

## Thoughts on the First ICUIL Meeting - Professor Ken Ledingham

First of all let me say I enjoyed meeting you all again on Friday/Saturday and I still feel a sense of excitement with the potential for this field. However this enthusiasm is somewhat tempered with realism which I thought of bringing to the attention of the meeting. However there was not quite the opportunity and I certainly did not wish to in any way dampen the general feeling of euphoria.

The thoughts that I wish to put before you now are thoughts that have developed out of working extensively in this field and carrying out experiments and visiting most of the ultra high intensity labs throughout the world. I am also invited to travel around the world trying to explain this field to fusion, nuclear, particle and medical people which of course I still love doing. I have felt for some time we as a community have promised much and not really as yet delivered. I am perhaps more critical of my own contribution than any one else because I have been brought up in the rigour of the nuclear community. My team and collaborators, as you all know, has carried out very exciting experiments in laser driven fission, laser induced gamma and particle beams, medical isotope production, laser driven heavy ion fusion reactions, laser transmutation of radioactive waste and most recently the first experiments in laser spallation of neutrons. Soon I hope to try laser production of pions. These experiments have given me and my staff and students great excitement and I hope have generated interest around the world. However I have known for some time that these experiments are largely uncontrolled and less than convincing to the nuclear, particle and medical communities.

My fear is that ICUIL tends to be technology driven rather than science driven. This means that we develop these large lasers and are uncertain of the science to do with it and much worse are not spending the necessary money to do the controlled and definitive experiments to move the field on. Of course I realise that the aim of many labs is fast ignitor or the production of high energy gamma beams but I do not believe we can sell to the world's tax payers the building of large installations without a compelling and widely based science case. Even the building of high intensity table top systems for Universities requires a well thought out science case.

I shall give just one example of what I am talking about. Over the last two years I and other members of the ICUIL group have been members of a number of teams both national and international that have attempted to get money to build lasers to produce PET isotopes and to investigate proton oncology. These were two of the dreams of the final report of the OECD science forum dealing with compact short pulse lasers. These submissions have been unsuccessful. Why? The referees did not believe we could build the lasers and did not believe we could control the proton beams that are necessary for the job and were not prepared to give us the benefit of the doubt. At present we produce our proton beams from layers of uncontrolled dirt and cannot make the beams monoenergetic. In principle we know how to do this in a controlled way and maybe we know how to produce monoenergetic beams. Yet there are no facilities around the world at present where these definitive experiments can be carried out. What I am saying is that we must be prepared to spend serious money to deliver the rigorous science to move the field on. Until we stop doing largely uncontrolled science we shall not persuade a largely unconvinced science community.

We were talking about a sub-committee to look at exawatt lasers. Of course I am excited about this and would take part enthusiastically. However I think this is a bridge too far at present. We should have a panel to look at how to deliver controlled proton and heavy ion beams. This is essential for medical and ion injector interests and if we could deliver this,

many people around the world would look up and take interest. Furthermore I do believe we can deliver this before the present committee demits office. In addition we should look at a laser design which could deliver PET isotopes. Of course this does not mean that we should compete with cyclotrons but let us look realistically if we can deliver this. I would dearly like to be part of a team that demonstrated that we could do this, not just wrote papers saying potentially we can do this. There are many other areas that we must deliver on e.g. how do these laser driven processes we talk about scale with energy, intensity and pulse width. Is there indeed some preferred pulse shape – a sort of coherent control? This is more than just cleaning up the pulse. Indeed cleaning up the pulse may be exactly wrong! I have only chosen one example in medical physics but I do believe that in general controlled experiments are necessary throughout the field because by default high intensity lasers produce intense photon and particle beams. It seems a pity to let them just plough into the walls that Rob Clarke so eloquently described at our meeting. We must show how to use them to best and general effect!

I hope that the committee takes this criticism in the spirit in which it is given because I realise that I personally have not yet delivered. My team and most of the field have only done the proof of concept experiments. The hard and rigorous work must now begin and as a community we must be prepared to do this to justify the money spent on the present technology before indeed we move on to the next stage of multipetawatt and exawatt. These are the reservations that are being directed at our community by the funding authorities in the UK. I, of course, am speaking as one of the ICUIL user community but I think without us the technology does not move on.

I would very much to hear your views and perhaps this letter might at least generate debate. Your views may of course be critical and I have to be prepared to take that but my sole motivation is to see this amazing field of science deliver the heady expectations that many of us have for it.