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EDITOR'S INTRODUCTION

Soft X Rays in the 21st Century II

Larry V. Knight

Department of Physics and Astronomy, Brigham Young University, Provo, Utah 84602

Four years ago in the introduction to the conference titled "Soft X-Rays in the 21st Century" I stated that the conference was about where soft x-ray science and technology stands in relation to its past and its future. In the conclusion to that editorial I added that the purpose of the conference was ". . . to set an agenda of key technical goals for the next decade. . . ." Then logically the purpose of the conference "Soft X-Rays in the 21st Century II" should be to monitor the progress in the past few years, make midcourse corrections, and establish a new agenda. In fact that was the purpose of the conference. However, in my view it was also time to consider "reinventing" the role of scientists in society.

HOW FAR HAVE WE COME?

The introduction to the first "Soft X-Rays in the 21st Century" conference called for demonstrations of useful soft x-ray technology. Recently someone who should know announced that XUV lithography will be in use in fabs in less than 3 years. A key to this encouraging judgment was the development of a phase shifting diffraction interferometer capable of accuracy higher than 1 nm in figure and roughness. Jorge Rocca has demonstrated lasing in a capillary discharge at EUV wavelengths. An x-ray tube using field emitter cathodes has been built. Superconducting energy dispersive detectors with high repetition rates are being used. Thus the feasibility of many applications has been demonstrated. There are many more examples. At this point it is tempting to say that we as scientists have done our job. However, the next step—commercial success—is the most important step and should not be turned over to others and ignored by the scientists who showed feasibility in the first place.

THE NEXT STEP

The commercial potential of these advances is enormous. EUV lithography will impact the entire integrated circuit industry. However, the technical and resource problems associated with putting an EUV lithographic system into hundreds of integrated circuit fabs are orders of magnitude greater than showing feasibility. A commercial EUV laser will also be in demand as a source for many applications including EUV lithography. Again the transition from feasibility demonstration to commercial product is loaded with technical and resource problems. An x-ray tube that uses dense arrays of field emitters as a cathode may produce radically advanced x-ray tubes with

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much lower costs, reduced size, and advanced capability. Similar comments could be made about a variety of x-ray detectors—superconducting x-ray detectors, x-ray diode spectrometers, etc. Almost 10 years ago, when this journal was founded, we justified starting a new journal with a lead-off article by Nat Ceglio: "Revolution in X-Ray Optics." The potential value projected from this revolution is being fulfilled. It is as if a basketball player had broken away and was going in for a slam dunk. The question is, Will he finish the play or will the ball bounce off the rim? If at the last second he passes the ball off, the chance of success is reduced.

SCIENTISTS AS PROBLEM SOLVERS

If the accomplishments–knowledge and experience gained in the study of soft x rays–of the past 15 years or so are to bear fruit, many of us (scientists) must see these opportunities through to their final conclusion. We must see that these promising applications are commercialized and impact the world economy. Why can't we turn these projects over to the engineers and business people who traditionally commercialize technology? I submit that we have come to a stage in technical development where the technical problems associated with commercialization of these and other advanced technologies are pushing the limits of scientific understanding. Commercialization of such technology will need the best efforts of engineers, business people, and the scientists who have spent years trying to understand the science behind the technology.

As a professor of physics for over 20 years, it is ironic for me to hear the whining about the state of science in recent years. The Internet is filled with horror stories of talented, young scientists who can't find a decent job. Articles and letters to the editor advise reducing the number of students in graduate school and also the number of undergraduates studying physics. My take on the situation is just the opposite. We need more trained scientists if new technology—such as x-ray technology—is to realize its potential benefit to society. As an educator I believe scientists are trained as problem solvers and learners. There is a great need for problem solvers and learners in industry today. I have commented to my students over the years—only partially with tongue in cheek—that if universities truly wanted a good general education program, they should make every student major in physics. Then the students could do anything they wanted. Several students have returned over the years—successful lawyers, business people, etc.—to support that conclusion. I advocate helping students realize that there are interesting challenges in industry. In addition, I am trying to make industry aware of the great treasure of talent available if they can get scientists involved in their problems. I am spending this summer at Ultratech Stepper (UTS) in San Jose, California. Ultratech Stepper is a good example. If UTS can solve problems associated with pushing their technology near the theoretical limits, their business will grow because they will make valuable contributions to the integrated circuit industry. My students need to learn the lessons that can be taught by working in such an environment. All scientists need to learn that lesson whatever role they play in the scientific and industrial community.

Those of us who have benefited from the exciting experience of developing a new technology must take the responsibility to see it through to a successful conclusion. This must happen if we are to attract growing support for fundamental research in x-

ray science and science in general. I have a favorite scripture. It says roughly, ". . . if you receive 'light' and continue in the 'light', the 'light' will grow brighter and brighter until the perfect day. . . ." I am suggesting we continue to apply the "light" we have. I would like to see "the perfect day."

THE JOURNAL OF X-RAY SCIENCE AND TECHNOLOGY

It is also time to look at the next step for *The Journal of X-Ray Science and Technology.* We have laid a foundation of the first few years of the journal. We are proud of the quality of the papers we have received and the support of many. We feel it now time to consider ways to increase the value of the journal to the community we serve and hopefully to expand that community. New technology is available, e.g., the world wide web. We are looking at the ways we can use the resources we have to become more effective in achieving our goals. As readers and contributors we seek your advice and suggestions. We also need your continued support.