, a project on which we collaborated with Stuart. He first saw this trap here, in 2009, when he was visiting another workshop we organized, we showed him around the WI and he was immediately struck by the elegance of the ES trap, recognizing a good thing, one of the first edicts I received from him when I got to LBL was: "you know that electrostatic trap, it's cool, build me one....".

Stuart was appreciated by his peers, and was awarded the Bonner prize in NP [22], was a member of the American academy of arts and sciences, and of the national academy of science, and chaired many a committee. But I think one of the best descriptions of him as a scientist that I've read is taken from Bob Chan's eulogy of him, and I'd like to share that with you: [23]

"He understood physics deeply. He could identify what was worth doing, he knew what would be required to do it right, and that's what he did. He could challenge the orthodoxy by looking for free quarks and such, and defend the orthodoxy by unmasking the spurious claims made against it. ...

"Hey, Bob, c'm here," he would say with a nod of his head as I passed by his open office door. And I would always stop, turn around, and walk back to enter, because I knew this was going to be the most interesting thing that happened to me that day. I was going to learn something new and I was going to be entertained by his unique sense of humor."

I'd also like to share with you some of my memories as Stuart and a mentor and friend, and he was truly the best of both. He shaped my career immensely, not just by writing reference letters, but by being a role model.

When I first came to Berkeley, I walked around with him and got introduced to people, he was quite amused by the fact that I'd spent a long time in the Israeli army, and his introductions were always something along the lines of: "this is my new postdoc, be careful around him or he'll waterboard you...". Invariably, he would get asked what I would be working on, and just as invariably, he would get a puzzled look and say: "what do you mean? What ever he wants to, of course".

Stuart gave his postdocs, and students, uncommon leeway to figure out what they want to do, and the means and guidance to do it, he would take someone on to work for him because he liked and believed in him, and not for some particular goal or project. And all of us knew, that if we ever had a problem or dilemma, we could just walk up to his office on the hill, or down to his office on campus (not forgetting to snag a cup of coffee, medium, black, no sugar) and sit down and discuss things with him. And he had a way of cutting to the chase, of challenging you. You'd start talking to him about some detail of your work which you were puzzled about, and he'd ask you an innocuous question, and you'd think to yourself, "come on, this is my experiment, I know this stuff intimately..." then you'd think a bit more, and realize that he was right, and he had picked up on something you hadn't even thought about, and all this while sitting in his office, fielding calls and regaling you with stories and jokes.

He also had a, shall we say, **unique**, way of dealing with bureaucracy, I'm going to share just three of the many stories about this, but they each give some insight into his character. My first week at Berkeley, they decided to order new furniture for our offices at the 88", I was supposed to move into a new office, but since the furniture was still on order I was using another temporarily. This dragged on, of course, for about two months, and Stuart was getting upset, not because of the office space, because of the ridiculousness, because he couldn't figure out how it took 2 months to get furniture from a catalog. So one day he comes into my office, calls me to the empty office next door, hands me a textbook and tells me to sit on the floor and pretend to read, he then takes out his iPhone, snaps a picture [24] and emails his to the admins, and to the division director, guess what? Two days later, new furniture shows up.

Stuart used to have constant arguments about storage space with the lab, every 6 months or so they would ask him to clear some space by throwing stuff out, and Stuart never would, he just would not agree to throw out good equipment because of storage space. And every so often, when we needed something from Stuart's stash, he would get a vindicated look on his face, and tell us all: "you never throw away good equipment". That's why, when we cleared out some lab space on campus he must have decided that the 40gallon drum of Freon that he had stored there would move up to the hill. The task of moving it fell to me, and being a lowly postdoc, I figured I would do this right; I called up the lab, and the university, to try to figure out what it would take. Now, Berkeley, as you all know, is a somewhat environment friendly town, and moving Freon around in rusty barrels is not a favorite pastime there, It turned out that we would have to pay a few thousand dollars to move that 40 gallon drum, which included hiring the only company in the area licensed for that, but also having the roads closed for a few minutes while the truck was driving. We're talking about a mile distance by the way, not a trek across the country. When I went with this to Stuart, of course.... Well suffice it to say I drove down to campus with a lab truck, loaded the Freon and drove back up, very, very, slowly.

Lastly, a few years back, before I got to the lab, word came down from on high that in addition to the lab wide safety meetings (which, by the way, I'm not even sure Stuart knew existed), each group would hold their own safety meetings. This was solved in typical Stuart fashion [25-26].

We were lucky enough to have Stuart and Joyce visiting us for 2 months last year. And our students were lucky enough to have been able to take a seminar class that we gave together. Stuart loved teaching, he loved interested students, and they loved him [27]. He would stay and chat with them after class, and I'm grateful that our students got to experience first hand what science should be like.

Stuart loved life [28], he loved exploring, seeing new things. He loved good food, and good wine, during his stay here I took Joyce and Stuart on a winery

tour [29], this was towards the end of their stay here, about 2 weeks before they were scheduled to leave for the US, and I'd expected them to have a glass of wine at each winery, maybe buy a bottle. As it turns out, we ended the day with about 10-15 bottles of wine, and when I asked Stuart and Joyce how they were going to ship it to the US, and should I help in arranging shipping, he looked at me with his customary mischievous look and said: "why would we ship it? We're going to drink it all before we leave", and they did.

[30]When I started thinking about what I'd say today, I thought about what Stuart would have wanted, how he would have liked this workshop to look, and how best we can honor his wishes. I came to the conclusion that what he would have liked most of all is for this workshop to seed debate and collaboration, but also, not less importantly to be fun. We're all blessed to have known and worked with him, and I'm sure we'll all honor those wishes. May he rest in peace.