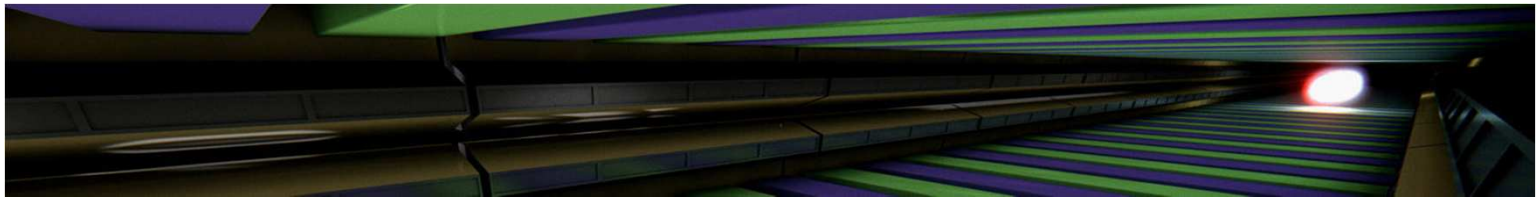

DAQ and control rack space estimate for SPB + SFX expt.

TC meeting 3.2.2012

C.Youngman with A.Mancusso, A.Aquila, N.Coppola, M.Kuster, J.Schulz…

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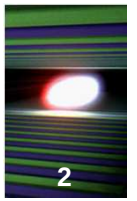
Aim and scope



- The aim is to estimate the space required for DAQ and control interface equipment . This includes
  - Chamber control: pump, gauges, valves, temp sensors…
  - Beamline control: KB lenses, CRL…
  - Detector control: HV, LV, cooling…
  - Diagnostic devices control: screens, backscatter monitors, spectrometers…
  - Detector and diagnostics DAQ: Sequencers, train builders, VETO…
  - Sample systems: injectors and fixed target
  - Network equipment

- Review cable length information

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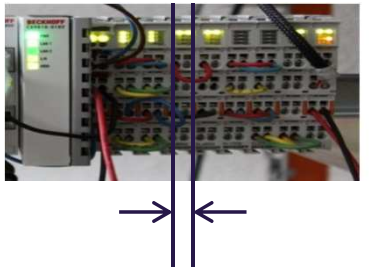
Units

- Racks – U height unit
  - Spacing of fixation cage nut = 44.45mm = 1 U

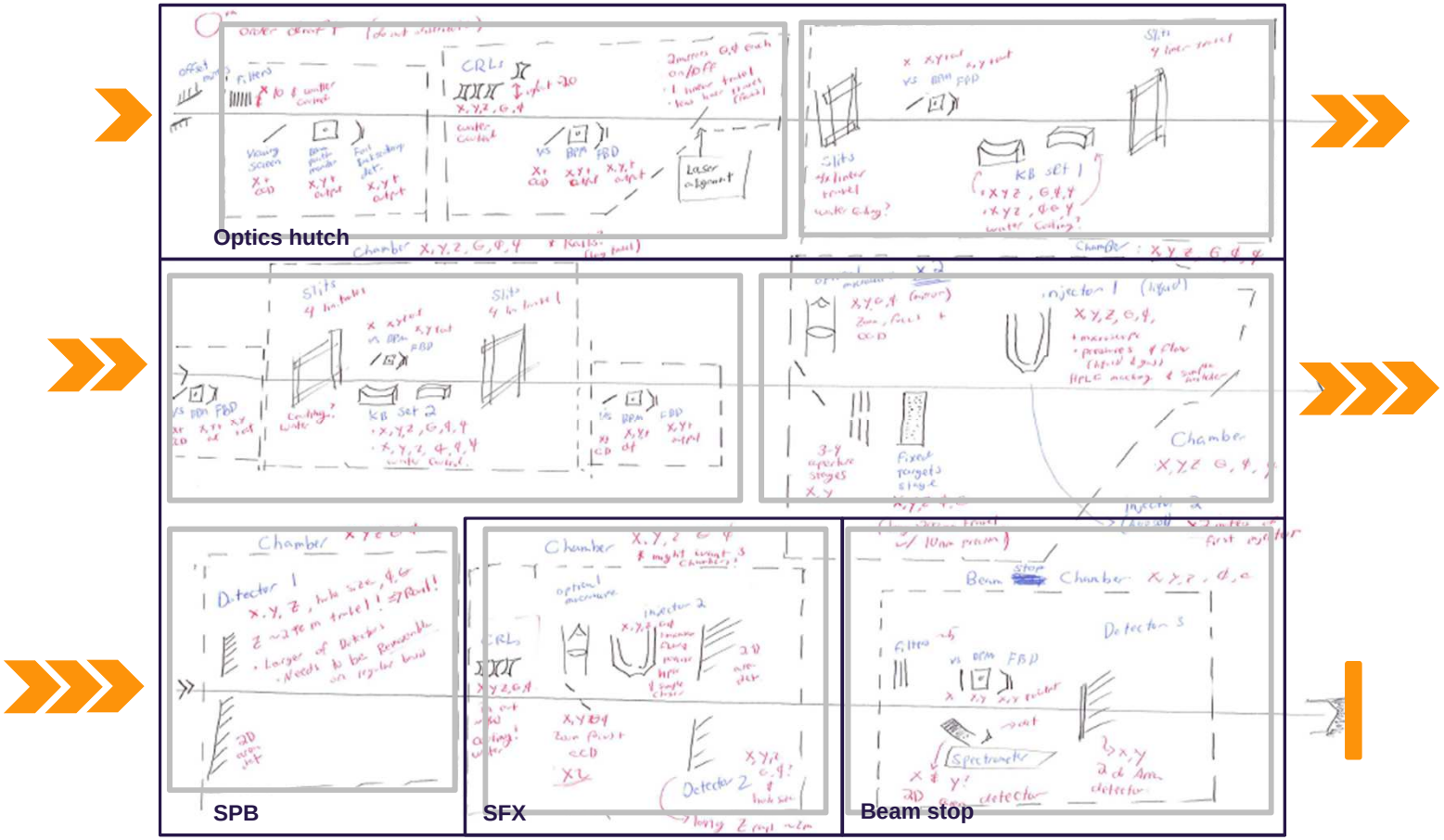
- Beckhoff – terminal width unit
  - Width of single terminal on rail = 12 mm



- Network – RJ45 plug unit
  - Cable connection point = RJ45

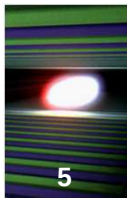
Aim = estimate total: Rack U height, Beckhoff rail length, Netowrk port count

Starting point – Adrian's schematic



Chamber

Chambers



- **7 chambers**
  - 7 turbo pumps
    - control = 4 (dual) serial Beckoff (double width) terminals + 4 (dual) analog-IO (s) terminals + ~6 (quad) digi-IO (s) terminals
    - power supply on pump (or 3U 24/42V DC)
  - 7 roughing pumps
    - control = 4 (dual) power relay Beckhoff (d) terminals
    - power supply = on pump (220V mains)

- **3 of 7 with differential pumps**
  - 9 ion pumps
    - control = 5 (dual) serial Beckhoff (d) terminals + 5 (dual) analog-IO (s) terminals + 12 (quad) digi-IO (s) terminals
    - power supply = 3 x 6U, ½ 19" Quad controller
  - 9 roughing pumps
    - see above = 5

- Gauge channels
  - 3 per chamber + 3 per diff. chamber = 30 channels
    - control = 3 (dual) serial Beckoff (d) terminals + 15-60 (dual) analog-IO (s) terminals + 11-16 (quad) digi-IO (s) terminals
    - gauge = 5 x 3U, ½ 19" six channel controller
- Valves
  - 2 valves per chamber + 16 for special windows = 32 valves
    - control = 8 Quad digital IO Beckoff (single width) terminals
- Residual gas analyzers (on chamber)
  - 1 per chamber
    - control = 7 Ethernet RJ45
    - analyzer = MKS-RGA
- Temperatures
  - 2 per chamber = 20 channels
    - control = 10 (dual) PT100 Beckhoff (s) terminals

Rack space: 12 + 9 = 21 U **Rail space: 2x(4+4+5+5+3) + (4+6+5+12+8+10+60+16) = 163** **Ethernet ports: 7**

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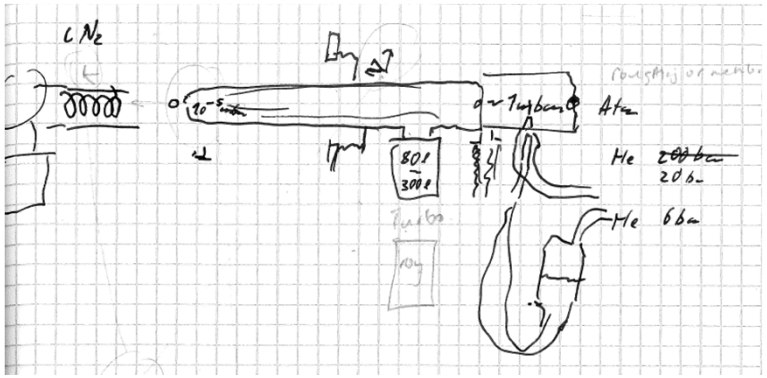
Sample injection systems

- 2 fluid or gas injection systems, with each:
  - Beckhoff terminals
  - Other rack allocation

3U = Piezo controller
3U = Turbo small pump power supplies
3U = pressure regulation
3U = Heater and butterfly valve control
3U = pressure gauges
3U = place holder (sample flow control?)

- 6 stepper motors with encoder terminals = 6 Bechhoff (d) terminals
- 12 end switches = 3 (quad) digi-IO (s) Beckhoff (s) terminals
- 2 roughing pump relay terminals = 1 (dual) power relay Beckhoff (d) terminals
- 1 turbo pump serial terminal = 1 (dual) serial Beckoff (double width) terminals + 1 (dual) analog-IO (s) terminals + 1 (quad) digi-IO (s) terminals
- 2 temperature sensors = 1 (dual) PT100 Beckhoff (s) terminals
- 2 pressure gauges (6 channel) = 1 (dual) serial Beckoff (d) terminals per
- 10 (s) terminal placeholder for regulation, heaters, flow control, etc.



Rack space: 18 U **Rail space: 2x(6+1+1) + (3+1+1+1+10) = 32** **Ethernet ports: 0**

Large area 1 Mpxl camera systems

- 2 x 1Mpxl AGIPD detectors
  - Control
  - Other rack allocation

16U train builder 1 RJ45 Ethernet
6U synchronization (clock and control) 1 RJ45 Ethernet

1 → 4 Mpxl camera

- Ethernet = 16 x RJ45 quadrant controllers
- Train builder = 32U
- HV and LV = 8 crates = 64U
- Cooling = 4 racks?

Two AGIPD module spectrometer

- Ethernet = 1 x RJ45 module controller
- HV and LV = 1 crates = 8U
- Cooling = ?

- Ethernet
  - 4 x RJ45 quadrant controllers
- HV and LV
  - Example: ISEG + Wiener MPOD

16U = 2 crates 2 RJ45 Ethernet

- Cooling system = 1 rack (total height?)
  - Example: NIKHEF - CO2

10U control (PLC/SPS/SPI…) placeholder 1 RJ45 Ethernet
30U cooling system

Rack : 2(16+6+16+40)+8 = 164 → 572U **Rail space: 0** **Ethernet ports: 2(1+1+4+2+1)+1 = 19 → 63**

Other DAQ and control systems – 1 of 2

- 6 x FBD = Foil Back scattering Detector (4.5Mz APD system)
  - Control: 1 x Ethernet + stage control by Beckhoff (see later)
  - Diode power supply: place holder 8U shared (i.e. MPOD) for all HV on this page
  - DAQ: 250MHz SIS8300 Fast ADC (Q_{meas}) = 3U crate

- 6 x VS = invasive diagnostic imaging station = for now use WP74 configuration
  - Control: 1 x Ethernet or Cameralink + PS and stage control by Beckhoff (see later)
  - DAQ: GigE or Cameralink cameras = space place holder 1U CPU

- 6 x Beam Position Monitor
  - TBD = 3U placeholder
  - Control: 1 x Ethernet or Cameralink + PS and stage control by Beckhoff (see later)
  - Power supply = MPOD of FBD
- 2 x Optical microscope = for now use WP74 configuration
  - Control: 1 x Ethernet or Cameralink + PS and stage control by Beckhoff (see later)
  - DAQ: GigE or Cameralink cameras = space place holder 1U CPU

Rack space: 8+6(3+1+3)+2= 52 **Rail space: 0** **Ethernet ports: 6+6+6+2 = 20**

Other DAQ and control systems – 2 of 2

- 1 x Master Veto Unit
  - Control: 1 x Ethernet
  - DAQ = MTCA.4 crate = 3U
- 5 x Local Veto sources
  - Control: 1 x Ethernet
  - DAQ = MTCA.4 crate = 3U
- Motion control system
  - Control: Beckhoff terminals
    - ➔ assume 250 x 50V/5A Beckhoff controlled stepping motors with encoders and end switches = 125 (quad) digi IO Beckhoff (s) terminals + 250 controller+encoder (d) terminals + 0-500A 50V power supply

Rack space: 3+5(3) = 18 **Rail space: 2x250 + 125 = 625** **Ethernet ports: 1+5 = 6**

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Size totals

What	Rack U's (44.45 mm)	Rail 12mm (s) units	Ethernet ports
Chambers	21	163	7
Sample injection system	18	32	0
Large area cameras and spectrometer	164 → 572	0	19 → 63
DAQ-control 1/2	52	0	20
DAQ-control 2/2	18	625	6
Totals:	273 → 681	820	52 → 96

- 250 cm height rack has 50U useable U
  - 273U = 5.4 racks
  - 681U = 13.6 racks
- 19" Beckhoff rail/box has 28 useable single terminal widths useable U
  - 820 units = 29 rails
  - If 4U per rail = 3 racks

Space estimates

- Adrian will compare XFEL (SPB) and LCLS (CXI) during his visit to SLAC 8.2.2012 on.
- Need to check the numbers for errors, double counting, grouping effects, missing items
- Accuracy estimate
- When KDS manpower hired insert planning

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Cable lengths

- Large area detector
  - Control = synchronizer fast signal cables = ≤ 15 m.
- Beckhoff
  - Maximum catalogue cable length = 10 m
- Silicon bias HV and electronics LV
  - Silicon detectors using MPOD typically ~20-40 m