Instrumentation Requirements for the Superstructure HOM Measurements

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Beam Test of the Superstructure

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Measurement of the HOM-coupler signals

Semi-automatic search for:

\[ f_{\text{HOM}} = n f_{\text{bunch}} \pm f_{\text{mod}} \]

Realisation:

- Measurement of the HOM-coupler signals in the **time-domain** with a spectrum-analyser set to zero-span.

- Analysis the signal decay after the bunch passage to determine the Q-value of the mode.
Measurement of the HOM-coupler signals

HOM Measurement Setup

accelerating structures:
2 superstructures (2 * 7-cell 1.3 GHz cavities) with 6 HOM-couplers

HOM-coupler signals
10 dB attenuators
SP6T microwave coaxial relais
microwave spectrum analyzer
microwave power meter

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Instrumentation details:

- 10 dB attenuators in the HOM-coupler signal path to reduce reflections and prevent overload of the spectrum-analyser.

- Measurement (network-analyser) of the insertion loss: HOM-coupler output – to – spectrum-analyser input of each HOM branch.

- GPIB-controlled SP6T microwave relais (Keithley S46 microwave switch system).

- The spectrum-analyser (HP E8563E) has to be external triggered (plus evt. appropriate gating of the video signal), resolution and video bandwidth has to be set to moderate values (typ. $\geq 100$ kHz).
GPIB instrument control and software:

- Spectrum analyser (plus evt. added power meter) and microwave switches are computer controlled through a LAN/GPIB gateway.

- A semi-automatic measurement procedure “HOM Search” (written in Agilent VEE Pro), running on a HP workstation, controls the instruments and stores the data.

- The driver sections for the new Keithley switch unit have to be rewritten, new drivers for the power meter have to be included!

- Other features could be further included into the procedure, like online Q-value determination...
Measurement of the HOM-coupler signals

Semi-automatic HOM measurement procedure “HOM Search”.

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Measurement of the BPM signals

Beside (?!?) the re-entrant cavity BPM (C. Magne), a **stripline BPM** (DESY-Zeuthen) will be used for the dipol mode search and analysis:

- The stripline BPM delivers high-level (100 mV range) broadband pulse signals, keeping the bunch structure.
- The read-out electronics of the undulator BPM’s (with very little modifications) will be used for the signal processing.
- Both planes (horizontal and vertical) can be analysed simultaneously.
Measurement of the BPM signals

- Single bunch position resolution is expected to be 50...100 \( \mu \text{m} \) @ 10 ns (!) measurement time.

- Limitations of the present electronics:
  Intensity dynamics may be limited to only 3...4.
  Beam position range is limited to 30...50 % of the aperture.

- For the data acquisitions a oscilloscope (Tektronix 7404) is foreseen, it can be computer controlled directly over the LAN.

- The setup of all this new hard- and software requires approx. 3 weeks of preparation!
Measurement of the BPM signals

Schema of the “monopulse” AM/PM BPM read-out electronics: Major modifications TBD: Bypass of the LNA’s and the T&H amp.

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The BPM electronics is implemented as modular hardware
The single bunch analogue position signal of the BPM electronics (between LP and T&H amp) resolves the beam displacement within 10 ns!

For the data acquisition of the individual beam positions of all bunches in the train a commercial oscilloscope (*Tektronix 7404*) will be used.
At least 6 Beam position monitors (BPM) are located along the linac. Button BPM’s at the injector, stripline BPM’s (Zeuthen type) at the accelerating structures and in the spectrometer.

- The read-out electronic system of the undulator BPM’s will be re-arranged and used for beam orbit / energy measurements.
- Data-acquisition time is limited to the usual 1 $\mu$s ($\equiv$ 1 MHz), the resolution is expected to be $\approx$ 100 $\mu$m.
Measurement of beam orbit and energy

- All hardware components are available; analogue read-out electronics, VME ADC- and trigger-boards, VXI- and VME-crates...

- Cableing will be an issue, only a few cables may be re-used. Good BPM performance requires well matched (electrical length) cables of high quality.

- The setup of the new infrastructure needs time and manpower!