Charge of WG1.

- Identify top level RF parameters for ≠ applications and provide RF Control system requirements (required A & ϕ control, etc...)
- List of various conceptual designs. (SEL or GDR, A/ϕ or I/Q, etc...)

loaded Q lowest Q for SNS → large cavity bandwidth
for moderate Q → RF match between RF source & load
when beam current is low → Q-value rather
determined by klystron level.

Lorentz force issue for pulsed machine with high G.

- presentation of G. Giovati on SNS prototype cavities.
  stiffening rings don't help if 'He-tank + tuner' system
  not stiff enough.
  present design for medium-β cavity ≃ 4 Hz / (MV/m)^2
  factor 2 larger than the specification.
- for application requiring very high gradient
  (TESLA 800 GeV) → active compensation
  with piezo-tuner is needed!

Beam phase Except for TESLA & CEBAF
running nearly on-crest
most of applications have non-zero synchronous phase
→ need cavity detuning for beam-loading compensation

No of cavities / klystron

- with relativistic $\bar{e}$ beams, multiple cavities powered by 1 common K easily controlled by the vector-sum (assuming good calibration)
  → TESLA plans to feed 36 cavities by 1 single K.
- However with proton beams, even when vector-sum is kept c^t perfectly, individual cavity voltages can fluctuate with large amplitude giving large error in the effective accelerating field.
  → could be envisaged only at high energy (> 400 MeV)

Nearest Mode

- To prevent from exciting the nearest mode a filter with high attenuation must be implemented
- But, if this mode is very close to the accel. mode the BW and then the performance of the system will be strongly degraded.
- Note: about same distance for all applications except for TESLA superstructure
  → critical issue for the RF system.

Klystron saturation.

In saturated regime, K has no gain any more and feedback is lost.

reasonable power margin from saturation ~ 10%

→ SNS could have some difficulties for a few cavities

Bunch charge fluctuation

critical issue when > 5%

expected fluctuations seem not severe for all applications

List of various conceptual designs

= input for WG2. → only few general comments.

- Self-Excited-Loop vs. Generator Driven Resonator.

loop frequency (= generator) tracks cavity frequency
well suited for cavities with large frequency variations.
CW = has been used for many years in heavy-ion accelerators
pulsed operation = implemented on TTF capture cavity.
with a seed at start-up.

→ with feedback
both systems have very similar behaviour.
(same performance, same total extra-power
although in-phase & in-quadrature components
are ≠ distributed).

→ during filling time (for pulsed operation)
with SEL = the proper input power is automatically
generated (even with non-linearities –
lorentz force – or with pre-detuning).
with GDR = the proper input power has to be
predetermined (to mimic what a SEL does)

⇒ Difference is rather in implementation

- I/Q vs. A/ϕ feedback.

  I/Q modulator should provide better performance.
  (cavity detuning recovered by a simple Q component instead of A + ϕ signals → 5. Delay ...).

  I/Q detectors = less clear
  (A-detector with Schottky-diode has lower noise).

  I/Q well suited in digital systems
  (components available with good linearity + no offset).

- Analog / Digital.

  Analog → lowest delays, highest feedback gains

  Digital → more flexible, diagnostics.
  feedforward ...

  for extreme performance → Hybrid system could be the solution!

  | fast feedback loops 'analog'
  | adaptative feedforward 'digital'