Program of the day

10:00 - 10:15 Welcome from our host John Womersley 15'
Director General of the European Spallation Source ERIC

10:15 - 11:00 What is the NPAP and its intellectual outputs? 45'
Prof. Anders Karlsson (Lund University / LTH), Dr. Christine Darve (European Spallation Source ERIC),

11:00 - 11:15 Coffee Break

11:15 - 11:35 Benefits of MOOCs and integrated learning 20'
Deana Nannskog, Project Manager and Educational Concept Developer at Lund University Commissioned Education

11:35 - 11:50 Collaboration possibilities through knowledge development 15'
Susanne Norrman, Director of Lund University Commissioned

11:55 - 12:40 Dialogue and panel discussion - how can research, higher education and business form closer partnership to enhance innovation? 45'

Panel participants:
Anna Hall, Program Director Big Science in Sweden
Susanne Norrman, Director LUCE
Dr. Søren Pape Møller, Director Institute for Storage Ring Facilities, Aarhus University
Ulrika Ringdahl, Deputy director Invest in Skåne

12:45 - 13:45 Lunch

13:40 - 16:10 Tour of the ESS and MAX IV facilities (Optional) 2h30'

Dialogue Event

NORDIC PARTICLE ACCELERATOR PROJECT

Background

- MAXIV and ESS
- Lund, a European center for accelerator technology
- Nordic Particle Accelerator Program (NPAP)
- Outcome of NPAP


MAXIV
ESS
European Spallation
Source.

Fun fact

The electrons in MAXIV have an energy of 3 GeV and travel with speed 1079252833 km/h (1 billion 79 million 252 thousand 833 km/h).

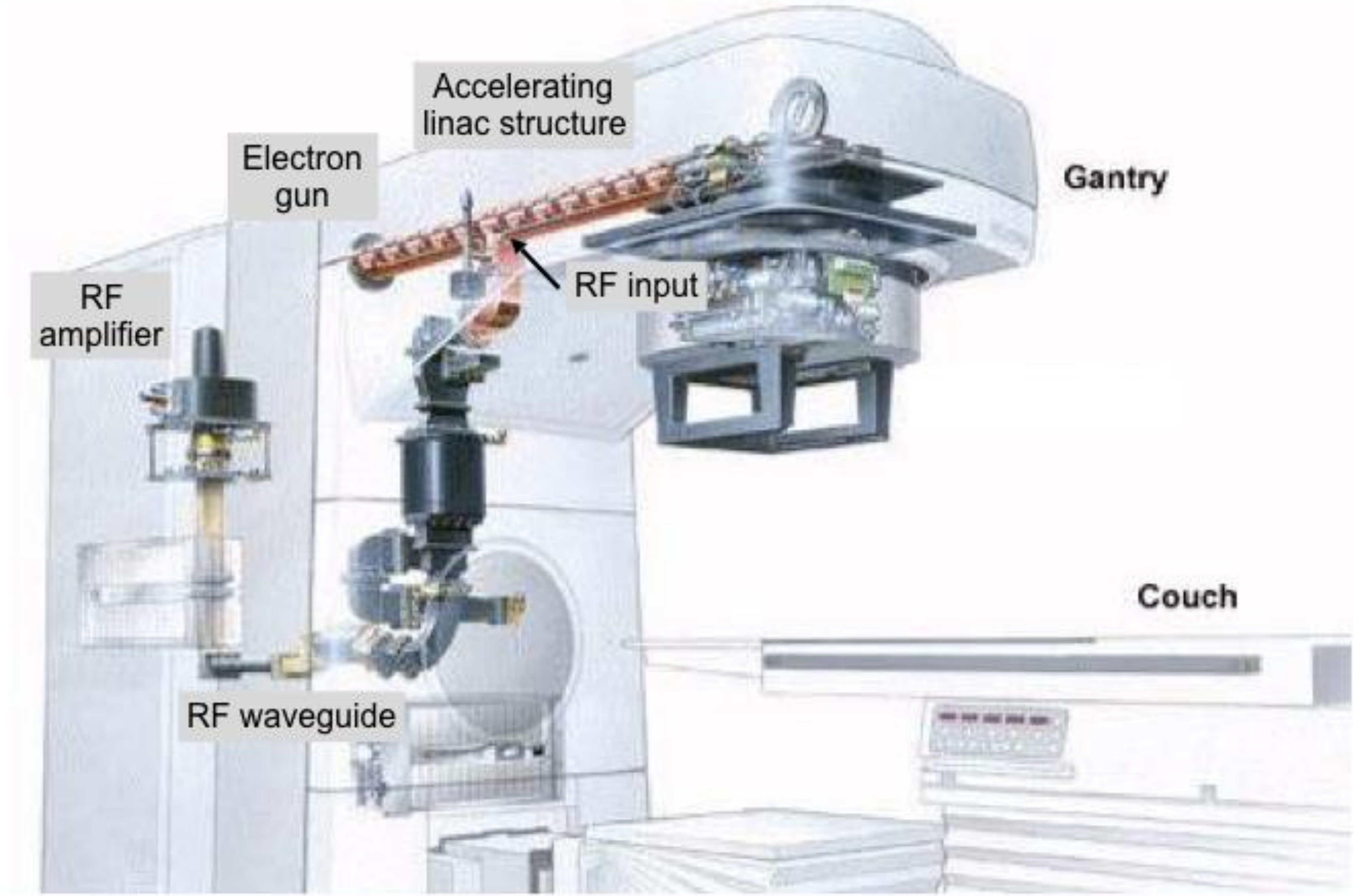
Their speed is just 15 km/h below speed of light!

Why the Nordic Particle Accelerator Program (NPAP)?

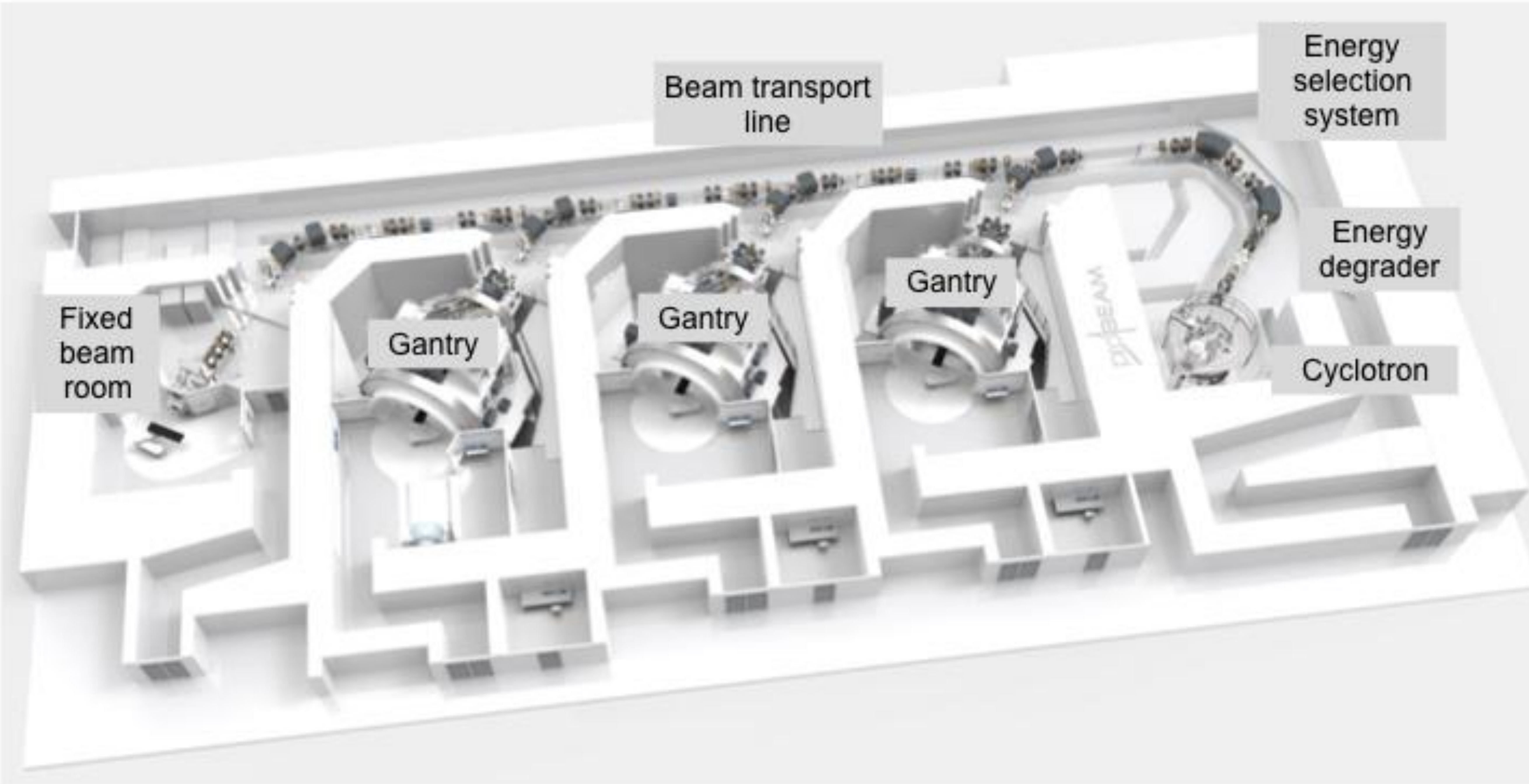
Fun fact: How many accelerators are there in the world today?

Answer: Approximately 30.000

Overview of RF system



Danish Center for Proton Therapy (DCPT)



Approximately 50 large accelerators in Europe

The technology of particle accelerators finds applications in many key fields of our lives

What is the NPAP?
Nordic Particle Accelerator Program

Context for Training in accelerator physics and technology

- Cooperation between ESS, MAXIV and Lund University (Faculty of Science and LTH)
- Particle Accelerator schools: JUAS, CAS, HASCO, USPAS, ACAS, ASP, etc
- EU-TIARA other market surveys
- EU-ARIES: Accelerator Research & Innovation for European Science and Society

Why do we need new Pedagogical tools for Accelerator science?

- School levels are typically advanced
- Domains/Field complementarity
- To provide sustainable and “users-friendly” tools

⇒ Develop capacity in Northern Europe with emphasize on MAXIV and ESS

Team building

Nordic Particle Accelerator School 2015 - The proof of Concept

Grant for the Nordic Particle Accelerator Program

Erasmus+

Application Form

Call: 2015

KA2 - Cooperation for Innovation and the Exchange of Good Practices

Strategic Partnerships for higher education

Erasmus Plus

Strategic partnership and building cross-sectoral bridges

KA2 - Support innovative practices from international to regional to organisational and individual levels.

Funded by the
Erasmus+ Programme
of the European Union

Impact and Dissemination

- New pedagogical tools and Innovative learning material
- Blended mobility of higher education students
- Improved education of talented students
- Identification of young researchers
- Strengthened collaboration between partners
- Increased awareness of possible research areas
- Channels: partners, accelerator community, web site: http://npap.eu

Target groups - Dialogue ?

- Students with basic knowledge in physics
- Worldwide Universities
- Employees at accelerators
- Companies
- Users
- In-Kind ESS collaborations
- Hospitals
- ...more suggestions?

Intellectual Outputs

- WP01: Two Nordic Particle Accelerator Schools, NPAS, preparation and implementation

- WP02: MOOCs and e-learning materials: preparation and implementation

- WP03: Seminar, webinars and other networking activities

Modularity and implementation of the MOOCs

Introduction to accelerators

11	**Introduction and basic accelerator science**
11L1	Introduction to light
11L2	Introdution to synchrotron accelrators
11L3	The evolution of accelerators
12	**Photon light sources**
12L1	Introduction
12L2	Bending Magnets
12L3	Free Electron Lasers
13	**Neutron sources**
13L1	Introduction and neutron science
13L2	ESS
14	**Colliders**
	Introduction
	The LHC and its experiments
	Linear Colliders
	Future circular colliders
15	**Pushing the Frontiers**
	Introduction
	Plasma wakefield accelerators
	Laser wakefield accelerators and laser technology
	Summary and outlook towards the future

Fundamentals of accelerator technology

21	**The RF System of Accelerators - Anders**
21L1	Introduction
21L2	RF-cavities
21L3	Waveguides
21L4	RF-Amplifiers
21L5	More about cavities
22	**Beam Diagnostics - Maja**
22L1	An overview
22L2	Beam Intensity and Position
22L3	Transverse Beam Profile
22L4	Longitudinal Beam Profile
22L5	Beam loss
23	**Basics of Vacuum techniques - Pauli**
23L1	An overview and motivation
23L2	Introduction to theory
23L3	Vacuum equipment
23L4	Other vacuum components
24	**Magnet Technology for Accelerators - Franz (Danfysik)/Søren**
24L1	Introduction, basic iron magnet concepts, types, design and measurements
24L2	Superconducting magnets, permanent magnets, technology, and future developments
24L3	Examples: Compact girder concept for MAX IV (and others examples?)

Medical applications of accelerator

51	**Introduction to the course and radiotherapy**
51L1	Introduction to the course
51L2	What is radiotherapy?
51L3	Introduction to the electron linac for radiotherapy
52	**Electron linacs for radiotherapy**
52L1	The multi-energy electron linac structure
52L2	Treatment head design
53	**Proton therapy I**
53L1	Rationale of proton therapy
53L2	Accelerators for proton therapy
53L3	Treatment delivery of proton therapy
54	**Proton therapy II and production of medical radionuclides**
54L1	Heavy ion therapy
54L2	Challenges in proton therapy and heavy ion therapy
54L3	Introduction to medical radionuclides
54L4	Production of medical radionuclides

1.Introduction to accelerators

- Accelerator physics
- Photon light sources
- Neutron sources (ESS)
- Colliders
- Frontiers

2. Fundamentals of accelerator technology

- RF-system
- Beam diagnostics
- Vacuum technique
- Magnets

3. Medical applications of accelerators

- Electron linacs for radiotherapy
- Proton and ion therapy
- Production of radionuclides

Collaboration & Partnership

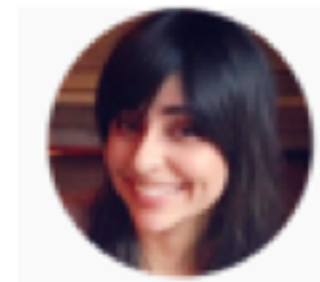
▪

▪

Our NPAP Team

Anders Karlsson
NPAP Coordinator (LU)

Deana Ekberg Nannskog
NPAP Project Manager (LU)



Karima Kandi (LU)

Julius Kvissberg (Evi

Christine Darve (ESS)

Francesca Curbis (MAXIV)

Søren Pape Møller (AU)

Erik Adli (OU)

Sverker Werin (MAXIV)

Pedro Fernandes
Tavares (MAXIV)

Maja Olvegård (UU)

Pauli Heikkinen (JU)

Summer Schools


Quadrupole scan
quadrupole magnet
beam size monitor
Measure the beam size w_1 behind a quadrupole with setting f_1
Change the quadrupole setting and measure the beam size again
Repeat until you have at least three measurements. With the transfer matrix known you now have enough information to extract the incoming beam parameters.


MAX IV

MOOC
Massive Open Online Course

Creating a MOOC

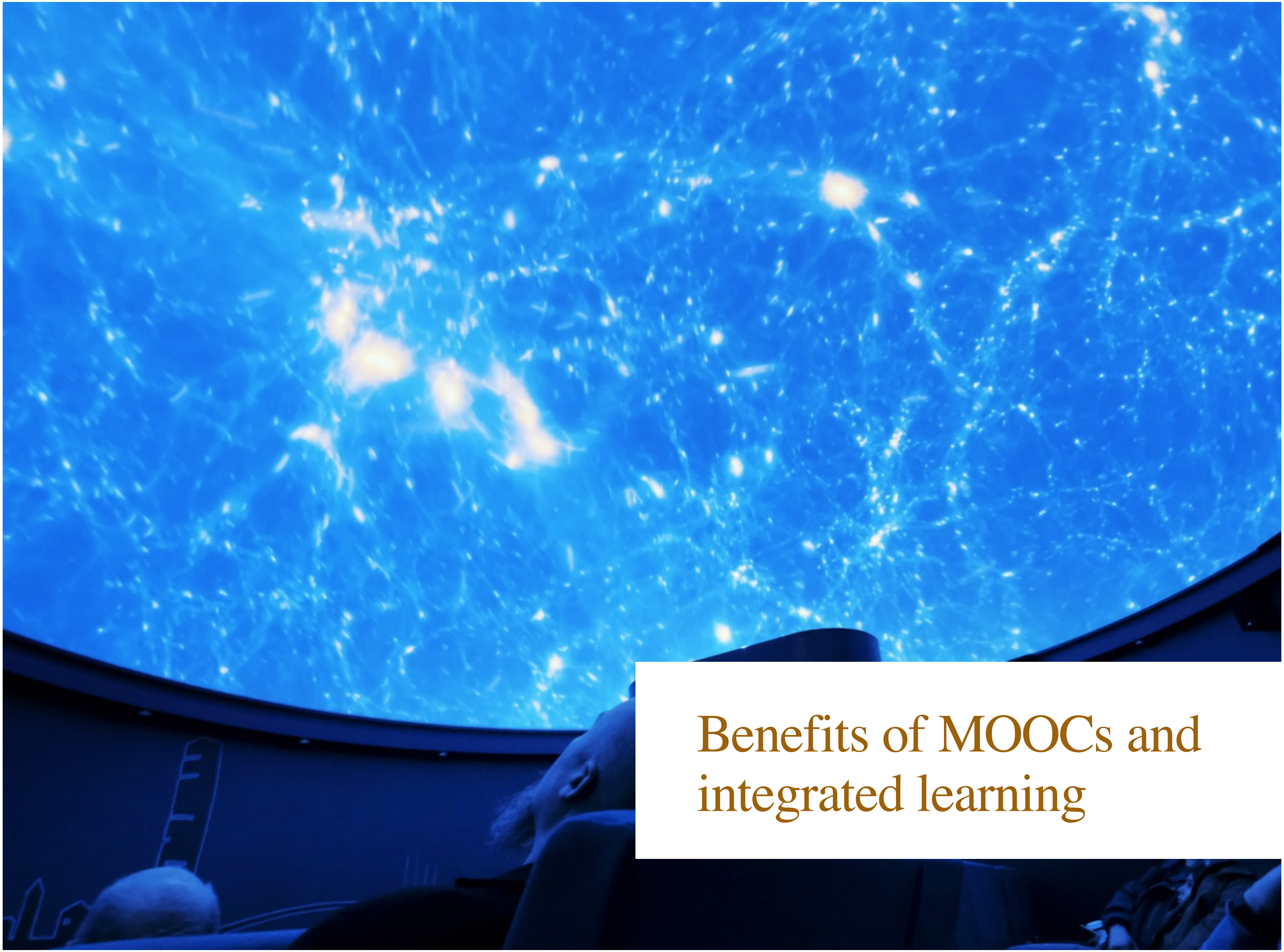
Producer: Julius Kvissberg

- Needs of the learners and learning objectives
- Modules
- Skeletons for modules
- Manuscripts for lectures
- Film the lectures
- Reading materials
- Quizzes

1. Introduction to accelerators
2. Fundamentals of accelerator technology
3. Medical applications of accelerators

Ee

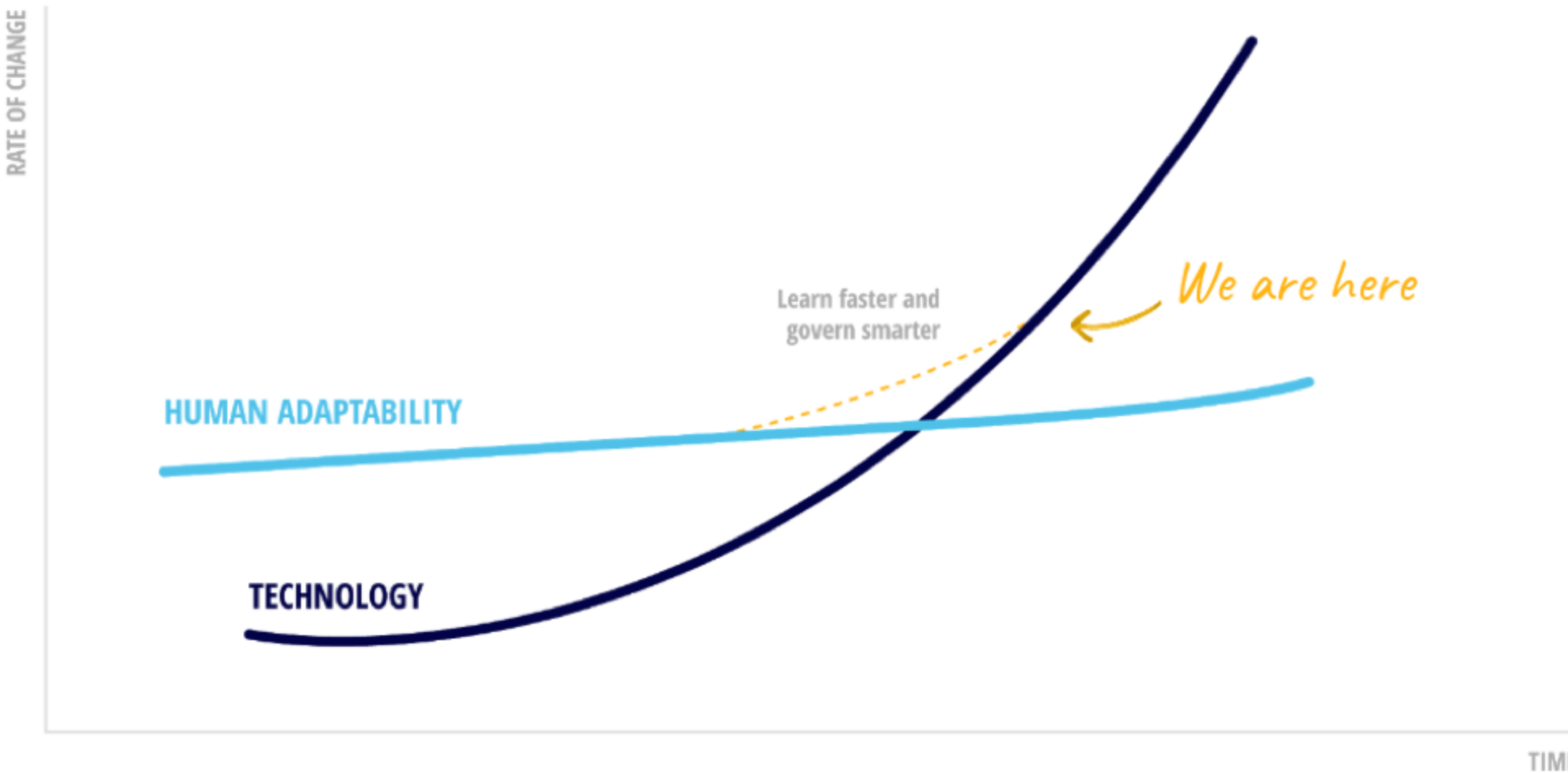
Deana Nannskog
slide 34-37



Benefits of MOOCs and integrated learning

A global learning ecosystem

Our future is discretionary



Source: *Thank You for Being Late*, Thomas Friedman

Challenges ahead

LUND UNIVERSITY

Collaboration possibilites through knowledge development

20 AUGUST 2018

Strategic plan of Lund University 2017–2026

Vision

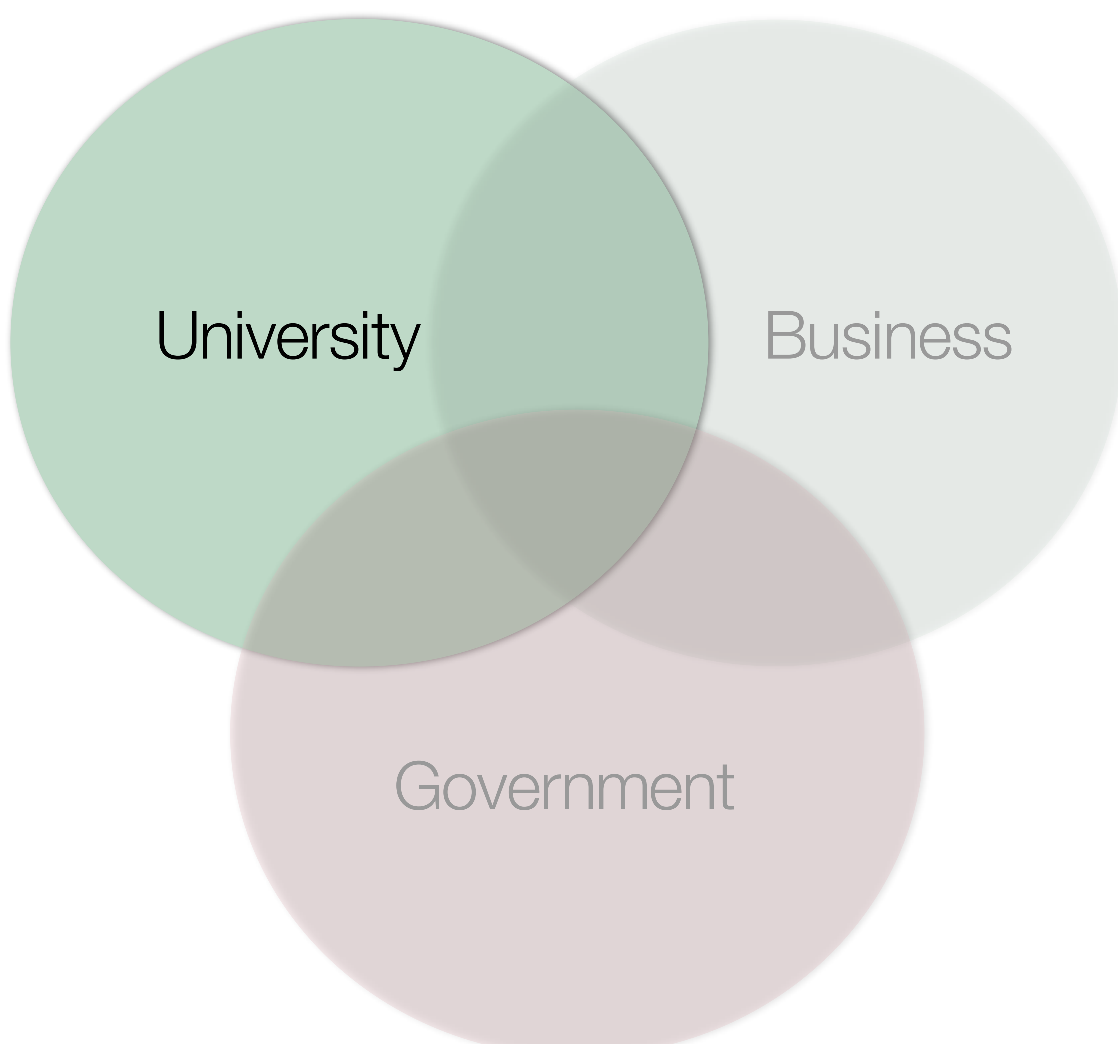
A world-class university that works to understand, explain and improve our world and the human condition

Priority areas

- Education and research are to be intertwined
- Stimulating active collaboration to solve societal challenges
- Continued development as an international university
- Well-developed leadership and collegiality
- Students, employees and visitors are to be offered attractive environments
- The potential of MAX IV and ESS is to be fully exploited

LUND UNIVERSITY

Collaboration with society



- Collaboration in research and development
- Strategic partnerships and cooperation agreements
- Technology transfer and innovation support system *(ex LU Innovation)*
- A structure for knowledge transfer, training and development *(ex LUCE)*

One of the universities' three duties - became law in 1977

LUND UNIVERSITY

Lund University
Commissioned Education

Lund University Commissioned Education

- LUCE is a central-level office which can provide custom-designed educational programmes drawing from the strength of all Lund University faculties.

- Contact point for companies, organisations and authorities seeking business/organisational and staff development

Commissioned education - a strategic tool

- an important, but currently underutilized, channel to communicate both general knowledge and the latest research results and thus contribute to life-long learning and development of society

- helps identify the needs and experiences of the outside world and brings back both to education and research, which contributes to the university's quality development.

LUND UNIVERSITY

Commissioned education - a strategic tool

- A meeting-platform for scientists and course participants for exchange of ideas and experience
- Opens for commissioned projects and external collaborations
- One way of contributing to internationalization
- Complete solutions – tailored to your needs
- More flexible and adaptable to the needs of society

LUND UNIVERSITY

Key Figures

160 courses and programmes

3900 participants

40 % of participants non resident in Sweden

80/20 National/International customers

MEUR 9 in turnover

LUND UNIVERSITY

Challenges for the universities

- **create a clearer supply** of lifelong learning activities
- make this supply **accesible** and **flexible**
- participate in and create **opportunities for dialogue** in order to get stakeholders input to what education is needed

LUND UNIVERSITY

How do we find out the needs of society?

LUNDS UNIVERSITET

What dialogues/
meeting places do
we have today?

What do we need?

Possibilities for the future

- Lifelong learning now on the agenda
- **New technologies**
- New financing possibilities
- Develop new knowledge development programmes in close collaboration with industry and public sector
- …

LUND UNIVERSITY

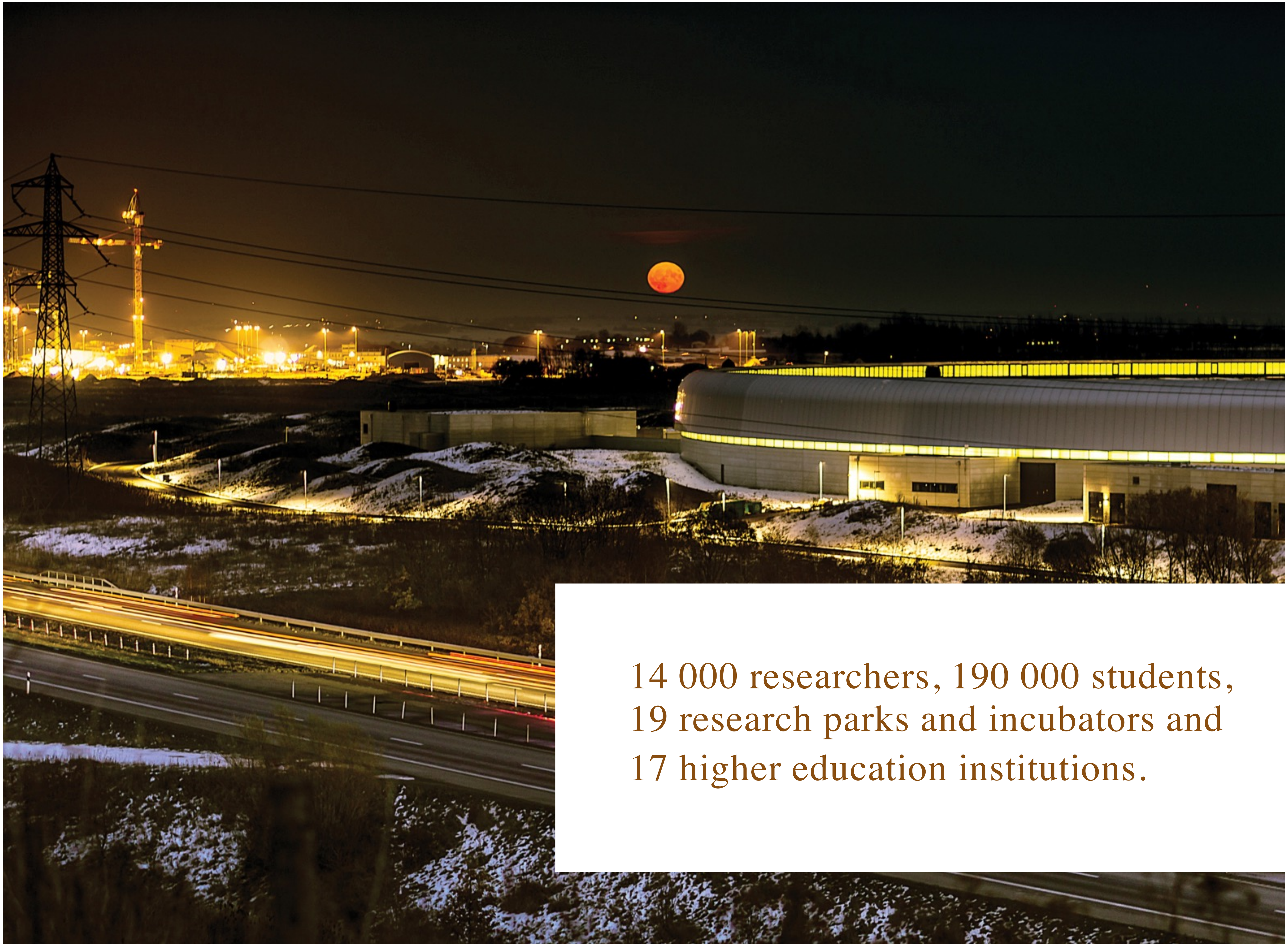

VECKANS
SOPPA :
MOROTSSOPPA
med VITA BÖNOR och
SELLERI.

One of Northern Europe's most knowledge-intensive areas

Greater Copenhagen

Home to 4 million inhabitants and Scandinavia's largest recruitment base of highly-skilled employees.

With world class research facilities.



14 000 researchers, 190 000 students, 19 research parks and incubators and 17 higher education institutions.

MAX IV – the most brilliant X-rays for research.

Medicon Village, a world-class infrastructure for Life Science

One of Europe's most successful meeting places for visionaries, entrepreneurs and venture capital – Ideon Science Park.

Some innovations from Lund

- The artificial kidney (Gambro)
- Diagnostic ultrasound
- Bricanyl – asthma medicine
- Nicorette – nicotine gum to quit smoking
- Axis – printer and camera servers
- Oatly – oat drink
- Proviva – probiotic fruit drink
- Orbital Systems – the world´s most water-efficient shower
- Endodrill – instrument for cancer diagnostics

LUND UNIVERSITY

EUROPEAN SPALLATION SOURCE

MAX IV LABORATORY

JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

UNIVERSITY OF OSLO

UPPSALA UNIVERSITET

AARHUS UNIVERSITY

Questions for Dialogue

1. What's your experience of working with MOOCs in organisations?

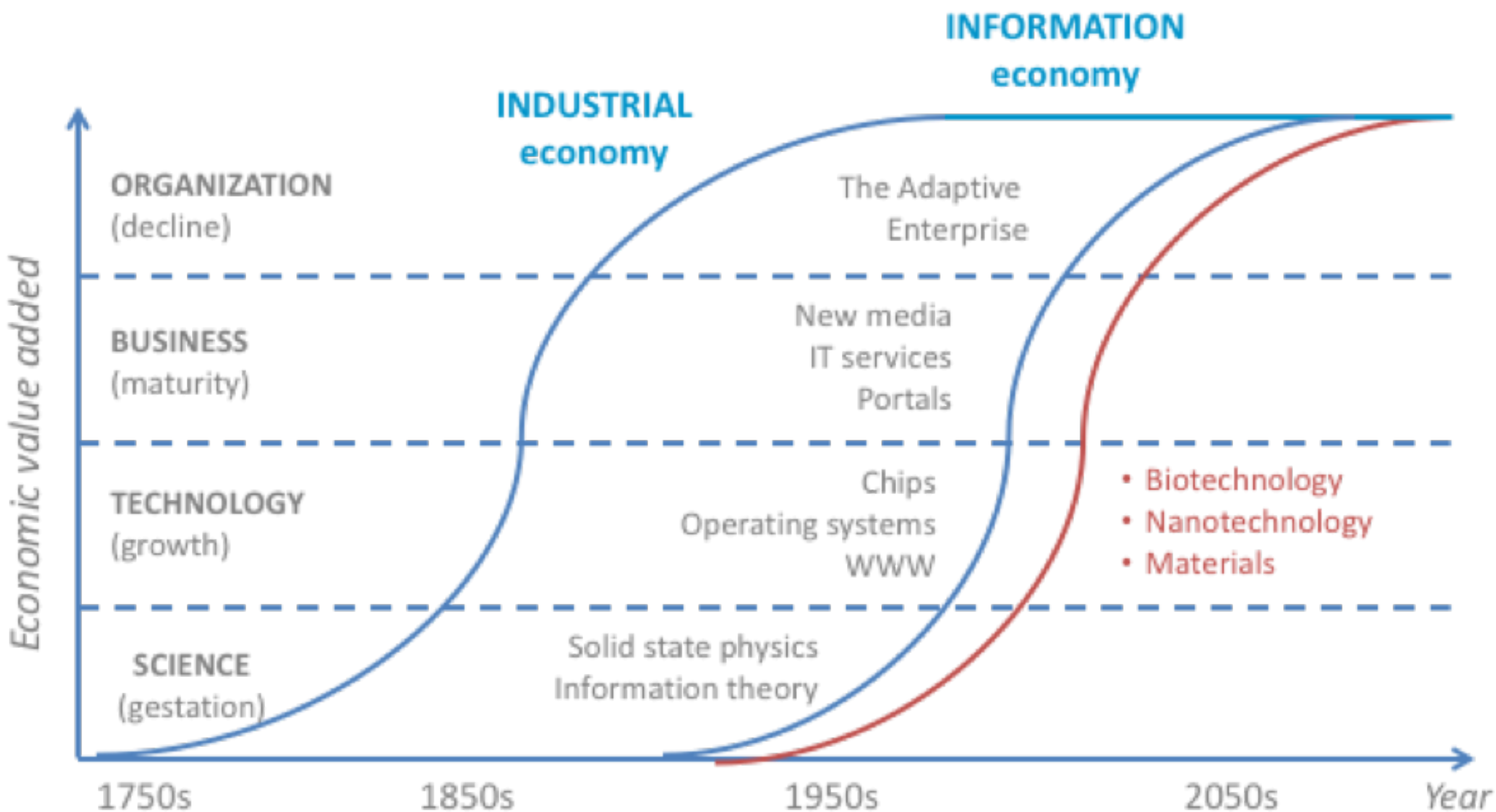
2. How would you define the needs of knowledge from your organisation's point of view?

3. What are the most significant factors driving the growth of companies, would you say?

4. How do your organisation/partners determine what type of knowledge is important?

5. How can we create valuable learning content in trans-sectoral networks?

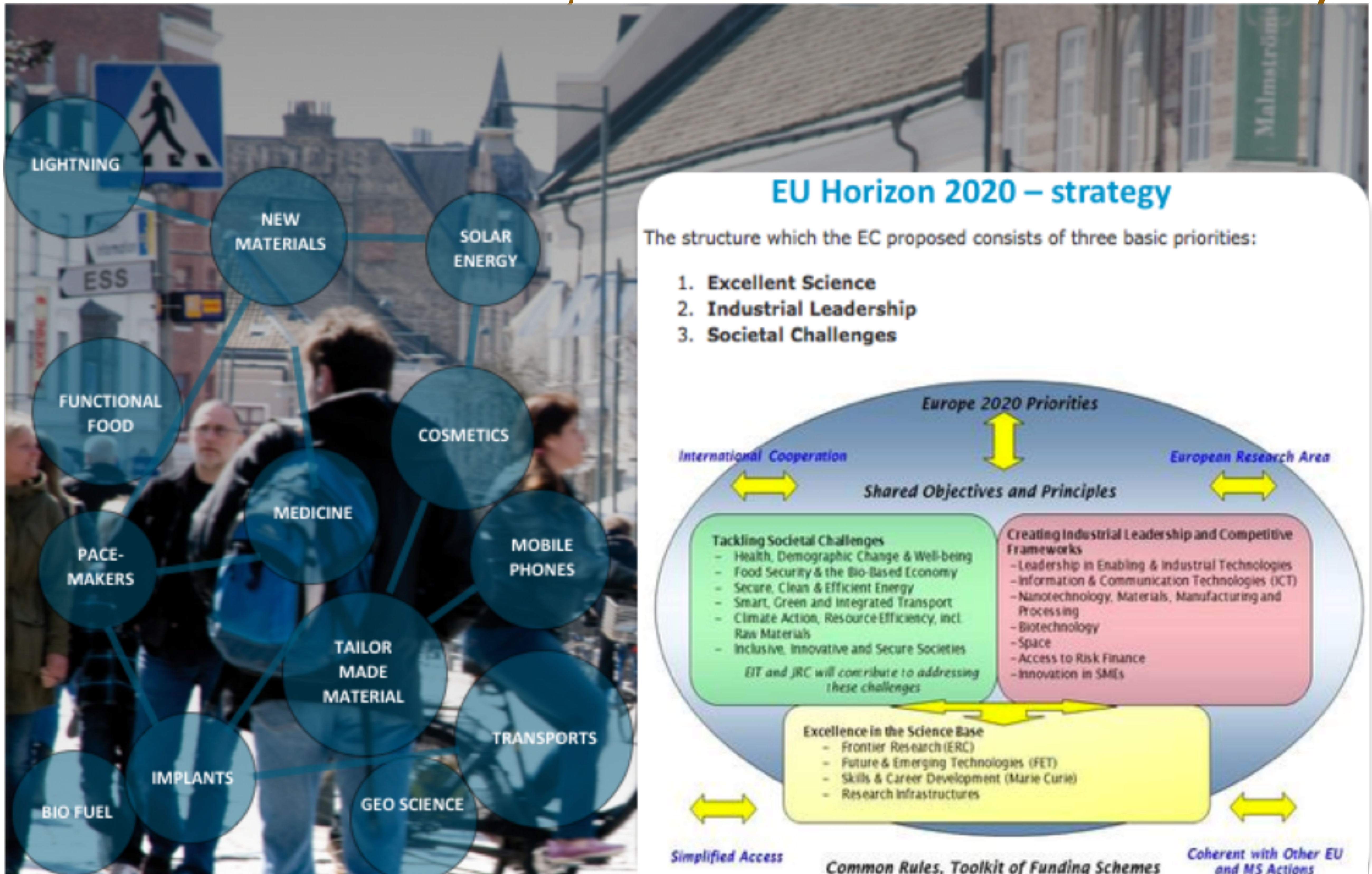
Technological Paradigm Evolution



Materials science facilities are keys to the new economy

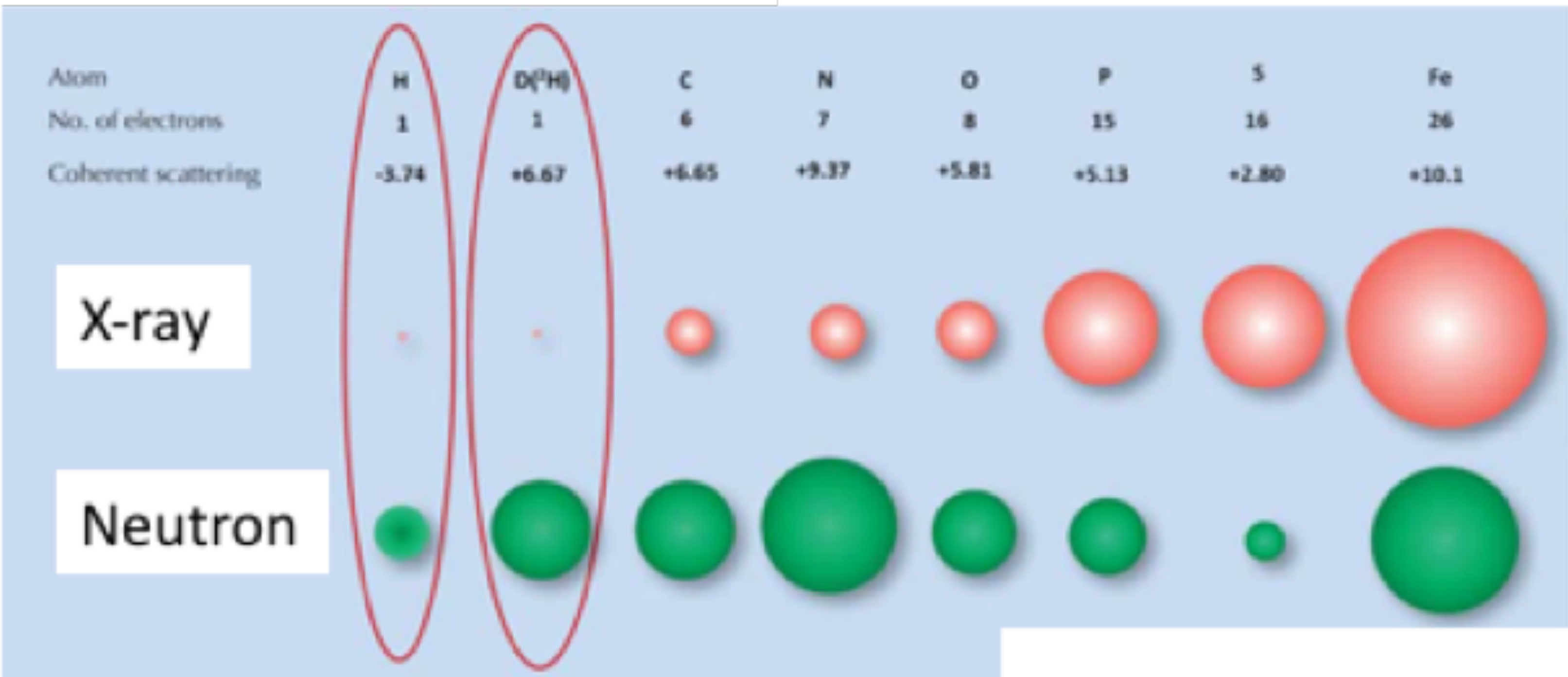
It's Alive - The Coming Convergence of Information, Biology, and Business

Materials, Life Science and Society



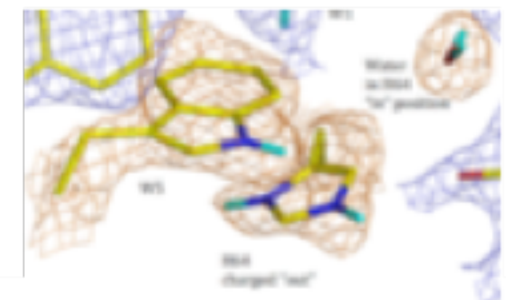
Complementarity between X-rays & Neutrons

Neutron scattering lengths for different atom types found in biological materials:

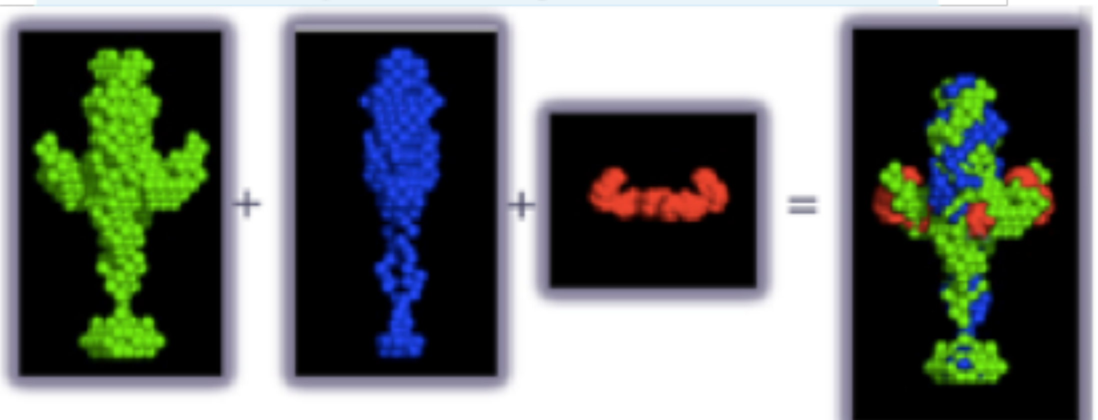


H atoms make up *~50% of atoms of biological macromolecules* (lipids, proteins, nucleic acids, carbohydrates).

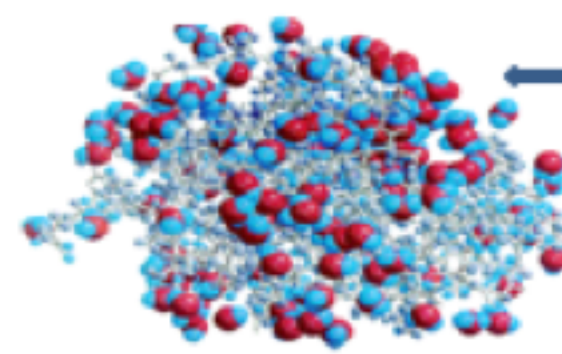
Localization of Hydrogen atoms



Appropriate isotope labeling is very important (replace H with D wherever possible)



X-rays



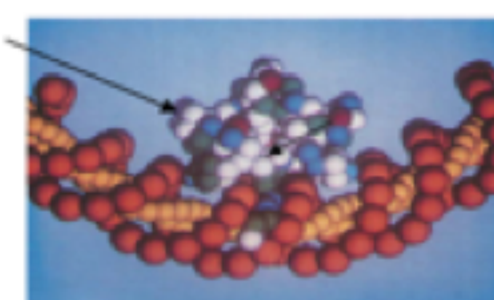
Neutrons

Water molecules Observed with neutrons

N. Niimura, et al.

Protein

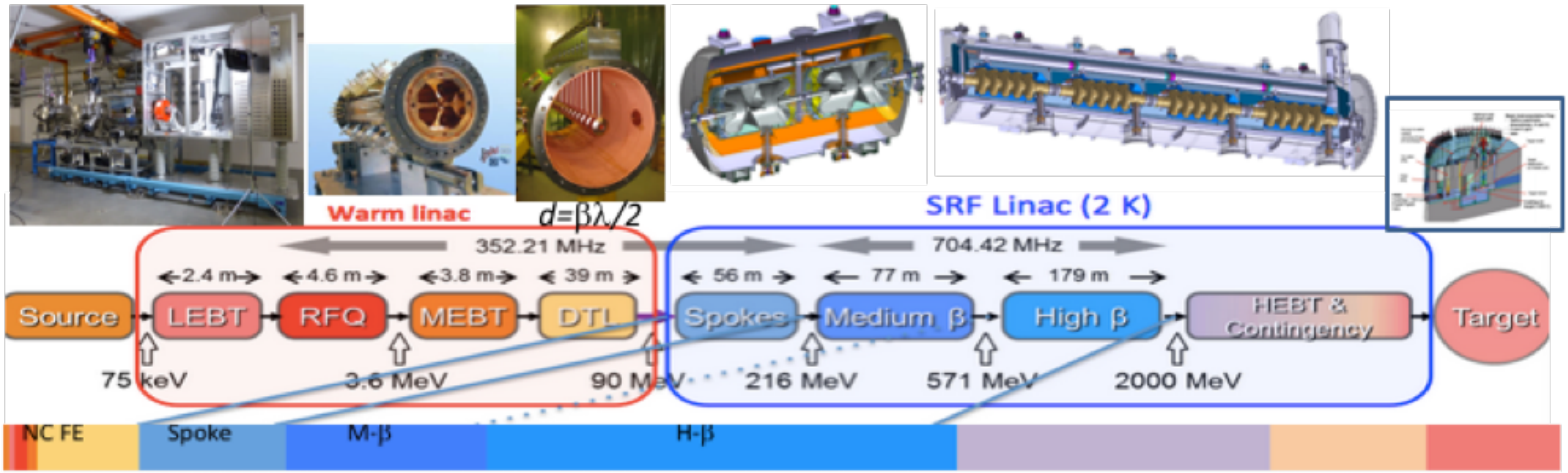
From structure to function



DNA

A proten molecule moving along theDNA chain

ESS Linear Accelerator

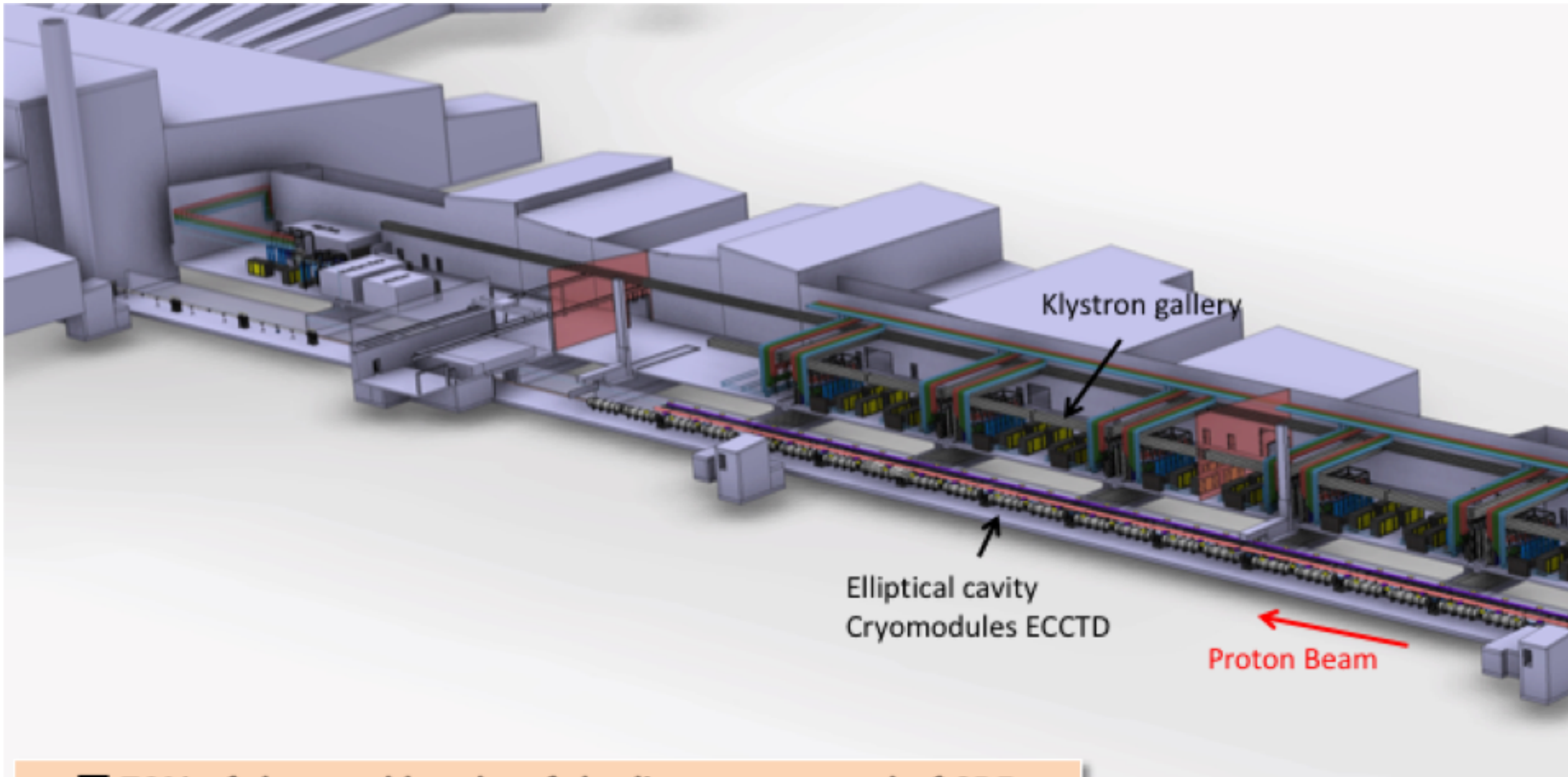


Key parameters:
→ 5 MW average beam power
2 GeV
62.5 mA peak
2.86 ms long pulses
14 Hz
4 % duty cycle

96% of acceleration will be provided by superconducting cavities supplied by dedicated high power RF sources.

Staged approach:
Construction scope: 1.3 GeV with 11 powered High β cryomodules (44 x 1.5 MW klystrons)

Nominal scope: 2 GeV with 10 more powered High β cryomodules (+40 x 1.5 MW klystrons)



☐ 70% of the total lenght of the linac composed of SRF cavities for the proton beam to accelerate from c/2 to ~c