WG 3 Report
Superconducting RF and RF Control

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Acknowledgements and Thanks

- All the speakers – all 25
- Everyone who attended the sessions, especially the volunteer notetakers
- Jens and Matthias for putting the programme together, and all their hard work
- Lia and Swapan for making it all possible and being excellent hosts

Charge

- …to identify critical SRF related items for the construction of ERLs, evaluate the readiness of the related science and technology, and to lay out an R&D path for solving remaining open issues.

Charge

- Review parameter space covered by ERLs, concentrate on the „tough ones"
- What are the SRF-related ERL-specific challenges?
- What solutions have already been developed?
- Which components still need more R&D work?
- Organise R&D effort, develop a roadmap to coordinate studies and identify collaborative possibilities

Program

1. Introduction and Overview
2. Cavities/Modules
3. Cavity Cell Shape/Design
4. HOM Damping and Power Requirements
5. High Q Operation
6. Microphonics
7. Tuners
8. RF Control
9. Couplers
10. RF Power Sources and Transmission
11. Assembly – Transfer to Industry
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Highlights and Recommendations
Cavity Shape

- Can optimize cavity shape for losses and HOM extraction simultaneously.
- 500 MHz cavities are not option at present.
- For up to 100 mA, present L-Band technology works. Residual losses (at low Tbath) push up frequency.

Highlights and Recommendations
HOM Damping

- Many schemes will work equally well, (except for loop couplers). Based on simulation and initial experiments
- Q = 10^3 to 10^4 which is good enough for 1 A machines.
- HOM power is a concern

Highlights and Recommendations
Cavity Preparation

- Q research still needed,
- Q 10^{10}, 20 MV/m
- EP not necessary, but may help
- Single crystal cavities are proving very promising and may be cheaper. Needs more research!
- Also magnetic shielding in modules needs to be investigated and possibly improved!!!

Highlights and Recommendations
Microphonics

- Proof of principle that low (10Hz pk) microphonics modules exists.
- But even high-microphonics can be controlled so again this is a cost issue!
- Microphonics fluctuate from cavity to cavity and this must be investigated with big statistics at JLAB or SNS.
- Also correlations must be investigated.

Highlights and Recommendations
Tuners

- Piezo element is required for fine tuner control
- Several designs have been tested (RIA has shown active control)
- Reliability is still a concern

Highlights and Recommendations RF Control

- No fundamental limit to operation $Q = 10^8$
- Proof of principle 10^{-4} is OK and 0.01 deg is OK.
- Distribution system must be able to handle this.
- The consensus was that a digital system was the way to go.

Highlights and Recommendations
Power couplers

- Power couplers suitable for the main linac have been demonstrated
- Injector power coupler under development
- Adjustability is desirable, but may not be essential
- Coupler is a critical item and cost driver.

Highlights and Recommendations
Power Sources

- IOTs look like the way to go for main linac, development nearly complete.
- Drive amplifier becomes a cost driver.
- Efficiency must still be demonstrated with the gain same time.

Highlights and Recommendations
Technology Transfer to Industry

- Lab must demonstrate in more module than 1 that the desired guarantees can be achieved.
- Small labs cannot do this and must therefore do "research" together with the bigger Labs and industry.

Highlights and Recommendations Cryogenics 1

- Fight residual resistance, then go lower in temperature (down to 1.8 K looks safe), retrofit system is possible.
- Module design for 2K should work at 1.8K provided BCS losses dominate.
- Capital cost does not increase as you lower the temperature (provided BCS losses dominate.) You trade off cold compressors versus warms screw compressors.

Highlights and Recommendations
Cryogenics 2

- Design headroom used is 50% by several large institutions. (This is a minimum)
- 4 K shield comes for free (capital cost versus 10 year operating) and 4K heat intercept is useful for coupler etc. anyway. And each 2K watt takes you closer to the limit. (Based on the TESLA module)

Highlights and Recommendations
Injectors

- Active field, three projects (Cornell injector, JLab 100 mA injector and 4GLS 4 mA).

Conclusions

- Did we meet our Charge

Probably

The next few weeks will tell