JAGIELLONIAN UNIVERSITY
IN KRAKOW

SOLARIS
NATIONAL SYNCHROTRON
RADIATION CENTRE

Status of Solaris

Carlo J. Bocchetta
ESLS XIX – Aarhus, Denmark
23-24 November 2011

JAGIELLONIAN UNIVERSITY IN KRAKOW

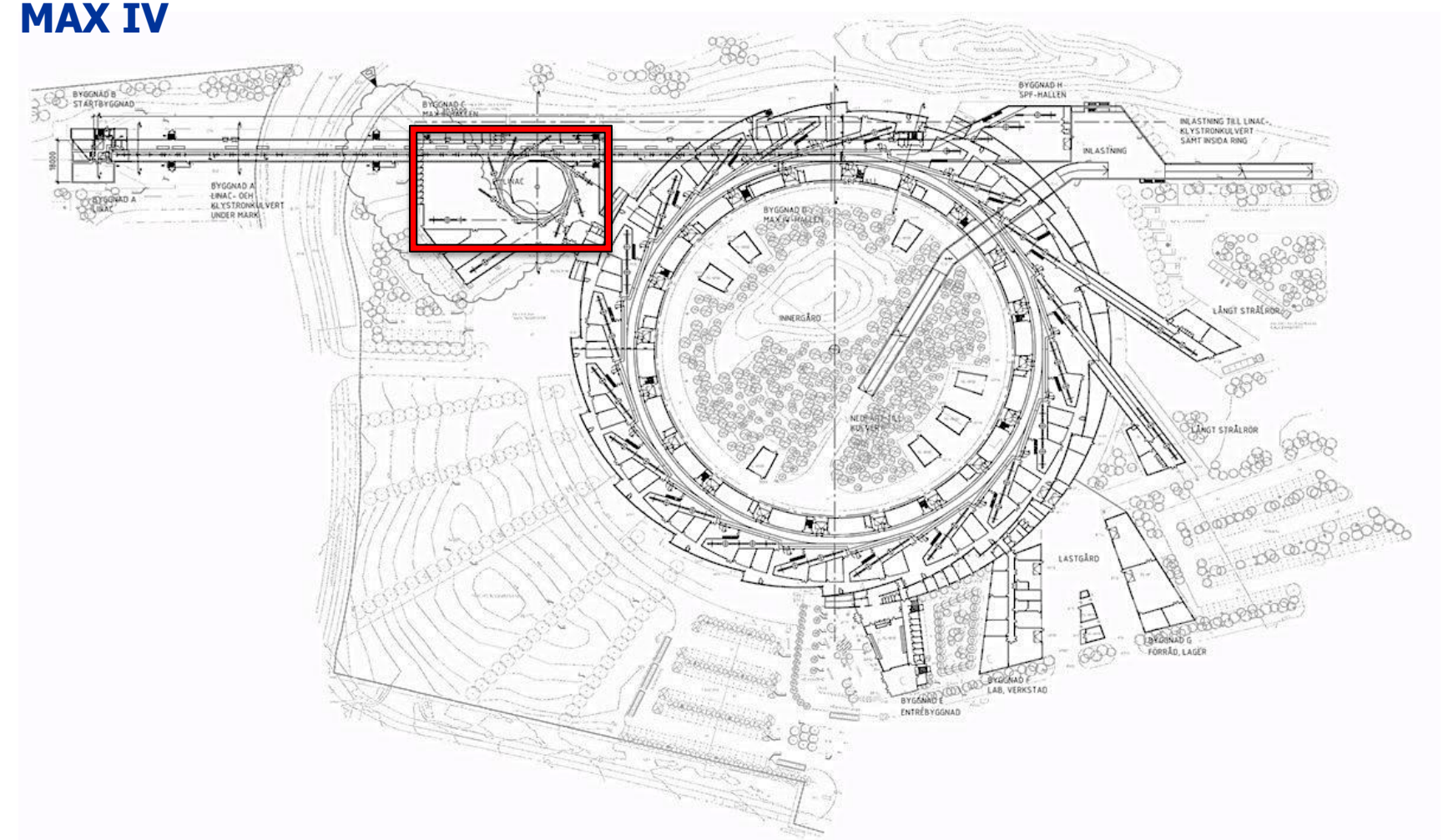
SOLARIS NATIONAL SYNCHROTRON RADIATION CENTRE

What is Solaris?

Polish Synchrotron Radiation Facility in Krakow

- **Replica** of the MAX IV 1.5 GeV Storage Ring and parts of the injection system being concurrently built in Sweden.
- SOLARIS is on the Polish Research Infrastructure Roadmap
- Agreement has been signed between Jagiellonian and Lund Universities for mutual cooperation in the construction of Solaris based on MAX IV.
- Unique collaboration between two EU countries
  - Maximises the utilisation of human and financial capital for more effective use of public (EU) funds.
  - Quick training of new people with optimal use of mentorship and expert knowledge through project objectives.
  - Procurement efforts are rendered more effective by not duplicating tasks and allows industry to program its response to large-scale research infrastructure requirements.
  - Sharing of critical knowledge of building design and construction.

MAX IV



3.0 GeV ring: 20 straights (ε=0.23 nmrad) 540 m circumference
1.5 GeV ring: 12 straights (ε=6.0 nmrad) 96 m circumference
3.0 GeV linac: Injector + Short Pulse Facility (+ FEL)

Project background - history

- Polish synchrotron radiation users community - >300

  Polish Synchrotron Radiation Users Society
- Long lasting initiative for a Polish synchrotron light source since 1998
- April 2008 project listed on the "indicative" list of EU Structural Funds Innovative Economy Programme and 40M€ allocated
- Autumn 2008 Contract for the feasibility study and conceptual design signed
- 2009-2010 breakthrough:

  Beginning of 2009: concept of SOLARIS emerges – synergy with MAX IV 1.5 GeV

  2009 – November – application for 1.5 GeV ring submitted

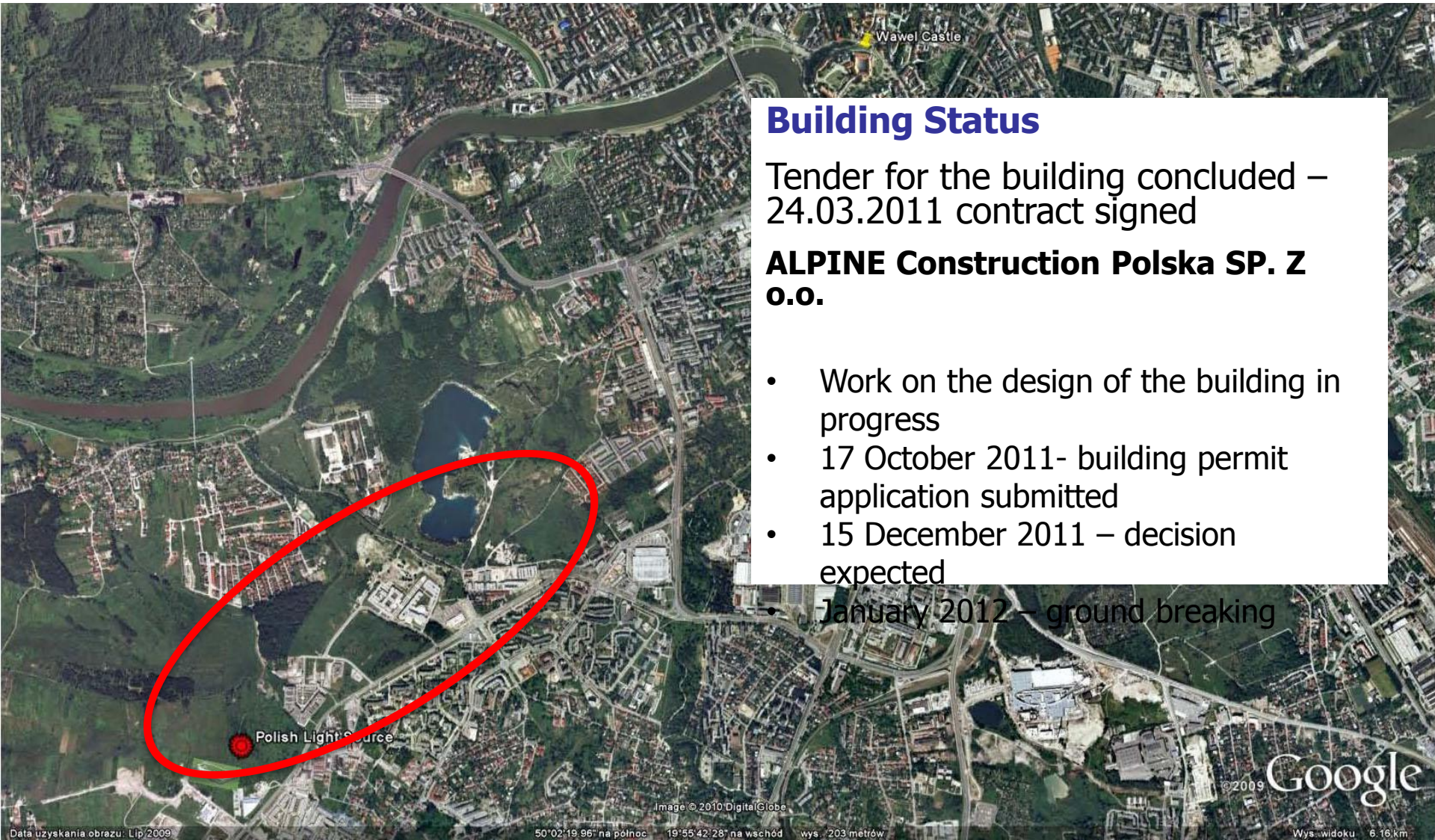
  2010 – March - project approved

  2010 – April – contract between JU and Ministry of Science and Higher Education signed

Project settings and boundary conditions

- Collaboration with MAX-lab in Lund - replica of the new 1.5 GeV MAX-lab ring
- Solaris is a national project but run by the Jagiellonian University
- Jagiellonian University support:
  - The plot – III Campus
  - Pre – financing
  - Administrative support (purchasing, travel, employment, legal advice)
- Budget:
  - 40 M€ = 143.7 MPLN - EU Regional Development Structural Funds
- Deliverables:
  - Building: 12 M€ = 43 MPLN
  - Machine: 25 M€ = 90 MPLN - State of the art facility
    - injection system
    - storage ring
    - experimental line
- Deadline: end of 2014

SOLARIS @ Jagiellonian University new campus: 50°01'21" N:19°53'37" E



Building Status

Tender for the building concluded – 24.03.2011 contract signed

ALPINE Construction Polska SP. Z o.o.

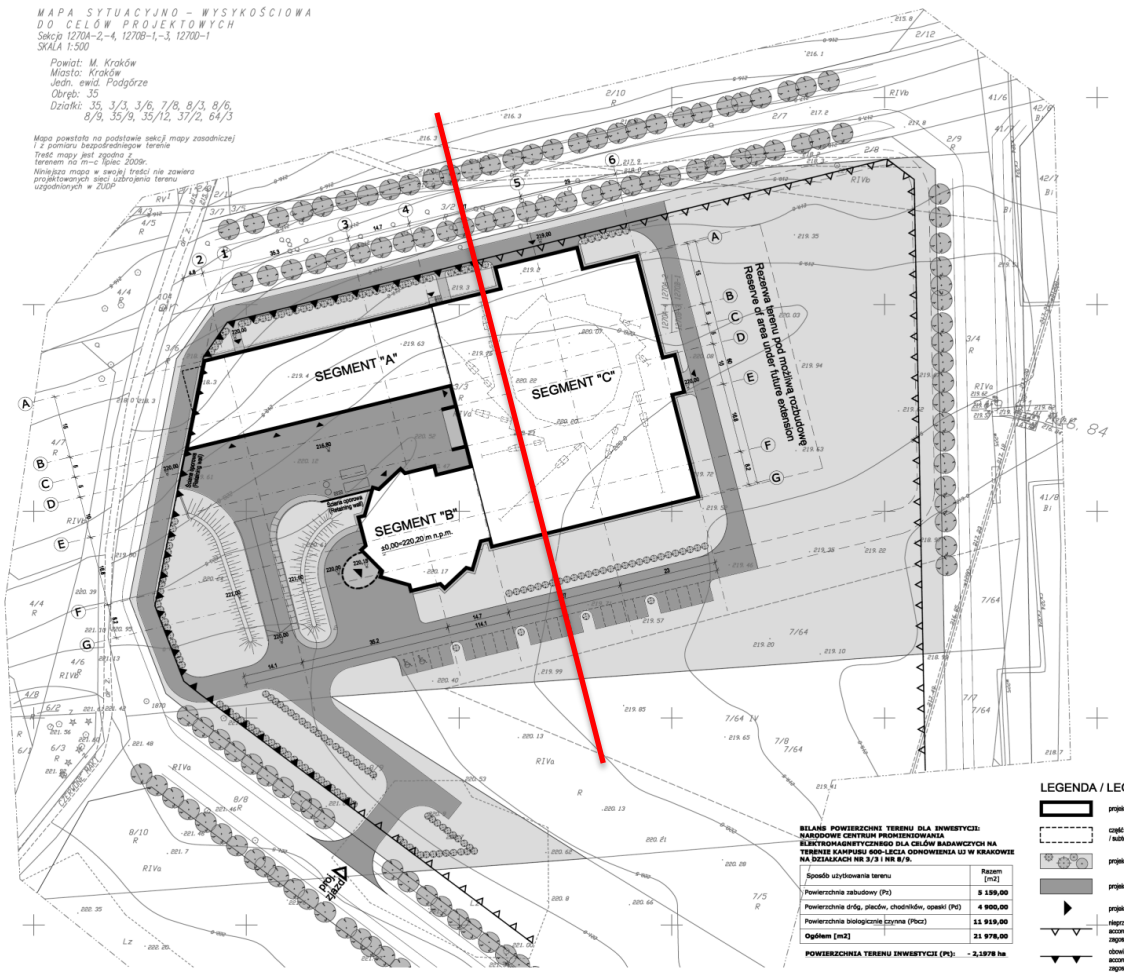
- Work on the design of the building in progress
- 17 October 2011- building permit application submitted
- 15 December 2011 – decision expected
- January 2012 – ground breaking

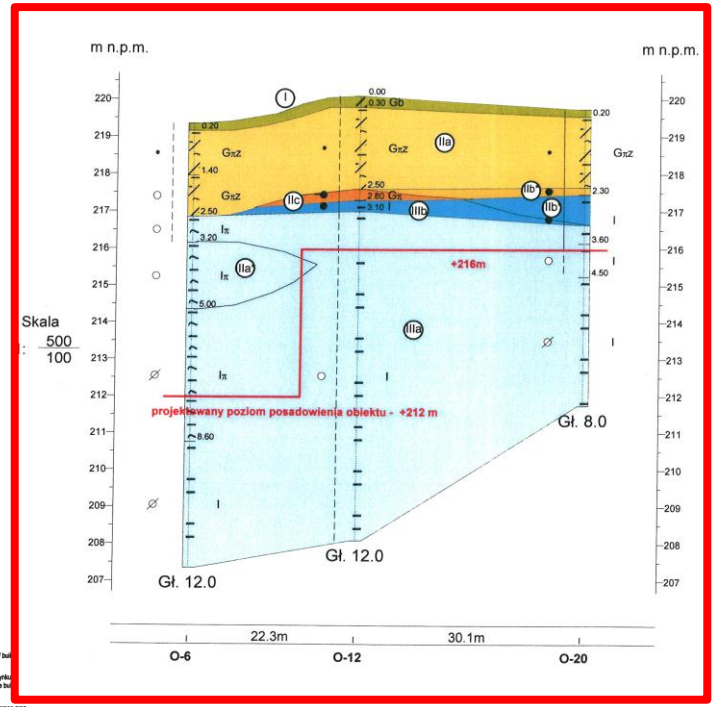
NARODOWE CENTRUM PROMIENIOWANIA ELEKTROMAGNETYCZNEGO DLA CELÓW BADAWCZYCH NA TERENIE KAMPUSU 600-LECIA ODNOWIENIA UJ W KRAKOWIE

NATIONAL CENTER OF ELECTROMAGNETIC RADIATION FOR RESEARCH PURPOSES IN THE AREA OF REVIVAL'S 600th ANNIVERSARY CAMPUS OF JAGIELLONSKI UNIVERSITY IN CRACOW

skala 1:500 / scale 1:500

Land area of ~22000 m^2





BILANS POWIERZCHNI TERENU DLA INWESTYCJI:
NARODOWE CENTRUM PROMIENIOWANIA ELEKTROMAGNETYCZNEGO DLA CELÓW BADAWCZYCH NA TERENIE KAMPUSU 600-LECIA ODNOWIENIA UJ W KRAKOWIE NA DZIAŁKACH NR 3/3 I NR 8/9.

Sposób użytkowania terenu	Razem [m2]
Powierzchnia zabudowy (Pz)	5 159,00
Powierzchnia dróg, placów, chodników, opaski (Pd)	4 900,00
Powierzchnia biologicznie czynna (Pbcz)	11 919,00
Ogółem [m2]	21 978,00

POWIERZCHNIA TERENU INWESTYCJI (Pi): - 2,1978 ha

LEGENDA / LEGEND:

projektowane obiekty / buil
część podziemna budynku / substratin level of the bu
projektowana zieleń / green area
projektowana komunikacja / paved area
projektowane wejście do budynku / entrance
nieprzekraczalne linia zabudowy / building front line according to "miejscowy plan zagospodarowania przestrzennego" regulations
obowiązująca linie zabudowy / obligatory building front line according to "miejscowy plan zagospodarowania przestrzennego" regulations

Przedsiębiorstwo Projektowania i Realizacji Inwestycji
PROBADEX - KRAKÓW
mgr inż. arch. Jerzy Bereda

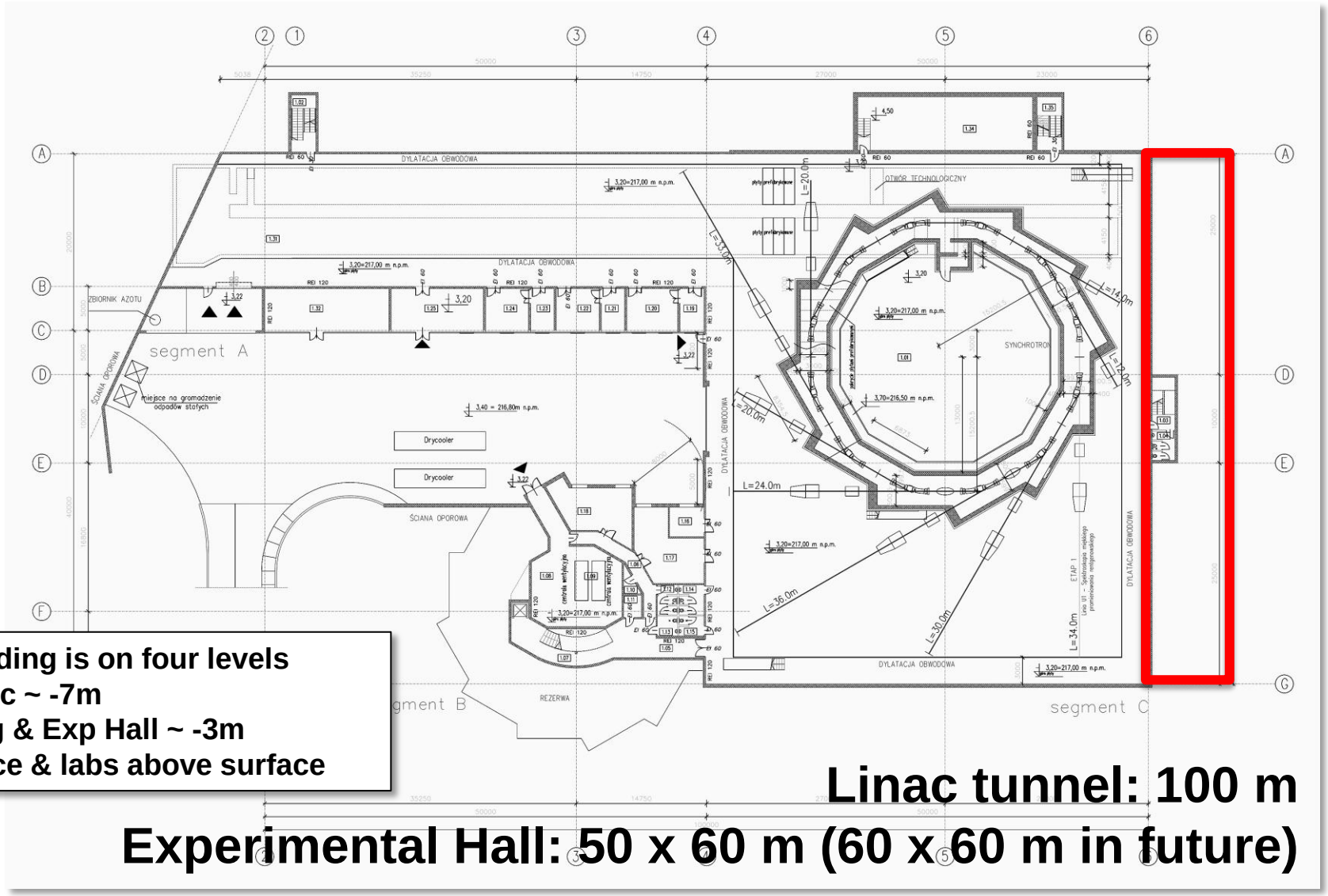
INWESTOR / INVESTOR: Uniwersytet Jagielloński, ul. Gołębia 24, 31-007 Kraków

OBIEKT / OBJECT: Narodowe Centrum Promieniowania Elektromagnetycznego dla Celów Badawczych na terenie Kampusu 600-lecia Odnowienia UJ w Krakowie
National Center of Electromagnetic Radiation for Research Purposes in the area of Revival's 600th Anniversary Campus of Jagiellonski University in Cracow

TYTUŁ / TITLE: Zagospodarowanie terenu / Layout

Branża / Discipline: Architektura / Architecture
Nr rys. / Drwg. no: 565-04
Wersja 12
25.10.2010

Facility Layout



Building is on four levels
Linac ~ -7m
Ring & Exp Hall ~ -3m
Office & labs above surface

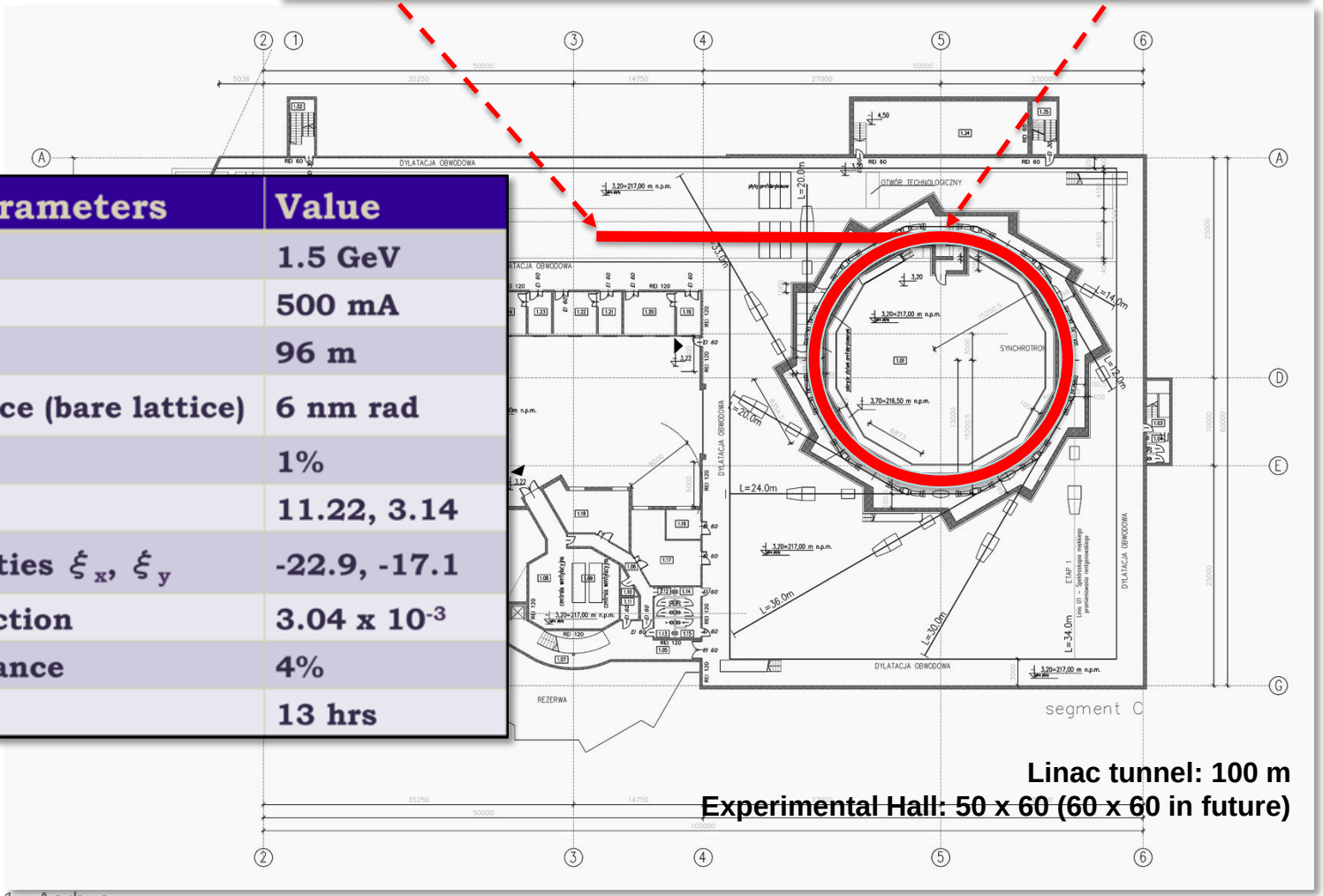
Linac tunnel: 100 m

Experimental Hall: 50 x 60 m (60 x 60 m in future)

Solaris Layout

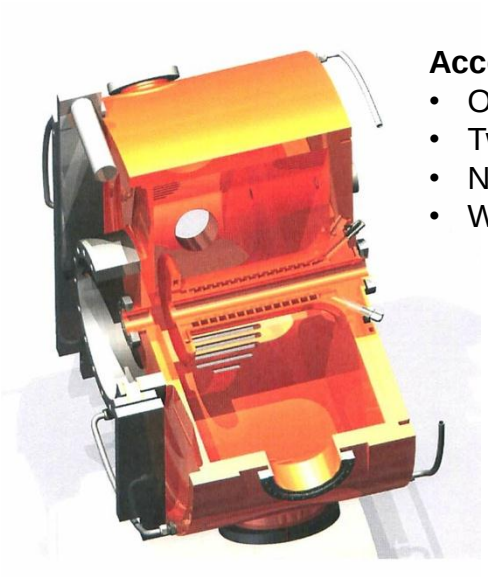
Thermionic RF gun, 3 GHz Linac. 550 MeV. ~50 m incl transfer line

Storage Ring Parameters	Value
Energy	1.5 GeV
Current	500 mA
Circumference	96 m
Horizontal emittance (bare lattice)	6 nm rad
Coupling	1%
Tunes Q_x, Q_y	11.22, 3.14
Natural chromaticities ξ_x, ξ_y	-22.9, -17.1
Momentum compaction	3.04×10^{-3}
Momentum acceptance	4%
Overall Lifetime	13 hrs

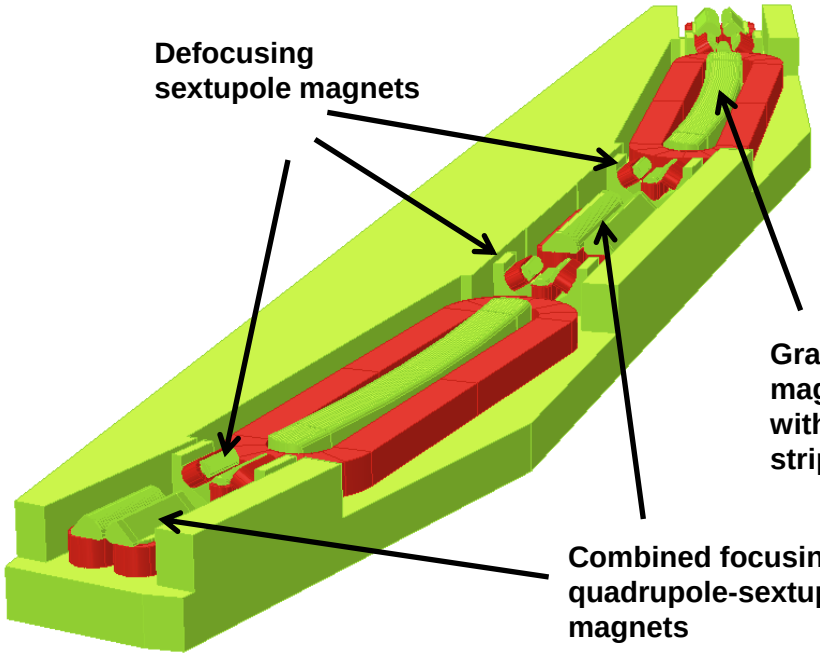


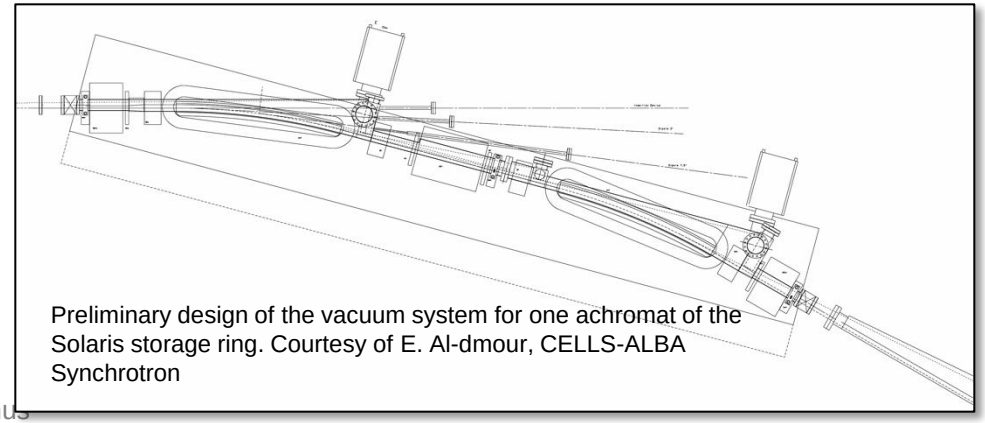
Linac tunnel: 100 m
Experimental Hall: 50 x 60 (60 x 60 in future)

Machine Components



Accelerating Cavities
- Optimized MAX-lab type
- Two 100 MHz Cavities
- Normal Conducting
- With HOM couplers





Preliminary design of the vacuum system for one achromat of the Solaris storage ring. Courtesy of E. Al-dmour, CELLS-ALBA Synchrotron

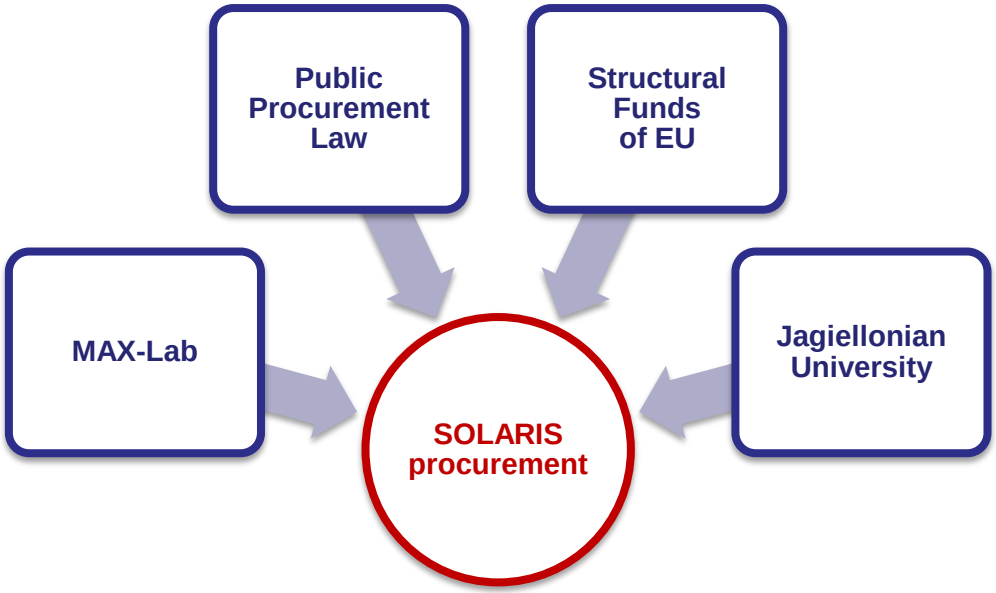
Vacuum System
- Design work by ALBA
- Conventional system based on MAX-lab
- Zero, 3 & 7.5° photon ports.
- Enlarged bores for central magnets
- Design completion early 2012

Implementation

Solaris team (technical) is hosted at MAX-lab and participates in project activities and training.

Sharing of mutual resources.

Procurements for Solaris are as options in MAX IV tenders – with constraints.



Purchases

	COMPLETED			
	Purchases	**Company**	**Price (EUR)**	**Date of delivery**
1	Building (design and build)	Alpine Construction Polska Ltd. Łęgprzem Ltd.		
2	Investor's supervision on building	Probadex		
3	Iron for SR magnets	AK Steel Ltd.		June 2011
4	Heat treatment of iron	Wilhelm Schulz GmbH		September 2011
5	RF Units for Linac	ScandiNova Systems AB		
6	Linac sections	Research Instruments GmbH		

		ONGOING	
	Purchases	**Company**	**Status**
1	Cavities for SR	Research Instruments GmbH	defining the scope
2	Power supplies	-	announced by MAX-Lab

Solaris People

- ~12-14 people to be initially on the team (Budget Constrained).

- 12 people on team so far (5 management & support, 6+1 technical)
- Tech people: Acc Phys, Controls, Vacuum, Linac, Magnets, Electronics/PLC, one PhD (gun/laser) – hiring Mech Eng, Civil Eng, support from JU

- Majority of technical activities are being conducted in Lund until the Solaris buildings are ready

- Activities at MAX IV: Participation in joint activities, getting to know the systems, preparation and understanding of installation and operation, training.
- Team interfaces to activities in Krakow: providing feedback on buildings and procurements
- Activities in Krakow: procurement, hiring, university support, building construction

SOLARIS – International collaboration initiatives

- **MAX-lab** (Lund-Sweden) – MoU + Collaboration agreement
  - Design of the machine
  - Tendering and purchasing
  - Training
- **ELETTRA** (Trieste, Italy) – MoU
  - Systems Expertise
- **ALBA** (Barcelona, Catalunya) – MoU
  - Vacuum systems – Via MAX IV-CELLS agreement
- **PSI** (Villigen, Switzerland) - MoU
  - RF systems – Training of personnel (SCIEX Grants)
  - Experimental Beamline
- **CERIC** initiative – Central European Research Infrastructure Consortium

SOLARIS – National Collaboration Initiatives

- Machine – accelerator expertise
  - **National Centre for Nuclear Research** – Swierk, PL
  - **Institute of Nuclear Physics PAN** – Kraków

- Beamlines
  - Photoelectron Emission Spectroscopy (PEEM) – **AGH** - project
    - Source: Bending magnet:
    - Energy range: 40 – 1500 eV
  - Ultra Angle Resoved Photoelectron Spectroscopy (UARPES) – **JU** – app. submitted
    - Source: Apple type undulator – variable polarization
    - Energy range: 8 – 100 eV
  - X-ray Photoemission Spectroscopy (XPS) – **Silesian University** – app. submitted
    - Source: undulator
    - Energy range: 40-1500 eV
  - Hard X-ray beamline – **Poznan University** – app. in writing
    - Source: SC 3-3.5T Wiggler
    - Energy range: x -15keV

Solaris Activities

- Follow machine design by MAX-IV team and provide support
- Handle differences – injection, ramping, ID's, Buildings, …
- Procurement – Main tenders & local supply
- Building team – training for installation and operations
- Track civil engineering
- Prepare laboratories and technical areas
- Prepare for component delivery (participate in FAT, oversee SAT)
- Installation and Assembly
- Commissioning and start of User Operation
- Prepare for full energy & future beamlines

Solaris Schedule

- Linked to MAX IV

- Purchasing for Solaris occurs as "Single Source Supply" ~ 3 months after MAX IV signed their contracts

- Start construction of building January 2012
- Building completed Autumn 2013
- Installation of Linac end 2013 – start 2014
- Installation of Ring early summer 2014

- Critical Areas – being addressed
  - Magnets
  - Vacuum System

Differences between MAX IV and Solaris 1.5 GeV

- Building and Services – Buildings, shielding, general services, access areas, transportation on the site and logistics are different.
- Linac – Solaris will us a reduced number of accelerating sections and injection will not be at full energy, differences exist to the distribution of power to electron gun and first sections.
- Transfer line – layout and support systems (beam heights and transfer line lengths) will be different although the same magnets will be used as for MAX IV. Injection to MAX IV 1.5 GeV will use a pulsed kicker to the first vertical deflection magnet, this option will not be used for Solaris.
- The layout of the storage ring will be identical to MAX IV but its placement within the tunnel and its connection to services (power, water, compressed air,..) will be unique to the Solaris site.
- Injection energy – the beam will be injected at ~550 MeV and will be energy ramped in the storage ring. Power supplies for magnets will have to be ramped and the control system adjusted for this. Tune and optics feedback may have to be implemented. Studies of ramping procedures, instabilities, ion trapping, cavity tuning will need to be performed and appropriate beam dynamics programs implemented.

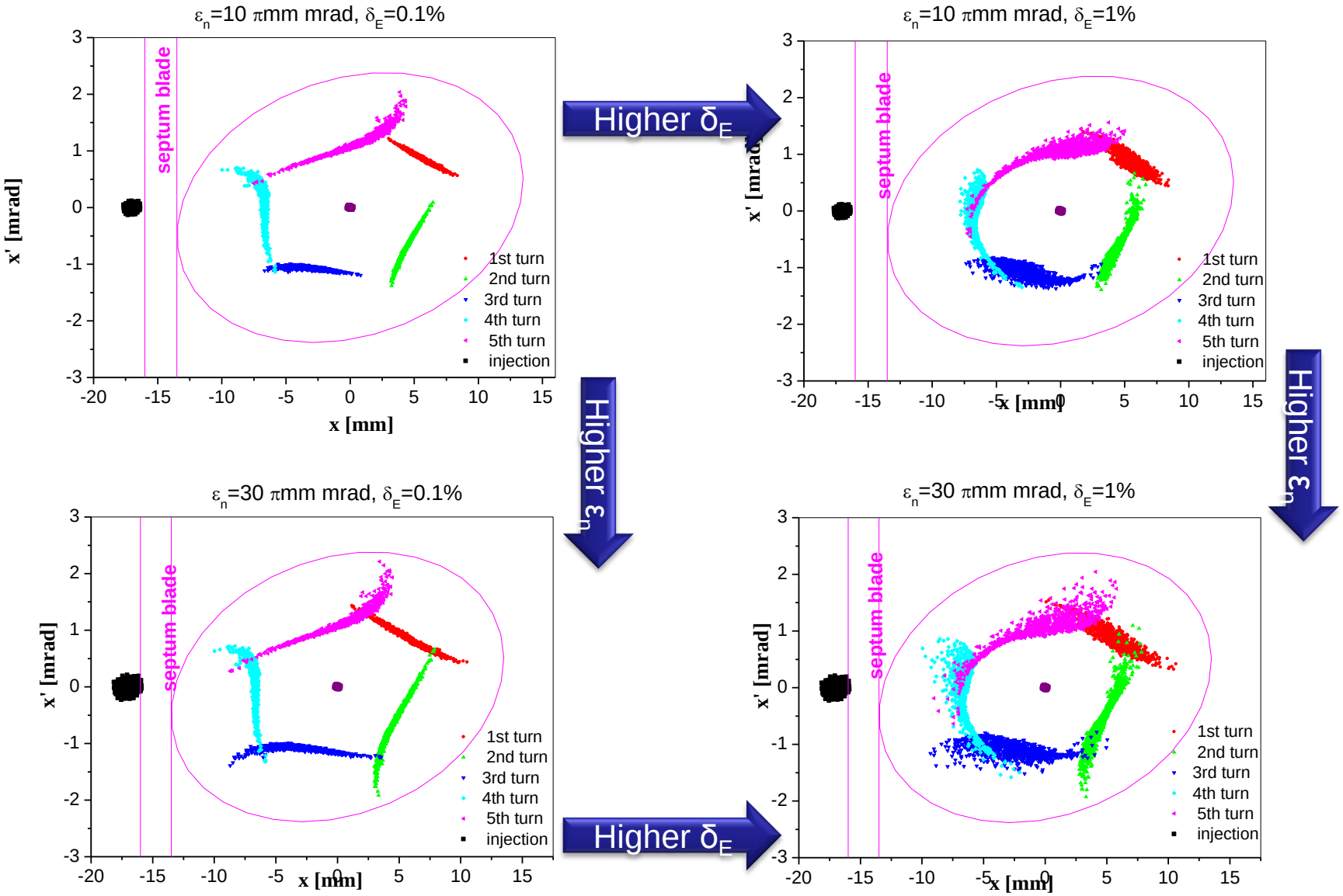
Differences between MAX IV and Solaris 1.5 GeV

- Front ends – differences may arise between Solaris and MAX IV, in terms of components and distances between machine and the inner side of the shielding wall, the thickness (and type of concrete) and continuation into the experimental hall.
- Installation – Machine installation and logistics will be unique to Solaris, which has a removable roof to the ring tunnel and linac access area, cranes will be used for component placement. Component preparation areas are unique.
- Control Access – The system will be unique for Solaris and its shielding architecture and access.
- Control system – Although the control systems for both Solaris and MAX IV are identical and based on the TANGO operating system, differences will arise from operations (energy ramping for Solaris, Short Pulse Facility operation for MAX IV linac) and physical layout including beamlines. Supplementary code and electronics will need to be covered.
- Beam line – the bending magnet beamline will be unique to Solaris and will require its own components, control system and electronics.

Differences between MAX IV and Solaris 1.5 GeV

- Future insertion devices – SCW (placement, installation, beam dynamics)
- Alignment – Although machine components are identical the network will not be, nor will the transfer line. Dedicated alignment procedures will be required for Solaris.
- Layout and drawings – creation and maintenance of the drawings database for Solaris systems, plants and infrastructures.
- Support laboratories – Layout, services, equipment, logistics

One-turn Injection



A very BIG Thank You
to the MAX-IV Team and Lund University

for sharing their design
and
the constant unhesitating help

As it looks now
Looking forward to the change at ESLS 2012