Working Group 1

High Power RF Distribution System

Introduction

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SPL General considerations:

Nb. of SC cavities: **234**
Power per cavity: up to 1MW (high β section)
RF pulse length/frequency/current: **LPSPL** 0.6ms -1.2ms / 0.4-1.25 Hz / 20mA
HPSPL 0.4-1.2ms / **50Hz** / **40mA**

Remarks:

- low β region: less power per cavity required
- **HPSPL vs LPSPL**: Same peak power but much higher average power, Important implications on power distribution scheme

Operation at 704.4MHz	**Application**	**RF Duty Cycle [%]**	**P pk [kW]**		**P av [kW]**	
cavity Beta			0.65	0.92	0.65	0.92
LP-SPL	LHC Injector/PS2/RIB	0.39	270	475	1	1.8
HP-SPL	"neutrino operation (0.4ms)"	3.92	540	950	21	37
HP-SPL	"high-power EURISOL (1.2ms)"	7.92	540	950	42	75

Same scale as LEP 2 RF system…. 272 cavities, ~ 40 klystrons installed

WG1 Workpackage Description - 1

Distribution of RF power from one 5-6 MW klystron (704 MHz) to 4/8 and, if possible, up to 16 cavities with the capability of adjusting/controlling the amplitude and phase of each cavity individually. The phase/amplitude control of the single cavity fields will have to reach a precision of -+ 0.5% and -+ 0.5 deg.

The following conditions apply:

- The input power couplers will be matched for an average current of 40 mA, yielding a maximum power per cavity of ~1 MW, (Qext ~ 1.0E6)
- Operation at 20 mA is foreseen using the same input power couplers, yielding a reflected power from the couplers of ~11%, and yielding a peak power per cavity of up to ~0.5 MW (+ reflected power),
- A power budget of 30% is foreseen to compensate cavity detuning caused by Lorentz Forces,
- The system must be designed for 50 Hz and a maximum RF pulse length of 2 ms,
- Due to space restrictions in the klystron tunnel the RF splitting has to be done in the accelerator tunnel.
- We assume a single RF output from the klystron. If it becomes apparent during the R&D phase that one output is not feasible due to restrictions on the window or due to a high risk of sparking 2 klystron outputs will be considered.

WG1 Workpackage Description - 2

The distribution system has to aim for the following features:

- Possibility to adjust for different gradients and phases (via mechanical phase shifters) in the cavities of one string without a large overhead of reflected power, this implies the use of variable splitters, which can be adjusted mechanically,

- Ideally there should be a possibility to “remove” a single cavity from the RF distribution in case of technical problems. This could be done by either detuning the cavity and/or adjusting the variable splitters to minimise the reflected power.

- “fast” phase/amplitude shifters should be used to compensate for transient effects such as Lorentz force detuning. These units should have a bandwidth in the 10 kHz range with approximately 50 us rise time, providing a phase/amplitude adjustment of -+60 deg/12 db.

- Space is a major concern, which means that the RF distribution system should be as compact as possible.

- It is desirable to be able to operate a string of cavities, even if one cavity of the string cannot be used. One can imagine a mechanical intervention to “manually” block the RF power from reaching this particular cavity. In such a case that RF distribution system should still allow the operation of the remaining cavities of the string.