



## Research and Innovation in Plasma Physics, a personal voyage.

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A university's primary role is to educate and produce research results, mostly funded by the common weal. A business's primary role is to survive. Generally business wants ideas that help with their immediate problems into a 3 month foreseeable future. Universities are used to timescales at least an order of magnitude longer. The speaker's experience as lead guitar in a rock and roll band, bass in a jazz band, building cars, running an offset printing firm, inventing the helicon source, creating 4 start-ups and interacting with industry will be presented. All great advances in physics have been inspired by the needs of society and innovation has been the process that leads to success.

The Helicon plasma source was invented as a part of my PhD in 1968 in response to the failure of the project I was originally given. It was regarded as a curiosity until the findings were finally published in an extended paper in 1984.

We carried out helicon plasma etching but they were not believed by Silicon Valley as the rates were 100 times higher than anything they had seen. Finally, it took off in

the early 1990s producing excellent results for both deposition and etching.

In the early 2000s, Christine Charles in our Laboratory discovered an electric double-layer in the plasma expanding from a Helicon source and this has been shown, in high power versions, to produce thrust comparable to Hall Effect Thrusters with a similar efficiency.

Both of these discoveries have been behind the industrial innovation that characterises our Laboratory.

With all of my start-up companies, the aim has been to develop and sell the best cutting edge technology, not to just promise to sell and then jump to an IPO. Apart from the software giants that many people mistake as being high technology, solid engineering and science lies behind successful enterprise. There are a number of phases that start-ups experience that are not dissimilar to those experienced by a PhD student: wonder, followed by confusion leading to depression and finally pride in a job well done. These are the innovators that pay their own way and carry the responsibility of the company on their shoulders. And most of the time, they succeed (after some years.....).

It has been noted by Lao Tsu:

公乃王，王乃天，天乃道，道乃久，沒身不殆。

There is a nobility in discovery and innovation.