



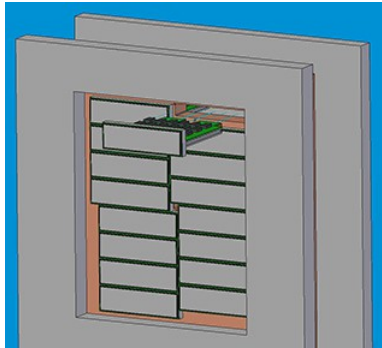
Status of the Detector Development Program WP-75

Markus Kuster, Jolanta Sztuk-Dambietz,
Patrick Gessler, Andreas Koch,
Monica Turcato

May, 14 2012

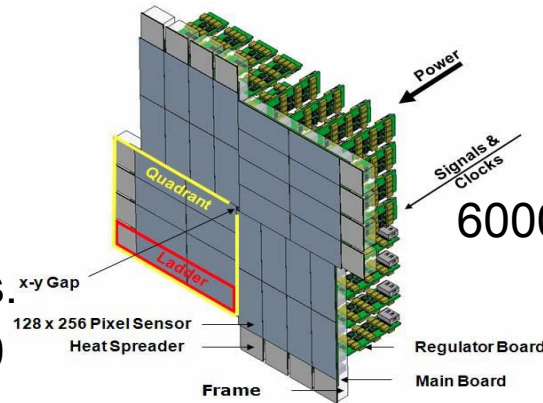
11th Meeting of the European XFEL Detector Advisory Committee
European XFEL GmbH, Hamburg

AGIPD Adaptive Gain Integrating Pixel Detector (AGIPD)



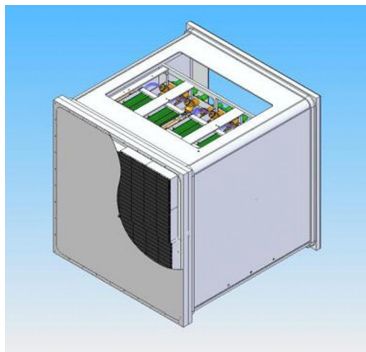
Energy range
3 - 13 keV
Dynamic range
 10^4 @12 keV
Single Photon Sens.
Storage Cells $\approx$ 300

DEPFET Sensor with Signal Compression (DSSC)



Energy range
0.5 - 6 keV (25 keV)
Dynamic range
6000 ph/pix/pulse@1 keV
Single Photon Sens.
Storage Cells $\approx$ 640

Large Pixel Detector (LPD)



Energy range
5 (1) - 20 keV (25 keV)
Dynamic range
 10^5 @12 keV
Single Photon Sens.
Storage Cells $\approx$ 512

Other Detectors

- APDs, SDDs, strip detectors for high repetition rate applications (e.g. veto, dispersive spectrometers)
- Small area, low rep. rate, low energy 2D imaging detectors



2D Imaging Detectors

Baseline

1 Mpix 2x DSSC, 2x AGIPD,
and 1x LPD

Potential non-baseline contribu- tion:

SFX user consortia 4Mpix AGIPD

Particle Detectors

- No specific request from leading scientists up to now.

1D/2D Small Area Detectors

Low rep. Rate/Low E Detectors

- CCDs for day one low speed/E
- Strip detectors for spectroscopy
- SDDs and APDs for calibration, veto etc.

High Energy Detectors for $E > 20 \text{ keV}$

- Requirement definition

General Infrastructure

- Test and calibration environment
- Laboratories + equipment



■ Detector Scientists

■ Jolanta Sztuk-Dambietz – since 4. October 2011

- Interfacing to AGIPD
- Detector calibration working group



■ Monica Turcato – since 1. March 2012

- Interfacing to DSSC
- Radiation damage studies with Uni HH/DESY
- Small area 2D detectors and strip detectors



■ Software Engineer/Physicist

■ Steffen Hauf – starting 1. September 2012

- Calibration, analysis and image processing software
- Calibration data base
- Detector performance and response simulation

WP-75 Group Structure

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Detectors

Scientist
A. Koch

Scientist
M. Turcato

Scientist
J. Sztuk-
Dambietz

Students

M. Eich

NN

Software/ Analysis

Scientist
S. Hauf

Technician
NN

PhD Student
NN

User Support

To be defined
3x NN

Mechanics

Engineer
NN

Technician
NN

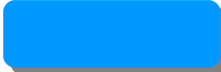
Electronics

Group Leader
P. Gessler

Engineer
NN

Technician
NN

WP-76
Staff

 Under recruitment
 To be hired/defined

- Implementation phase
 - Negotiations on extension of contracts with LPD and DSSC are ongoing
 - Definition of deliverables and milestones
- Radiation damage
 - Negotiations with Uni Hamburg and HASYLAB
 - Activities continued with Uni Hamburg E. Garutti/R. Klanner
 - ➔ Device simulation and optimization
 - ➔ Radiation damage tests
 - Contribution from XFEL 0.2 FTE (M. Turcato)



Maintain expertise in Hamburg area!

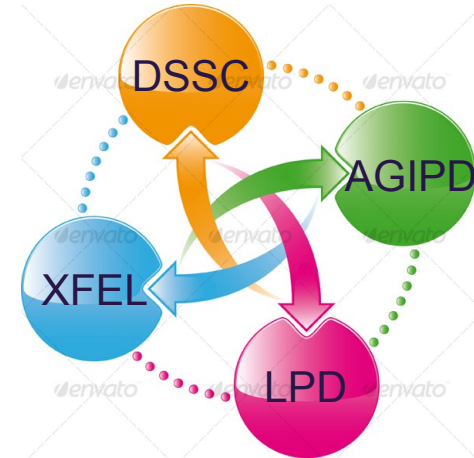


- Definition of calibration infrastructure requirements
 - ➔ requirement document Q3/2012
- Operation phase and life cycle management of imaging detectors
 - Spare parts for imaging detectors
 - ➔ Requirements for sensors tiles, cooling etc
 - ➔ Negotiation with consortia: delivery, time scale ...
 - Definition of the transition from start-up to operation phase
- Analysis software, performance simulation etc.
 - Start activities at XFEL Q3/2012
 - ➔ Definition of software requirements, implementation
- Calibration working group
 - 2nd meeting on March, 7th 2012
 - ➔ Detailed summary will be presented by J. Sztuk-Dambietz



- Detectors for spectroscopy, veto and low repetition rate applications
 - APDs, SDD, CCDs, strip detectors ...
 - Evaluating different options for day one
 - Defining requirements beyond day one

- Interface to LPD – Andreas Koch
 - Monthly integration meetings + weekly teleconferences
 - ➔ Consortia members + leading scientists + WP-75/76
- Interface to DSSC – Monica Turcato
 - Integration meetings on request
 - ➔ Consortia members + leading scientists + WP-75/76
- Interface to AGIPD – Jolanta Sztuk-Dambietz
 - Monthly integration meetings
 - ➔ Consortia members + leading scientists + WP-75/76
 - XFEL participation in regular AGIPD meetings



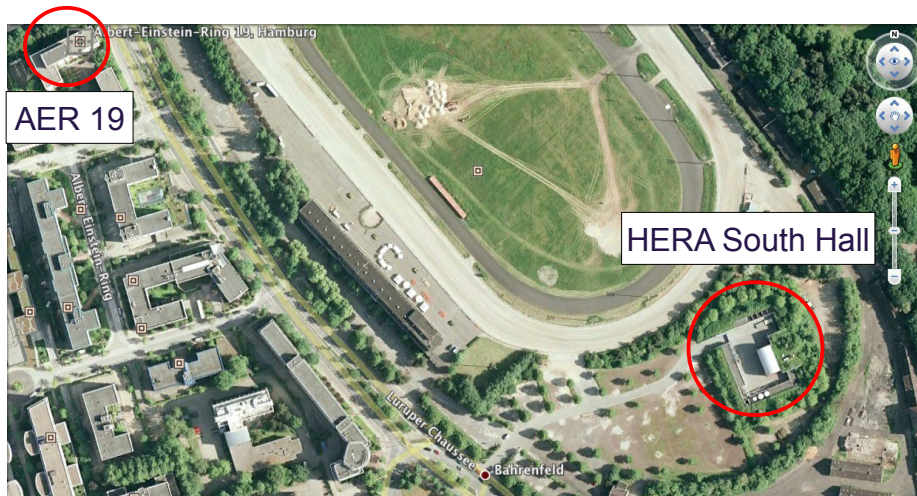
Topics

- Detector mechanics
 - Flexible hole
- Cooling
- Experiment integration
- Software integration
- ...

Detector Laboratory (Start Up/Operation Phase)



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HERA South Hall

- Start up solution for detector, beam line optics, diagnostics etc.
- Clean tents for integration and test environments for prototype 2D detectors
- Development of calibration infrastructure
- Interim IT infrastructure, elect. lab



XFEL Headquarters (XHQ)

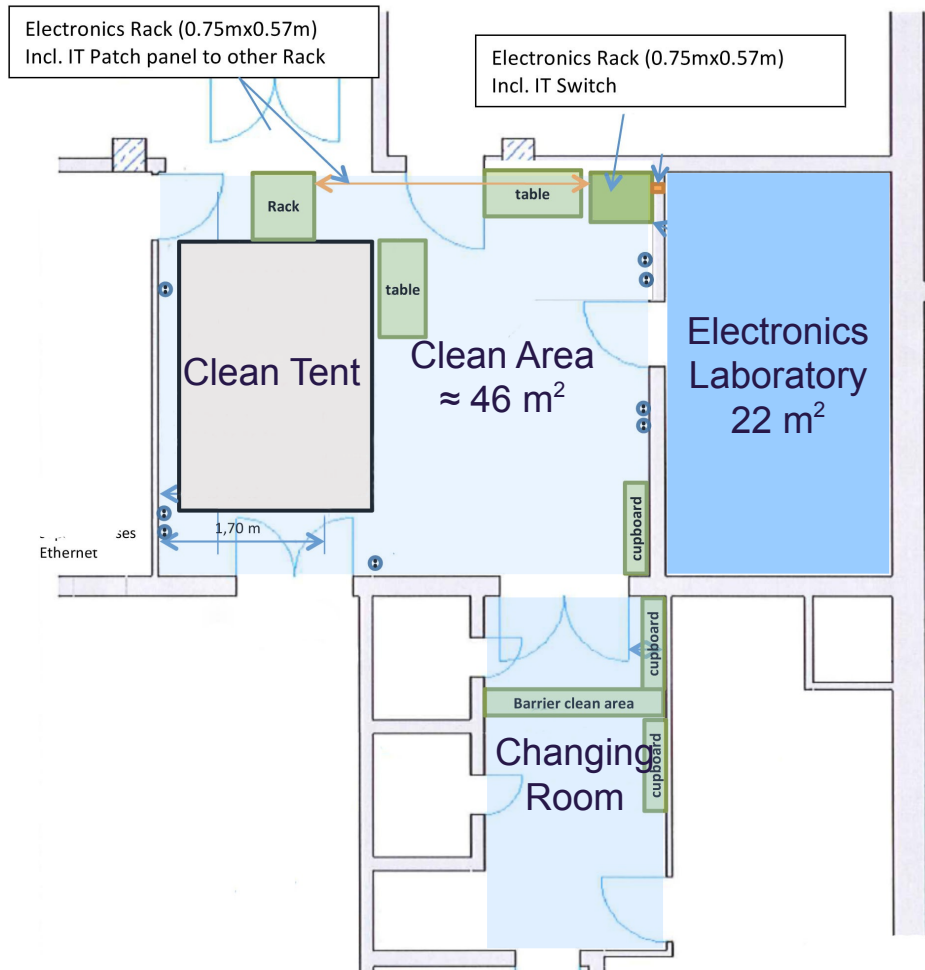
- Clean room for test, qualification, calibration + detector laboratories
- Detector electronics test laboratory
- Storage for detector, vacuum, electronics etc. components
- IT infrastructure

Detector Laboratory – Start Up (May 2012)

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Clean + Electronics Laboratory

HERA South 6th Floor



- Definition of laboratory requirements ✓
- Electronics laboratory ✓
- Detector test laboratory ✓
 - Electricity, gases ... ✓
 - Clean tent ✓
 - Measurement equipment ✓
 - Laboratory equipment
 - Furniture
- Safety and risk assessment
- Calibration sources
- Installation of detector test setup

Detector Laboratory – Start Up (May 2012)



HERA South 6th Floor

- Definition of laboratory requirements ✓
- Electronics laboratory ✓
- Detector test laboratory ✓
 - Electricity, gases ... ✓
 - Clean tent ✓
 - Measurement equipment ✓
 - Laboratory equipment
 - Furniture
- Safety and risk assessment
- Calibration sources
- Installation of detector test setup



Detector Laboratories

- Clean room 225 m²
 - Detectors WP-75, diagnostics WP-74, beam line optics WP-73
- Detector test laboratories 100 m²
 - Prototype system tests, R&D
- Storage space 50 m²
 - Spares, loan pool ...

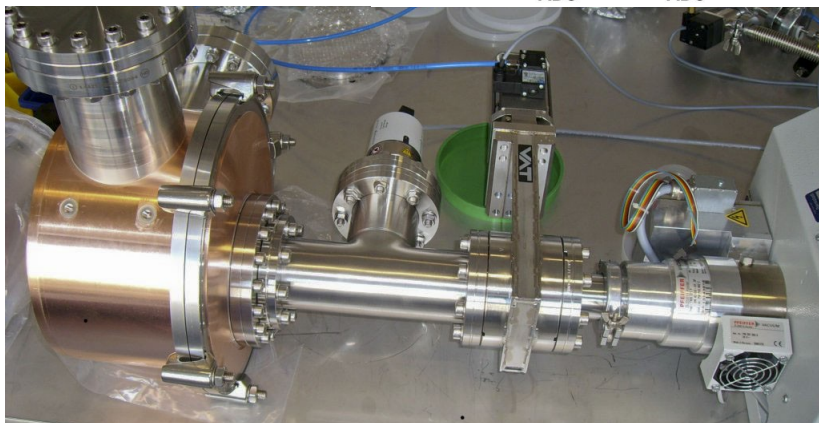
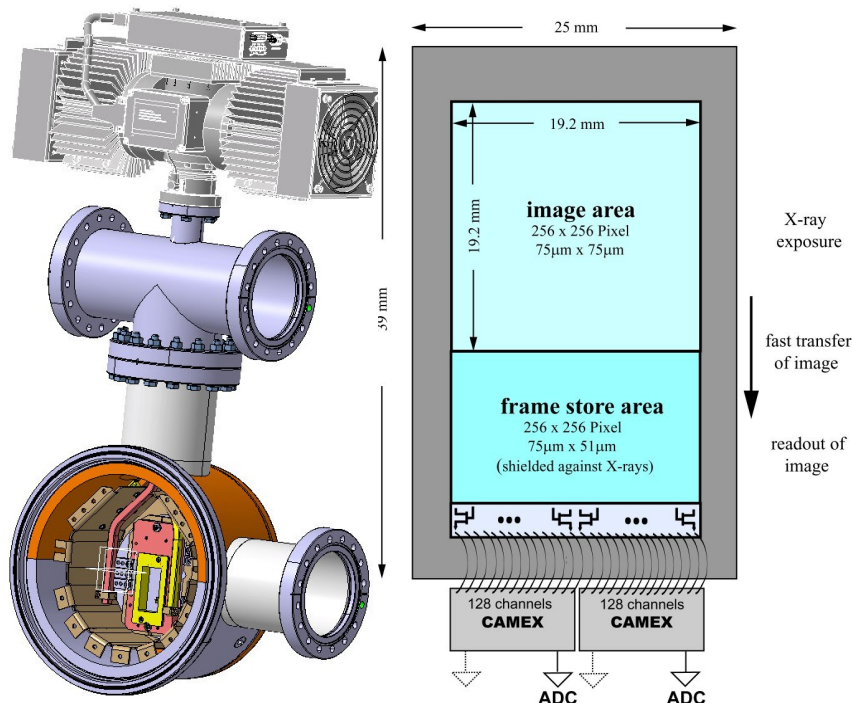
Clean Room Laboratory

- Laboratory specifications and requirements ✓
- First floor plan ✓
- Detailed laboratory planning Q3 2012
 - Planning of functional areas
 - Furniture
 - Equipment
 - Safety aspects/risks assessment
 - EMI aspects
- Entrust external planning office
- Installation 2014/15
- Ready for usage > 2015

Small Area 2D Detectors – pnCCD Test System



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- Test bed and reference test system
 - Laboratory infrastructure ✓
 - Detector support ✓
 - PLC control system for vacuum/DAQ system
 - Commissioning cooling/vacuum system
 - FE electronics Q3 2012
 - DAQ integration Q4 2012
 - Analysis software Q4 2012
- Prototype for small and compact 2D imaging systems

Low Rep. Rate/Low E Detector for Day One



Motivation

- Mitigate risk for 2D detectors
- Backup with reduced performance
- Day one solution for low energies/small pixels

Status

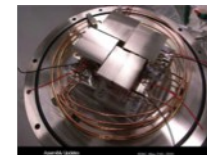
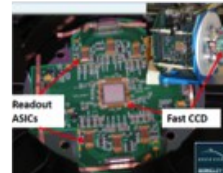
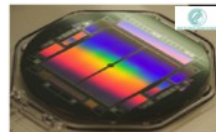
- Market scan ✓
- Identification of low risk solutions ✓
- First performance tests ✓
- Preparation of MB proposal
- MoU/contract negotiations

Labs

Cornell Uni.
BNL
LCLS CEA
SACLA DESY
ESRF
LBNL

Companies

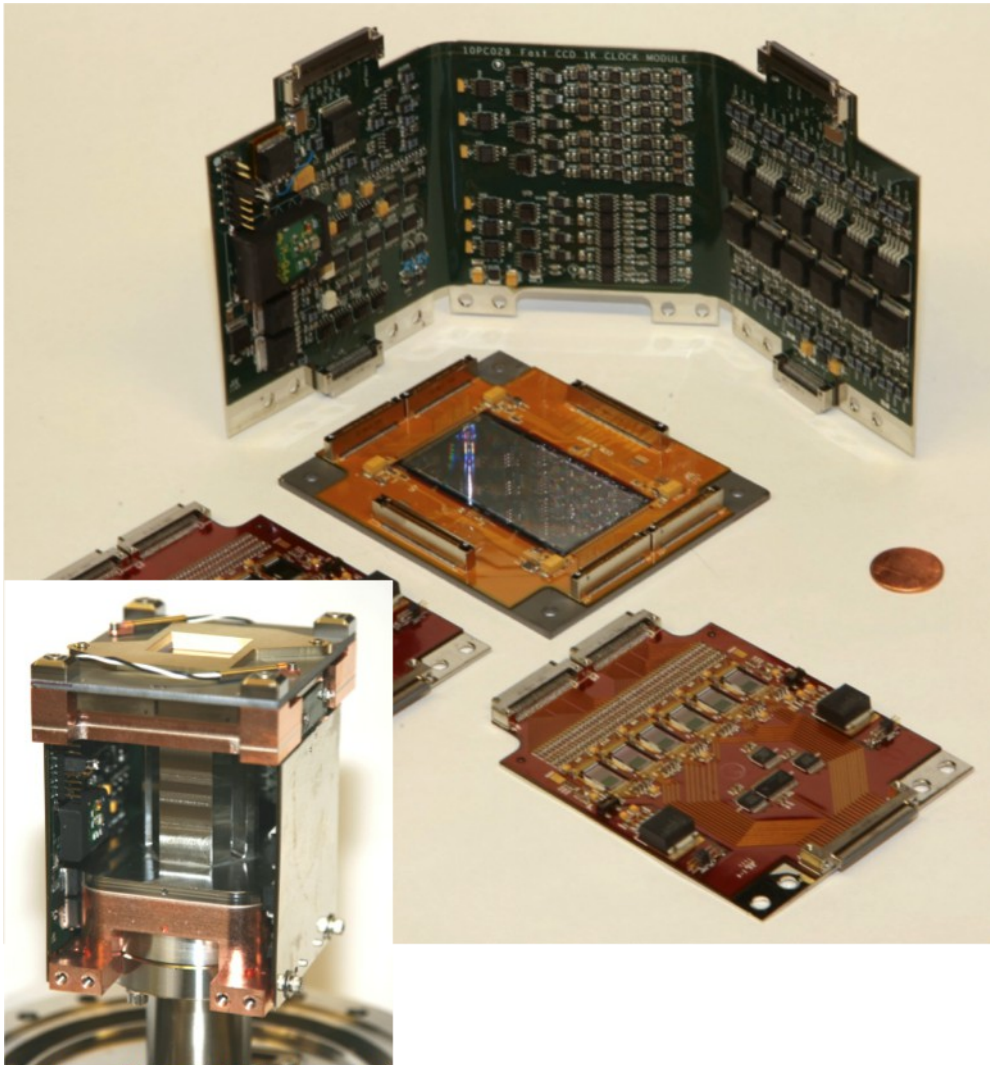
e2v Phyxalis
Hamamatsu
Bruker
Photonic Sci.
Dalsa
Dexela



Low E/Rep. Rate Detector - LBNL Fast CCD



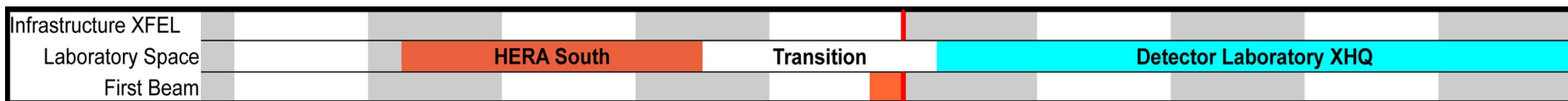
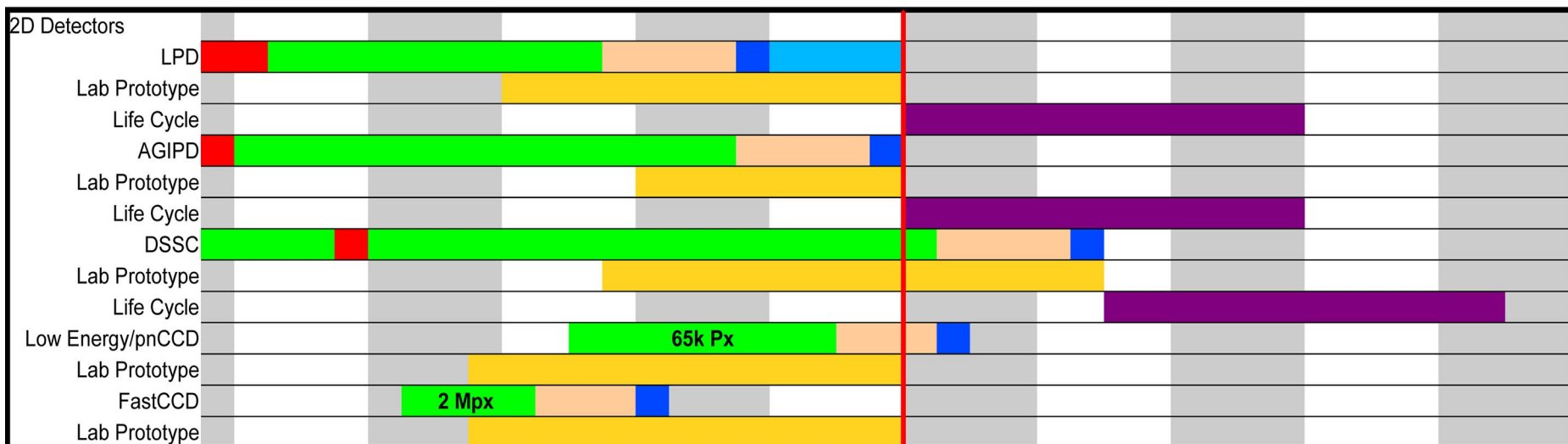
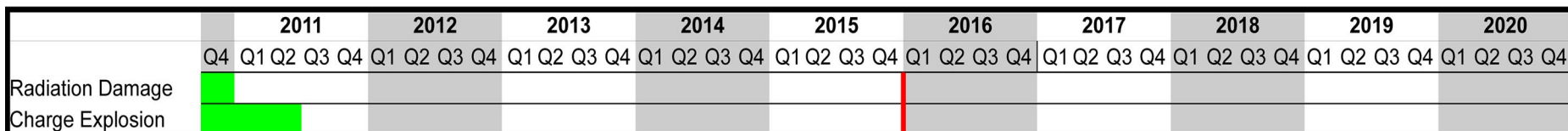
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- Fully depleted CCD
1920 x 960 pixels
- Energy range
 $0.25 < E < 6 \text{ keV}$
- Pixel size $30 \mu\text{m} \times 30 \mu\text{m}$
- Read out 100 – 200 fps
- QE
 $> 80 \% \text{ } 1 - 8 \text{ keV}$
 $> 50 \% \text{ } 250 \text{ eV}$
- Electronic noise
 $< 50 \text{ e}^- \text{ rms}$
- Well depth
 10^6 e^-
- First performance tests OK

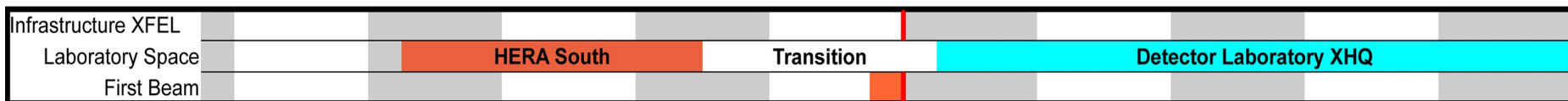
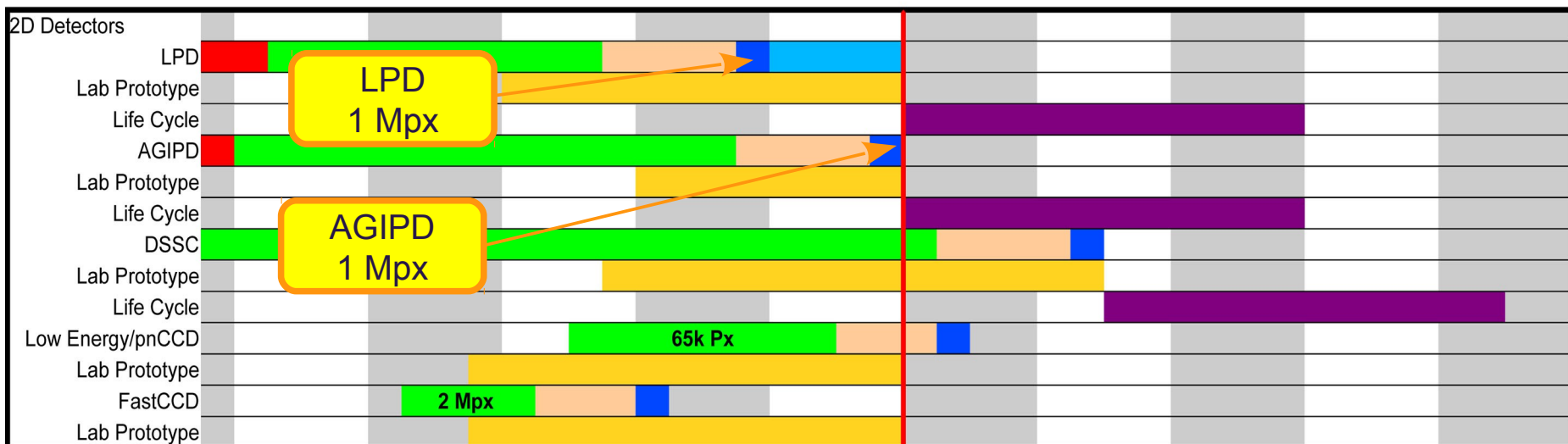
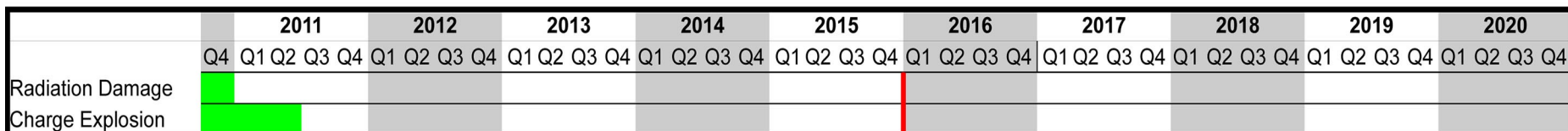
WP-75 Schedule

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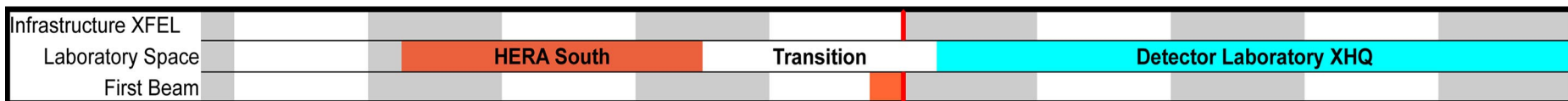
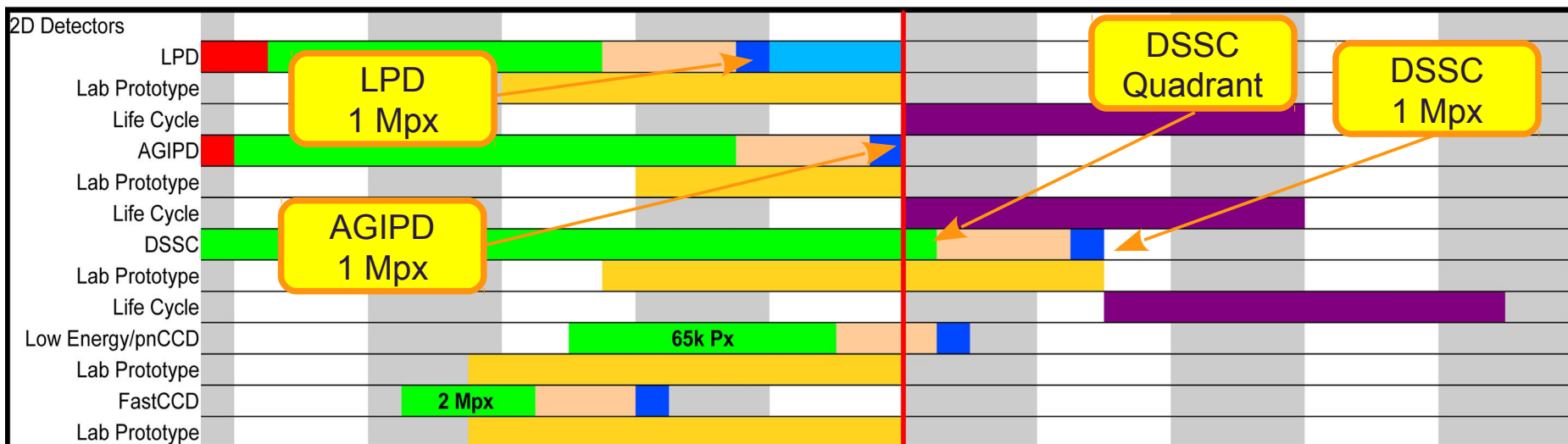
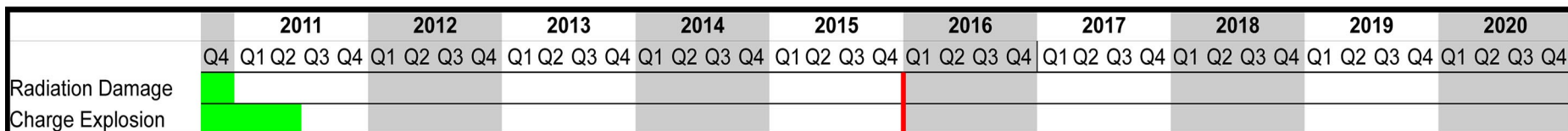
Commissioning Lab Test Detector R&D/Construction Data Taking/DAQ Int. Life Cycle

WP-75 Schedule



Commissioning Lab Test Detector R&D/Construction Data Taking/DAQ Int. Life Cycle

WP-75 Schedule



Summary and Conclusions



- Build-up of detector group is progressing well
- Communication between XFEL and consortia has been improved
- Day one options for 2D imaging detectors technologies for low energy and low repetition rate applications have been identified)
- Installation and planning of laboratory, test and R&D infrastructure for Schenefeld and HERA South is in progress
- Integration of first small area detector system started (DAQ, control, detector ...)
- Planning commissioning and integration schedule for detectors
- Second generation 2D imaging detectors
 - Study of potential solutions has been started