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Angstroemquelle Karlsruhe ANKA

ANKA
ANGSTRÖMQUELLE KARLSRUHE GMBH

Source, Beamlines, Controlsystem, Certification)

Presentation: K.Cerff FZK/ISS

DESY/ Zeuthen 11.03.2003

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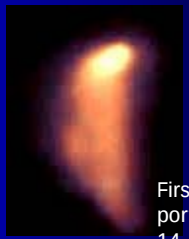
ANKA Milestones

Turn of the first sod,
2. July 1996

February 2001, Inauguration of ANKA

Erection of the ANKA hall, spring 1998



First beam (IR view port),
14. March 2000

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ANKA embedded in the FZK

Institut für Synchrotronstrahlung (ISS)

Institut für Mikrostrukturtechnik (IMT)

Institut für Nukleare Entsorgung (INE)

Institut für Festkörperphysik (IFP)

Institut für Technische Chemie (ITC)

Institut für Nanotechnologie (INT)

Bereich Infrastruktur (BTI) und Verwaltung (HPS, EVM)

Hauptabteilung Information (HIK) und Kommunikation

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ANKA Persons

Institut für Synchrotron Strahlung (ISS)

Administration: 4

Machine Group: 7

Beamline Group: 10

Technical Group: 9

Computer Group: 4

$\Sigma = 39$

ANKA GMBH:

Marketing: 5

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ANKA Budget

Erection 35M€
Operation, R&D 2.7M€ (2003)

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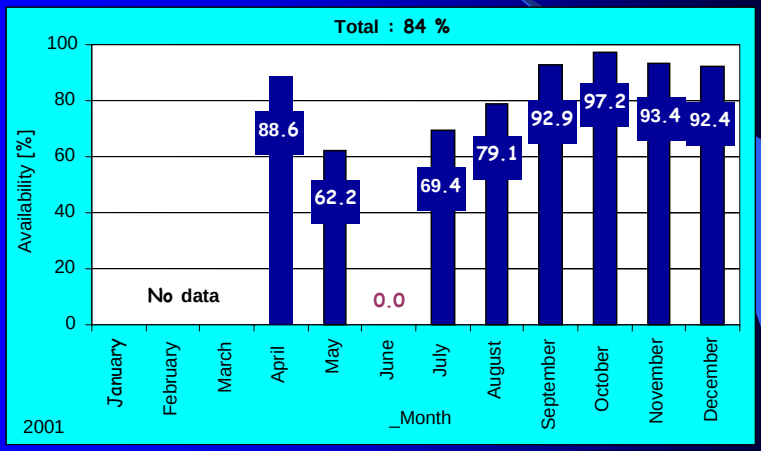
Availability and Reliability



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Beamtime Schedule

Users operation
2.5 GeV

IMT special
1.3/1.6 GeV

Maschine
optimisation

	Oktober					November					Dezember				
			Schicht					Schicht					Schicht		
	KW	1	2	3		KW	1	2	3		KW	1	2	3	
Mo	1	MB	MB												
Di	2	MB	MB												
Mi	3	MB	MB												
Do	4	MB	MB	SNB		1	KB	KB							
Fr	5	MB	MB	SNB		2	KB	KB							
Sa	6					3					1				
So	7					4					2				
Mo	8	KB	MB			5	KB	MB			3	KB	MB		
Di	9	NB	NB			6	NB	NB			4	NB	NB	SNB	
Mi	10	NB	NB			7	NB	NB			5	NB	NB	SNB	
Do	11	NB	NB	SNB		8	NB	NB	SNB		6	NB	NB	SNB	
Fr	12	MB	MB	SNB		9	SNB	SNB	SNB		7	SNB	SNB	SNB	
Sa	13					10					8				
So	14					11					9				
Mo	15	KB	MB			12	KB	KB			10	KB	MB		
Di	16	NB	NB			13	KB	KB			11	NB	NB		
Mi	17	NB	NB			14	KB	KB			12	NB	NB		
Do	18	SNB	SNB	SNB		15	KB	KB			13	SNB	SNB	SNB	
Fr	19	MB	MB	SNB		16	MB	MB			14	MB	MB	SNB	
Sa	20					17					15				
So	21					18					16				
Mo	22	KB	MB			19	KB	MB			17	KB	MB		
Di	23	NB	NB			20	MB	MB			18	NB	NB		
Mi	24	NB	NB			21	MB	MB			19	NB	NB		
Do	25	SNB	SNB	SNB		22	MB	MB	SNB		20	NB	NB		
Fr	26	MB	MB	SNB		23	MB	MB	SNB		21	KB	KB		
Sa	27					24					22				
So	28					25					23				
Mo	29	KB	MB			26	KB	MB			24	KB	KB		
Di	30	NB	NB			27	NB	NB			25	KB	KB		
Mi	31	NB	NB			28	NB	NB			26	KB	KB		
Do						29	SNB	SNB	SNB		27	KB	KB		
Fr						30	MB	MB	SNB		28	KB	KB		
Sa											29				
So											30				
Mo											31	KB	KB		

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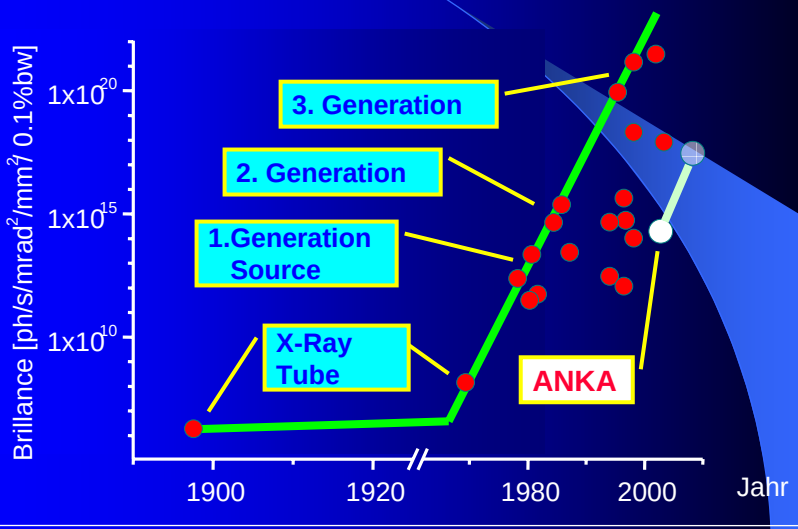
ANKA Generation



The ANKA Machine

circumference: 110.4m
diameter: 35 m
Energy 2.5 GeV
current ca. 200 mA
lifetime: > 20 h

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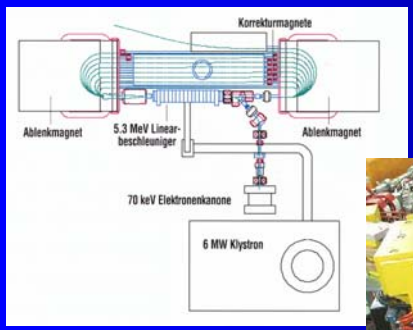
Electron Source and Microtron



Electron Energies:

Electron Gun 70 keV

Linac of the Microtron: 5.3 MeV

Racetrack-Mikroton 53 MeV

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The ANKA Booster

Gun pulse current 500 mA
pulse length 4 ms

mikrotron current 4 mA
pulse length 1 ms

Booster current 8 mA
Circulation time 88 ns
repetition rate1 Hz

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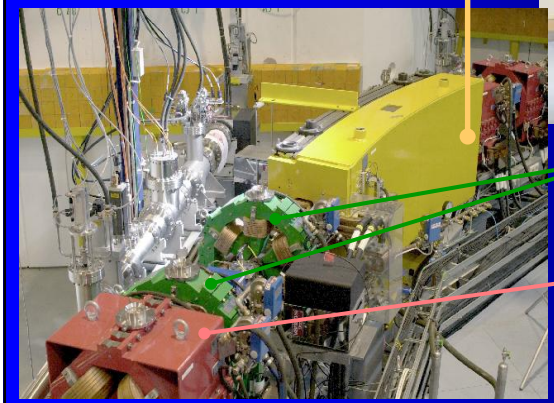
ANKA Magnets

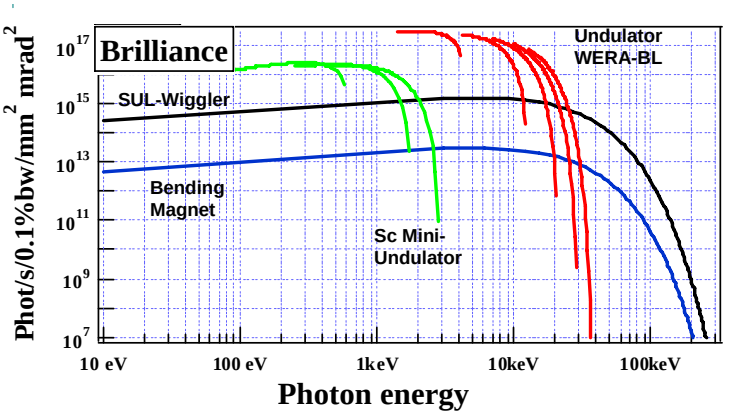
Dipol Sources:
16 magnets with a radius of 5.56 m each, angled 22.5°, mag. field 1.5 T, 80 coils, current 687 A, watercooled.



Sextupole:
compensation of ´chromatic abberation`.

Quadrupole: focussing of the electron beam

Spectra of ANKA BM and Insertion Devices



R.Rosmanith, ISS

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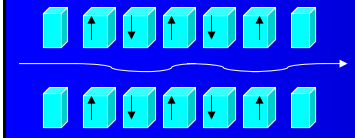
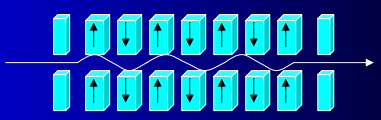
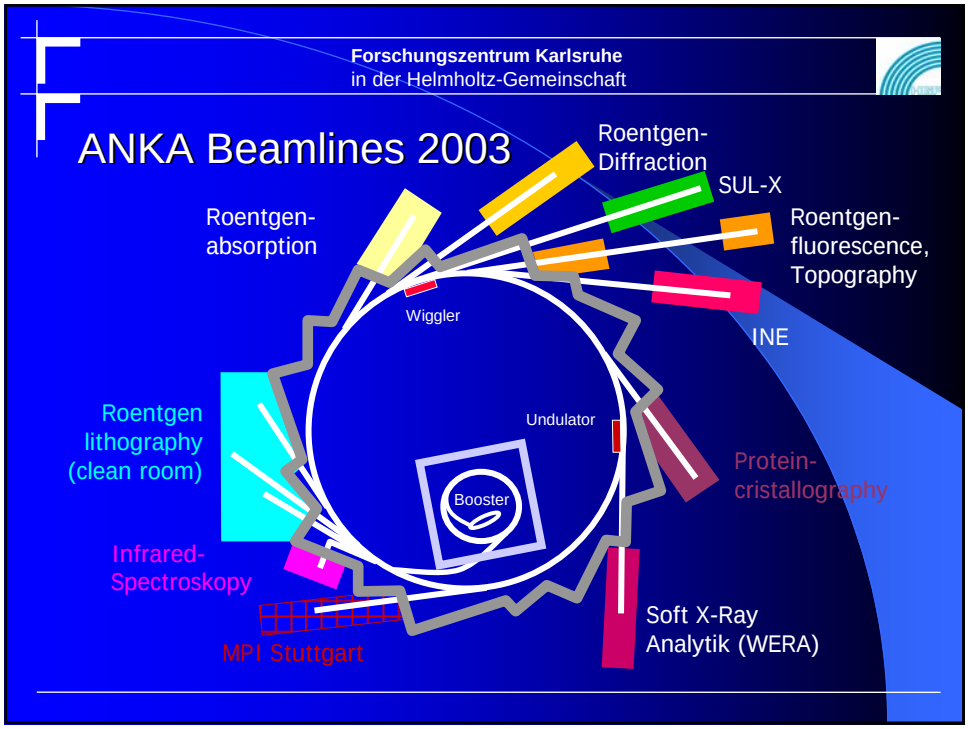
ANKA Wiggler and Undulator



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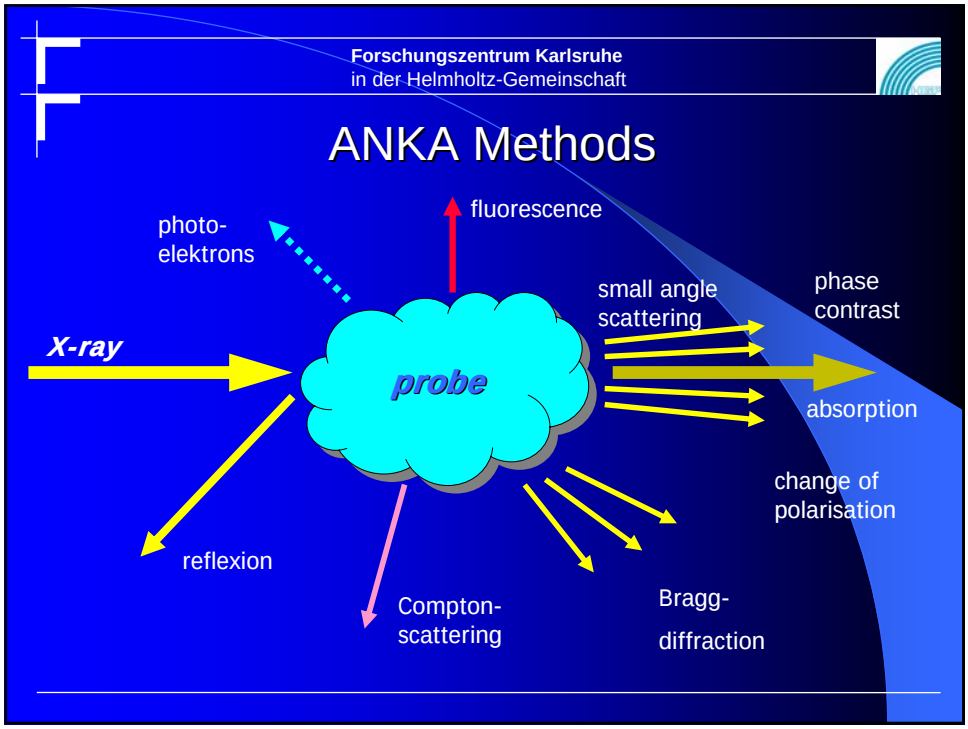
ANKA Beamlines 2003
Roentgen-
Diffraction
SUL-X
Roentgen-
absorption
Roentgen-
fluorescence,
Topography
Wiggler
INE
Undulator
Roentgen
lithography
(clean room)
Protein-
cristallography
Booster
Infrared-
Spectroskopy
Soft X-Ray
Analytik (WERA)
MPI Stuttgart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ANKA Methods
fluorescence
photo-
elektrons
small angle
scattering
phase
contrast
X-ray
probe
absorption
change of
polarisation
reflexion
Compton-
scattering
Bragg-
diffraction

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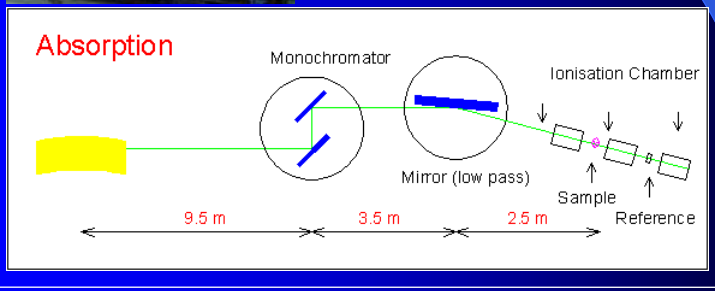
ANKA Absorption Beamline

Energy Range:	2-30	keV
Energy Resolution:	2 x10^{-4}	keV
Probe Size:	40 x 0.2	mm
Flux:	2 x10^{11}	Ph/(s 0.1%Bw)



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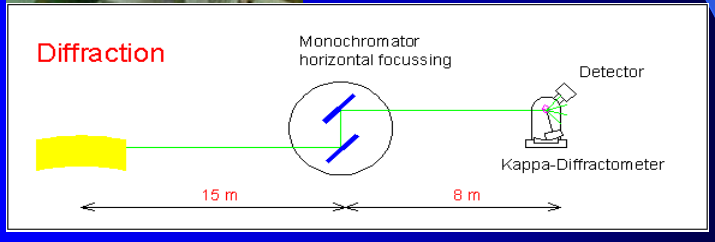
ANKA Diffraction Beamline

Energy Range	6-20	keV
Energy Resolution:	2 10^{-4}	keV
Probe Size:	1 x 0.2	mm^2
Flux:	5 x10^{11}	Ph/(s 0.1%Bw)



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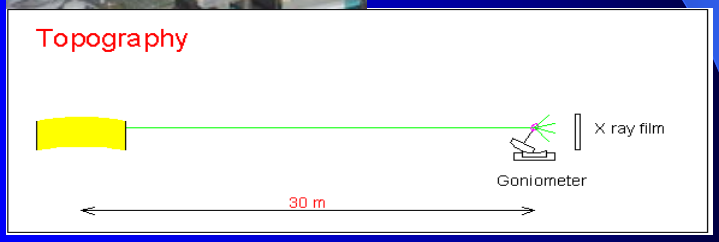
ANKA Topography Beamline

Energy Range		white light
Probe Size:	10 x 10	mm^2
Flux:	10	W



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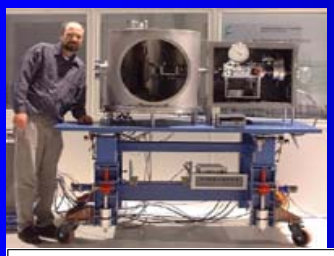
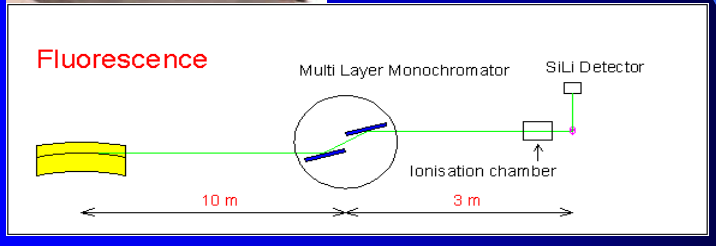
ANKA Fluorescence Beamline



Energy Range:	1-20	keV
Energy Resolution:	5 x10-2	keV
Probe Size:	1 x 1	mm
Flux:	1 x10^{13}	Ph/(s 0.1%Bw)



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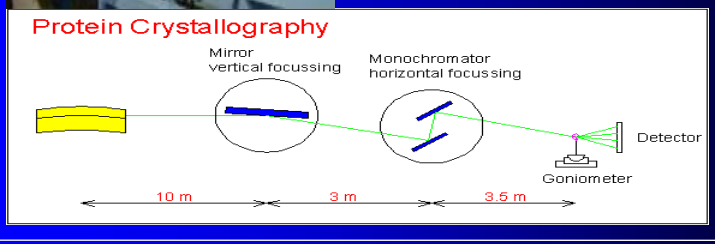
ANKA PX Beamline

Energy Range:	4-20	keV
Energy Resolution:	$5\ 10^{-4}$	keV
Probe Size:	0.5 x 0.5	mm
Flux:	$1\ x10^{12}$	Ph/(s 0.1%Bw)



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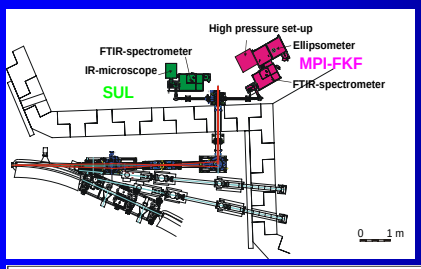
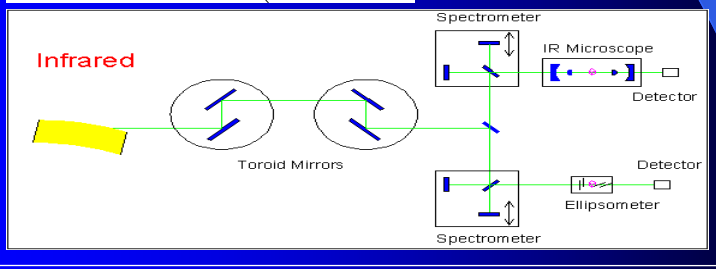
ANKA IR Beamline



Energy Range:	4-20	keV
Energy Resolution:	$5\ 10^{-4}$	keV
Flux:	0.5 x 0.5	mm



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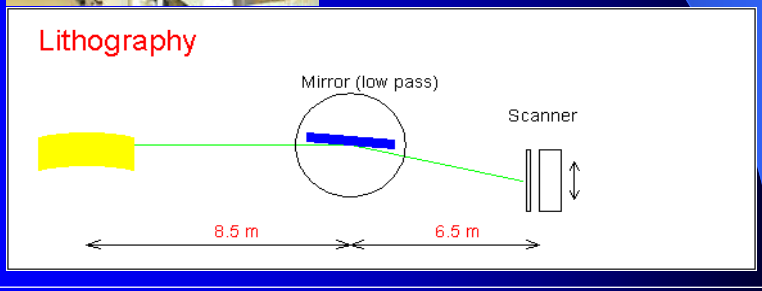
ANKA Lithograpy I-III

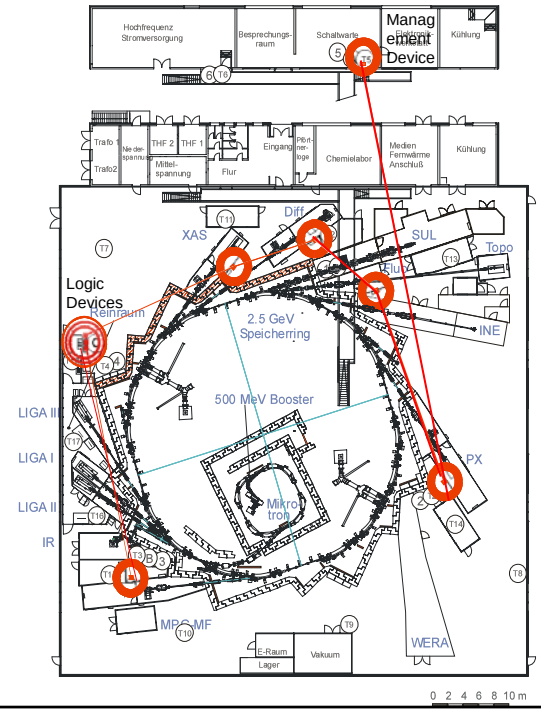
	Energy Range	Power [W]	Probe Size [mm]
Lithography I	1.5 - 4	6	120 x 10
Lithography II	2-8	40	120 x 10
Lithography III	5-40	100	120 x 10



Location of PLCs and safe CAN-Bus for up to 32 ANKA Beamlines

Transmission rate: 250 Kbit/s (250 m length) max. 64 Bus subscribers and 32 alarm groups
alarm response time < 50 msec

Line-Bus topology



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Lithography I-III Beamline Control and BPSS Cabinets

Left: two cabinets with 68k VME controllers for LIGA I, II Beamlines.

Right: three Personnel Safety Controller cabinets for LIGA I – III.

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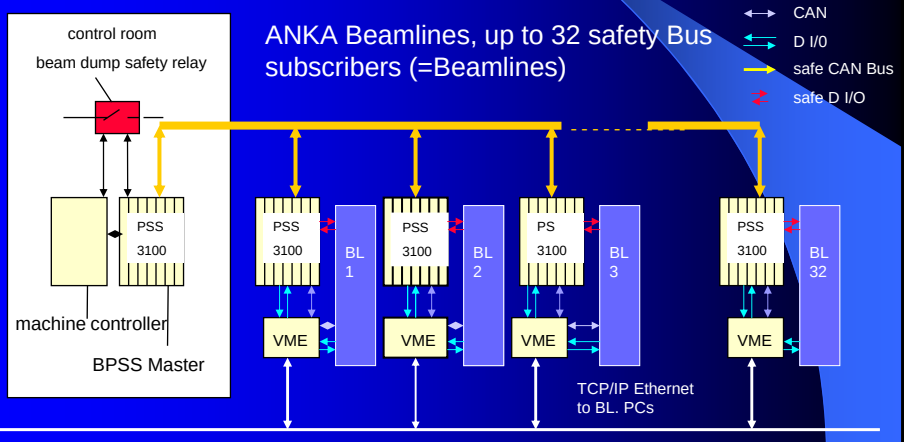
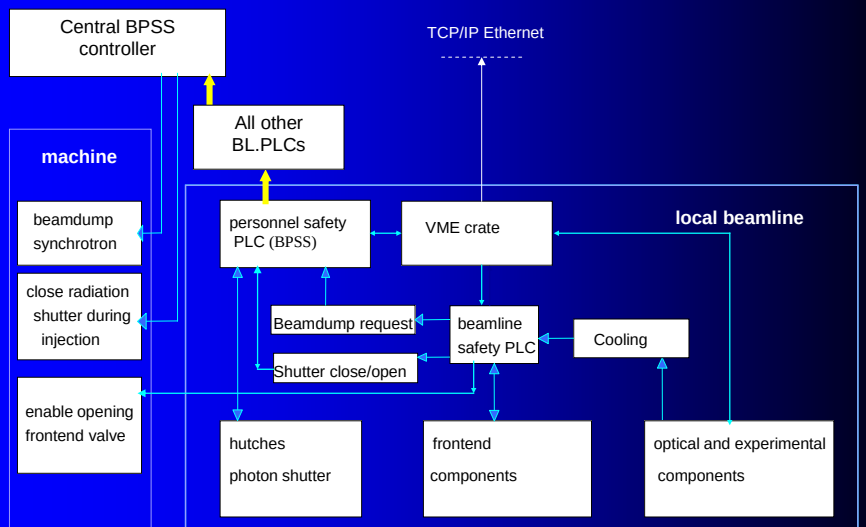
Interface of the ANKA Machine/Beamline Interlock



Local Control System Details



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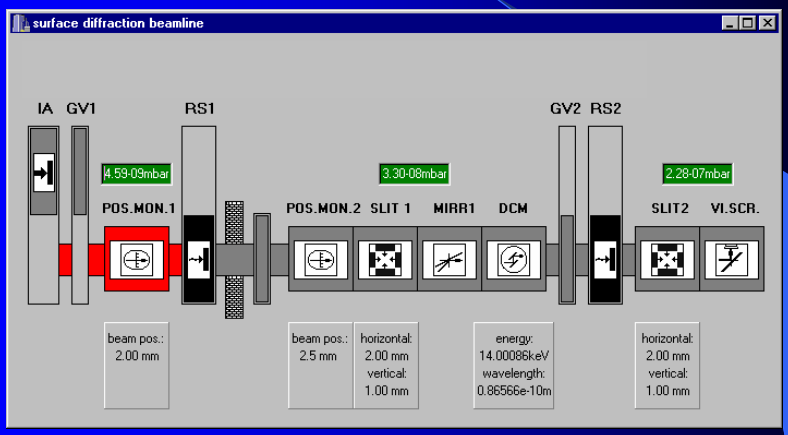
ANKA Beamline GUI



Frontend Radiation Shutter

Two pairs of end switches are monitored.

Allowed states of Front-end Shutter (FS): open or closed, max. allowed state transition time <10sec.

In case of failure:

If FS close: hutch access is denied

If FS open: beam shutdown is initiated in less than 50 msec

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Hutch Safety Interlock

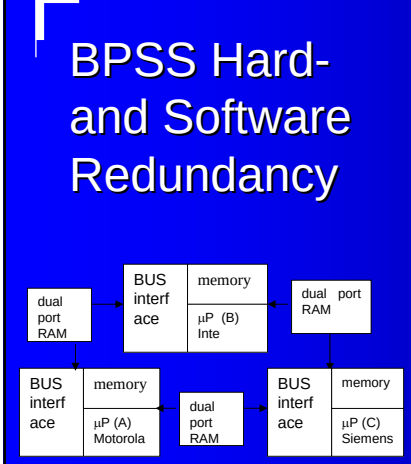
inside radiation hutch:

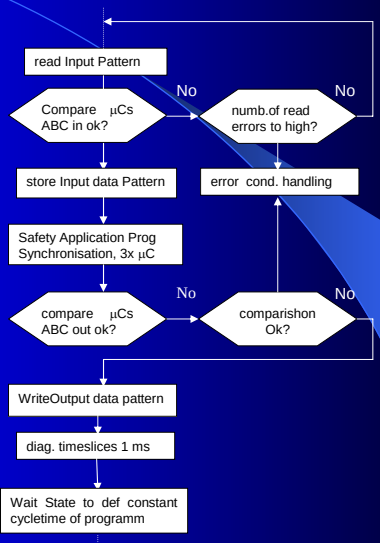
electromagnetic door lock

with panic break

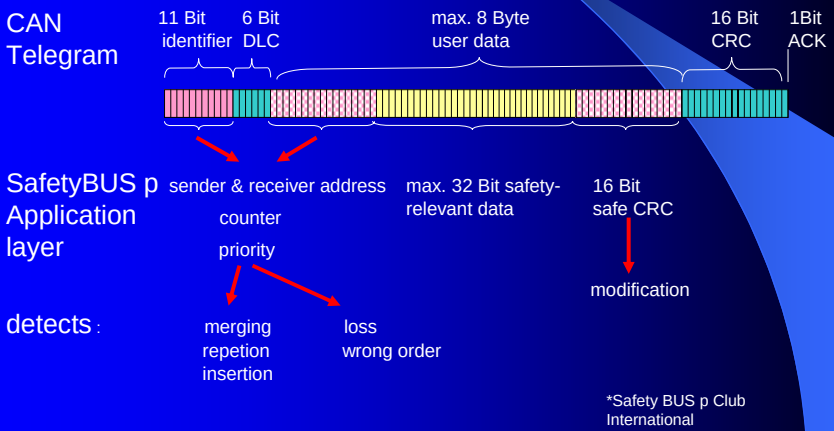
preventing hutch access during beam exposure time

BPSS Hard- and Software Redundancy





SafetyBus-p* Telegram Structure



Can-Interface BPSS

Message groups	Type of Data
• Status of Safety Components (shutters, hutches)	Bit Pattern (**D**ata**W**ord)
• Alarms (beam dump)	
• Diagnostics of Safety Components	
• Diagnostics PLC (Error Stack)	Numbers

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Can Interface BPSS Details

PDO*	DW	Meaning	Type of Data	Number of Bits
1	1	Hutch 1 State	Bit Pattern	16
	2	Alarm Hutch 1	#	#
	3	Hutch 2 State	#	#
	4	Alarm Hutch 2	#	#
2	5	Diag. Safety Comp. H1	Bit Pattern	16
	6	#	#	#
	7	#	#	#
	8	#	#	#
3	9	Diag. Safety Comp. H2	Bit Pattern	16
	10	#	#	#
	11	#	#	#
	12	#	#	#
4	13	Diag. Safety PLC, Err. Stack	Hex	1
	14	Parameter	#	#
	15	Err. Location	#	#
	16	-	#	#

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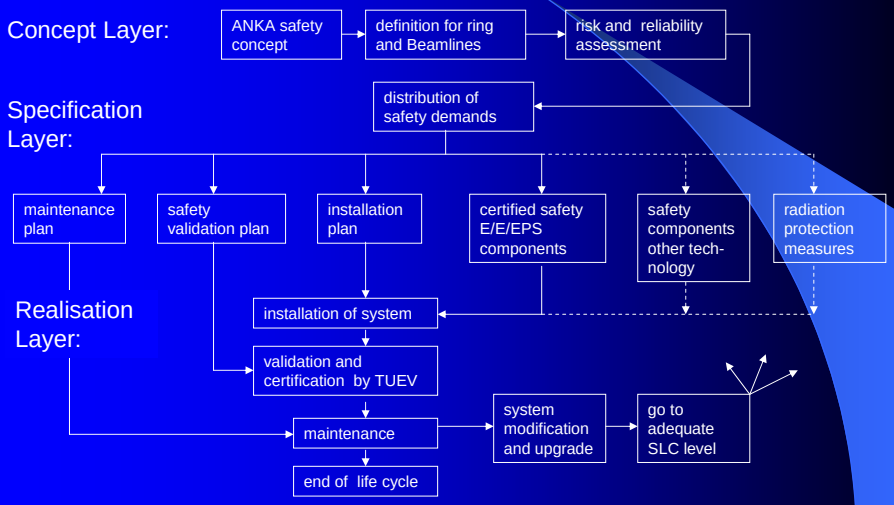
ANKA BPSS Safe Life Cycle



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Risk Assessment, EN 954-1

Risk Levels:

measure possible but accompanied with additional protection :

measure proportional to the level of risk encountered :

measure of comfort, excessive categories:

Severity of the injury: S1 naturally reversible, slight injury

S2 irreversible serious injury or fatal injury

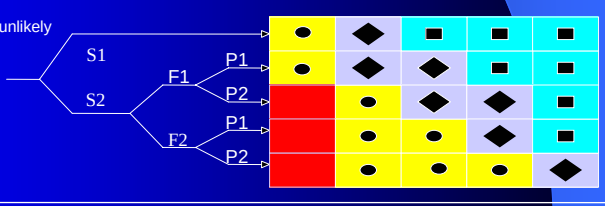
Frequency of exoposure: F1 exposure rare to fairly frequent

F2 exposure frequent to constant

Possibility of avoiding the risk: P1 possible under some conditions

P2 highly unlikely

safety solution category hard - and software classification				
B	1	2	3	4



See you!

www.fzk.de/anka