RF Upgrade Plans at DELTA

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DELTA parameters:

Beam energy: 550 MeV – 1.5 GeV
Beam current: 130mA @ 1.5GeV
Beam lifetime: 12h @ 130 mA
Availability: 95 %
Operational: 3000 h / year

Personnel:

2 Professors
4 Accelerator physicists
2 Beamline scientists
1,5 Administration
9 Engineers / Technicians
X Students

DELTA 500 MHz RF Systems

I S A S | LINE

Beamline 2

Beamline 3

Beamline 1

Analog LLRF @ 499,82 MHz
Klystron amplifier YK-1265 (42 kW)
DORIS type single-cell cavity
DESY HOM-Antenna damper

Analog LLRF @ 499,82 MHz
Klystron amplifier YK-1265 (15 kW)
DESY type 3-cell cavity

technische universität dortmund

Beamline 4

JÜLICH FORSCHUNGSZENTRUM

Beamline 5

UNIVERSITÄT OSNABRÜCK

technische universität dortmund

JÜLICH FORSCHUNGSZENTRUM

Beamline 12

Delta

BoDo

technische universität dortmund
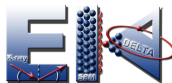
Beamline 11

Beamline 7

U55

SAW

Beamline 10

Beamline 8

Beamline 9

BU Wuppertal

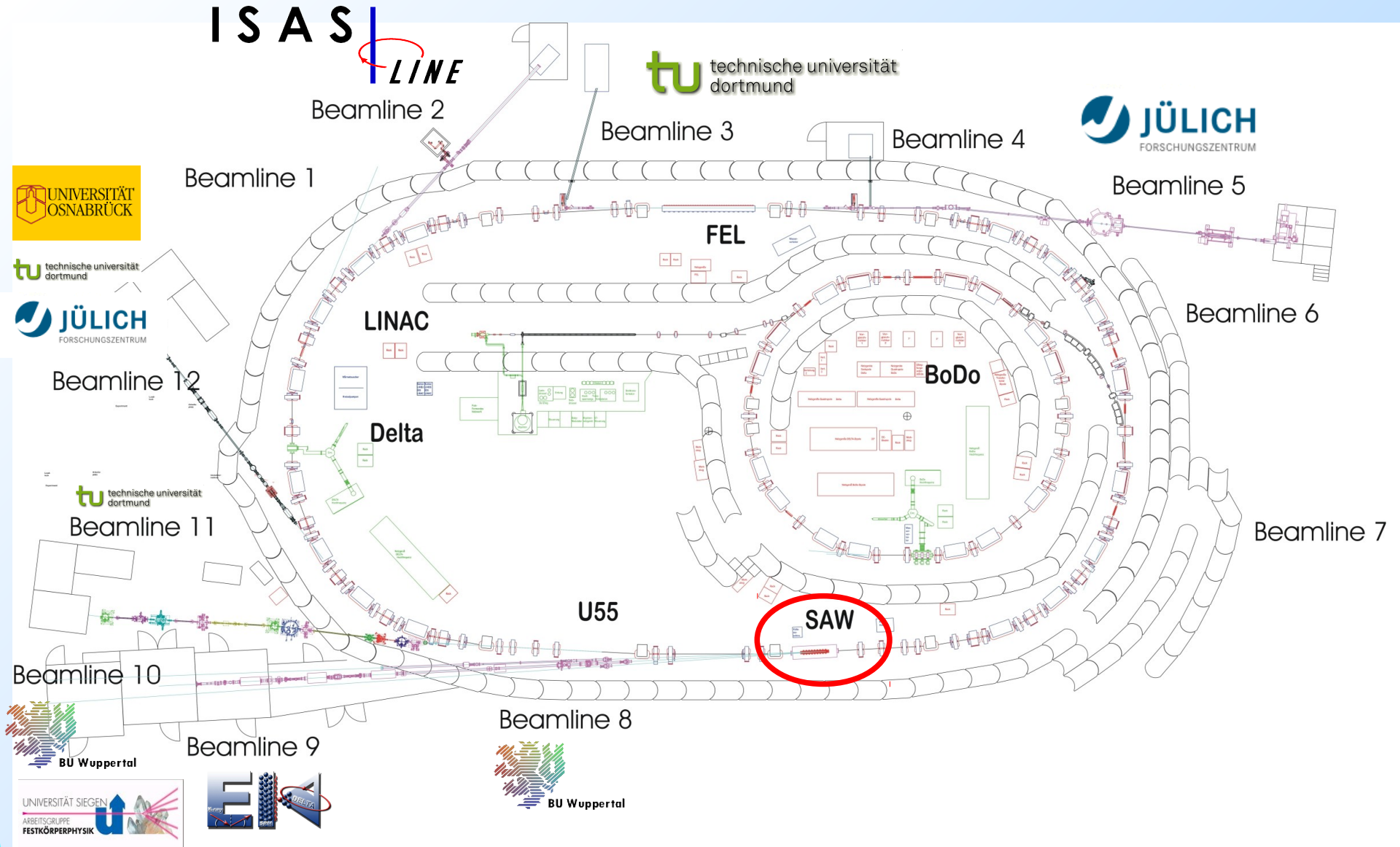BU Wuppertal
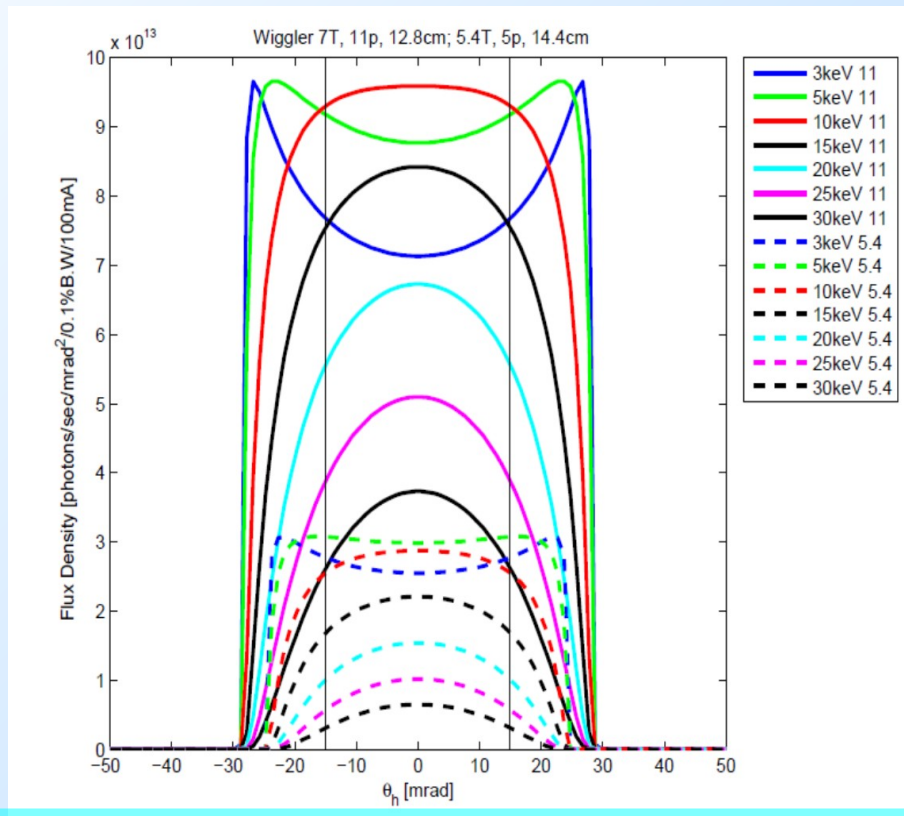
UNIVERSITÄT SIEGEN ARBEITSGRUPPE FESTKÖRPERPHYSIK

DELTA Users

Wiggler upgrade

	Unit	Current wiggler	New wiggler
Type		asymmetric	symmetric
Periods		5	9
Magnetic field	T	5,3	7
Critical energy	keV	7,9	10,5
Irrad. power @ 100 mA	kW	2,2	9,8

Call for tender in spring 2016

Order to Budker Institute / Novosibirsk

Delivery expected end of 2018

Storage ring RF upgrade options

	Unit	1	2	3	4	5
Total power loss	kW	20,44	31,2	31,2	31,2	31,2
Power loss wiggler	kW	2,86	13,6	13,6	13,6	13,6
Energy loss / turn	keV	157,2	240	240	240	240
Number of resonators		1	1	2	3-cell	2
RF power per cavity	kW	41	50	25	50	50
Cavity voltage	keV	350	330	240	582	455
Power loss resonator	kW	20,4	18,8	9,6	18,8	34,5
Coupling factor β		2	2,7	2,7	2,7	1,4
Synchrotron frequency	kHz	15,1	14,8	17,4	19,7	17,8
Synchronouos phase	°	26,7	46,6	29,9	24,3	15,3
Momentum compaction		0,0053	0,0053	0,0053	0,0053	0,0053
Energy acceptance	%	0,76	0,43	0,83	1,03	2,2
Damping time long.	ms	3,67	2,4	2,4	2,4	2,4
Bunch length	ps	46,2	61,3	52,2	46,2	25,2
Quantum lifetime	h	$>10^{10}$	$<10^{-4}$	$>10^{4}$	$>10^{11}$	$>10^{80}$
Touschek lifetime	h	24	8	33	48	157

Already in the queue: Booster RF Upgrade
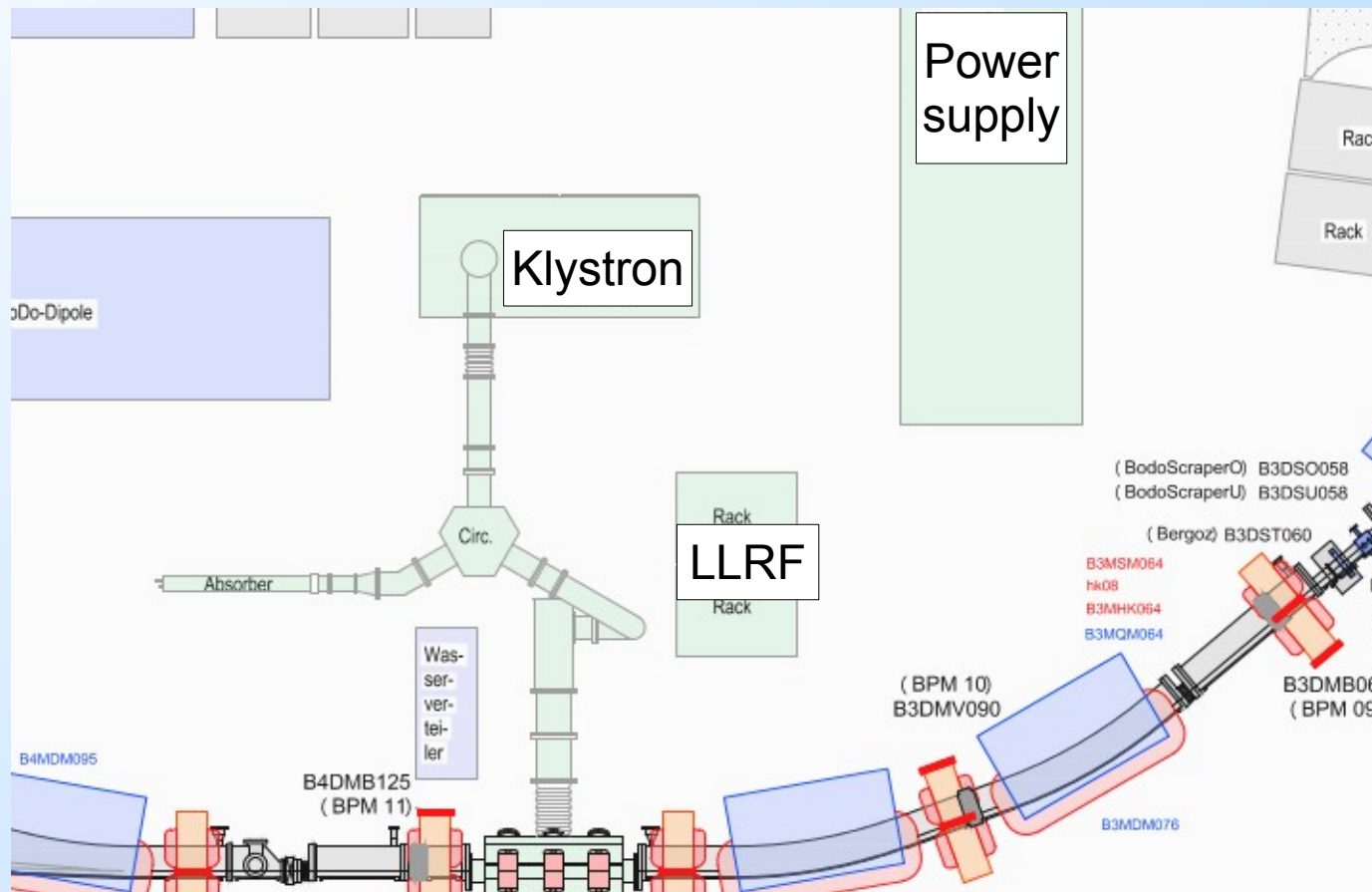
RF upgrade for Booster and SR:

2 power amplifiers (75kW + 20kW):
    Call for tender in spring 2016
    4 bidders, net price range from ~500 k€ t
    Order to Cryoelectra GmbH, - lowest pri
                       - presumab

1 EU-cavity (HOM damped):
    Call for tender in summer 2016
    1 bidder
    Order to Research Instruments GmbH

Infrastructural and other upgrades:
- 150 kW additional power from university tra
- 150 kW additional water cooling power
- Cavity support, waveguides, tapers, ...

Required:
20 years of operation
- with or
- without company support

Problems:
Local console based on Win XP / LabView
Devices w/ proprietary firmware
Spare parts

Solution:
- Use parts w/ longtime support if possible
- Complete documentation of hardware (NDA)
- More spare parts when proprietary firmware
- Virtualization of local console
- Only network communication in VM
- Still: What about activation of XP ?

# Positions and Schedule

Week 08-10/2017 (3 week shutdown)
- Delivery of amplifiers
- Installation and commissioning of booster amplifier
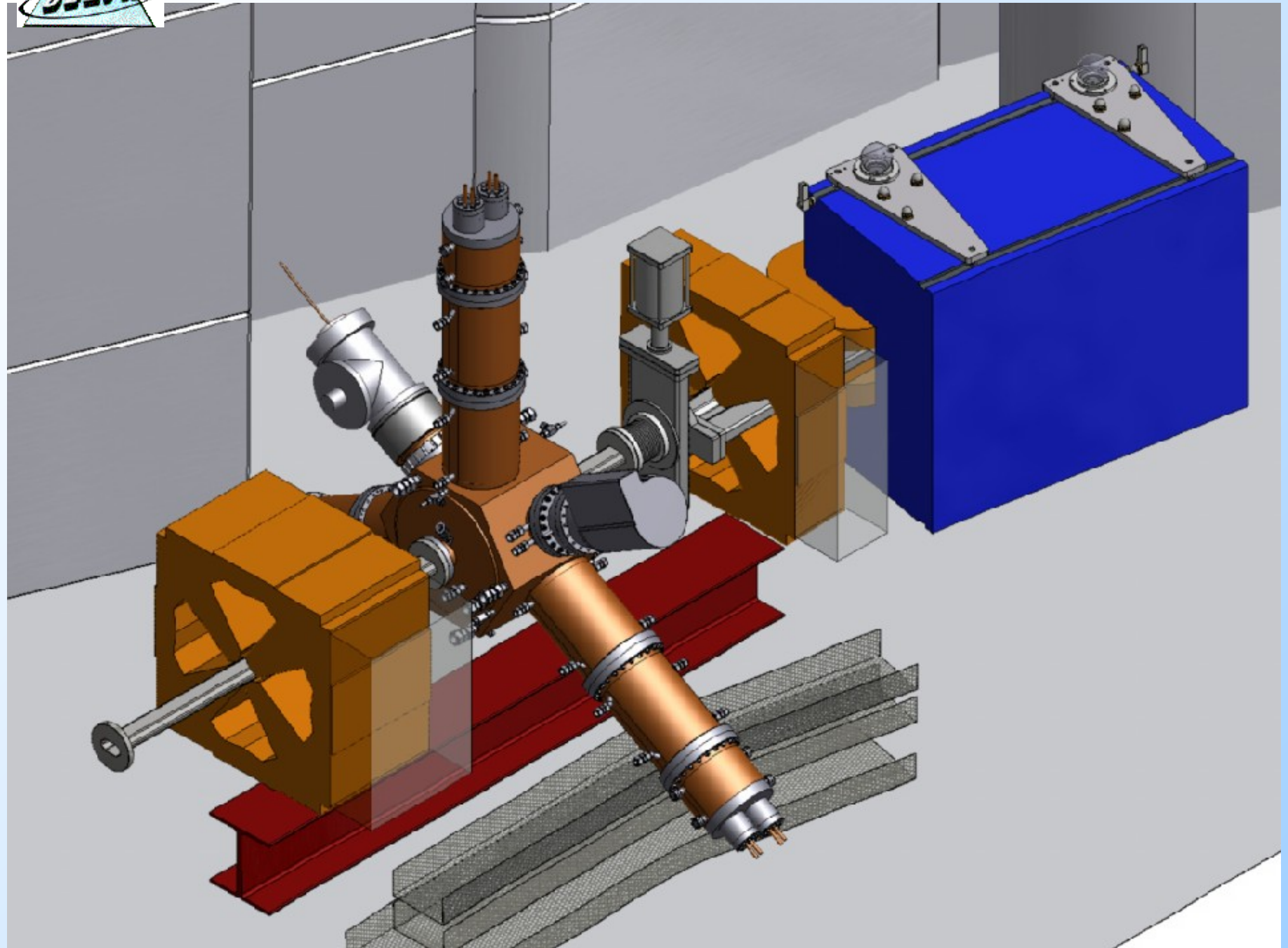- Installation of SR amp (outside the ring)

Feb. 2018:
- Installation of cavity in the storage ring
- Re-commissioning

Nov. 2017
- Delivery of EU-Cavity
- Installation of Cavity in Weis-Bunker (outside the ring)
- Commissioning and burn-in of cavity with amp indep. of accelerator. operation
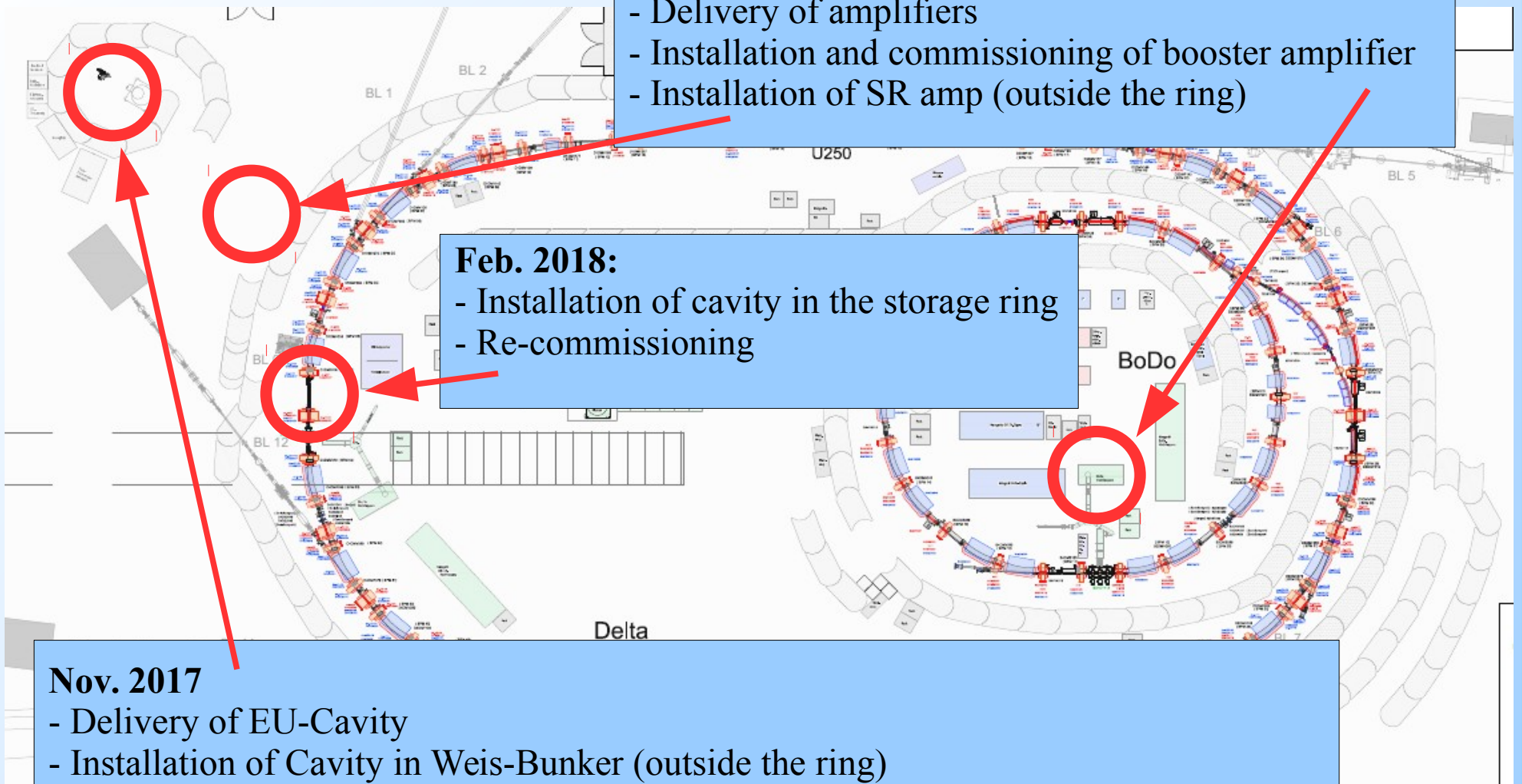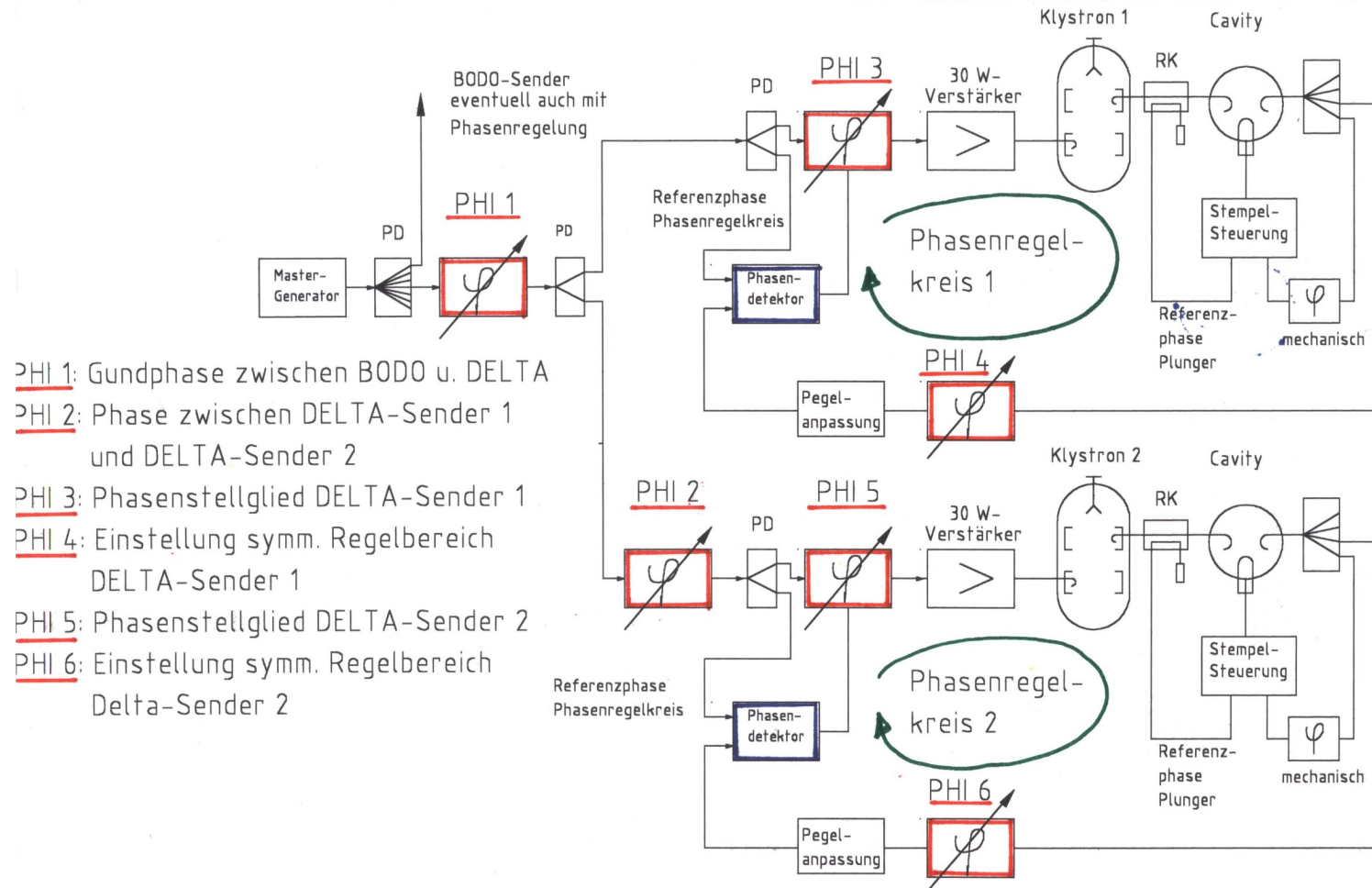
Cavity sketch courtesy Research Instruments GmbH

Analog Low Level RF

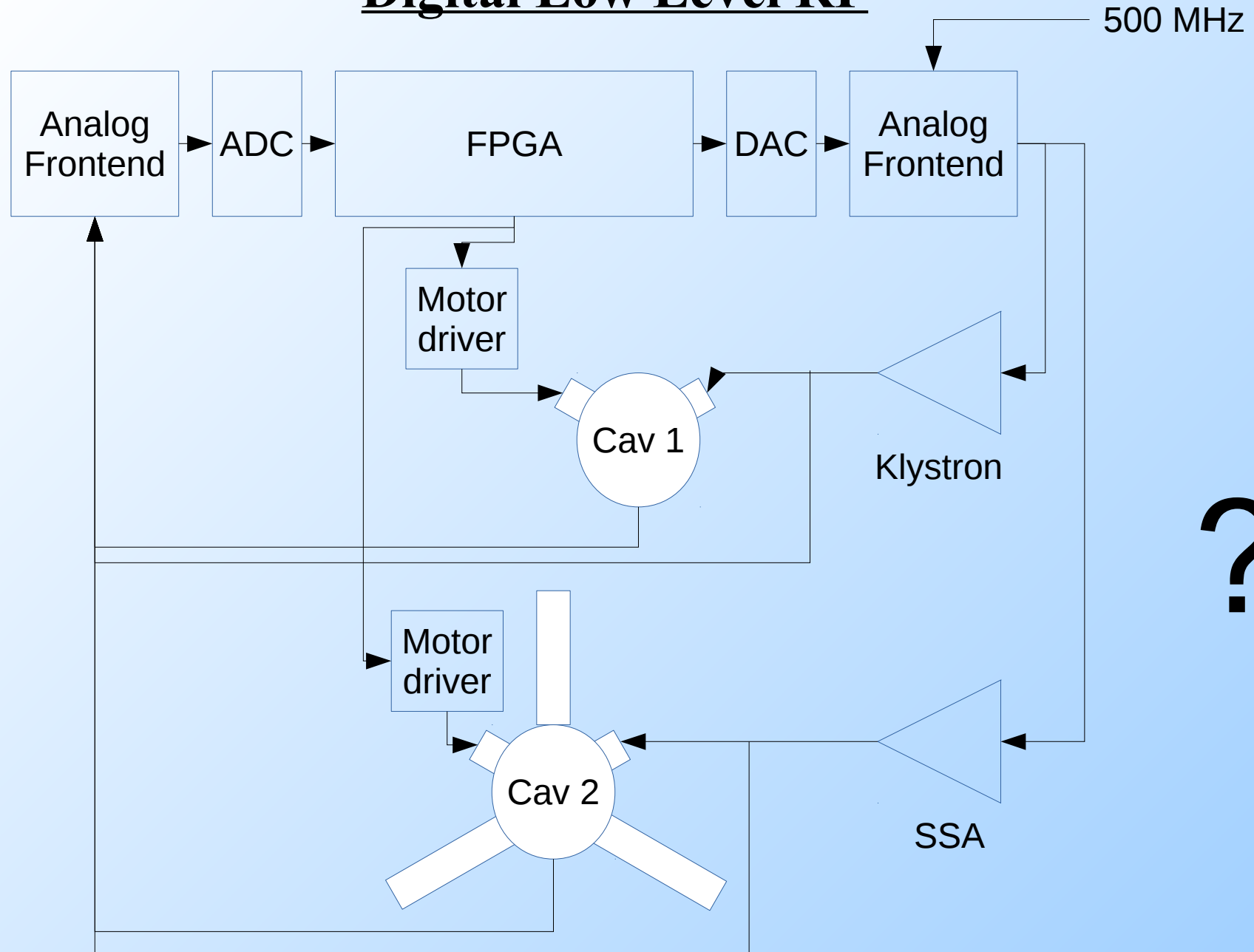Phasenstellung + Phasenregelung bei 2 Cavities im Speicherring

PHI 1: Gundphase zwischen BODO u. DELTA
PHI 2: Phase zwischen DELTA-Sender 1
und DELTA-Sender 2
PHI 3: Phasenstellglied DELTA-Sender 1
PHI 4: Einstellung symm. Regelbereich
DELTA-Sender 1
PHI 5: Phasenstellglied DELTA-Sender 2
PHI 6: Einstellung symm. Regelbereich
Delta-Sender 2

Digital Low Level RF

500 MHz

Analog Frontend → ADC → FPGA → DAC → Analog Frontend

Motor driver

Cav 1

Klystron

Motor driver

Cav 2

SSA

?

Do we need a power circulator for the storage ring ?

What is your advice ?

Thank you !