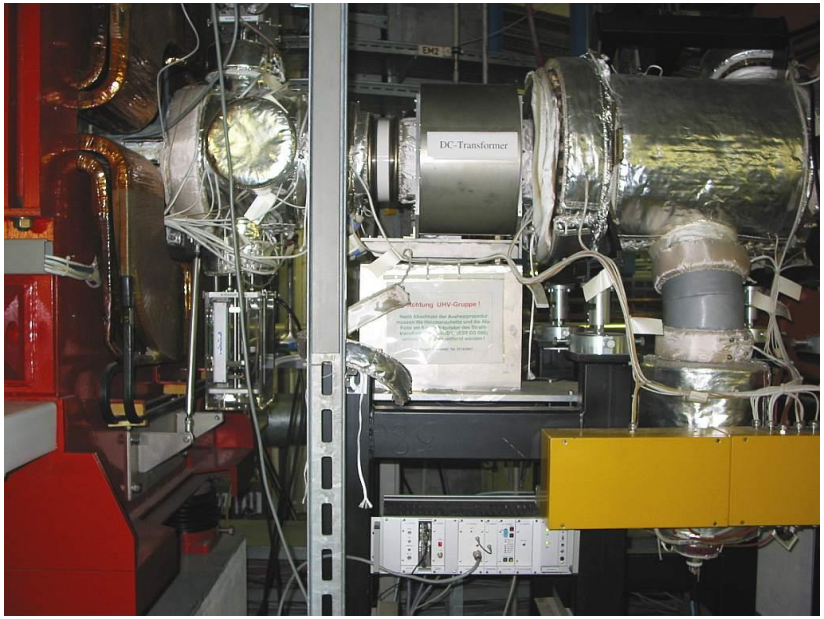
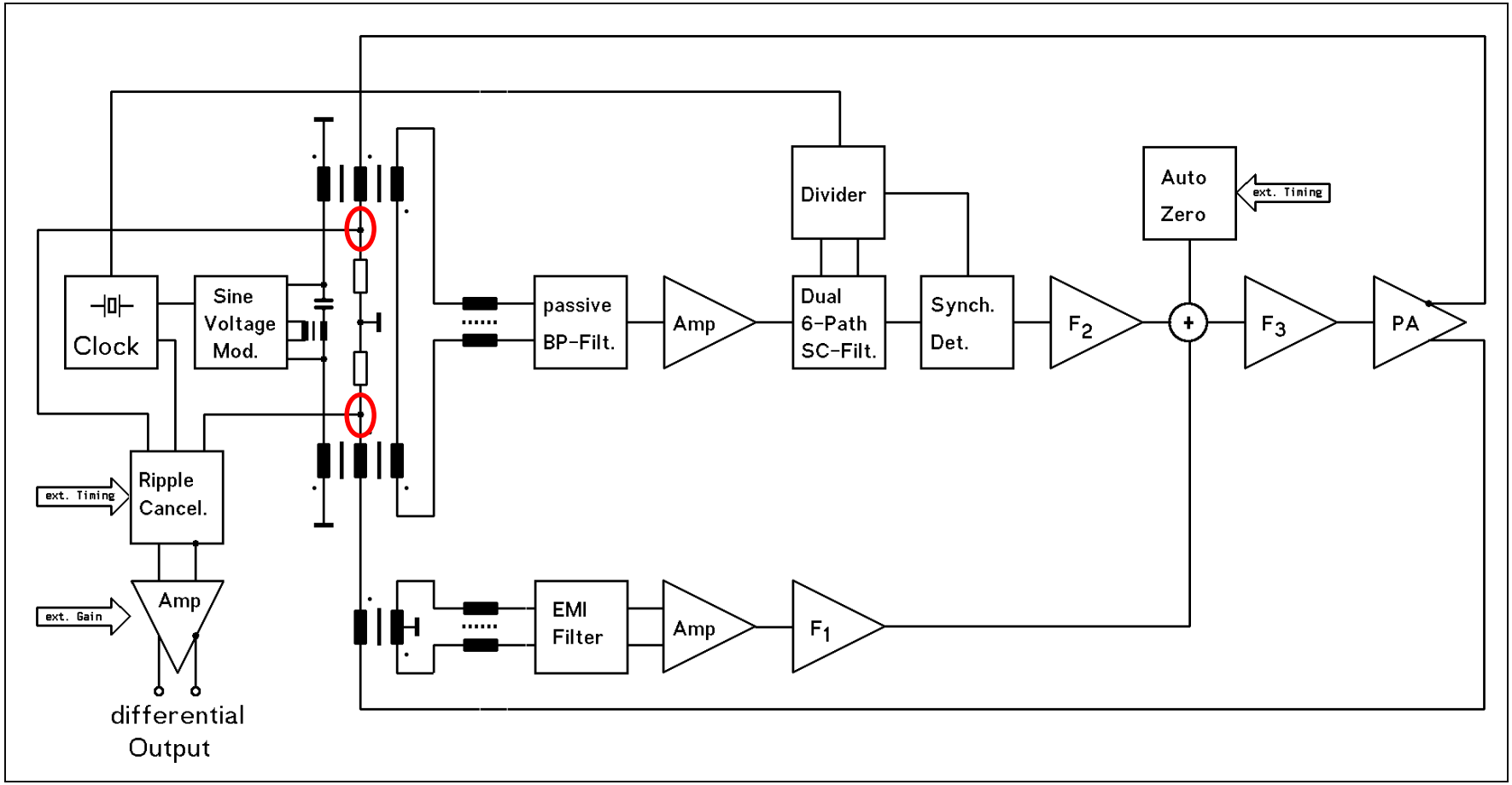
DCCT **GE02DT-ML**, mounted in the **ESR** (GSI development)

- Chamber for UHV, bakeable upto 300°C
- Aperture: DN200CF
- Length: 600mm
- Al_2O_3 ceramic gap, resistive coating on inner surface
- Dual-layer Mumetal® magnetic shield
- Additional toroid for fast transformer system added in 2019 (photo from 1993)



- Remote control / ADC placed outside of tunnel
- Locally mounted 19“ front end electronics (see bottom)
- DCCT upgraded with V/f-converter output, fixed range 1 MHz / 10mA
- Influence of quadrupole‘s stray field is corrected by Hall probe voltage, fed into DCCT electronics (see cable between quadrupole coil

GSI DCCT block diagram



O => differential voltage proportional to DC beam current / $U_{diff} \sim I_{beam}$, * 16.66 V/A, dynamic range ≥ 100 dB

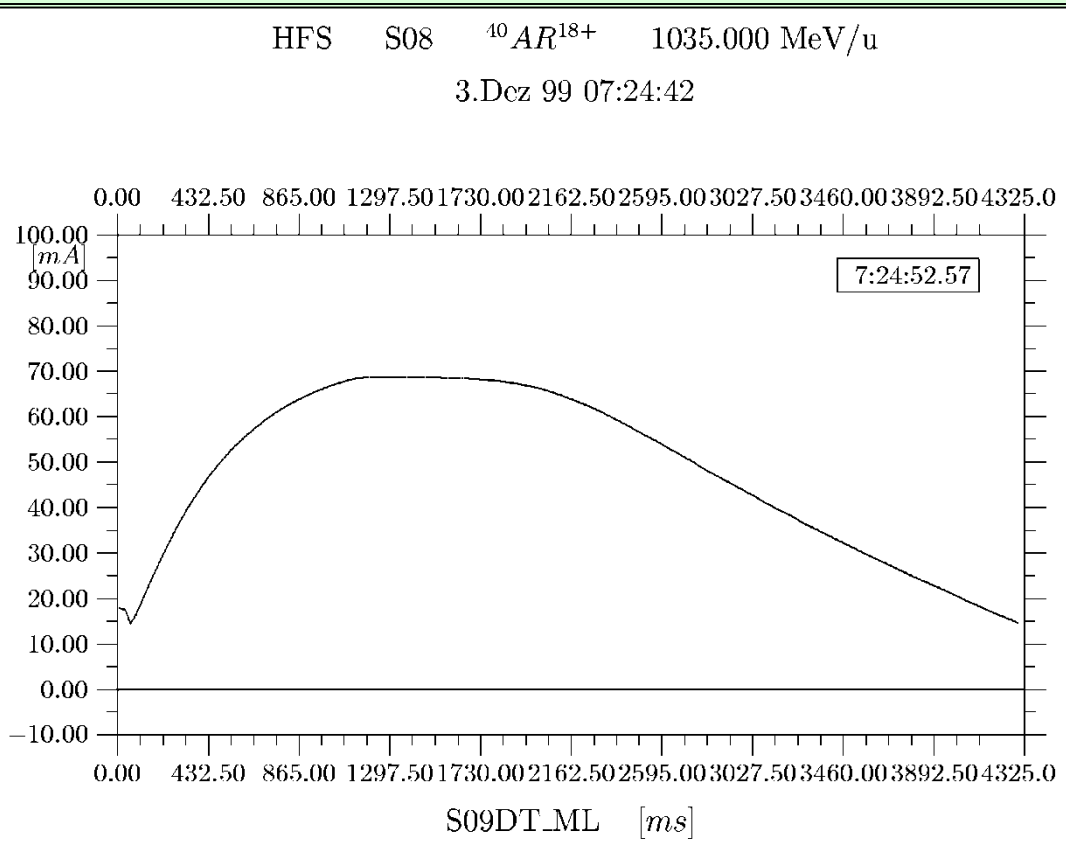
GSI DCCT: A magnetic modulator with the usual 3-core scheme

• **Dimensions of toroids**:	264 x 284 x 10 mm
• **Magnetic ribbons:**	VITROVAC® 6025F, t = 25 µm
• **Winding schemes:**	N_{loop}=12, N_{DC}=16, N_{AC}=96, N_{mod} =16
• **Main control loop:**	Current driven, burden resistance 200 Ω
• **Control sub-loops:**	Peak modulation current, Auto-Zero
• **Modulation characteristics:**	Sine voltage, with avalanche capacitor
• **Modulation frequency:**	987.5 Hz
• **Peak excitation field:**	**~** 20 A/m
• **Crossover frequency DC/AC channel:**	~ 6 Hz
• **Open loop gain at DC:**	>120 dB
• **Open loop - 0 dB crossing frequency:**	~ 0.4 Mhz
• **Signal transmission, toroids to front end:**	differential, twisted pair lines
• **Cable length, toroids to front end:**	2.5 m, limited by cable capacitances
• **Min. Shunt impedance @ DC:**	**≥** 2 kΩ, across toroid stack

GSI DCCT Specifications

• **8 Current Ranges:**	± 300 µA to 1 A DC f. s., (1... 3 ... 10 ...)
• **Bunched Beam Current Limit:**	~ 40 – 100 mA, dependent on bunch frequency / harmonic no.
• **Gain error:**	≤ 0,1 % (for I < 20 mA)
• **Linearity error:**	≤ 0,1 % (for I < 20 mA)
• **1/f-noise corner frequency:**	~ 2 Hz
• **Offset Temperature coefficient:**	~ 5 µA/°C
• **Zero error absolute:**	± 2.5µA (by automatic zero adjustment, activated whenever a Faraday-Cup is moved into the beam path
• **Error due to external mag. fields:**	~ 10 µA max. (stray field from quadrupole on the left)
• **Current resolution:**	~ 5 µApp @ 20 kHz bandwidth (~1 µArms), S/N=1
• **Output bandwidth:**	DC .. ~ 2 kHz (small signal; new output sample every ~ 506 µs)
• **Ripple cancellation:**	2 * f_{Mod}-synchroneous sampling at zero-crossing of output signal
• **Built-in Voltage-to-frequeny converter :**	TTL 50Ω output, f_{max} = 1MHz @ 10 mA beam current

Typical operation of GSI/SIS18 DCCT at higher beam intensity



A beam current cycle in SIS18