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From ICANS to UCANS

How ICANS came about, how UCANS came about, where UCANS might go from here

UCANS-1,

First meeting of the

Union for Compact Accelerator-based Neutron Sources

Tsinghua University, Beijing

16 August 2010

J. M. CARPENTER

Early events that led to ICANS

- 1968-1969, Argonne Committee on Intense Neutron Sources:

  H- injection, 500-MeV Booster conceived for ZGS

  Best prospect for n's: proton-driven pulsed spallation neutron source

  Doubts: intensity and scientific effectiveness

- 1971-1972, JMC sabbatical at ANL

  Discovered Be reflector, conceived ZING

  Remaining question: scientific effectiveness

- 1973, David Price and JMC convened Workshop to evaluate applications of ZING

  20 scientists, including Motoharu Kimura

Early events that led to ICANS

Early 1973

- 200-MeV proton synchrotron prototype, Booster-I, for testing H^- injection already on
- Kimura had doubted our performance estimates, but after the Workshop, was convinced

  "You must build a prototype," he said, and stayed on at Argonne to help
- Kimura brought young protégé Noboru Watanabe to design a diffractometer
- With engineer Robert Kleb, we designed ZING-P, requested $30,000
- Kurt Sköld designed and built a backscattering spectrometer

Early events

- October 1973 money came
- January 1974 finished ZING-P. Two vertical neutron beams,
  2 polyethylene moderators.
- Everything built from junk and reclaimed equipment:
  - used battleship armor
  - A^2R^2 beryllium blocks
  - 4-input, 4096-channel t-o-f analyzer
  - target ½ lead brick
- H- injection worked, ZING-P (with Be reflector) produced neutrons as predicted, the two instruments actually produced science.
- U.S. Patent granted for Be-reflected, synchrotron-driven neutron source

More early events

1975

- ZING-P results reported at Petten Neutron Diffraction Conference
- Booster-I shut down for replacement with 500-MeV Booster-II
- ZING-P improved, becomes ZING-P': three more neutron beams and neutron scattering instruments
- JMC left U of M, joined ANL
- Proposal to AEC to build the bigger source, ZING
- Sam Werner and JMC convene 2nd ZING workshop. Many attendees

1977-1980

- ZING-P’ produced science, also engineering data for IPNS, provided tests of new ideas
- ZING (too cute) renamed, became IPNS
- 1978 IPNS-I funded
- 1979 ZGS and CP-5 shut down—liberated people, funds, materials, accelerators, buildings, infrastructure, …

1977, Founding of ICANS

- Rex Fluharty from **L**os Alamos, JMC from **A**rgonne, Leo Hobbis and George Sterling from **R**utherford Laboratory, and Motoharu Kimura representing Japan met at Argonne. Decided that we needed a forum at which to share information, we outlined its purpose, how it would be organized, and called it "**LARJ**." I never liked that name.

- Torben Brun, Argonne scientist, and JMC conceived the name "**ICANS:**"
  The International Collaboration on Advanced Neutron Sources.

- ICANS meetings began, held regularly, produced proceedings, promoted discussions and collaborative work on timely subjects.

- Workshop format to promote discussions, promote collaborative work, and share experiences of successes and failures

- Three foci—ACCELERATORS, TARGETS AND MODERATORS, and INSTRUMENTS

- Much later, we created a Website www.pns.anl.gov/related/icans/shtml

ICANS Meetings

Since its founding, ICANS has convened 19-1/2 meetings.

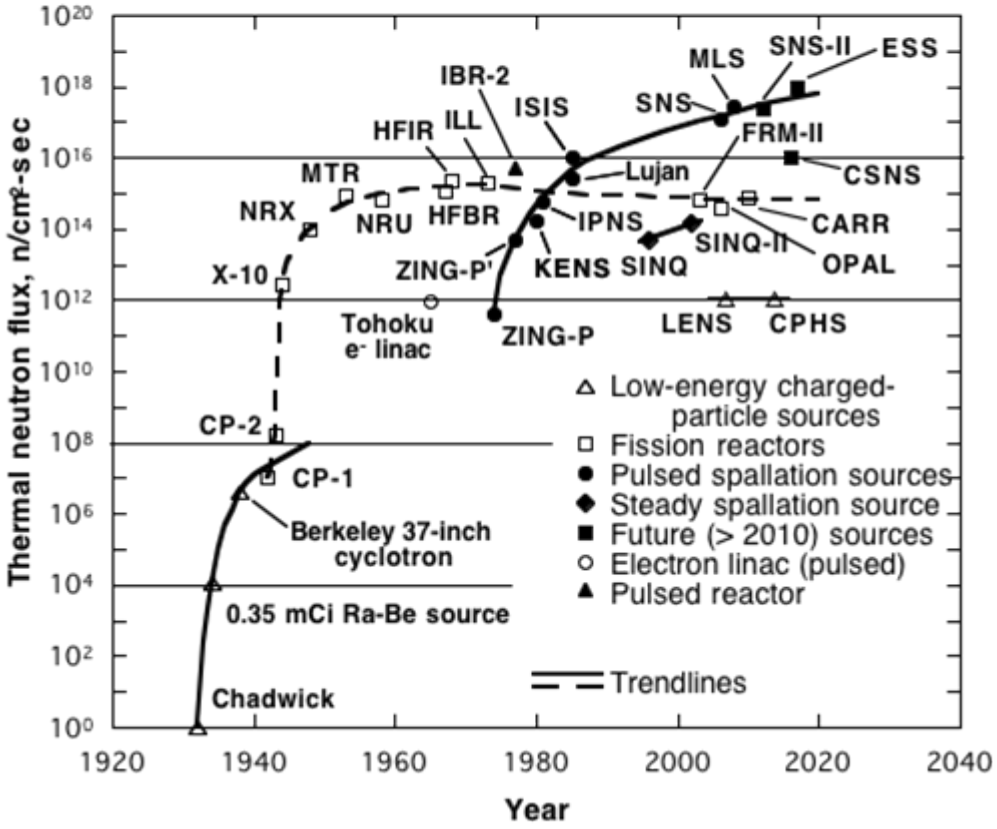
Host institutions organize and support the meetings, which rotate among collaboration member institutions, and publish proceedings.

Special interest groups formed, holding occasional meetings on special topics: Cold Moderators, High Power Targets

Then…….

1978 received money to build IPNS, completed in 1981, others put forward proposals and built new installations

And here we are—see Brugger plot



UCANS, 2010

After the nineteenth meeting, ICANS XIX, at Grindelwald, Switzerland, scientists interested in developing low-power accelerator-based neutron sources met on Saturday, 13 March 2010, in Kloten, near Zürich airport, to discuss their common interests.

Lively discussion and strong interest in Low-Energy Neutron Sources followed, spurred by successes (and other experiences) at the LENS at University of Indiana, operating, and the launching of the Compact Pulsed Hadron (CPHS) source at Tinghua University, Beijing. Representatives of other institutions with parallel interests also took part.

Leadership emerged, responsibilities assumed, our name agreed to, Union of Compact Accelerator-based Neutron Sources—UCANS—purposes and procedures outlined, and a next meeting agreed: HERE WE ARE!—UCANS-1.

Just for Fun—the earliest neutron sources

Chadwick's neutron chamber in which alpha particles from a polonium source at one end bombarded a beryllium target at the opposite end. The vertical pipe was attached to a vacuum pump. (From the *Photographic Archives of the Cavendish Laboratory, Cambridge. Courtesy of* G. L. Squires.)

The nuclear reactions are

$$Po^{210} \rightarrow Pb^{206} + \alpha(5.3MeV)$$

$$\alpha + Be^{9} \rightarrow C^{12} + n(4.9MeV)$$

Diagram from Chadwick's 1932 paper

When a sheet of paraffin wax about 2 mm. thick was interposed in the path of the radiation just in front of the counter, the number of deflections recorded by the oscillograph increased markedly. This increase was due to particles

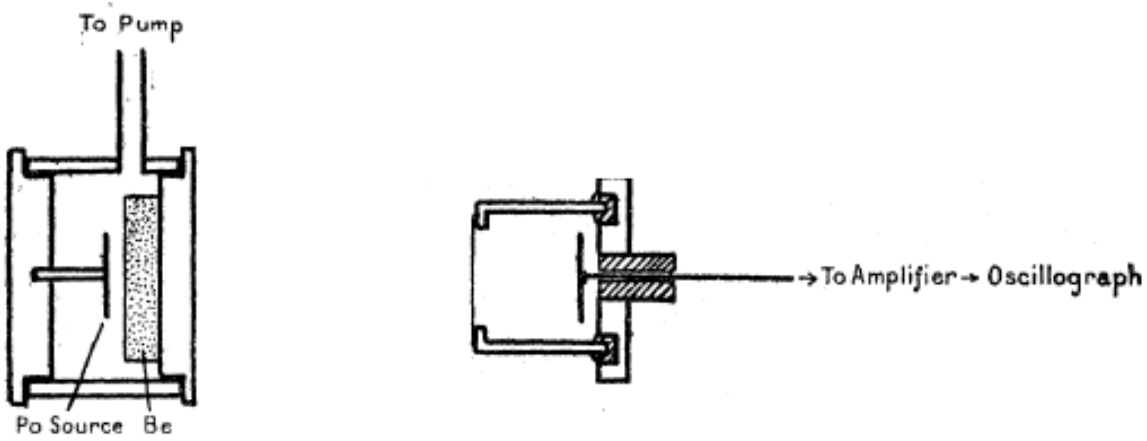


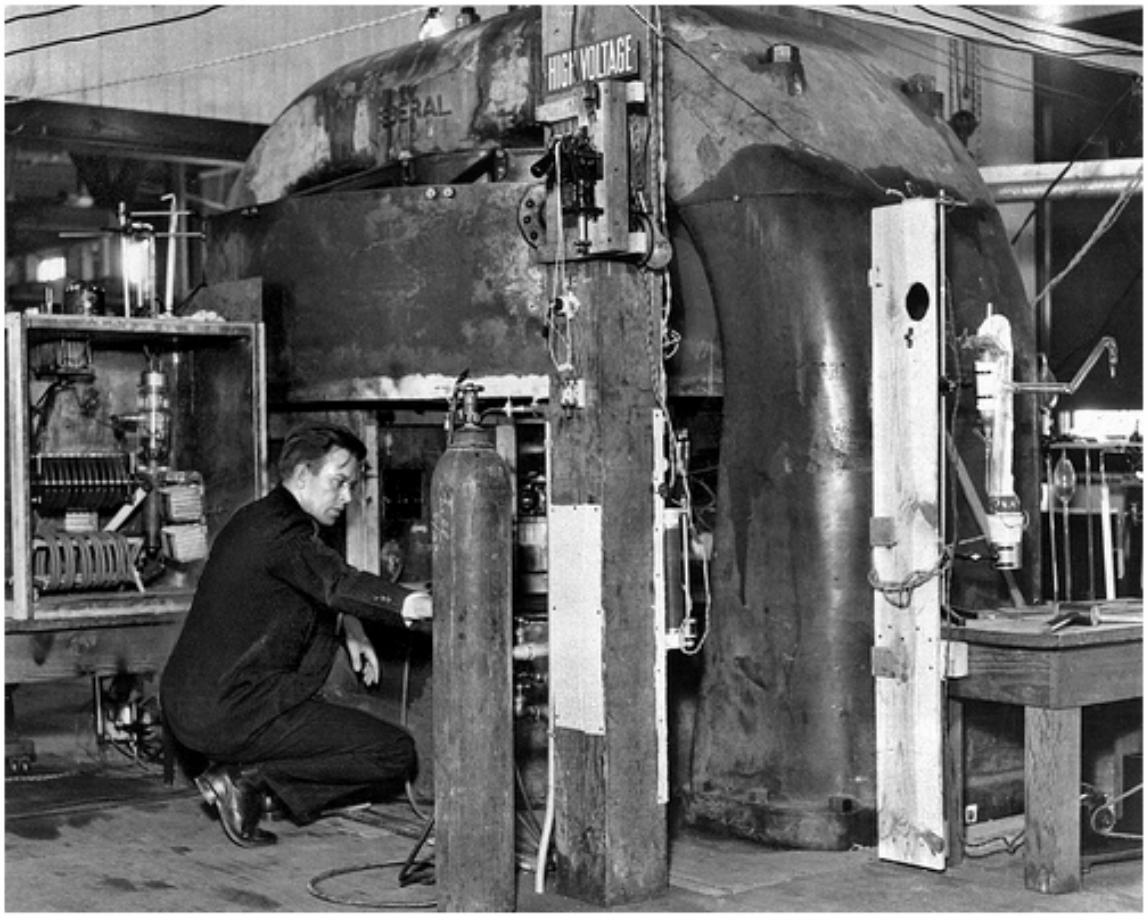
FIG. 1.

ejected from the paraffin wax so as to pass into the counter. By placing

Berkeley 37-inch cyclotron

Lawrence at the 37 inch Cyclotron

ALL SIZES



Neutrons from the 37-inch cyclotron

Glenn Seaborg arrived at Berkeley in 1934 to work on his PhD thesis. By 1937 Lawrence's 37-inch cyclotron was delivering 8-MeV deuterons. Seaborg used the deuteron beam to generate neutrons by the d-d reaction in a target of 77° K D_2O ice,

$$d + d \rightarrow He^3 + n(2.2MeV)$$

Seaborg told the great story of his long and distinguished career in his lecture, *An Early History of LBNL*, August 1996,

www.lbl.gov.LBL/LBL-PID/Nobelists/Seaborg/65th-anniversary/30.html

What's clever about the D_2O ice target?

8-MeV deuterons penetrate only about 0.26 mm in aluminum.

Need a windowless entry from cyclotron vacuum to target material.

77° K D_2O ice has very low vapor pressure, so don't need window.

Enrico Fermi: CP-1
The first (man-made)
self-sustaining nuclear reactor

Critical 2 December, 1942, Stagg Field, Chicago

Where are the parallels between early ICANS activities and our work in the present day?

Original inspiration, evolving leadership

Prototypes: ZING-P, ZING-P'; LENS (IU), ABNCT (MIT)

Applications workshops

Outreach to other interested groups

Use of abandoned facilities and existing infrastructure and materials

Student involvement

Organization around existing local expertise

Formal organization, connection of UCANS to ICANS

Regular meetings

Published and circulated meetings proceedings

Recent ICANS meetings have drifted from the **workshop** flavor. I hope that we can **restore** this aspect in UCANS meetings. This will require extra efforts of the organizers, and also effort and cooperation of UCANS participants.

What do we do next?

Already our organizers have drafted some of the procedures under which UCANS will operate, which we will hear more about later, and will evolve in further discussions and be written down.

Membership and participation in the Union are open to all qualified interested scientists and institutions. And already eight (?) institutions are represented here today.

Those already involved welcome and strongly encourage other participants and representatives to join in.

Uses of Compact Neutron Sources: Add to these as we progress

Education

- Student involvement in design and fabrication of source and instruments
- Thesis opportunities
- Developing qualities of leadership, teamwork, and responsibility

Recycling

Science

- SANS
- Reflectometry
- Imaging
- Target systems development
- Moderator development
- Tune-up measurements in preparation for experiments at large facilities

New direction

Peter Egelstaff for many years urged that there should be “a neutron source in every state” in the U.S. Already, we have

- LENS at University of Indiana
- CPHS at Tsinghua University (soon)

- Small, university-based sources, using low-energy neutron-producing reactions

Cheap to build, mostly from existing infrastructure and equipment and to operate

Easy to access, good testbeds for new developments, good training venues for students and new neutron users, capable of certain types of science

VIVE the Low-Energy Neutron Sources!

May they multiply and go far!

THANK YOU,

Chun Loong, Hiro Shimizu, Paul Sokol, Jie Wei, Dong Xu, Prof. Chuan Xiang Tang,

and all who helped to make this meeting possible.

THANK YOU!