LUND – the home of ESS and MAX-IV

The ESS accelerator

EUROPEAN SPALLATION SOURCE

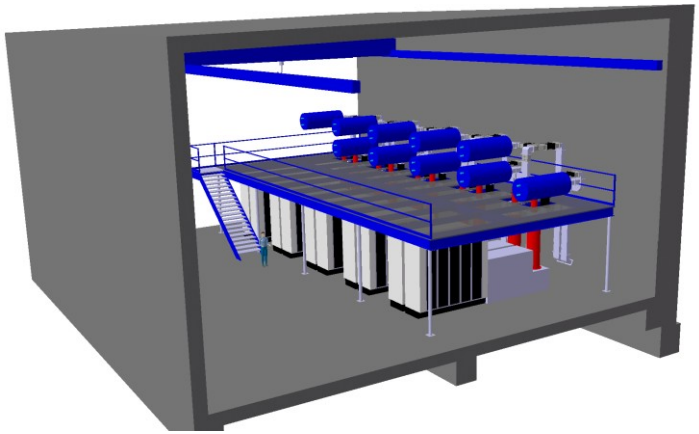
Mats Lindroos

Head of the ESS Accelerator Division

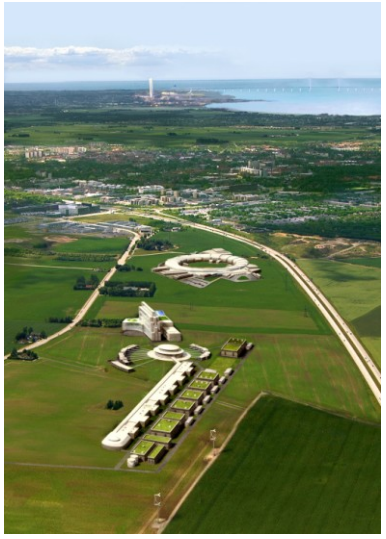
collaboration meeting, CERN, 20

I hope to answer…

- Accelerator projects
  - Design Update Project
  - Prepare to Build Project

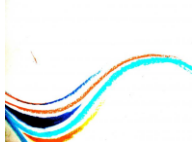


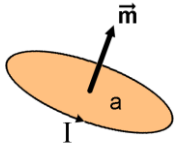
- Accelerator
  - Baseline design
  - Challenges
  - How can you get involved



Neutrons are beautiful !

Wave Particle Magnetic moment Neutral





Diffractometers - Measure structures

atoms and molecules are

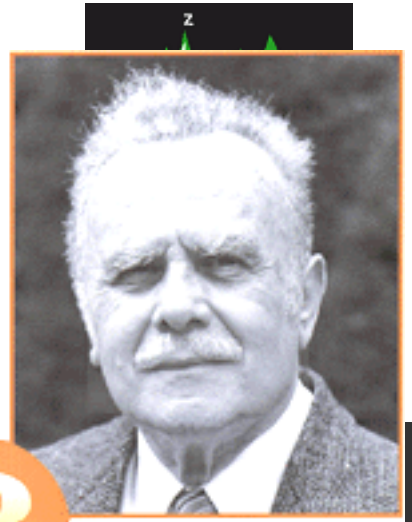
10 Ångström

Clifford G. Shull, MIT, Cambridge, Massachusetts, USA, receives one half of the 1994 Nobel Prize in Physics for development of the neutron diffraction technique.

-s - Measure dynamics

toms and molecules do

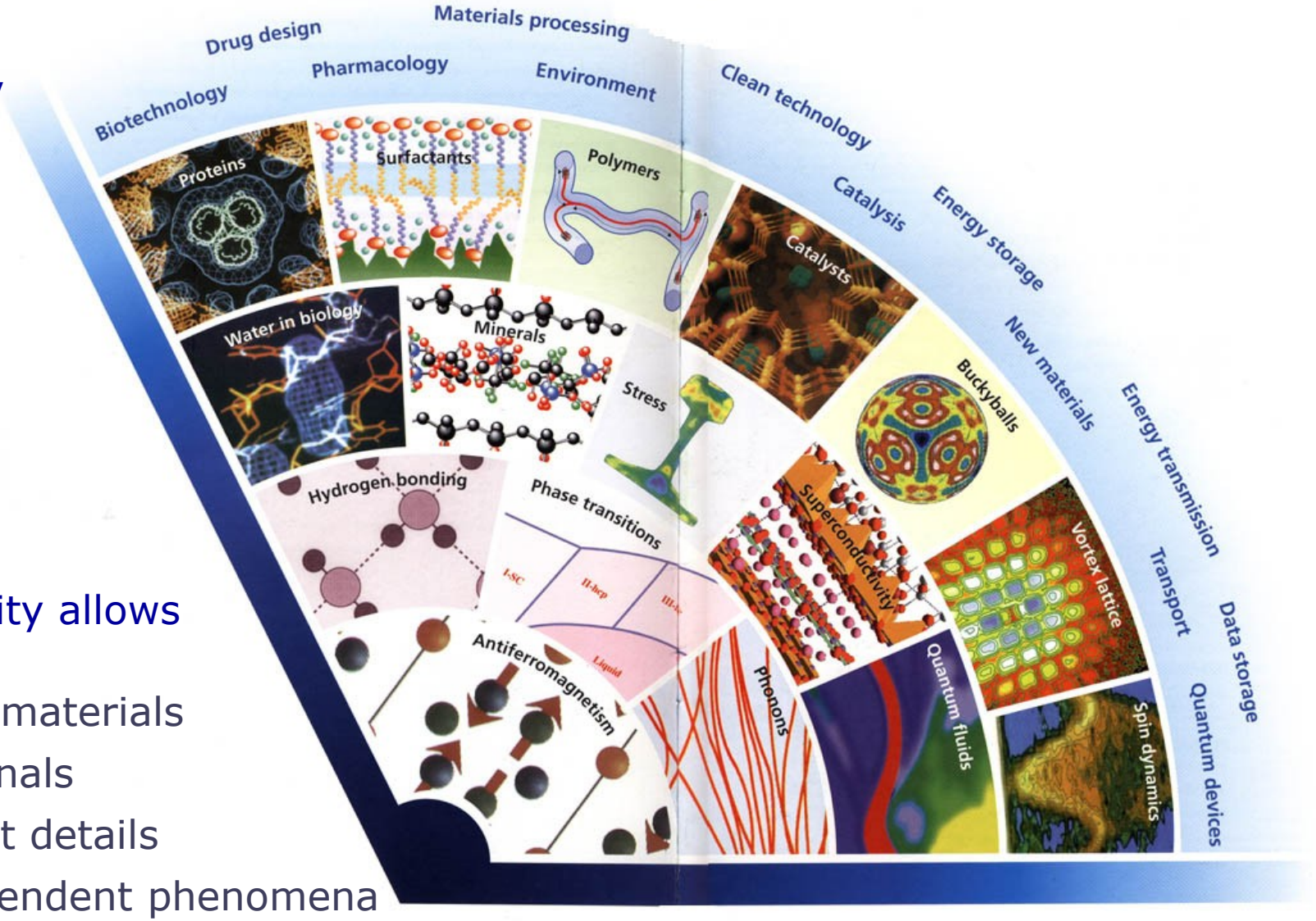
1 - 80 meV



Betram N. Brockhouse, McMaster University, Hamilton, Ontario, Canada, receives one half of the 1994 Nobel Prize in Physics for the development of neutron spectroscopy.

Why ESS? (1) – High time average and peak flux

Complexity/
Count-rate

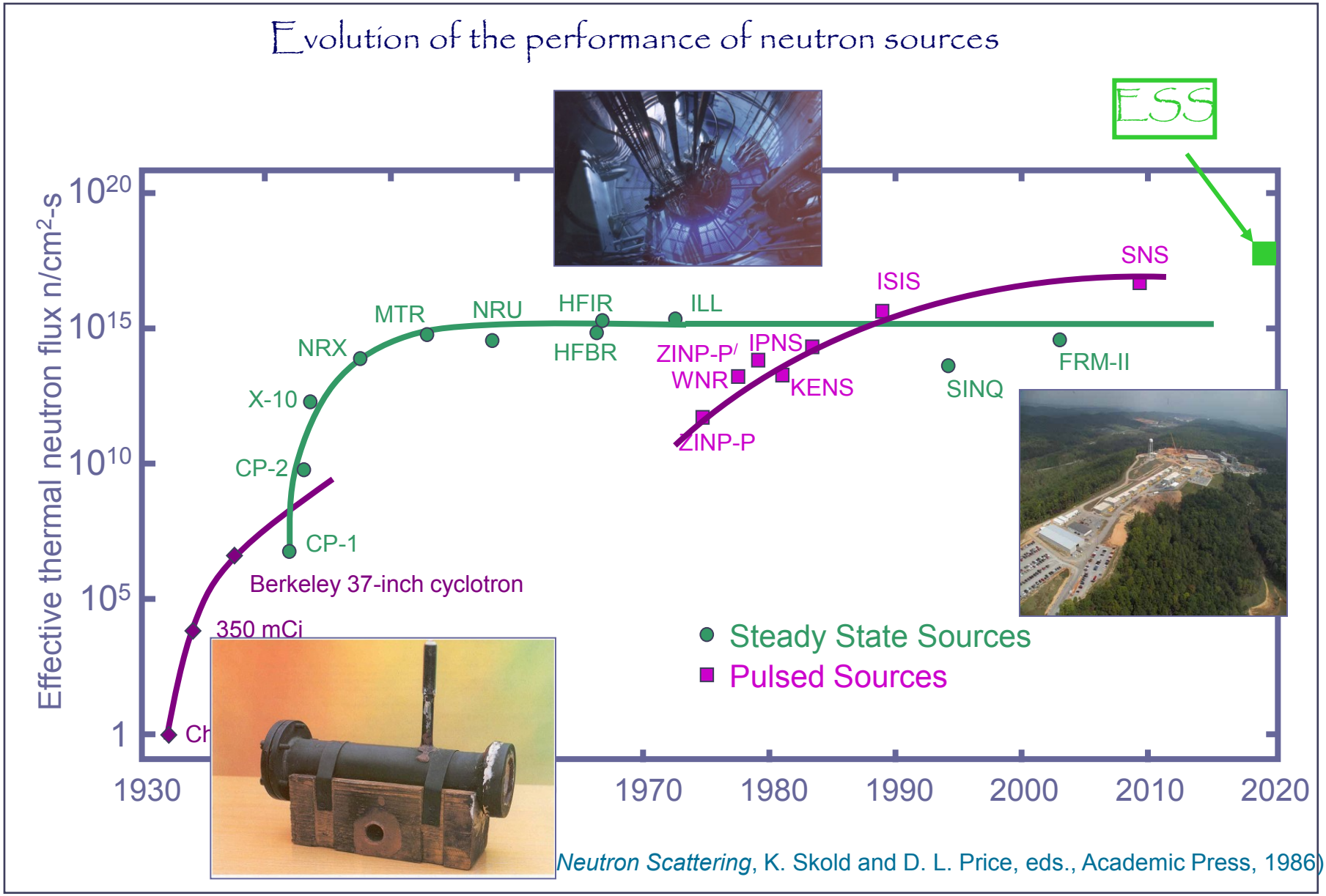


ESS intensity allows studies of

- complex materials
- weak signals
- important details
- time dependent phenomena

Details/Resolution

Why ESS?(2) - High time average and peak flux

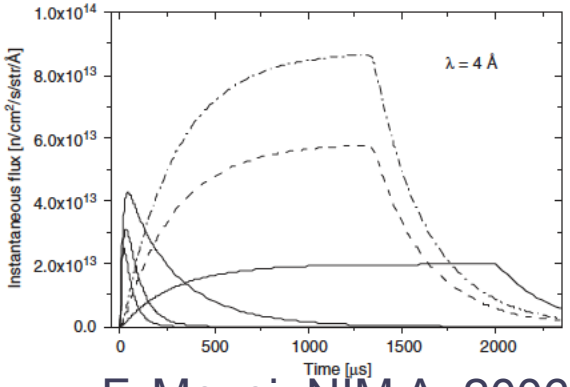


Neutron Scattering, K. Skold and D. L. Price, eds., Academic Press, 1986)

Why ESS? (3) – Cold neutrons

- Many research reactors in Europe are aging and will be closed before 2020
  - Up to 90% of the use is with cold neutrons
- There is a urgent need for a new **high flux cold neutron** source in Europe
  - The vast majority will profit from a pulsed structure
  - A large fraction (70%) are fully satisfied by a long pulse source (approx 2 ms, 20 Hz)
  - Existing short pulse sources (ISIS, JPARC and SNS) can supply the present and imminent future need of short pulse users
  - Construction must start now for use in 2018-2019

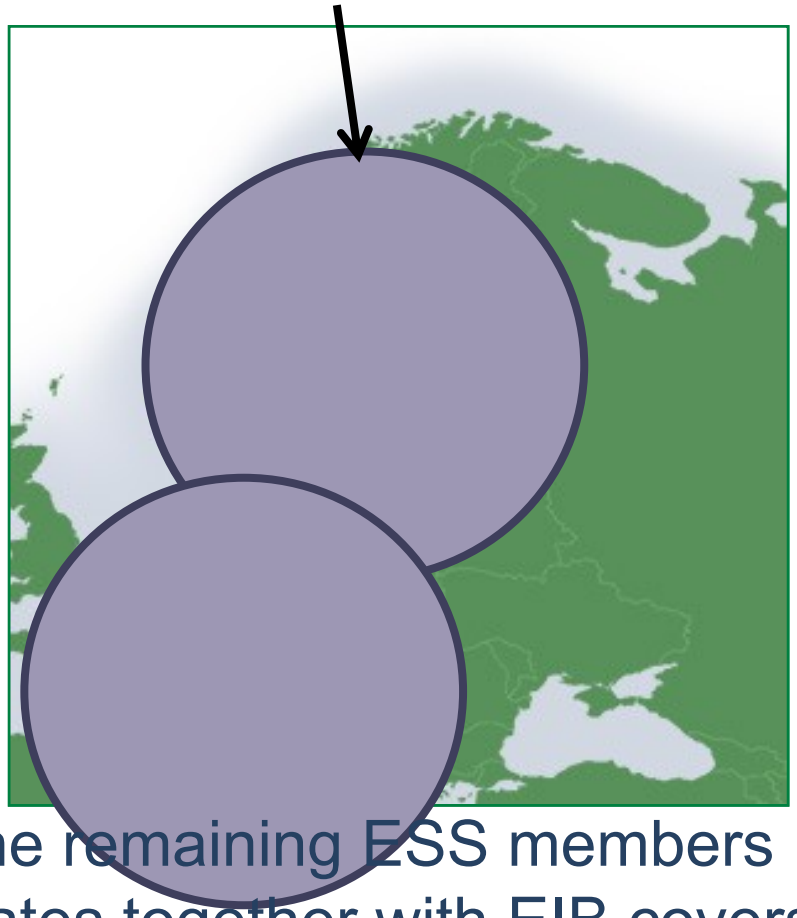
"Pulsed cold neutrons will always be long pulsed as a result of the moderation process"



F. Mezei, NIM A, 2006

International collaboration

Sweden, Denmark and Norway
covers 50% of cost



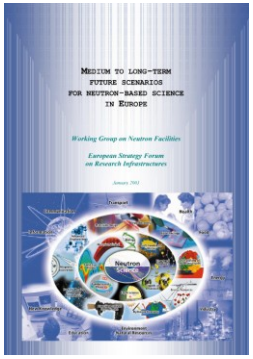
The remaining ESS members states together with EIB covers the rest!

16 Partners today

Time lines

first design

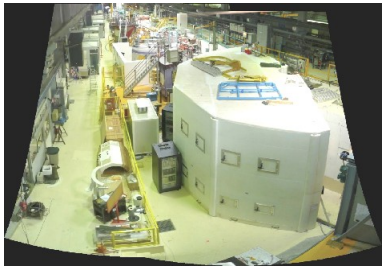
2002-2003



ESFRI Report
2003

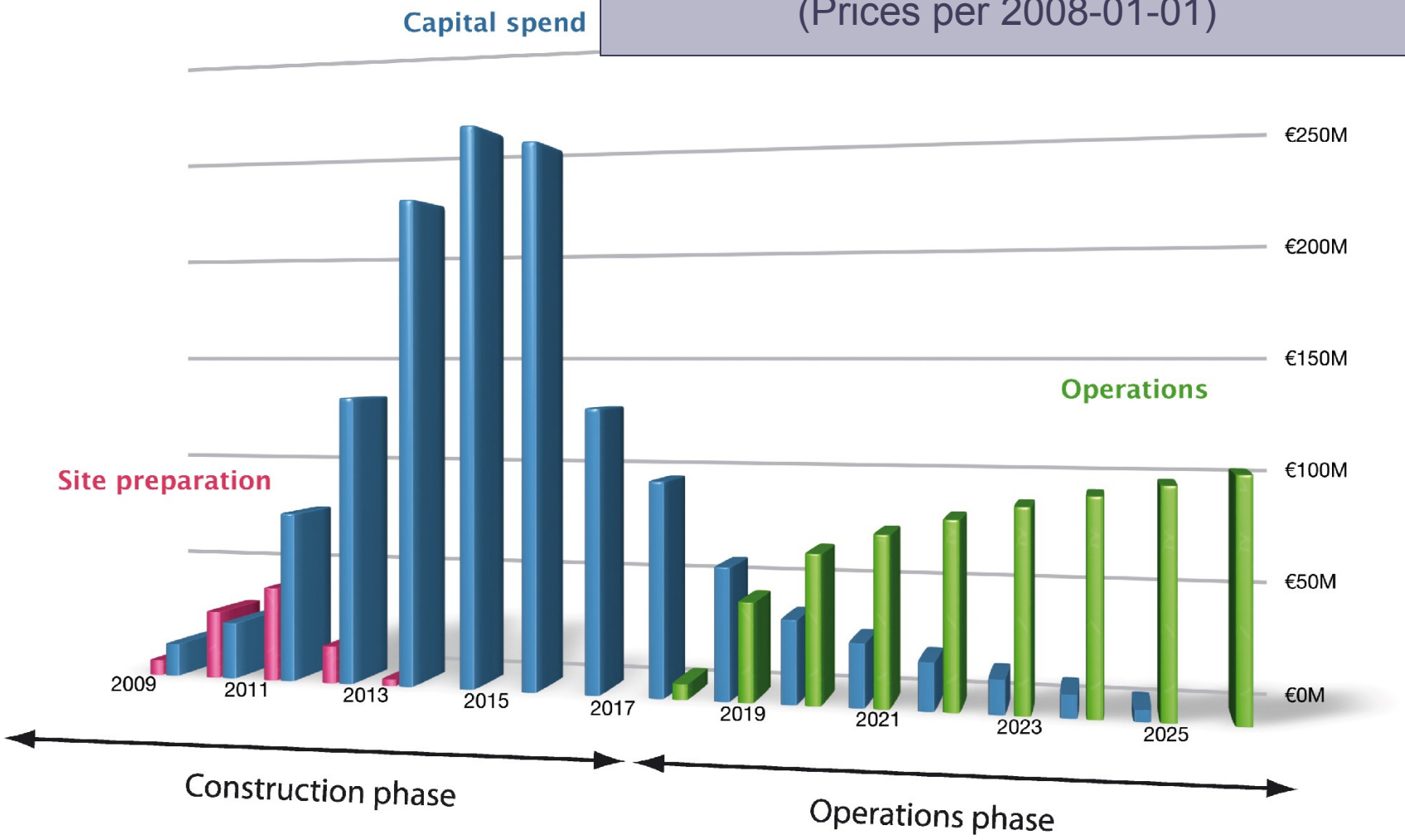
site
decision
2009

ESS Pre-construction phase	2010-2012
ESS Construction phase	2013-2018
Completion phase	2018-2025
Operations phase	2026-2066
Decommissioning phase !!!	2067-2071



ESS cost estimates

Investment: 1478 M€ / ~10y
Operations: 89 M€ / y
Decomm. : 346 M€
(Prices per 2008-01-01)

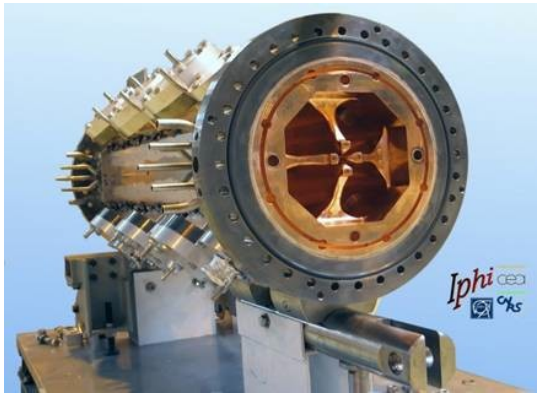


New accelerator design

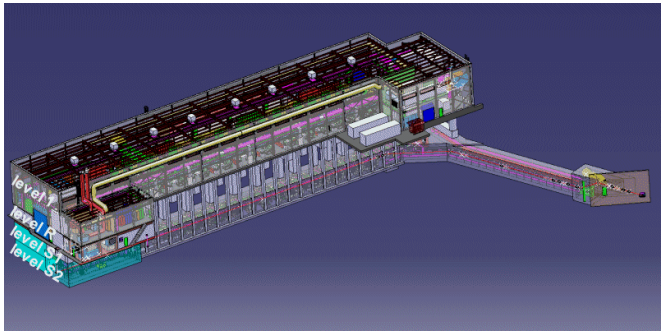
ESS **accelerator** high-level technical objectives:

- 5 MW long pulse source
  - 2 ms pulses
  - 20 Hz
  - Protons (H+)
  - Low losses
  - High reliability >95%
  - Flexible design for
  - Future upgrades

Linac R&D in progress



IPHI RFQ at CEA-Saclay

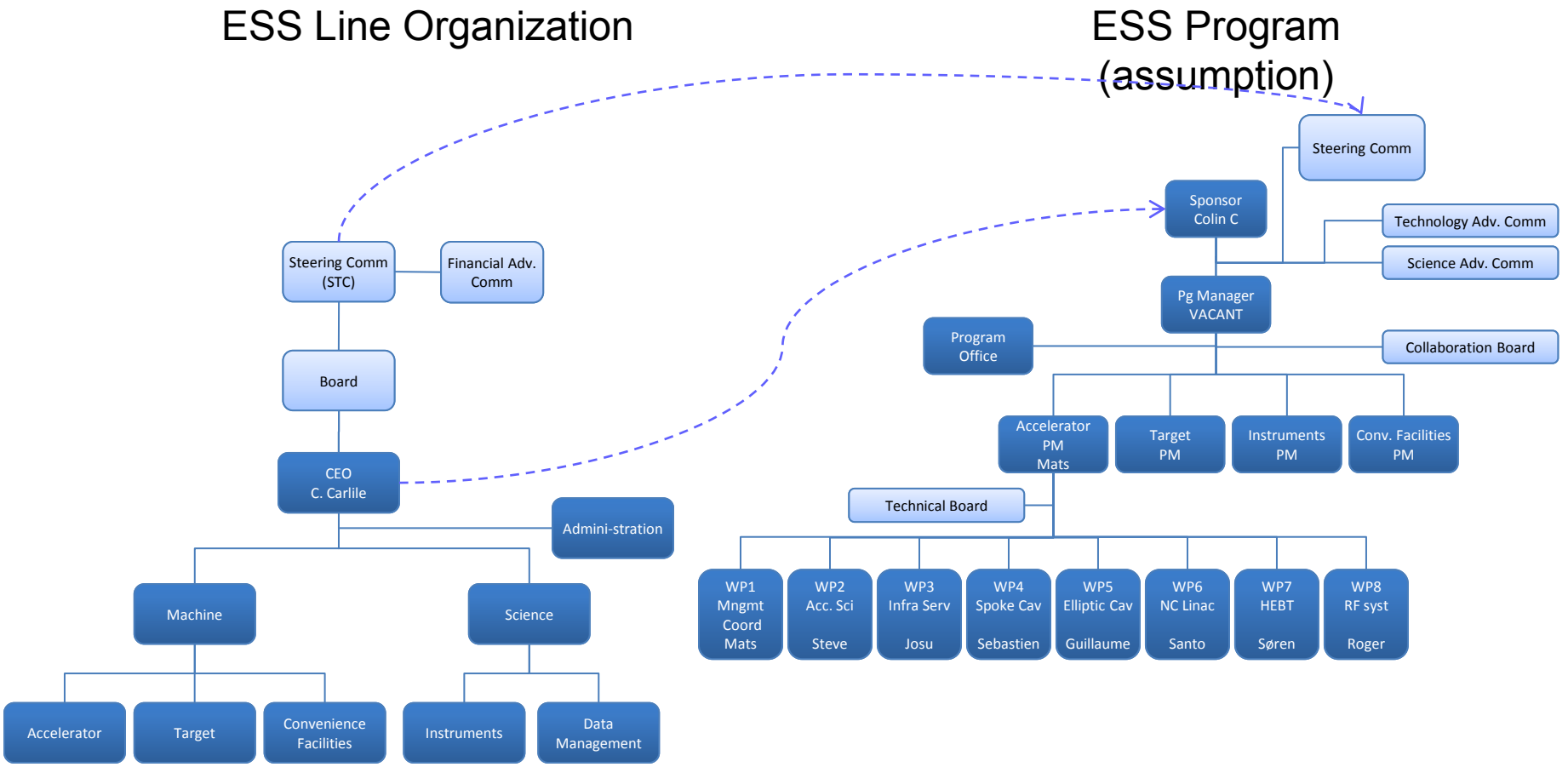


LINAC 4

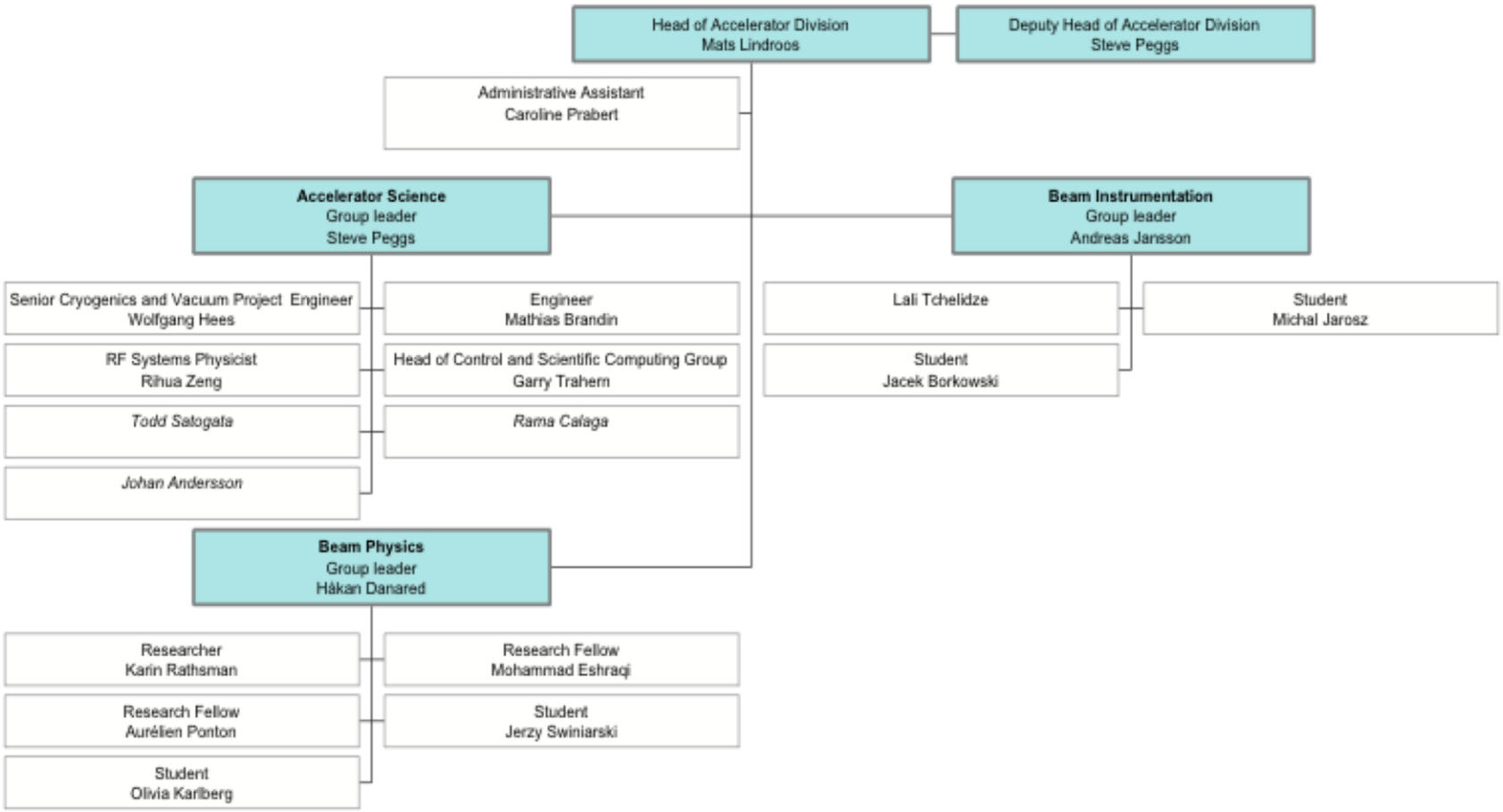
SC single spoke cavity, IPNO (CNRS)

SC 5 cell cavity for 704 MHz, CEA and CNRS

ESS-AB and collaboration projects

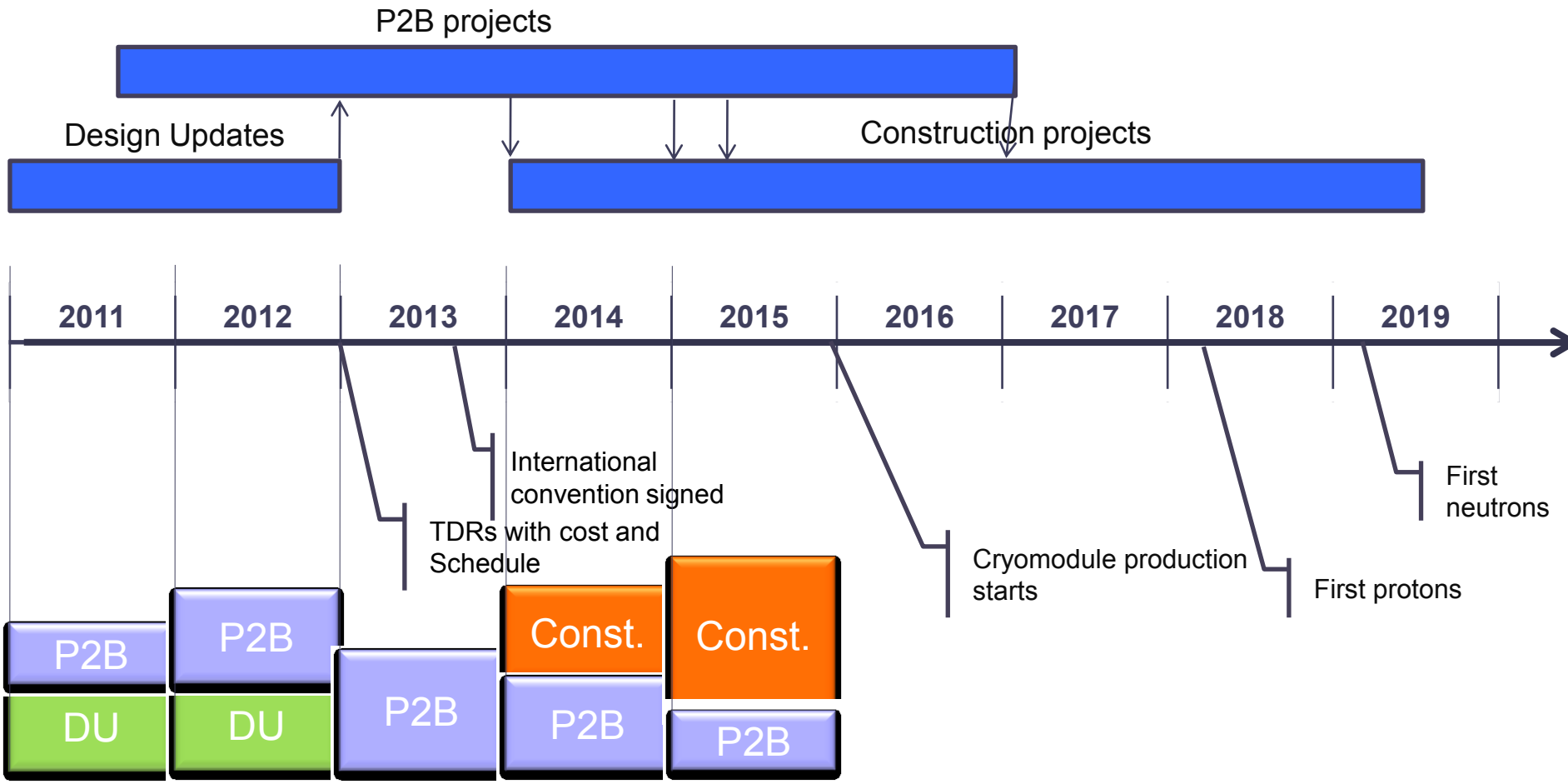


ESS Accelerator Division



ESS project strategy

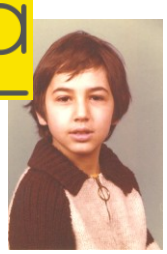
P2B assures a stringent project framework for prototyping and engineering design reports, a continuous transition from design to construction and keeps the collaborations intact through the construction decision process



Writing Group for linac project plan

- Project plan for the linac design update and prototyping
  - Design Report for the end of 2012,+/- 20% precision in costing
  - Readiness to construct by the end of 2012 -- the design will be a safe baseline design with technical choices made for which the writing of specifications, detailed drawings and completion of late prototypes could be launched without any further delay after 2012
  - Energy budget and sustainability should be taken into account in each work package
- Responsibilities within WG
  - S.Peggs – Accelerar Physics and configuration control
  - R. Duperrier – System engineering
  - C.Oyon – Project planning
  - M. Lindroos – Coordination and planning
- WG schedule and milestones
    - Project specification for ESS STC in October
    - Start date 1 January 2011

Accelerator Design Update



Romuald Duperrier
(30 years ago)

Steve Peggs

Cristina Oyon

Josu Eguia

Work Package (work areas)

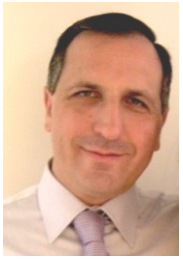
1. Management Coordination – ESS (Mats Lindroos)
2. Accelerator Science – ESS (Steve Peggs)
3. Infrastructure Services – Tekniker, Bilbao (Josu Eguia)
4. SCRF Spoke cavities – IPN, Orsay (Sebastien Bousson)
5. SCRF Elliptical cavities – CEA, Saclay (Guillaume Devanz)
6. Front End and NC linac – INFN, Catania (Santo Gammino)
7. Beam transport, NC magnets and Power Supplies – Århus University (Søren Pape-Møller)
8. RF Systems – Uppsala university (Roger Ruber)

Guillaume Devanz

Mats Lindroos

Roger Rub

Søren Pape Møller



Santo Gammino

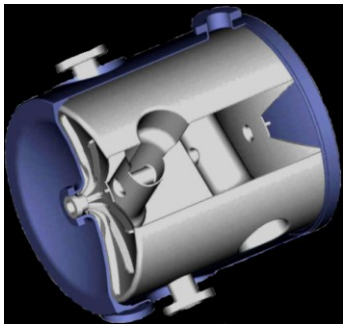
Sebastien Bousson

Prototype strategy

- Planned and proposed prototypes in DU phase (before 2013):
  - SC Cavities (Elliptical and spoke types) at CEA and IPNO
  - Half length cryomodule for 4 elliptical, with CERN
  - Existing ion source and RFQ in Catania and at CEA
  - Control system HW unit with SW interface (“Control box”)

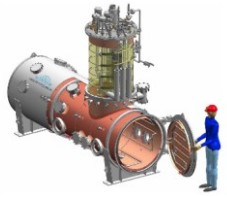
- Planned and proposed prototypes in (pre-)construction phase based on preparatory work in DU phase (2013++)
  - RF source, control and distribution system in Uppsala
  - Full length cryomodules for all SC cavity types
  - Beam instrumentation in Lund
  - LLRF in Lund
  - Final version of Ion source in Catania
  - DTL at Legnaro

SC elliptical cavity



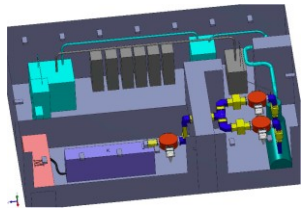
SC spoke cavity

Test stand strategy



Test cryostat

- 704 MHz test stand for SC elliptical cavities and a cr e
  - Possible sites CERN, CEA, Uppsala and DESY (after XFEL)
  - Study and costing in progress for CERN, CEA and Uppsala
  - Focus in Uppsala on RF source, control and distribution
- 352 MHz test stand for SC spoke cavities and cryomodules
  - One test stand at CEA
  - One test stand under construction at IPNO in Paris
- 352 MHz test stand for NC structures in Saclay
- Test area for Ion Source development in Catania



Proposed test stand in Uppsala

Important issues

- Configuration management:
  - Requires 6 months lead time and central repository for baseline parameters

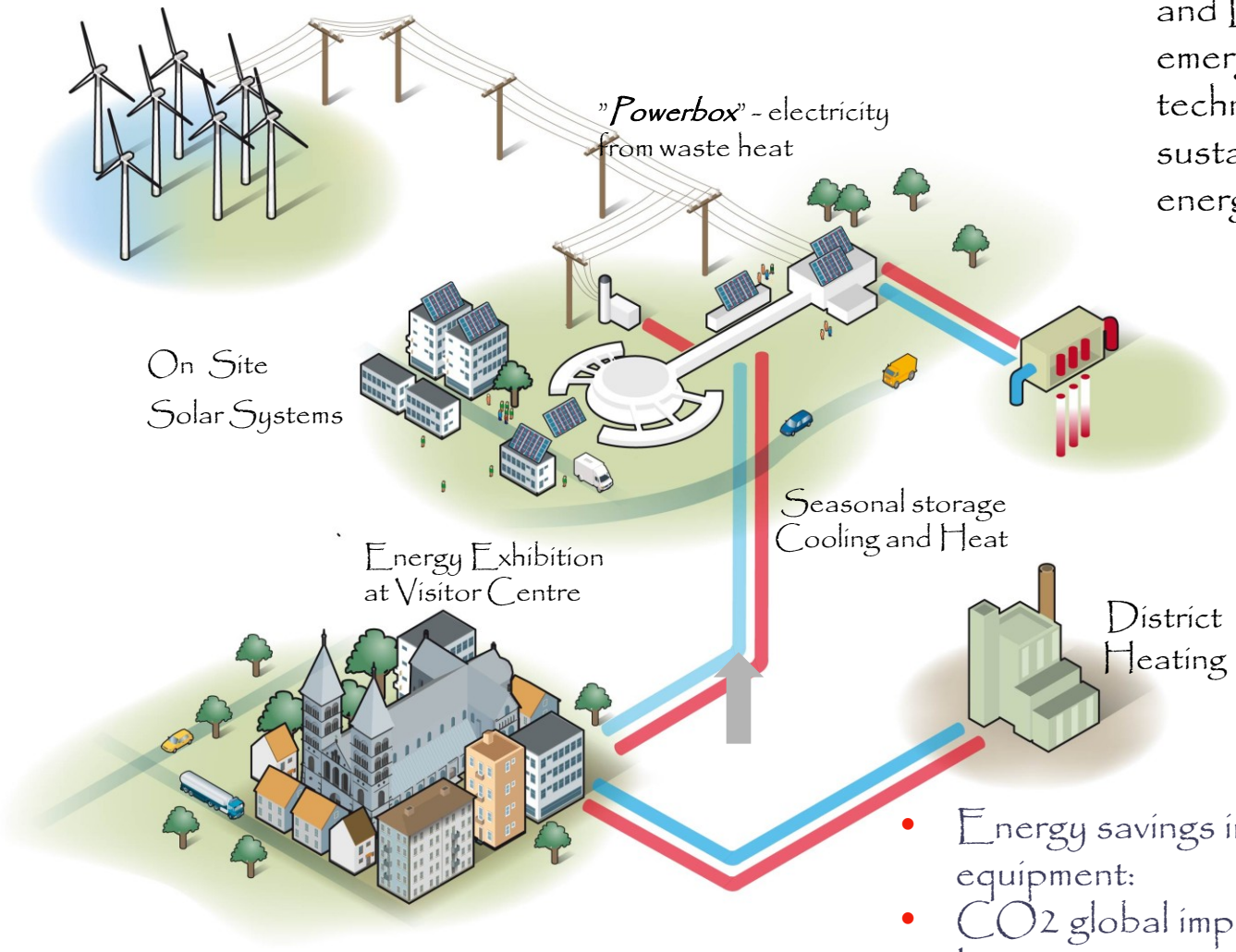
- Reliability and upgrade strategy - Mandate from STC is a 5 MW accelerator
  - Physicist can always use more intensity…
  - “More power can’t hurt and it will do a lot of good for some instruments”, F.Mezei (5 MW, 7.5 MW towards 15 MW)
  - Important to be study upgrade scenarios now with proper costing including the additional cost already at construction

What are we doing now?

- Just completed a Technical Board with all WP leaders to:
  - Complete PMI compliant project specification and project planning (WBS, PBS, Ghatt chart fully resourced, Budget)
  - First structure for reporting during project
  - Parameter list and lattice database
  - Communication tools and EDMS structure
  - Risk analyses
- Next:
  - Sign contracts with partner labs and collaboration agreement before the end of the year
  - “Frozen” parameter list for TAC meeting 14-15 January

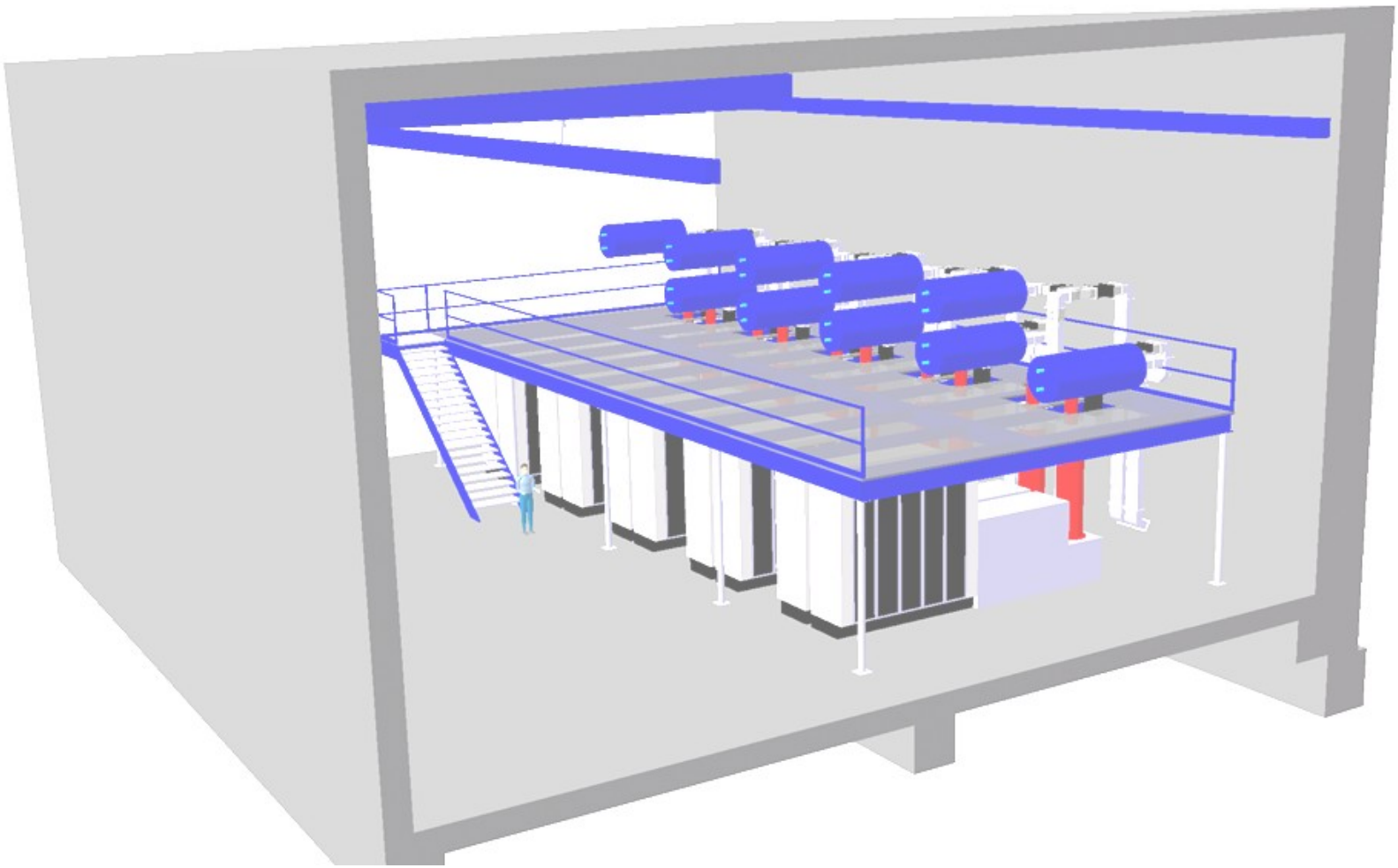
ESS Energy Solution - Development and Demonstration

- Research, Development and Demonstration of emerging energy technologies strengthen sustainability message and energy culture



- Energy savings in improved effiency equipment: 20 %
- CO2 global impact: 0 ton/year
- Investments connection DH: 1 M€
- Operating costs (revenue) : - 1,5 M€

1/20 of RF gallery

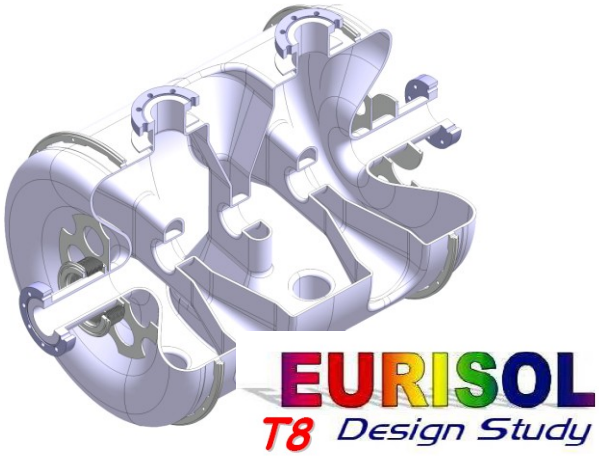


Spoke cavities

- Most of the spoke cavity tests were performed in vertical cryostat. Only a few were done in an accelerator-like configuration.
- Tests with beam have never been performed!

BUT expected performances and added flexibility are worth it !

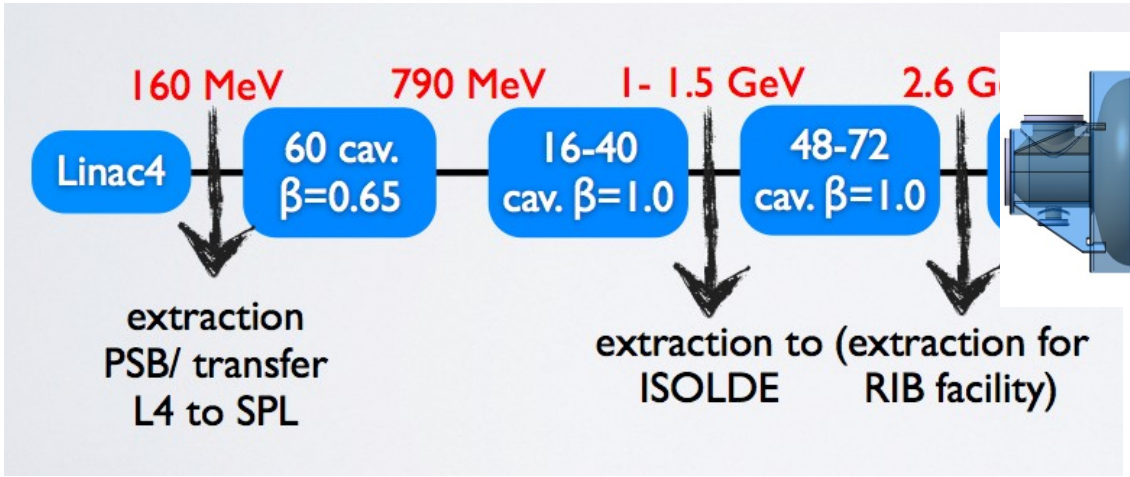
Support from first TAC meeting for use of spokes

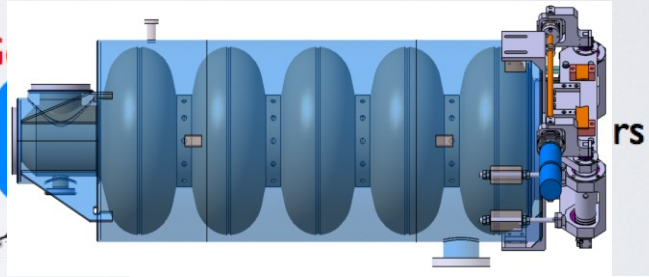


CERN and ESS

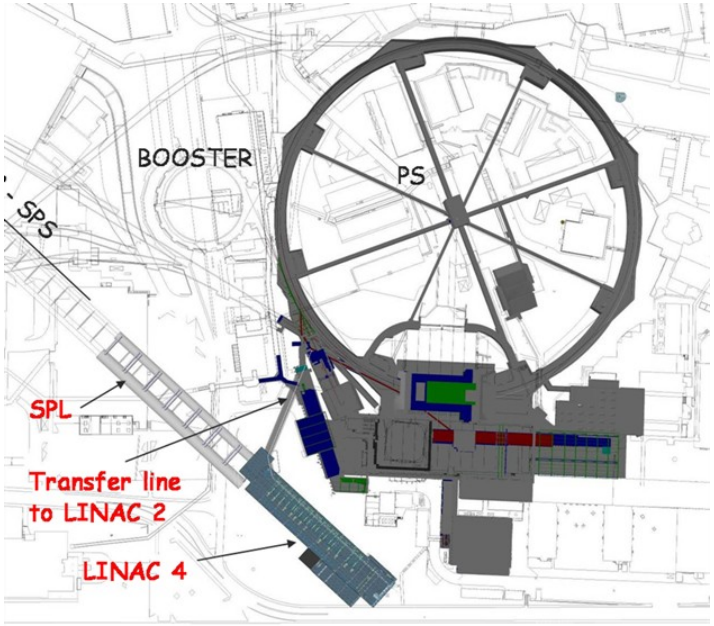
- Collaboration agreement in place with several addenda
  - Training of staff in target and accelerator technology
  - Enrico Chiaveri senior advisor to Colin Carlile for accelerator issues
  - Consulting on Accelerator science
  - **Joint design, construction and test of a (half length) elliptical cavity cryomodule**
    - Link to SPL collaboration
    - ESS will tender for a modulator for the test stand
    - ESS can help with e.g. with staff, design office resources and workshop resources

Synergies with High Power SPL study at CERN





SPL SC cavity built within Eucard at CEA-Saclay (beta=1)



Construction of joint prototype cryomodule for ESS and SPL under discussion

Conclusions

- The European Spallation Source will be built in Lund
- The Design will permit a long life with many upgrades
- The accelerator design, prototyping and construction will be done in a collaboration
- CERN is a very important partner for us
- Welcome to be part of ESS!

- Many Thanks to all members of the emerging ESS accelerator collaboration

Tack!

EUROPEAN SPALLATION SOURCE