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Dear family and friends of Chris Wootton,

My name is Steven Lund. I was Chris's research supervisor at Lawrence Berkeley Lab. I met several of you at the Berkeley Nuclear Engineering Department gatherings on Monday. I wish the meeting could have been on a less somber occasion to celebrate Chris's many achievements and bright future rather than mourn his loss. I would like to express my deepest condolences. Chris was good hearted, hard working, and talented. We will all miss him profoundly as both a friend and a colleague.

There is little I can say that will ease the pain. But perhaps, for those that were not present, I can tell you a little about Chris's experience with our research group at Lawrence Berkeley National Laboratory. I hope this can add to the memories of Chris as an outstanding young man. In spite of his life being cut tragically short, he has left a positive impact on many of us that will not be forgotten.

I was introduced to Chris in the summer of 07 via Sven Chilton, a graduate student working with me who was teaching assistant for one of Chris's Nuclear Engineering classes. Sven mentioned that Chris was a good student and that he had heard about our group work on using accelerators for nuclear fusion based power plants and was interested in working with us. This particular approach to electrical energy generation is at present long range research. However, it will likely be one of the next major energy sources in the future. Working on it now helps narrow the goal of achieving an abundant, clean energy source that will prove necessary for the continued advancement of society. It is a noble goal associated with a difficult problem with profound implications. Many contributions will prove necessary over an extended period to perfect this new technology. I think that Chris's desire to participate in this research was driven by his desire to help and to have an influence in a pressing problem.

On Sven's recommendation, I invited Chris to Lawrence Berkeley Laboratory for an interview. He talked with a number of physicists in our group (Fusion and Ion Beam Technology Group) and he left a positive impression on us. We recommended that he enroll in the laboratory's summer program and then we would try and pick him for our projects among the student candidates. This turned out not to be possible due, unknown to us at the time, to the enrollment window for that program already being closed. But Chris impressed us enough where we took the unusual step of paying for his help directly for the summer with the expectation that it would be a good risk of scarce financial resources.

That turned out to be a good decision based on Chris's accomplishments in his limited time with us. In applied physics, people must often work many years to be effective. It can be overwhelming for students in theory support work since the mathematics and computer modeling is often fairly involved with much practical knowledge necessary. Theory work also interfaces strongly with laboratory experiments and there is often much confusion over what is done in the lab and how to best model effects. I decided to start off training Chris by having him take a part of a graduate/researcher level course on the dynamics of charged particles that would be relevant to the particular problem we would work on. The problem identified for Chris to support was associated with precisely controlling a charged particle beam in an accelerator in the presence of errors associated with imperfect construction. While this is a mundane sounding problem on the surface, it is essential for operation of these machines since errors are inevitable and precise control of the beam is necessary for proper function. Chris, as any scientist or engineer would, had some degree of struggle starting up and mastering the material. But he immediately left an

impression on me as a smart and dedicated worker who strove to learn and improve. With an engineering background, physics material can prove difficult for even experienced engineers to master. But Chris kept working on it and improving until he rapidly became effective and insightful. This same pattern was repeated in learning a programming language used for the mathematical modeling. He quickly adapted from being a novice to a level necessary for productive research advances.

There were many reasons for Chris's success in our work together. First he was very intelligent with good skills. But I think what set him apart was his no-nonsense approach to problems and his diligent, industrious nature. Many problems in research are quite difficult and far from the limited-scope textbook problems in classes. Even smart people get bogged down and frustrated. It can take considerable perseverance to wade through research level material. Chris's virtue was that he applied himself to the fullest. He was persistent and worked hard in the time he spent with us at Berkeley Lab. So much so, that he was a positive influence on the other students and even myself. Realistically, all of us have many demands in life: family, friends, social events, work, classes, research, reports, forms, and bureaucratic necessities. Sometimes it can become overwhelming and it is all so easy to give the inevitable "dog ate my homework" variety of excuses. Chris was the polar opposite of this. He always applied himself to the utmost and made no excuses. He would show up to work in spite of busy exam schedules, family troubles and trauma, social activities, and on. And he would do this all while maintaining balance and perspective on needs and obligations. I found this admirable and inspiring and even a model for my own personal work and obligations.

An amusing digression on this point is illustrative. In the summer that Chris started working with our group, he was in an office with two other undergraduate students. There was another larger office with more graduate and undergraduate students. The office that Chris was in was very focused and did an enviable amount of work. This was accomplished without being machines. Chris and the others were still friendly and helped one another like you want to see. It seemed a model environment. The second office with more students had various issues with excessive distractions and poor progress on assigned problems. Much of this performance gap we attributed to Chris's positive influence in the productive office in helping to set a good balanced tone. Leadership by understated example you might call it. My other colleagues recognized much the same and we even joked that we should pair problematic students with Chris for his positive influence. I believe that Chris has left a lasting influence on his fellow students and researchers in these interactions. I can also attest from a personal standpoint that interactions with people like Chris leave me, a 42 year old experienced research scientist, more resolved to meet obligations in the face of the inevitable distractions and turmoil that life some times throws at all of us.

By the end of the summer, Chris had been effectively trained and was productively engaged in our research. His progress was good and we decided to continue his employment with our group during the term – which is unusual for an undergraduate student. Chris was enthusiastic to continue. He was learning valuable skills that would help him in his future career and he was helping our group with an important problem. Chris told me that he would work about 15-20 hours a week since his diligence in course work had paid off by his senior year and he could take a limited class schedule. I listened and estimated based on usual experiences with other students on such declarations that we would be lucky to get five to ten hours a week. Such is usual with the demands of classes especially as the term progresses. But given Chris's performance I thought it would be good for the group to keep him engaged and take whatever effort could be given. So I told Chris not to torture himself and we would work around whatever schedule he could keep. Nevertheless, Chris kept to his estimate regardless of the term demands and really *did* put in 15+ hours a week. I would have to even pry for a suggestion if something was amiss to tell him that it would be OK to leave early to allow more preparation time for exams and such matters. He continued with this pattern throughout our work. Even when his brother Josh was severely injured in a motorcycle accident he would first prioritize what needed to be done in

helping his brother and family as much as possible, then when that was taken care of to the best of his abilities, and then he would still manage to juggle his work and school and maintain progress. It was a very impressive feat.

Chris was often quiet. He would often join a number of colleagues for lunch at Berkeley Lab. As with all gatherings involving Ph.D scientists, these lunches often turn into active debates on every topic imaginable from technical to social events and trends. Arguments can often become aggressive and heated. Chris could positively contribute in such active discussions with thoughtful and insightful comments that were well timed in spite of his quiet demeanor. Chris would more than hold his own in these interactions. This helped cement my confidence that Chris would even have leadership potential as he continued to mature.

Chris decided to apply for graduate school. During the fall term I wrote Chris a number of letters of recommendation for a collection of the best Universities in the country to which he was applying for graduate study. Admissions are highly competitive and it is always difficult to write proper recommendation letters. But it was easy to say kind, genuine words about Chris without embellishments. This sense of ease stemmed from him being a sure success with his combination of intelligence, drive, hard work, and no-nonsense sense of priority. Evidently others recognized this too. He was admitted into many top institutions with full support – which is an impressive feat. We discussed at length the attractive choices he had between MIT, UC Berkeley, and UC Santa Barbara. He was easy to give advice to and I feel that he effectively evaluated his choices and came to a good decision. He chose to remain at UC Berkeley. I believe this was for a number of reasons: to remain relatively close to family, to allow him to continue a dedicated relationship with his girlfriend Brandy DeOrnellas, and to work with a professor Brian Wirth on reactor design – an area with both attractive job and research prospects. This particular research choice also was ideal to allow Chris to decide whether to continue for a Ph.D or stop at a Master's in an expedited fashion. Having worked with Chris, I was sure that he would be more than capable of completing a Ph.D and I estimated that he could set a record time in receiving a Masters with an expedited start and local familiarity. Chris was a straight arrow prospect with little worry for failure or problems. I could not imagine any personality dispute causing problems. He was practical and not confrontational. All that needed to be done was for him to find his best path and he was doing so effectively.

The day before Chris was killed we last talked in an office at Berkeley Lab with Peter Seidl and Steve Lidia -- two experimental physicists working on the experimental measurements that Chris and I were modeling as theory support. We were discussing work and measurements to be made. Chris had laboriously cataloged and plotted data that was helping sort out an intricate sign issue in achieving correspondence between theory and experiment. We were good-naturedly joking with Chris about his choices while being confident that he would go on to do well. The discussion also signaled the closing weeks of our particular project with Chris's involvement. After a break, Chris was going to start on reactor design with Brian Wirth on campus to get an advanced start on his graduate studies. I expected this and it was no problem. But in his typical fashion, Chris did not want to leave his responsibilities without things being complete and was very generous to set up a transition timeline to see the project through to the right phase. I think he was concerned in discussions the previous days that I would be upset with him for the needed change of direction. But I assured him it was a good and natural progression and that he owed us nothing further. In short, it was a good situation in that we had benefited from his work and he benefited from our training. One of the prime duties of all scientists is to train the future generation to continue advances. The system requires such to remain healthy and continue. With Chris we were all confident that a talent was flourishing and this provided us all with a high degree of professional satisfaction.

Our group will finish the research that Chris was involved with. We will attempt to publish it in a

prominent peer reviewed journal in accelerator physics. The material was formulated in a manner where it should remain applicable for many years. This way Chris's legacy can live on as a small part of a growing body of research that advancement of our society requires. I will provide copies of the finished research along with material that Chris presented with us last summer at Berkeley Lab. It will likely take a considerable time for completion, peer review, and publication. More time still to get incorporated in the next generation of advances. But this is the way science works. To build on the advances of others over time. Perhaps this work can serve as a small tribute to Chris and what should have been. In presentations of this research in future scientific meetings I will try to make note of the Chris's contributions along with memorial comments.

Please remember Chris in happy times as well as his achievements. He accomplished a lot of good in a life cut tragically short. I think he would want to be remembered for his positive influences and I will try to do my small part to see that happen.

Sincerely,

Steve Lund