



EUROPEAN
SPALLATION
SOURCE

Välkommen till ESS
Engineering in Neutron Science
Personal experiences

19 September 2016

Masatoshi Arai
Senior Technical Advisor
European Spallation Source ERIC

ESS, MAX IV and Science Village
will form a research complex, and eventually it will
become a world science center.



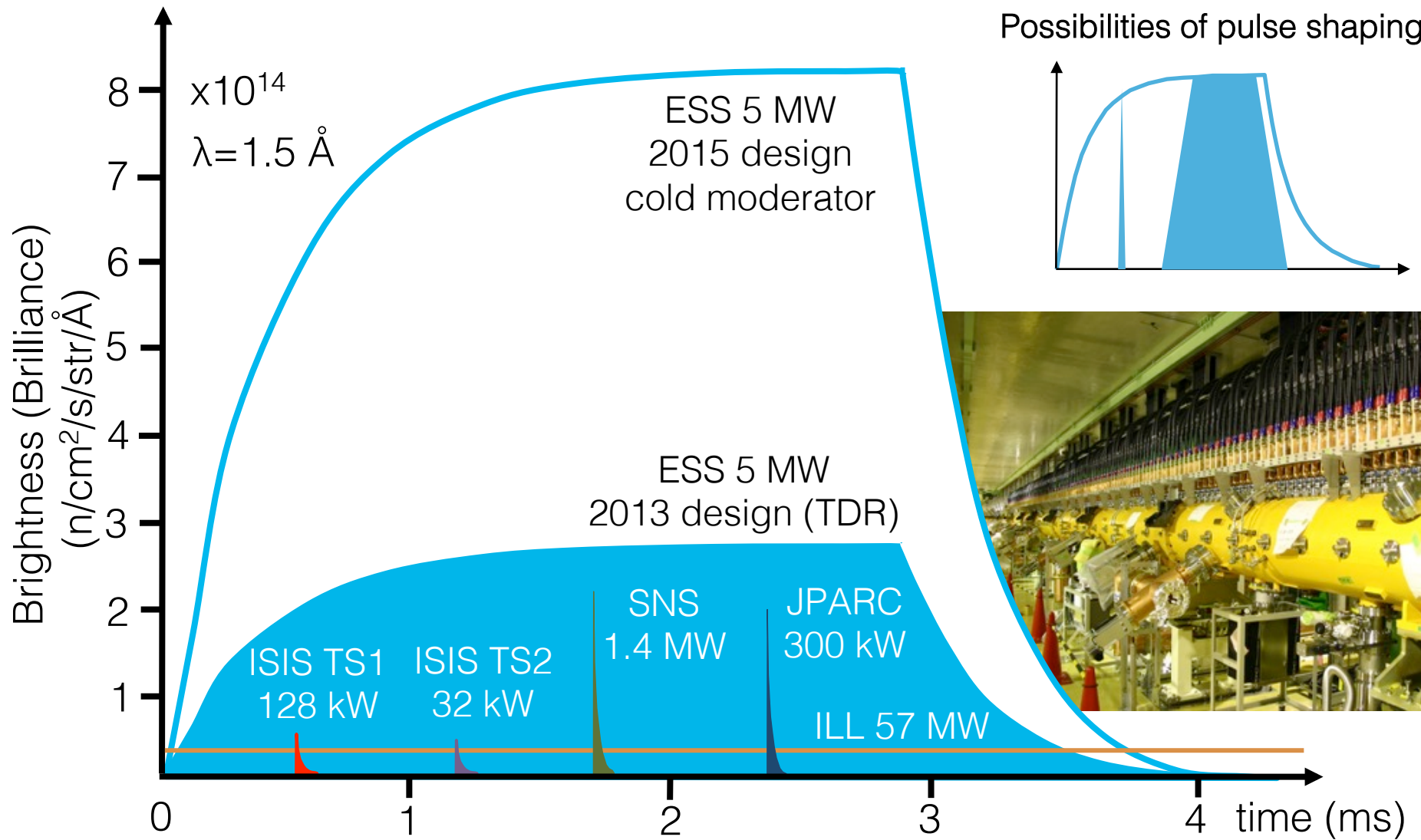
Aerial view

26 August 2016 (started in Sep. 2014)



ESS long pulse neutron source (5MW)

(Brilliance enhances for thin moderator because of property of para-hydrogen)

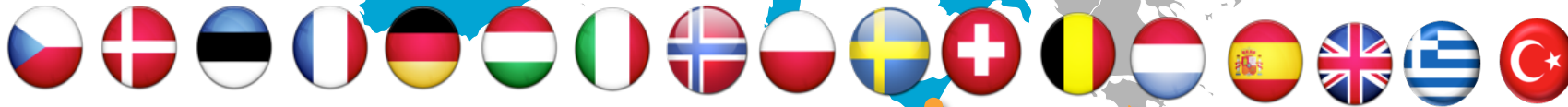
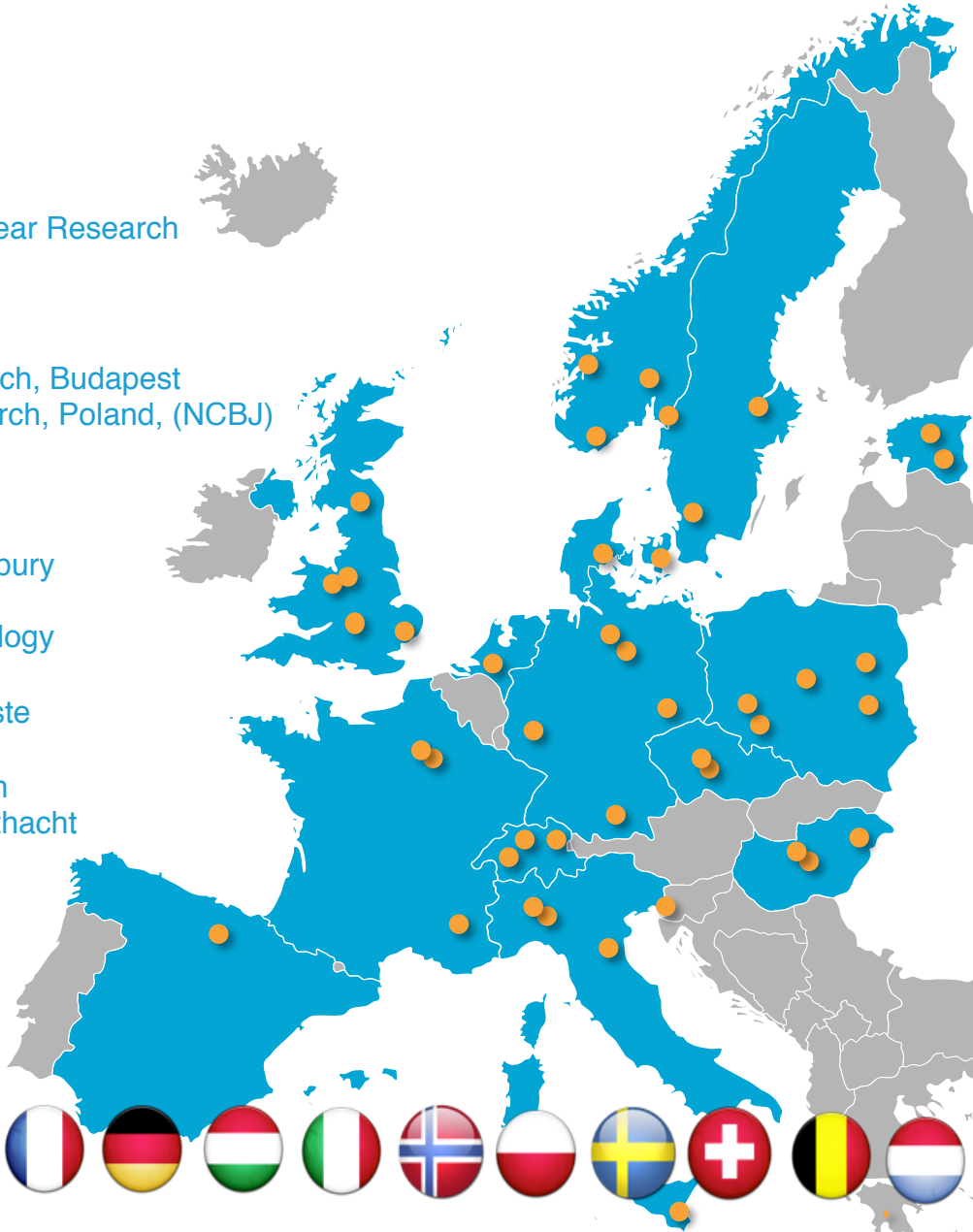


In-kind Partner institutions and collaboration for ESS

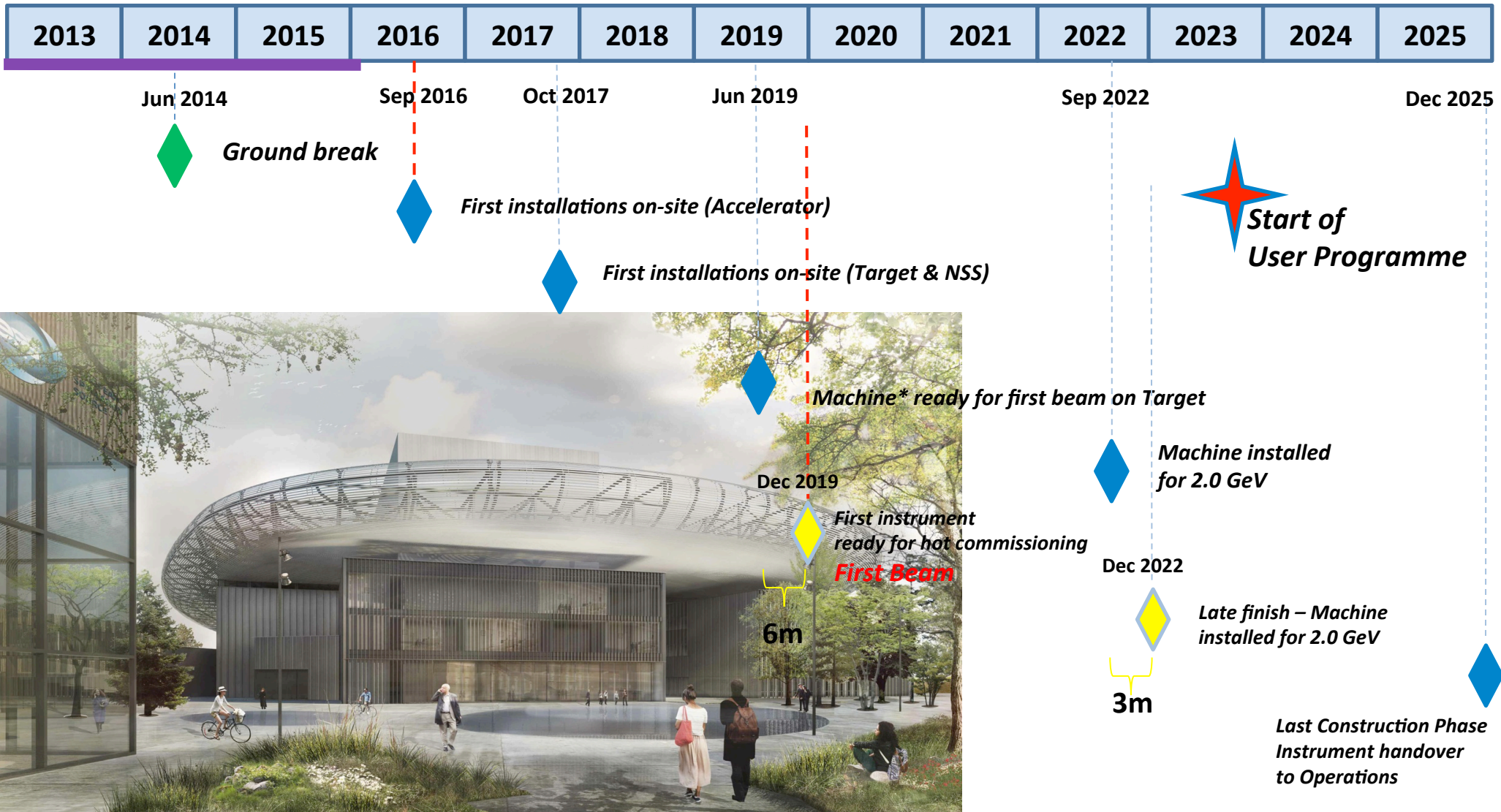


Aarhus University
 Atomki - Institute for Nuclear Research
 Agder University
 Bergen University
 CEA Saclay, Paris
 Centre for Energy Research, Budapest
 Centre for Nuclear Research, Poland, (NCBJ)
 CERN, Geneva
 CNR, Rome
 CNRS Orsay, Paris
 Cockcroft Institute, Daresbury
 DESY, Hamburg
 Delft University of Technology
 Edinburgh University
 Elettra – Sincrotrone Trieste
 ESS Bilbao
 Forschungszentrum Jülich
 Helmholtz-Zentrum Geesthacht
 Huddersfield University
 IFJ PAN, Krakow
 INFN, Catania
 INFN, Legnaro
 INFN, Milan

Institute for Energy Research (IFE)
 Institut Laue-Langevin (ILL)
 Rutherford-Appleton Laboratory, Oxford (ISIS)
 Copenhagen University
 Laboratoire Léon Brillouin (LLB)
 Lodz University of Technology
 Lund University
 Nuclear Physics Institute of the ASCR
 Oslo University
 Paul Sherrer Institute
 Roskilde University
 Tallinn Technical University
 Technical University of Chemnitz
 Technical University of Denmark
 Technical University Munich
 Science and Technology Facilities Council
 University of Tartu
 Uppsala University
 WIGNER Research Centre for Physics
 Wrocław University of Technology
 Warsaw University of Technology
 Zurich University of Applied Sciences (ZHAW)

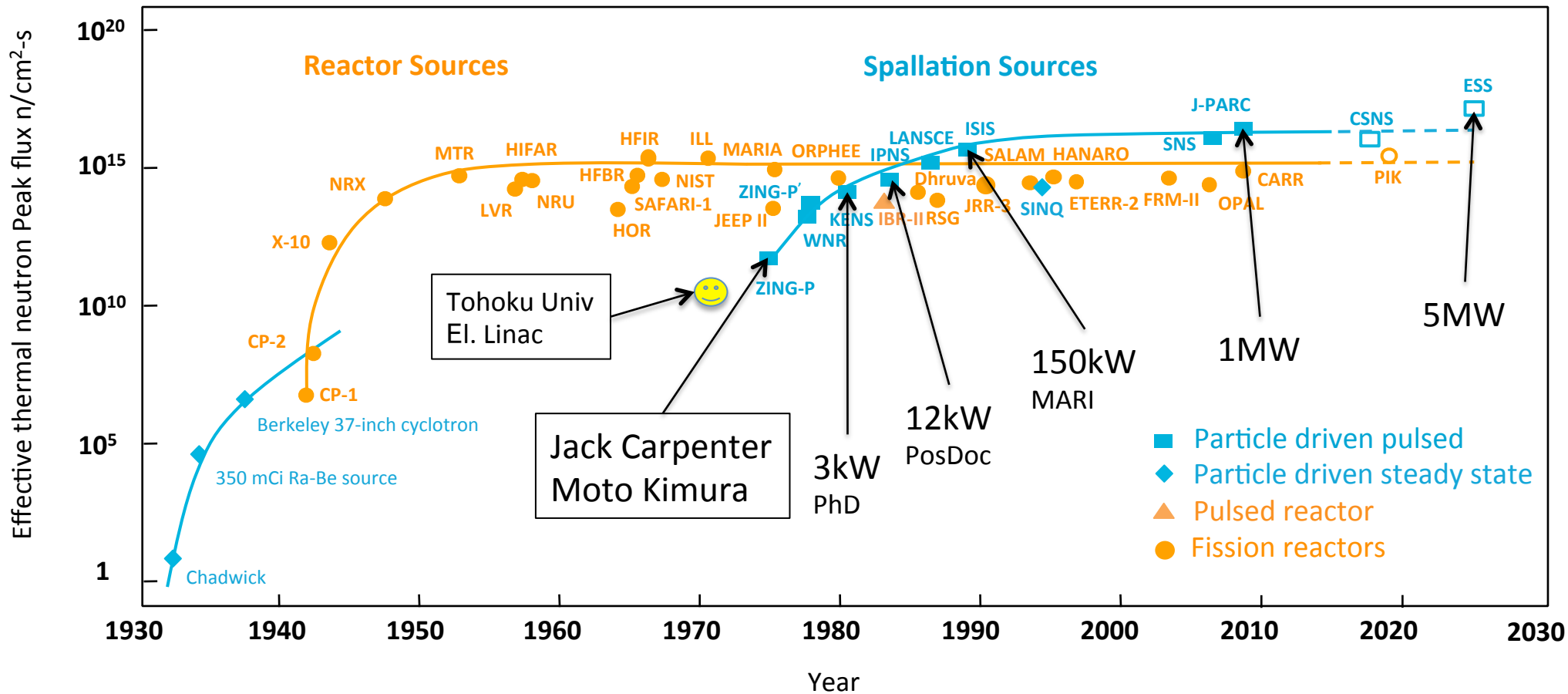


ESS Schedule Objectives

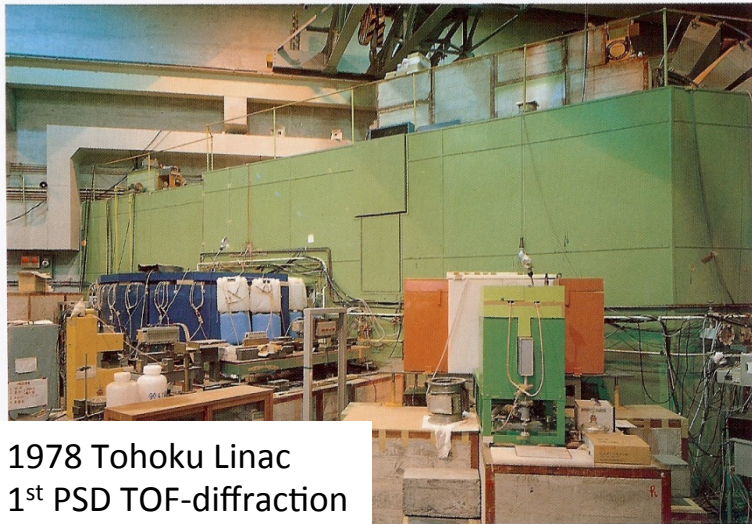


Neutron Facilities – and my history

Importance of ICANS collaboration



Technology growing

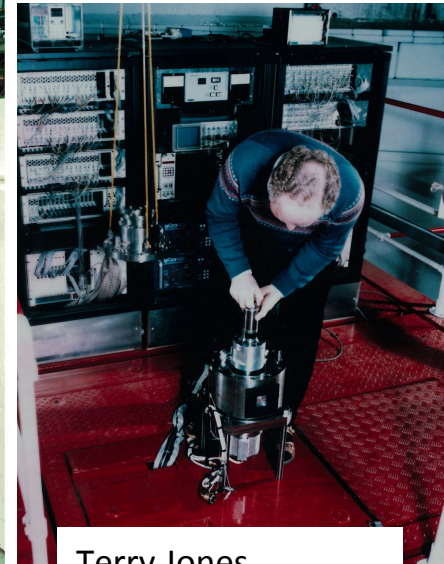


1978 Tohoku Linac
1st PSD TOF-diffraction
(Harwell PSD)

子散乱実験施設



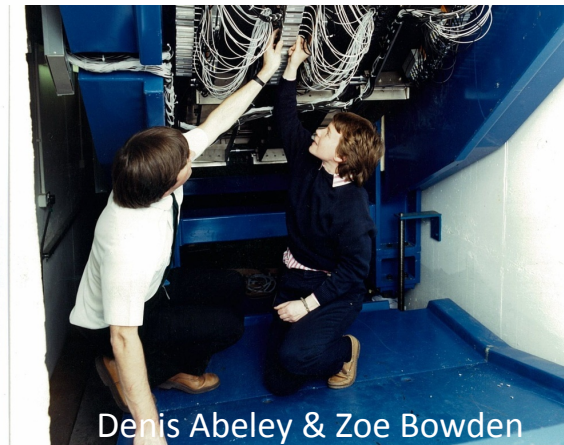
1989 MARI at ISIS



Terry Jones
and Jeulich chopper



1982 SANS at KENS
1st PSD-array TOF-SANS
(Reuter Stokes PSD)



Denis Abeley & Zoe Bowden

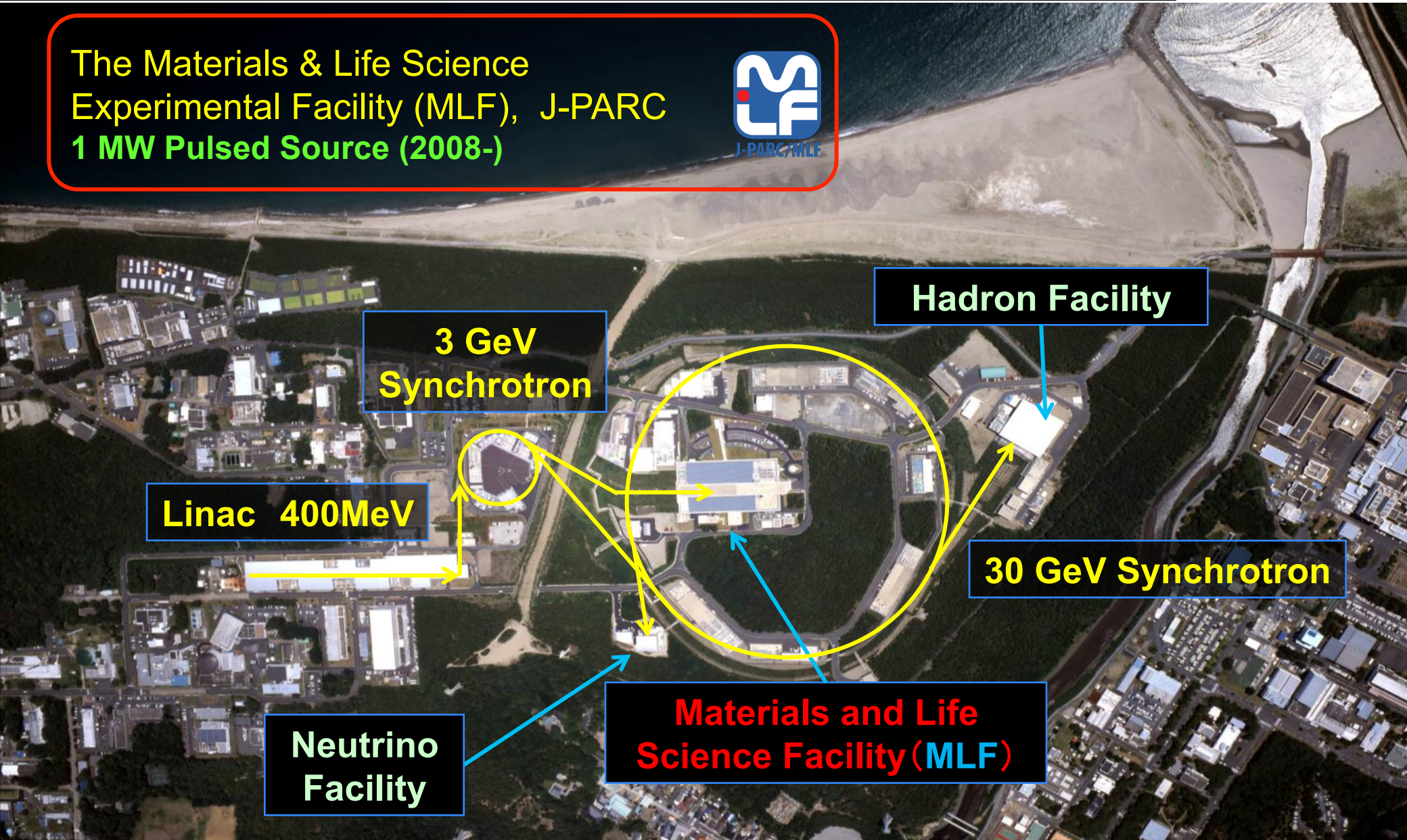
Worked with nice
engineers and
technology

J-PARC, Japan Proton Accelerator Research Complex

3 GeV **1 MW** & 30 GeV 0.75 MW proton synchrotrons



The Materials & Life Science
Experimental Facility (MLF), J-PARC
1 MW Pulsed Source (2008-)



**3 GeV
Synchrotron**

Hadron Facility

Linac 400MeV

30 GeV Synchrotron

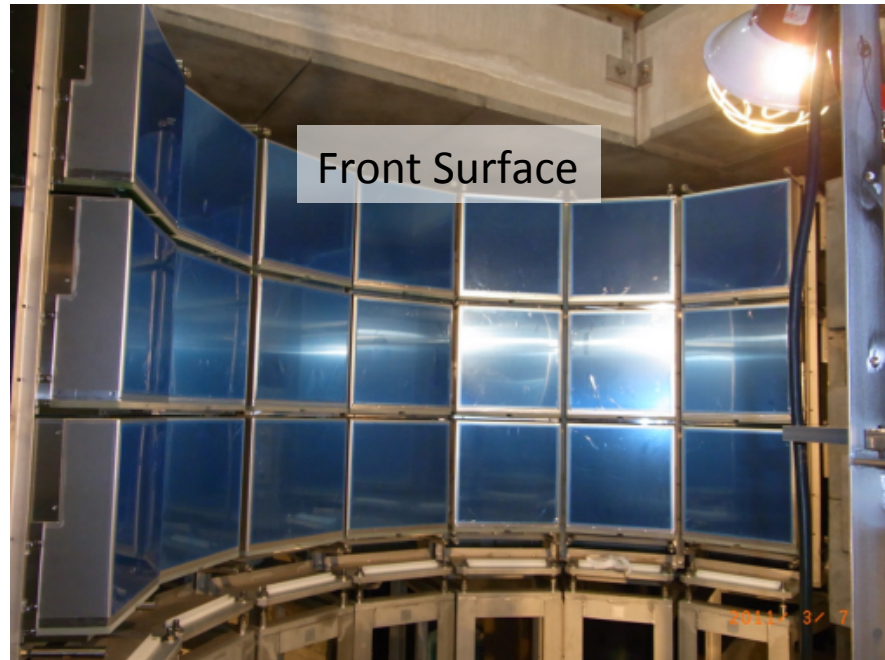
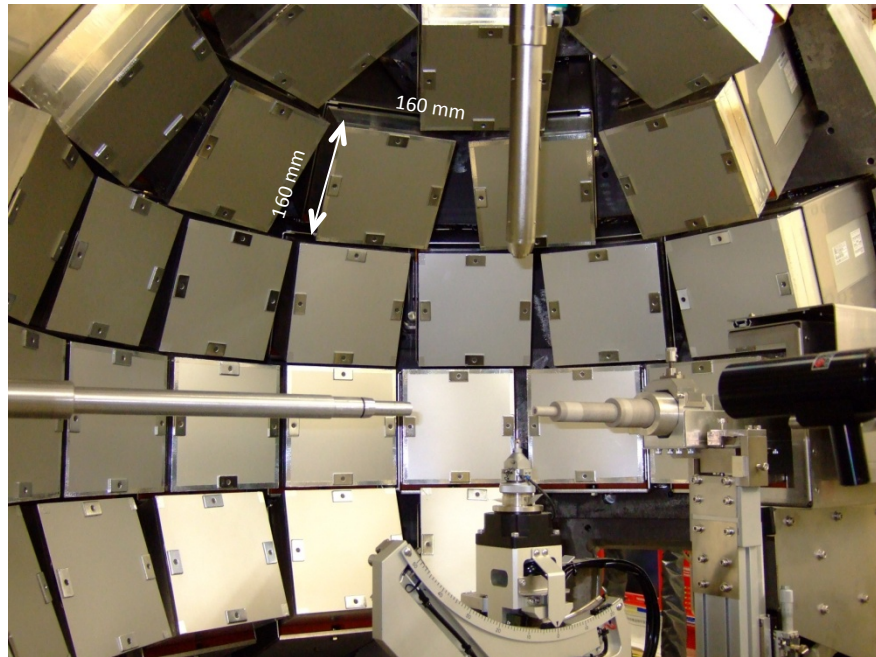
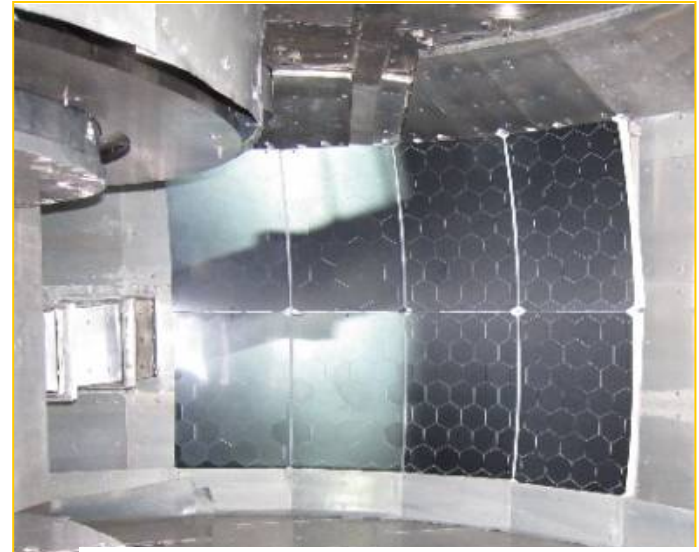
**Neutrino
Facility**

**Materials and Life
Science Facility (MLF)**

Detector developments

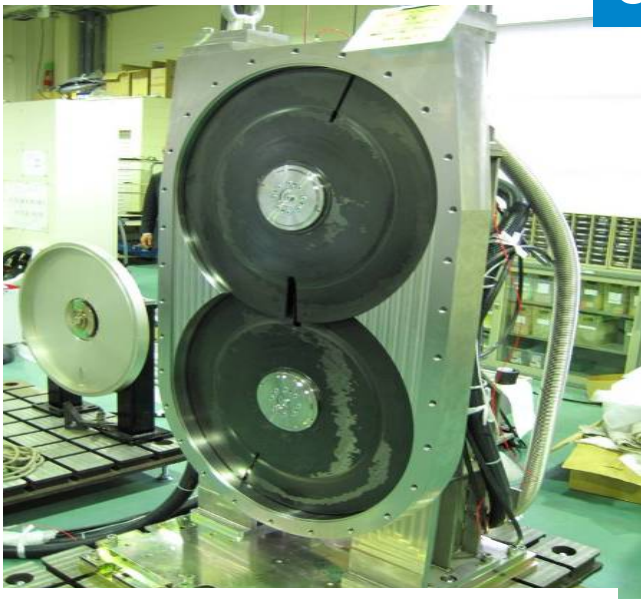


^3He -det; Collaboration with TOSHIBA and GE (RS)



nd In-

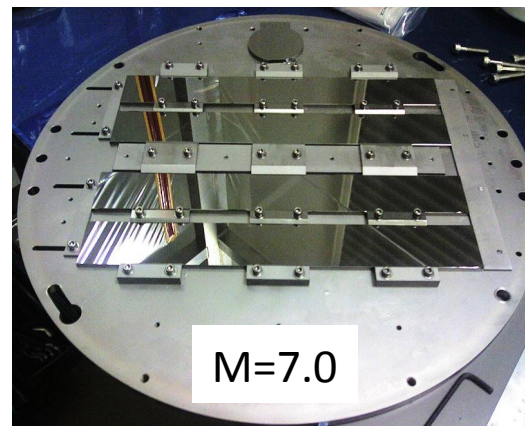
Chopper and Optics Developments



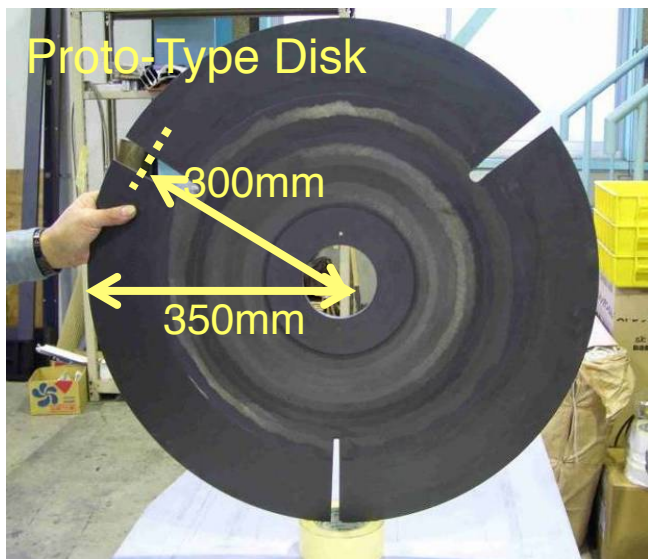
Fast Disk-Chopper; KOBELCO, MEISHO



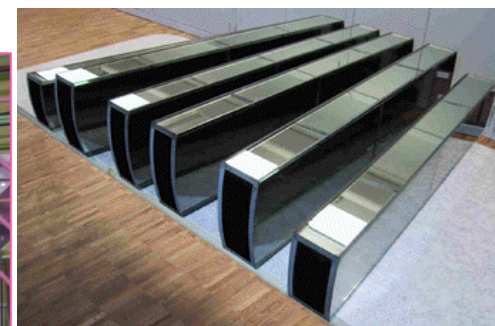
Fermi-Chopper;
SNS & SKF



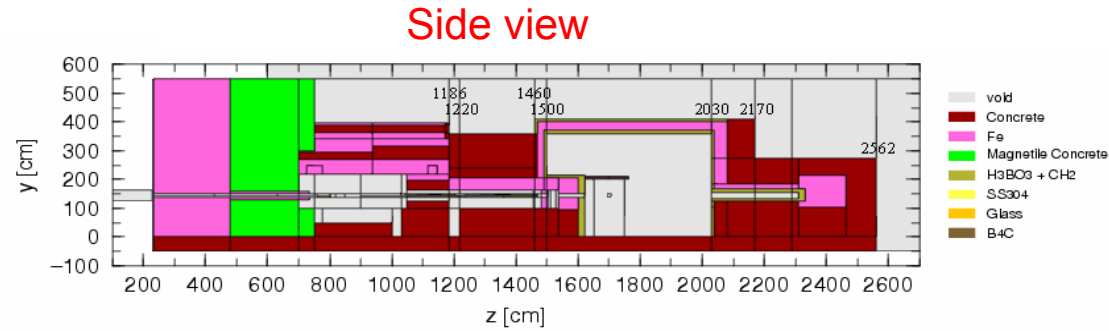
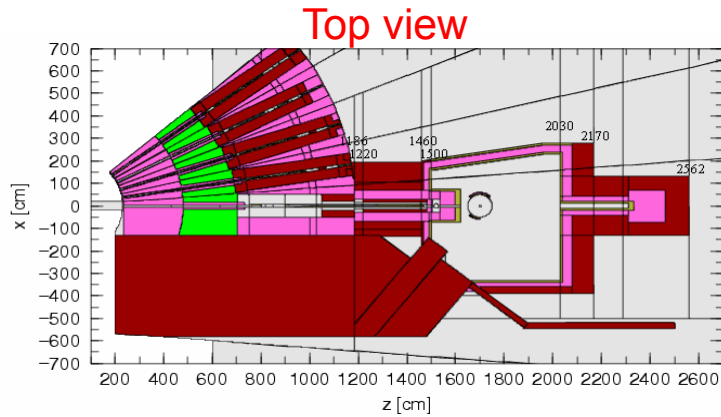
Guide; Mirrortron, Swiss-Neutronics
and In-house efforts (M>4)



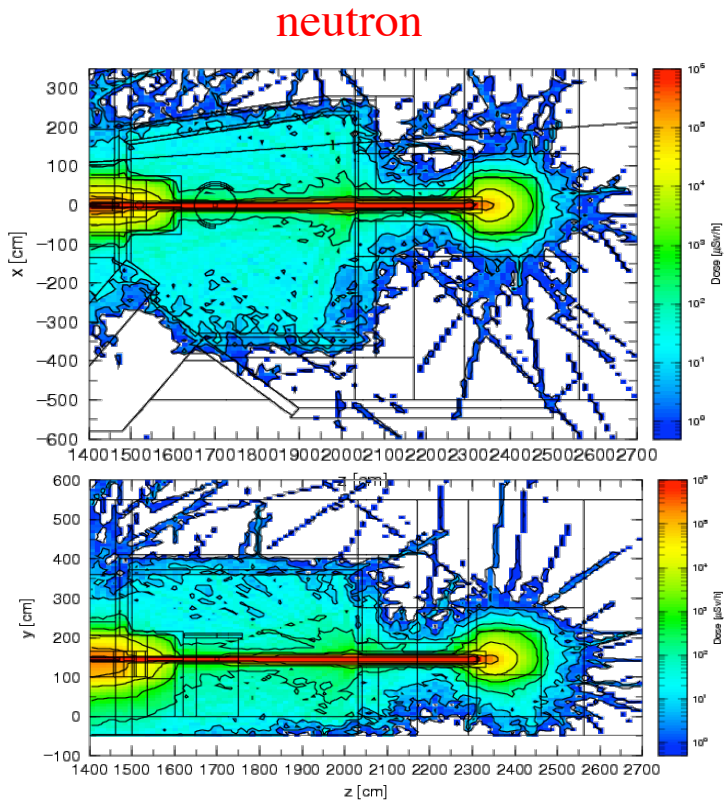
Vac. Tank; Local companies, KOBELCO
etc

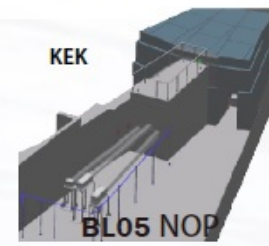
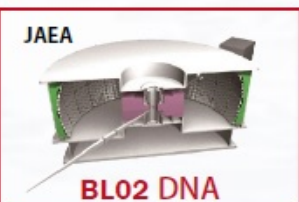
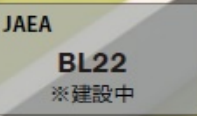
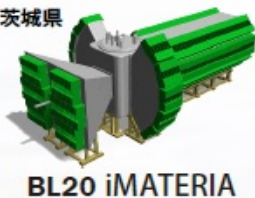
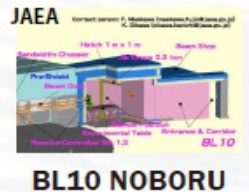
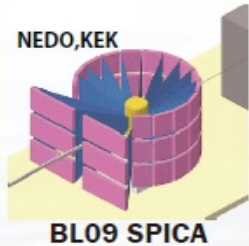
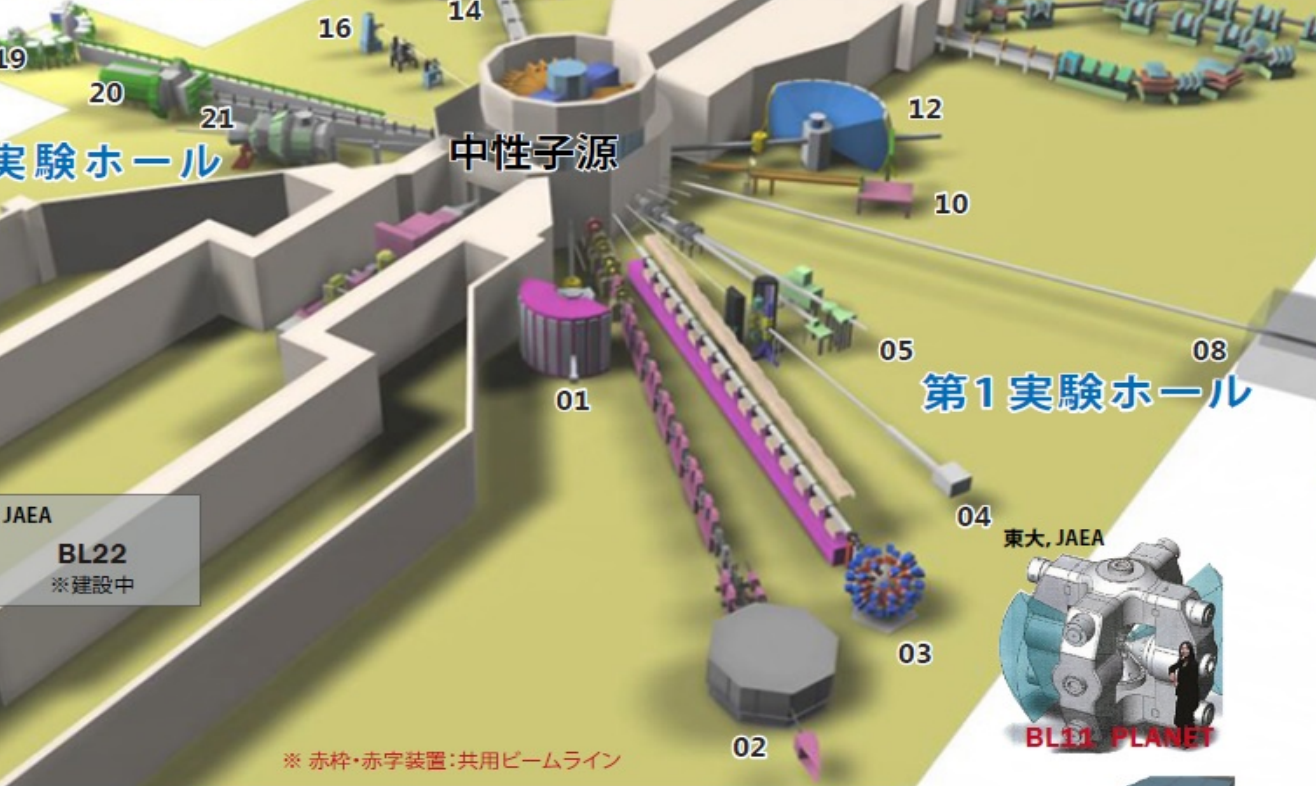
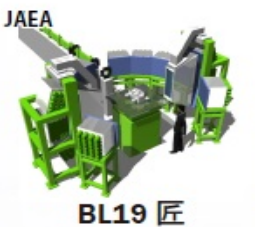


Neutronics Calculation and Shielding Developments



- Development of Neutronics Calculation code
- Development of shielding materials;
- B₄C-Concrete, B₄C resin
- Colemanite-Concrete ($\text{CaB}_3\text{O}_4(\text{OH})_3 \cdot \text{H}_2\text{O}$)





Challenge in Technology and Engineering Creates New Science
Collaboration among engineers, technicians and scientists
On Recovery from the Earthquake in 2011.



Sincere comments;

- Challenging technology
- Global communication and collaboration necessary since neutron facility is very limited. We need mutual help and mutual development
(DENIM, ICANS etc. have a important role)
- Balance between scientific concept and achievable value engineering;
collaboration between scientists and engineers
- Instrument and target communication;
integration in Target – moderator – beamPort – guide - instrument
- In house and out sourcing technology collaboration;
collaborative relation between staffs and providers
- Alignment of staffs towards a single goal.