

The History of the Synchrotron Radiation Center

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The intent of this document is to explain and clarify the majority of the historical materials I've collected in the last 10 months. This will be essentially broken down into three chapters, my objectives when I arrived in February 2009, the summer Research Experience for Undergraduate (REU) program, and the last semester here— which was September – December 2009.

I will address issues such as my methods, thought processes, revelations, and the overall content of the historical archive I built. All mentioned documents, lists, articles, etc... are included within the digital archive.

An Introduction to Synchrotron Radiation

The History of the SRC, also called Tantalus to Today, was a project that sought to preserve and uncover the rich underlying history of the facility. The facility is historically important because it was the first of its kind.

In 1968 the first light source dedicated to materials research came online and brought with it the start of an international community of scientists. The accelerator, known as Tantalus, was a 5 meter in diameter circular accelerator whose purpose was to rotate electrons near the speed of light around the inner race track. In doing this, the electrons would emit light every time they rounded a corner. The electrons were forced to continually circle around the accelerator by strong magnets known as bending magnets

The figure below is a schematic drawing of the Tantalus accelerator. The RF cavity was a device that replenished the electron's lost energy. As electrons rotate around the corners they emit light, which is a form of energy and that energy comes from the electrons. If the RF cavity didn't exist the electrons would eventually slow down too much and be useless. The RF cavity kept the electrons flowing continuously.

The main objective of the Tantalus accelerator was to produce light. The light coming off the electrons would continue in a straight line as the electrons bent around

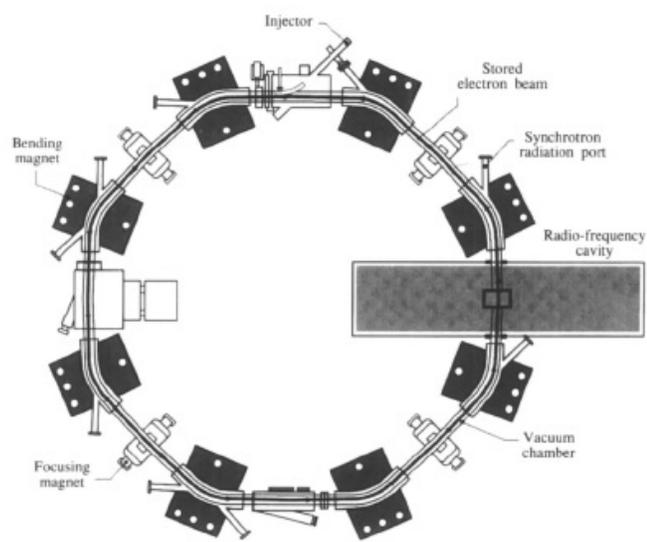


Figure 2
Schematic drawing of Tantalus without beamlines or injector.

the corner for another pass. That light was collected by long tubes called beamlines that connected to the Synchrotron Radiation ports as seen in the figure. The light was then modified and manipulated and shined on material samples at the end of the beamline. This process acts like a microscope and tells the scientist a lot about the material they are illuminating.

The Tantalus Facility

Although the phenomenon of synchrotron radiation had been known about since the 1940's when at a lab at General Electric (GE) an accelerator there demonstrated the event that electrons emit brilliant light when they are spun around near the speed of light. Since then accelerator physicists considered synchrotron light to be wasteful because that meant you had to re-supply your spinning particles with more energy to keep their momentum. The Tantalus facility was different because their intention was to use that "waste" in order to understand how matter behaves and its structure. The Tantalus facility ran from 1968 through 1995 when it was finally decommissioned and disassembled for permanent storage at the Smithsonian Institute. However, in 1984 construction on a newer and much larger accelerator known as Aladdin began and succeeded the smaller Tantalus ring. The Aladdin accelerator is a bigger and more advanced version of the Tantalus ring and it sits similarly in an underground bunker-like vault within a building named The Synchrotron Radiation Center

Preserving that History

The two main objectives of the project were to conduct oral history interviews with the physicists who were a part of either of the facility's two chapters, the Tantalus era and the Aladdin era. The second objective was to compile an archive full of documents that tell the story of the facility as a whole. These documents were scattered all around Kegonsa Research Campus (KRC) and they needed to be centralized. The KRC is made up of three primary buildings, the SRC, the old Tantalus building across the street and the Physical Sciences Laboratory (PSL) which is located next to the SRC. PSL is an organization with the University of Wisconsin Madison that specializes in designing and assembling unique parts for accelerator physics or other specified physics engineering requests.

Readings

The History of the SRC project began in February 2009. After getting acquainted with the accelerator the first task was to read the available published articles about the history of the SRC. These 5 articles were thought to be the only literature about the past:

- Bancroft, Michael G. "The Canadian Synchrotron Radiation Facility (CSRF) in Madison Twenty Five Years of Soft X-Ray Research." Canada Journal of Chemistry 85 (2007): 637-44"
- Lynch, David W. "Tantalus, a 240 MeV Dedicated Source of Synchrotron Radiation 1968-1986." Journal of Synchrotron Radiation (1997): 334-43.

- Lynch, David W. "The Early Years of Tantalus." Synchrotron Radiation News 5.2 (1992): 16-21.
- Margaritondo, Giorgio. "The Evolution of a Dedicated Light Source." Physics Today 61.5 (2008): 37-43.
- Rowe, Ednor M. "The Beginning Under the Lonely Hill." An Informal History of the Synchrotron Radiation Center of the University of Wisconsin-Madison 1965-1968 (): 1-4.

In particular, the last article in the list written by Ednor M. Rowe is the most concise version of the beginnings of the Tantalus facility. Each of these articles contributes uniquely to the overall history. Some are more specific in explaining the physics of the accelerator such as David Lynch's articles and others tell the overall story like Giorgio Margaritondo's.

Interviews

Oral history skills are not taught in the classical history of science field. So paired with common sense I referenced a book called *A Field Notebook for Oral History 2001 (Fourth Edition)* from Idaho Oral History Center. This notebook tells many of the do's and don'ts of interviewing such that the interviews could be as fruitful as possible.

Equipment

Phillips 7655 Digital Voice Tracer recorder, RadioShack Telephone Recorder Controller, personal computer, external hard drive. In addition, we created a contact list that has information of all potential interview subjects. The list helps prioritize the contacts helping to organize the interview schedule.

Interview Process

Interview sessions consisted of one on one meetings, group meetings, or telephone calls. The use of a digital recorder recorded the conversation and allowed for later transcription. After transcribing, hard copies were printed and later re-read while highlighting broad, central, and repetitive themes that is located on a word file creatively titled *Big Themes*. Every interview audio file and transcription were saved to the central SRC server and SRC external hard drive.

The Phillips recorder creates obscure audio files in the form of .zvr. The software that comes with it allows you to convert that .zvr to .wav. I found it best to then use a different third party software (any one on download.com will do) to convert the .wav into an .mp3. MP3s can be slowed down without distorting.

I also kept a central notebook in which I actively scribbled notes during the interviews. Aside from interview notes the notebook contains all sorts of thoughts, comments and physics related things.

Arrival

The first leg of the project was mostly interviews and familiarizing myself with the accelerator and its dictionary of physics jargon that comes with it. An intimate knowledge of the physics and mechanics of all the accelerator components is *not* necessary to learning the history. All necessary knowledge for understanding the physics can be found on the internet and within the aforementioned articles.

REU Summer Program

The start of the REU at the end of May 2009 kicked the *Tantalus to Today* (for the sake of a catchy title that's what we called the history project) project into high gear.

The first task was to create a roadmap of where the project was going to go. It was decided that the main objective for the REU project was to be primarily fact finding and data gathering. This meant many more interviews. However in the time before we could get all the interviews setup my first task was to examine thoroughly the Smithsonian videos.

In 1995 the original Tantalus accelerator was officially decommissioned after 27 years of service to the synchrotron radiation community. The Smithsonian offered to take half of the historic accelerator to store at their facility in Washington D.C.—it is still awaiting to be put on display.

Prior to Tantalus' deconstruction a curator of science at the Smithsonian by the name of Paul Foreman interviewed 6 of the original and significant figures who got the Tantalus facility on its feet: Ed Rowe-SRC Director, Charlie Pruett- SRC Senior Scientist - Optics and Instrumentation, Roger Otte-SRC Operations Manager, Fred Brown-Professor of Physics - University of Illinois, Jim Taylor-Professor of Chemistry - UW-Madison, Co-Director - CNTech, Director – SRC, Cliff Olson-Research Scientist - Ames Lab, Iowa State University.

These interviews tell a wide angled story about the facility's beginning and the scientific atmosphere for synchrotron radiation research. As I watched these unpolished interviews I took notes which are under *Tantalus Decommissioning Video Summations*. These notes were the highlights of each interview and each video tape—this can be useful for searching through the interviews rather than sitting through them.

The Smithsonian videos were originally on VHS video tapes which are prone to aging and degradation so we digitized them at the University of Wisconsin's Do-It technology shop. We have all of the videos stored in two different file formats on an external hard drive—the one this file is saved on. Within the video file folders is a document that explains how to overcome some of the technical complications with viewing some of them. Sometimes the audio and video files get out of sync with each other and need to be corrected.

Summer Interviews

As mentioned before the REU program kick started the interview process. We went from 4 interviews to 20 by the end of the summer. See the poster I made for the REU program under the folder titled *REU* and then *REU History of SRC Poster*. Inside is the poster used for the poster sessions. It explains much of the overall project and has some useful visuals. One shows the differing interviews I've done and how long each person has worked here. The other shows a chronology of the different agencies that have funded the SRC throughout the times.

Finishing up the REU program was the final presentation which also gives a guided tour of some of the history I uncovered. That too is located in the *REU* folder under *Eric Verbeten Final REU Presentation*

It should be noted that the one main issue with the interviewing process were the interviewees struggles to remember exact dates. Understandably, it is easy to forget months and even the years when certain events happened but generally they were able to give a timeframe which frequently proved accurate when cross-checked with the historical documents in the archive.

Fall Semester (September-December 2009)

The main objective for these last four months began originally to write a formal senior thesis analyzing some aspect of my research for the History of Science major at UW Madison. That however shifted to concentrating on just creating a working archive of documents.

The purpose was to submit all of the things I've collected and research to the University of Wisconsin Archives for safe keeping.

Since the start of Tantalus in 1968 there have been many documents stored in boxes waiting to be looked through. After corraling all of the known boxes of material from the various buildings I set forth with a plan of what and what not to use for the archive.

Documents that are included in the archive are: newsletters, proposals, schematics, meeting minutes, photographs, publications, magazine articles, and personal correspondence letters.

Items were not included in the archive if they were collections of raw data, numbers and calculations such as seen in log books. However I included a scan of a logbook and some other of the 'non-essential' items to give the viewer a glimpse of what is out here. The logbooks and things not included in the archive will be stored at the SRC and researchers are encouraged to come out and look through them and use them if so desired.

The Process

Once I centralized all of the scattered boxes in a trailer office I grabbed my dust mask and began looking through the hundreds of individual papers and things. As mentioned above I was looking for items that told a general story about the accelerator and the community around it. On several occasions I found

informal write ups by some of the most involved physicists describing the general state of synchrotron radiation research in the country.

The main objective of each year folder was to use the documents to illustrate some of the central themes and tasks going on that year. Additionally the archived documents serve to verify and reinforce the information gained from the interviews.

The archive could have developed into any number of different things, but it seemed for now the best path was to create a qualitative outline of the facility's long history. There remain tons of raw data, booklets, and other documents which don't tell a story by themselves.