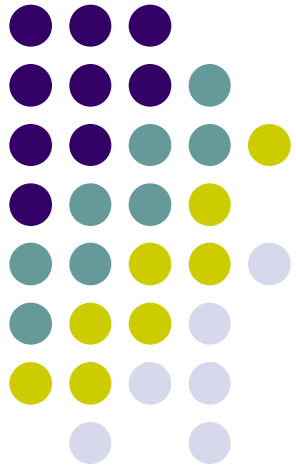
Workpackage 5 Radiation Protection

Progress Report

Thomas Otto,

on behalf of partners

CERN, CTU Prague, GSI, PSI, U Sheffield,



WP5 aims

- Contribute to validation of simulation tools
- Identify potential “bottlenecks” motivated by radiation protection on the path to 10-fold luminosity
  - Milestone Month 12
- Perform an analysis of the bottlenecks and propose remedies
- Make a waste- and environmental impact study

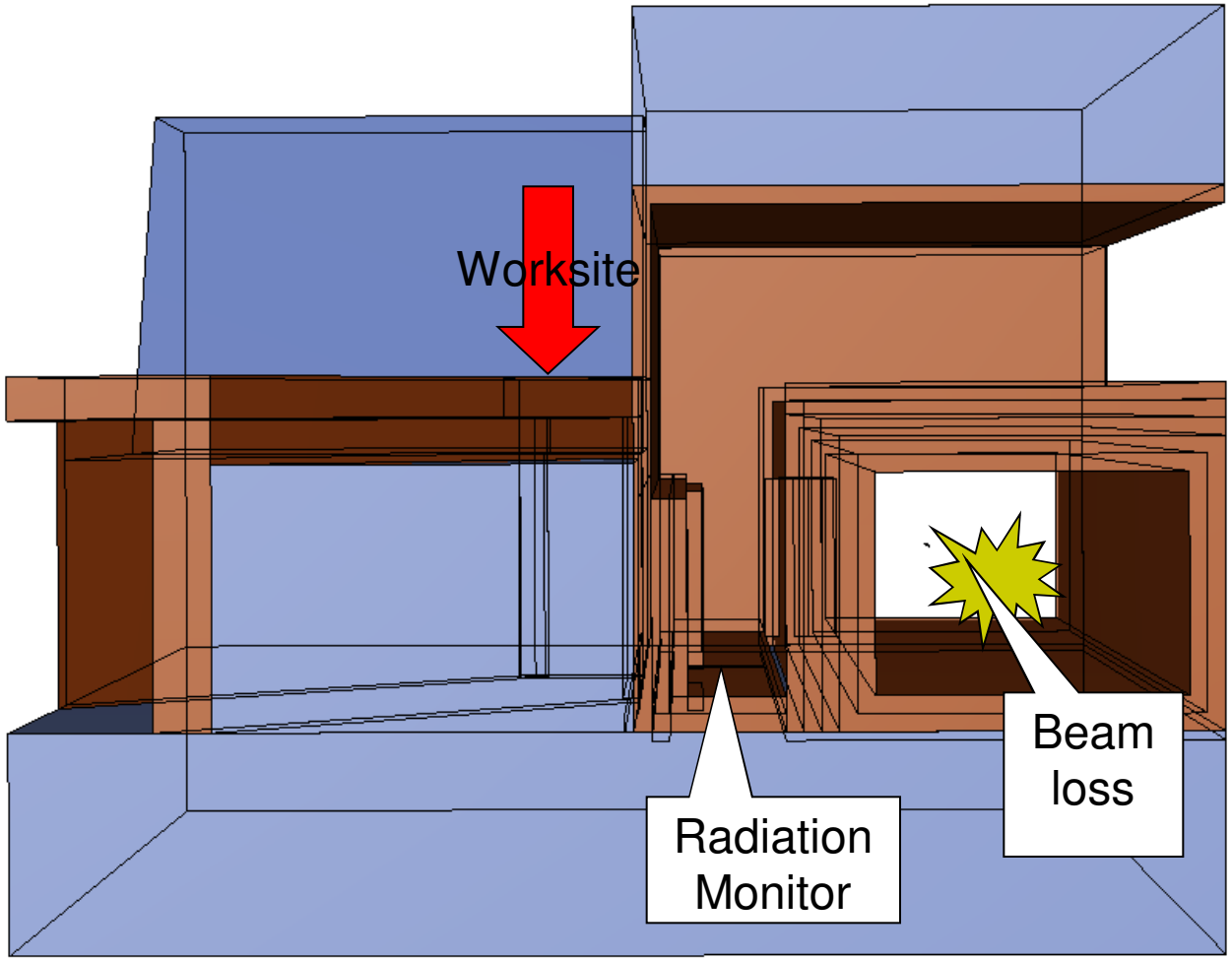
WP5 - Deliverables Year 2

5.1.1	Validation of simulation tools with measurements at LHC	Report, March 2010
5.1.2.	Estimation of radiation levels for critical areas of the experiments at sLHC	Report, March 2010
5.2.1.	Estimation of radiation levels for critical areas of sLHC and its injectors	Report, March 2010

LINAC 4

- New H^--injector, providing approximately 2 times more intense beams via PSB to PS
- The first element of a future SPL-PS2-superSPS injector chain
- Low loss design, building thoroughly optimised
- Interference with existing LINAC 2 during construction

LINAC 4 - LINAC 2 Interface



LINAC 4 is built in vicinity of operating LINAC 2

Radiation protection of members of the public (Construction workers)

Unusually (for CERN) “low” energy radiation (50 MeV p)

Complex geometry: tunnel, gallery, …

If radiation transport simulation is justified, then here!

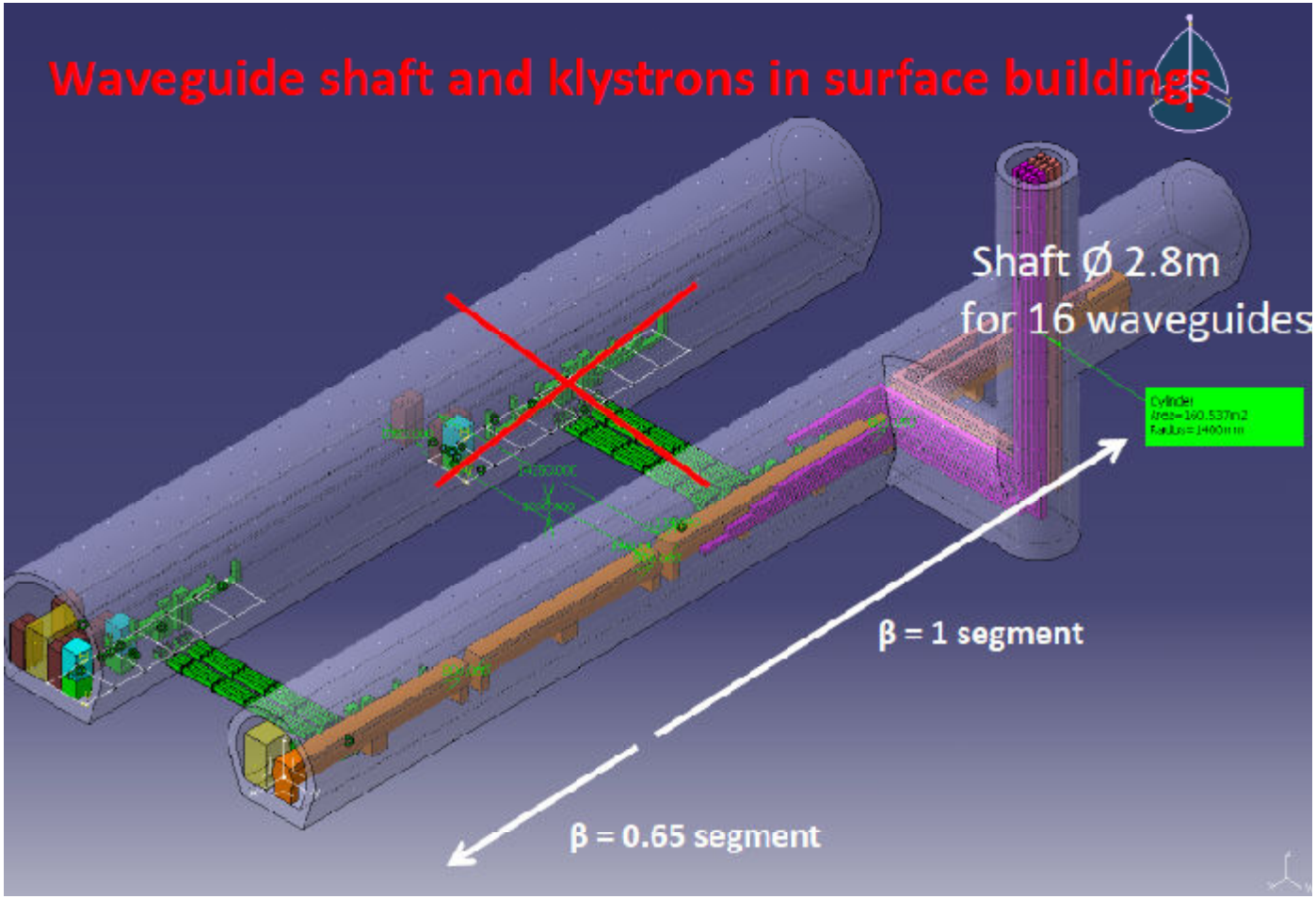
H. Richter, CERN

SPL and PS2

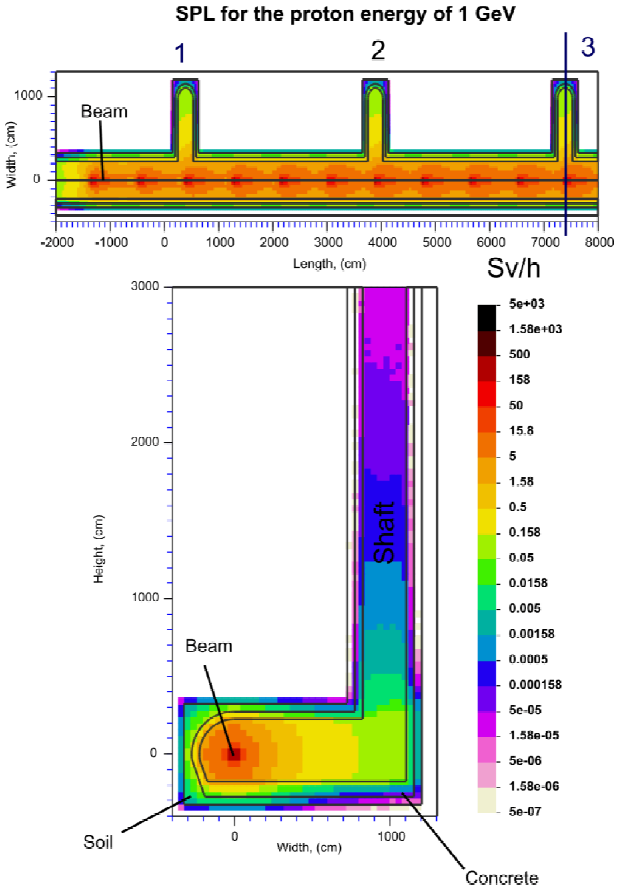
- SPL: low-loss, superconducting H^- LINAC
- PS2: 50 GeV proton synchrotron

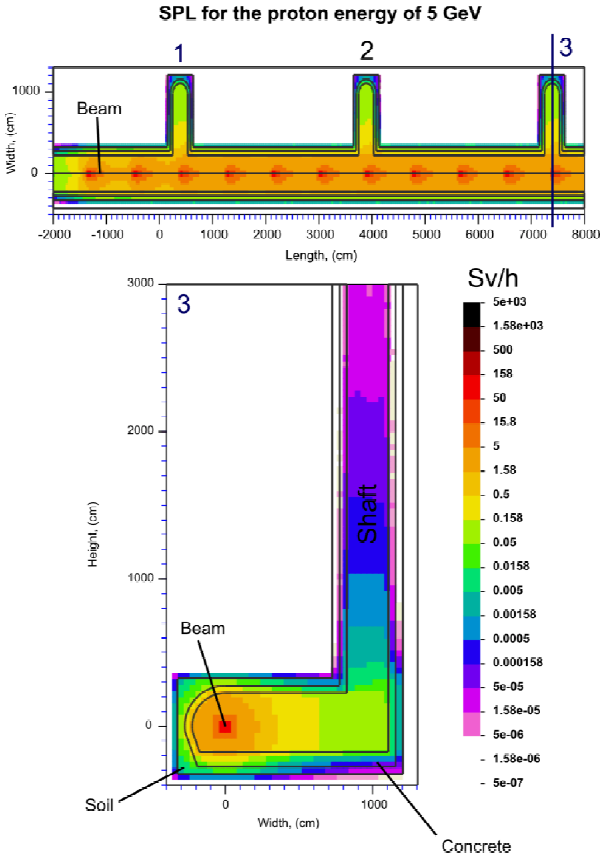
- Neutron streaming through RF ducts
- Various beam dumps for
  - Set-up and commissioning
  - Absorption of neutral particles after charge-exchange injection SPL-PS2

Neutron streaming through RF ducts



Dose rate on top of shaft



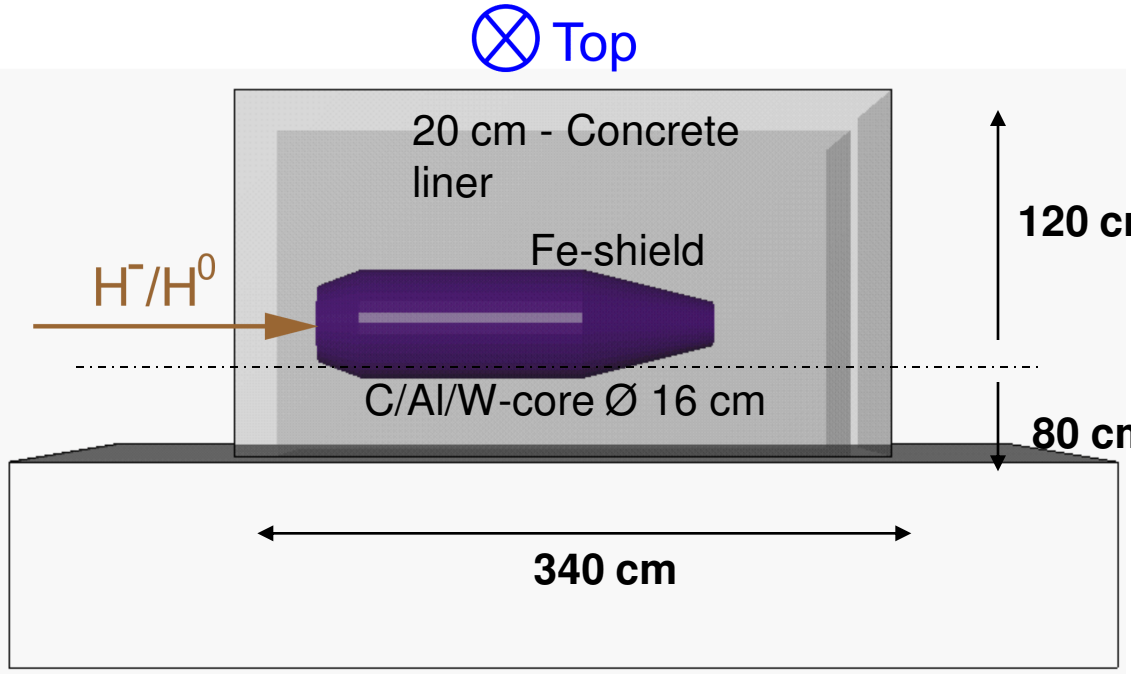


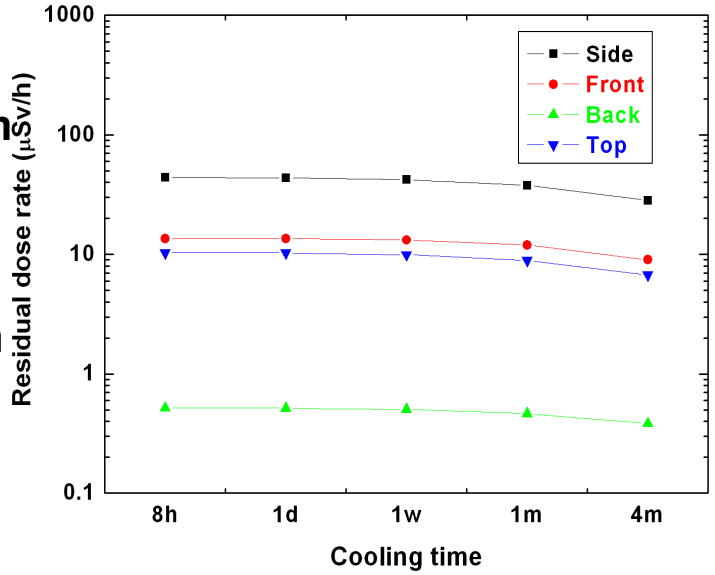
- H*(10) < 50 μSv/h for 1 W/m loss power

E. Kozlova, GSI

Generic SPL/PS2 Beamdumps

2 kW, 4 GeV beam for 10 years (8 months on, 4 months off)





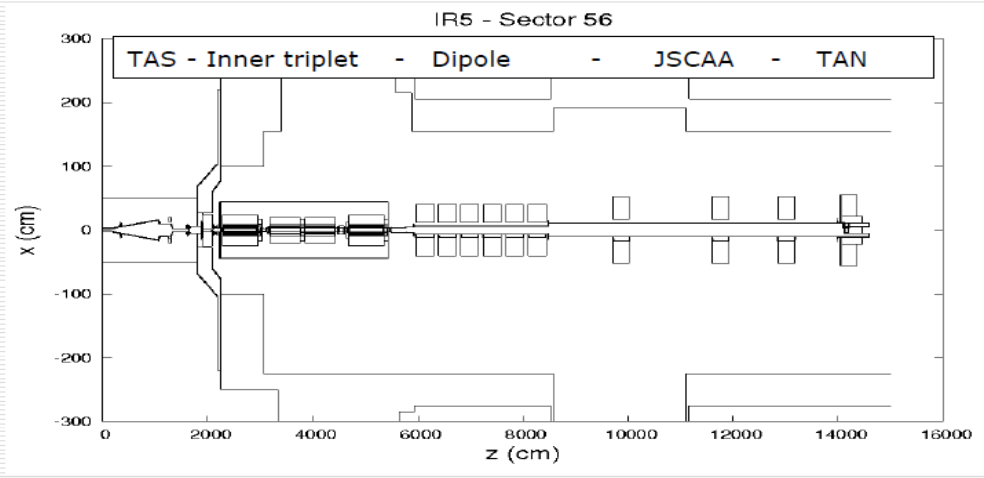
Dose rates in vicinity of dump acceptable.
Next step: study ground activation around dump cavern.
Independent of radiation protection: optimize dump core

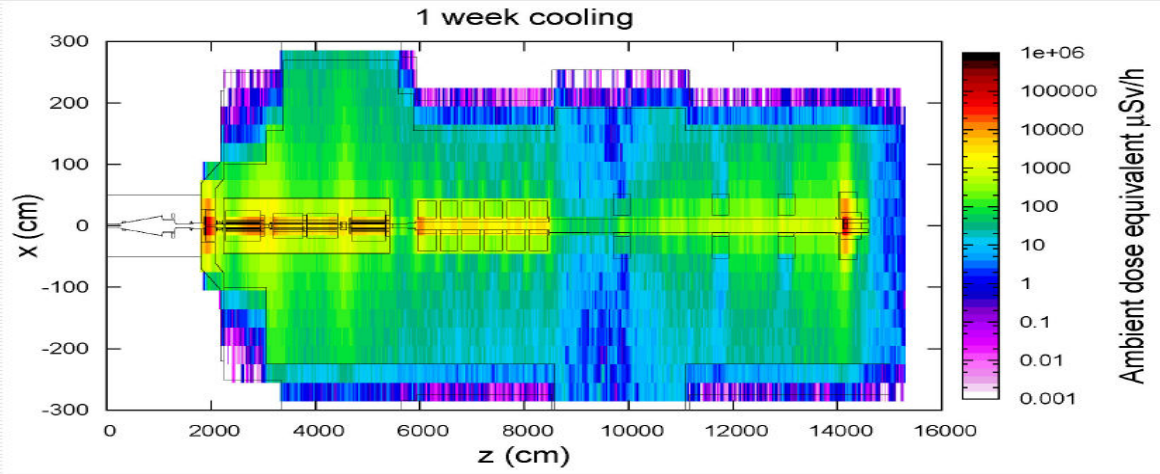
E. Kozlova, GSI

sLHC: inner triplets

- Last Focusing element before interaction region
- Upgrade necessary for higher luminosity or because of radiation damage after 400 fb^{-1}
- Before upgrade, remove the present triplets

Inner Triplet IR 5 (CMS)





Ambient dose rate map around old triplet

After one week, dose rate in excess of 100 µSv/h at 1.5 m distance

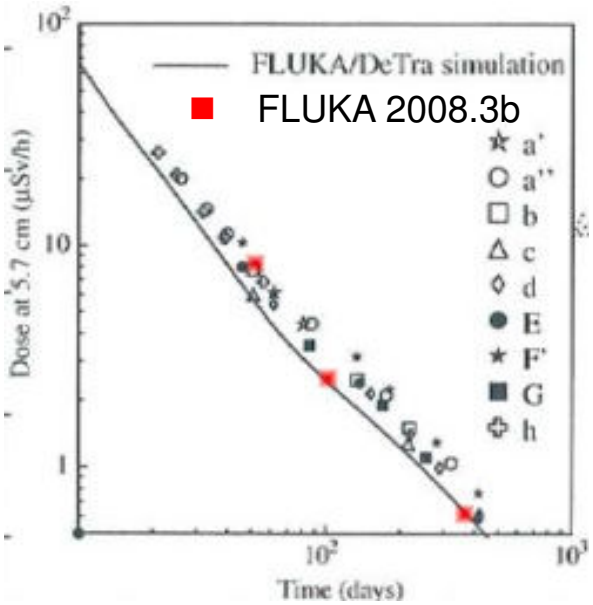
Severe constraint for manual labour in the triplet region

Similar environment expected for upgrade Phase I -> Phase II

M. Fürstner, S. Roesler, CERN

CMS: Crystal Calorimeter Activation

- Monte Carlo Simulations of Hadron effects in $PbWO_4$ and CeF_3 in collaboration with ETH Zurich

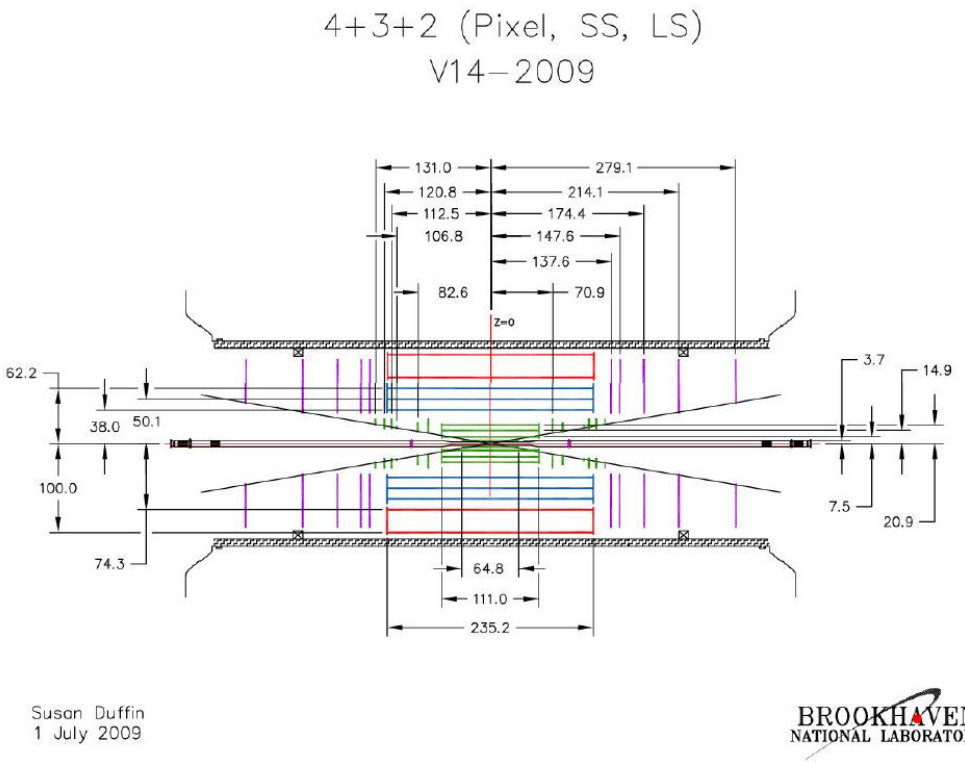


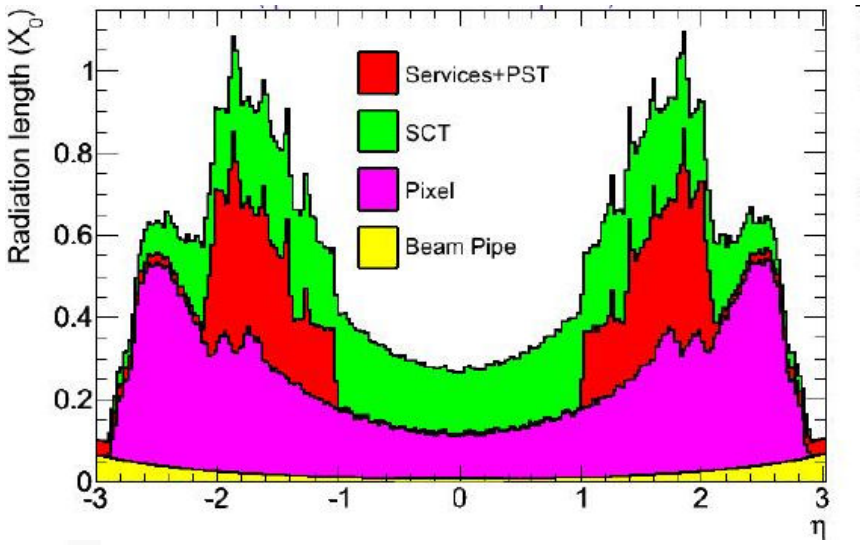
- Satisfying agreement – MC code reliable

C. Urscheler, CERN & F. Nessi, ETH

S-Atlas- Inner Detector

- Includes new neutron moderator and the Upgrade strawman layout v14 2009 (4+3+2 Pixel, SS, LS) active regions:

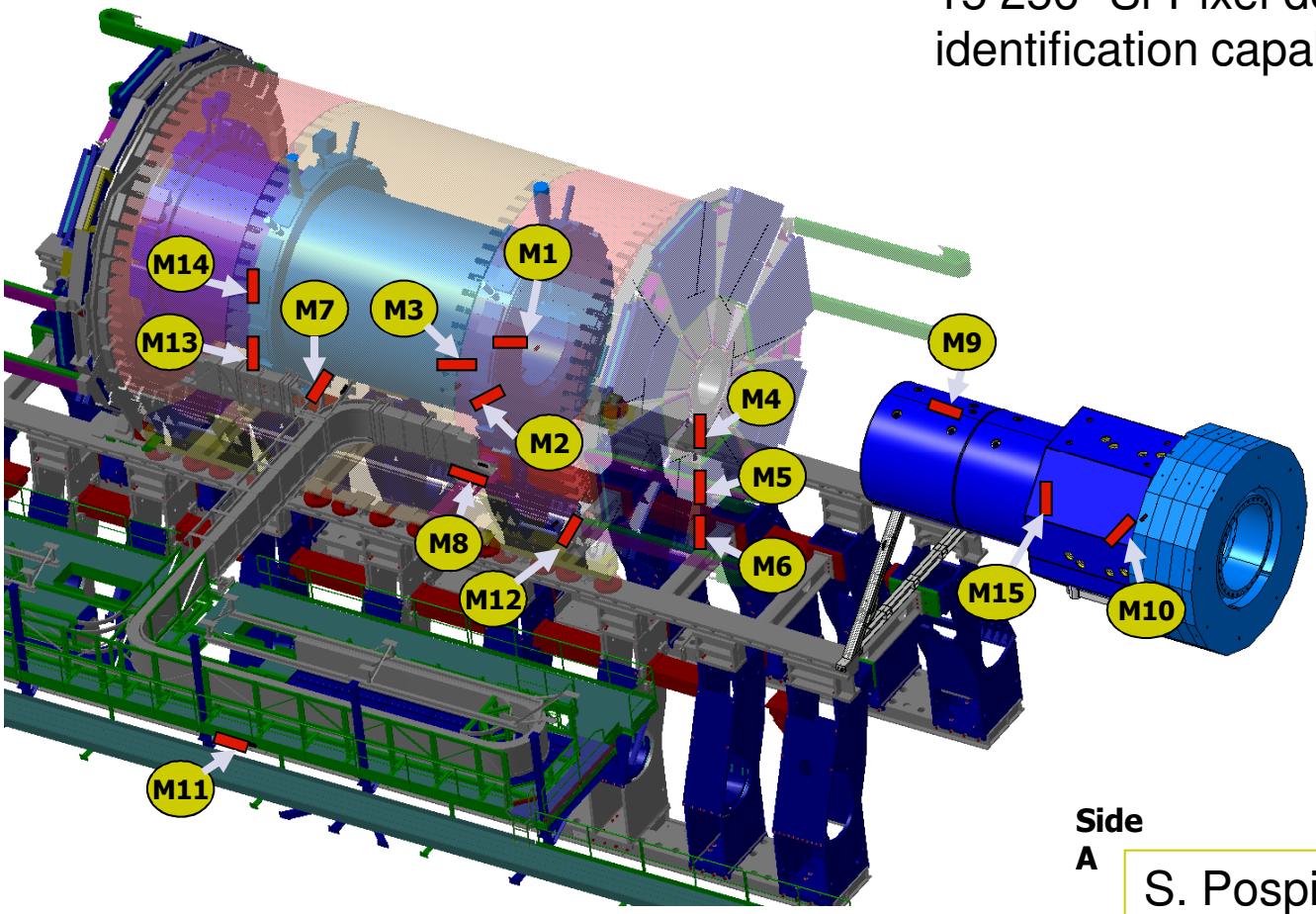




Influence of different detector parts on radiation length (as function of eta)

L. Nicolas, I. Dawson, Univ. Sheffield

ATLAS-MPX



15 256^2 Si-Pixel detectors with particle identification capability

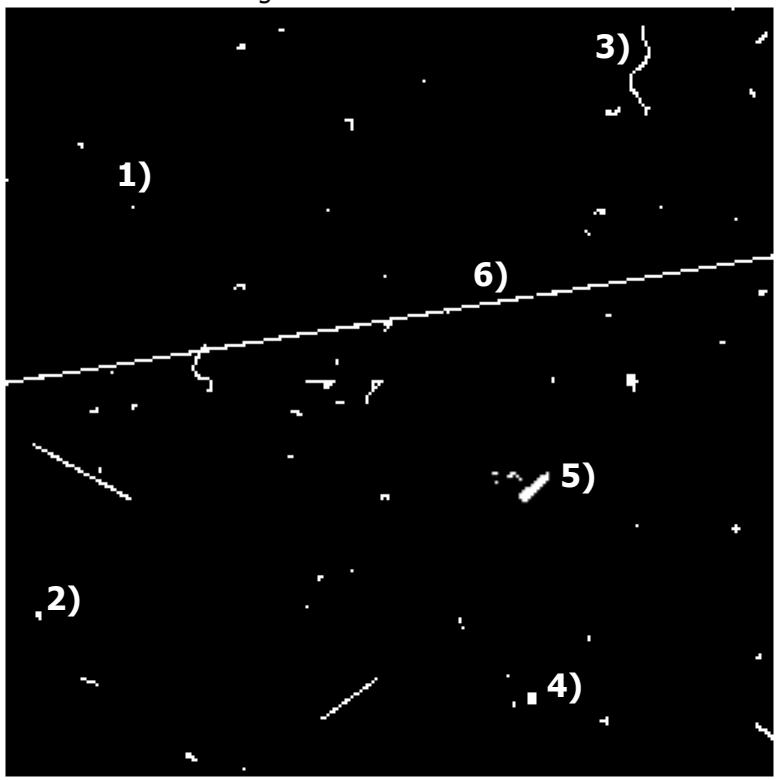
MPX01	between ID and JM plug
MPX02	between ID, LARG and JM
MPX03	between LARG and LARG EC
MPX04	between FCAL and JT
MPX05	between LARG and JT wheel
MPX06	between LARG and JT wheel
MPX07	top of TILECAL barrel
MPX08	top of TILECAL EXT. barrel
MPX09	corner between JF cyl. and hexagon
MPX10	cavern wall A or C side
MPX11	cavern wall USA side
MPX12	small wheel
MPX13	between ID and JM plug
MPX14	between ID, LARG and JM
MPX15	at the back of Lucid detector

Side A

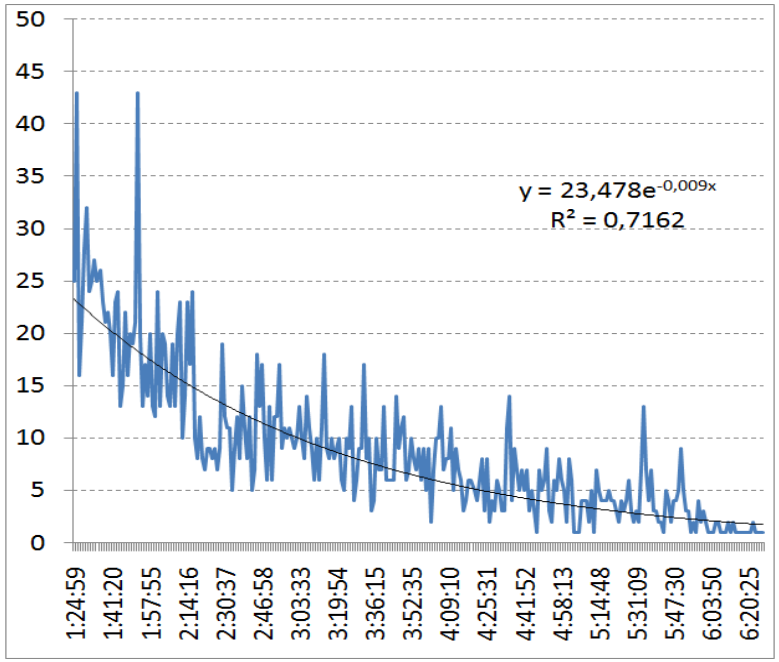
S. Pospisil, Z. Vykdal, M. Suk and ATLAS-MPX collaboration

MPX Performance

Background in ATLAS – 100min

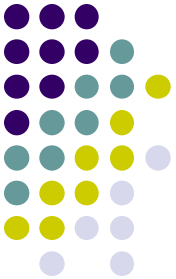


1) Gamma, X-rays 2) Gamma, X-rays, low energy electrons 3) electrons (MeV range)
4) alpha particles and ions 5) protons 6)MIP, μ



During coasting beam, signal rate follows beam intensity

Status of deliverables



5.2.1 Radiation levels for critical areas of sLHC and its injectors

- Linac 2 – Linac 4 interface (H. Richter)
- SPL RF-ducts (E. Kozlova)
- SPL/PS2 generic beam dump (E. Kozlova, ThO)
- Ambient dose rates at inner triplets (S. Roesler, M. Fuerstner)
- Phase 2 collimators by scaling from Phase 1 (S. Roesler)

5.2.2 Radiation levels for critical areas of the experiments at sLHC

- Interpreted as radiation levels during the upgrade work
- Compile the existing estimations from ATLAS (V. Hedberg et al.) and CMS (M. Huhtinen et al. and C. Theis et al.) for a comprehensive picture of radiation levels at the time of upgrade to new inner detectors

Strategy for Deliverable 5.1.1.

Validation of simulation tools with measurements at LHC

This deliverable is understandably late – not enough integrated luminosity to get useful data for validation

Submit a preliminary report, consisting of:

- Listing of types and locations of passive detectors (M. Fuerstner)
- Augmented by listings of types and locations of active radiation monitors in ATLAS (Z. Zajacova and G. Mornacchi) and in CMS (St. Mueller)
- Activation of CMS $PbWO_4$ and CeF_3 Crystals (C. Urscheler)
- ATLAS-MPX first results vs. background simulation studies (S. Pospisil, L. Nicolas et al.)

Report to be completed with data from 2010-run by end-of-project

Conclusion and Outlook

- Enough material for deliverables of M24 by re-interpreting the scope of the study
  - more useful to study and compile radiation levels in the existing detectors than in an approximated set-up which may never be built
- Do not underestimate the editorial work, help by all partners needed

- The deliverables for the end of the project are
  - Waste Study (activation of material)
  - Environmental impact study (mainly activated air releases)