9mA study plan – DESY, Sept. 2009

Cavity model / cavity coupling optimization with beam

Goals for the study:

Demonstrate optimal tuning of power division, loaded Q (Q_L) and resonance control for ILC-like operating conditions. (NOTE: We are aware that not all knobs will be available compared to simulation work but we still think an optimization is possible with what's available.)

- Verify cavity model against experimental data (understand discrepancies + improve model)
- Calculate and implement coupler/power tuning optimization (benefits for power, for gradient, for beam loading?)
- Develop a calibration and machine setup procedure (commissioning coupling of a multi-cavity/single klystron machine)

Preparation:

1. compare model with results from previous study
2. enquire about which parameters can "easily" be modified on site (tuning range?)
3. enquire about which parameters can "easily" be measured on site
4. understand tuning ability of the motorized 3-stub tuner vs. motorized couplers
5. update model with knobs available at DESY and actual tuning parameters
6. investigate optimization scheme with available knobs using simulation

no beam study (on-site):

1. record all possible parameters: Q_L, Power to each cavity, detuning, gradient
2. verify cavity behavior against simulation → understand/update/modify
3. investigate cavity behavior at different gradients
   (Lorentz force detuning effect? Piezo compensation? High power limitations?)
4. update cavity model

low gradient, beam ON study (on-site):

1. running with beam, observe and measure beam loading effect as we lengthen the flat top
2. beam loading effect match predicted behavior? (cavity gradients above vector sum droop, cavity gradients below vector sum increase?)
3. if simulations match experiment, look for coupling optimization to optimize gradient, to optimize power consumption
4. if not, try to understand discrepancies between theory and experiment
5. if possible, suggest tuning calibration (Q_L, P_k) and see impact on vector sum, on beam energy, on power consumption, on reflected power

high gradient, beam ON study (on-site):

1. if all above succeeded, increase gradient while maintaining 9mA beam
2. limitations ? high power tripping ?
3. is the model still valid at higher gradients ?
4. can more complexity be added to the model (non-linearities, saturation effects)

study wrap-up:

1. documentation of results
2. ideally, results allow us to propose a calibration procedure for commissioning the coupling of single-klystron / multi-cavity super conducting linacs.