



清華大學
Tsinghua University

ACCELERATOR LABORATORY
of TSINGHUA UNIVERSITY 

Development of a parallel-coupled structure for short filling time

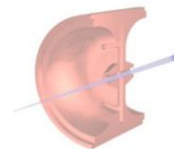
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2022/5/17

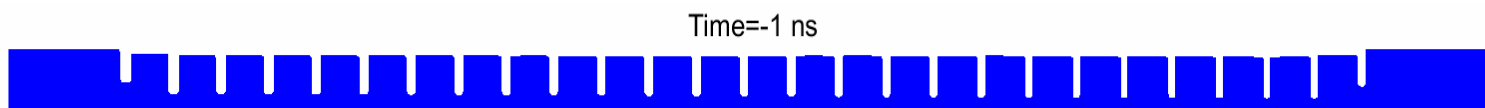


Why parallel-coupled structure?



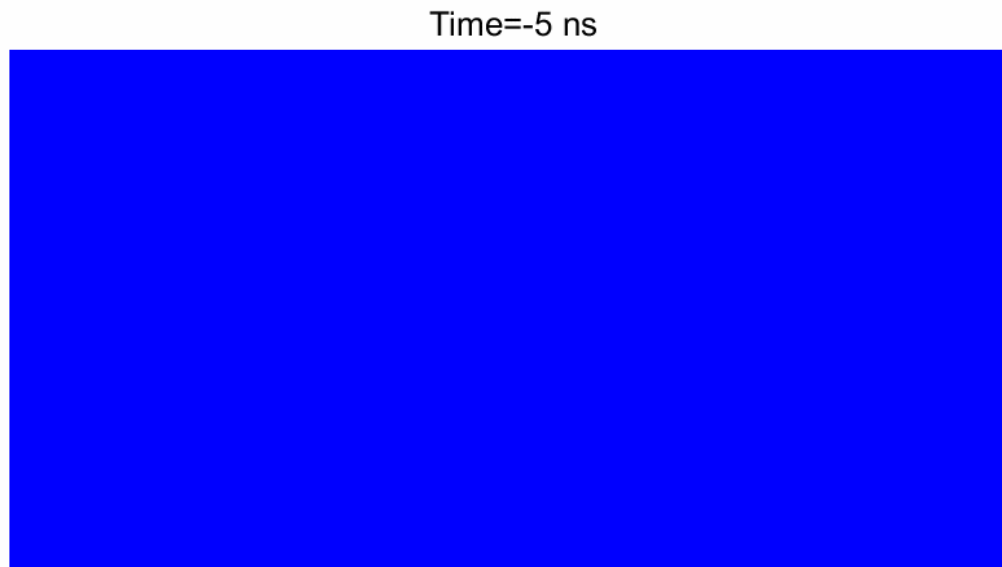
➤ Traditional structure

- **Typical input pulse length > 100 ns**



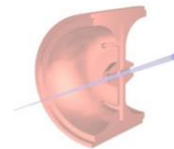
➤ Parallel-coupled structure

- **The input pulse length can be shortened to 10-ns scale.**





Theory and Design



➤ Coupling coefficient of the whole structure

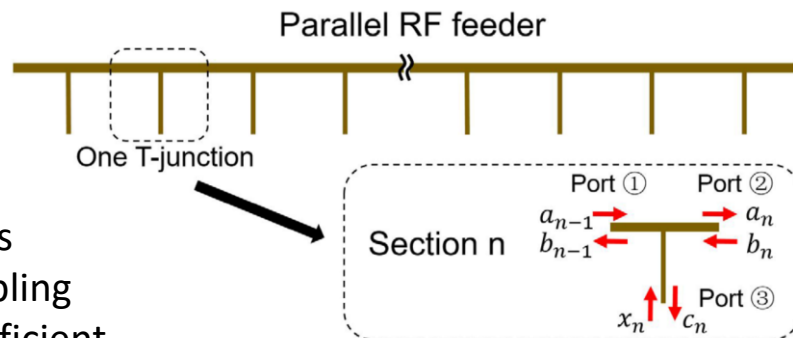
$$\beta' = (2N\rho)^{\mp 1} \beta = \left(2N \frac{1 - |S_{33}|}{1 + |S_{33}|} \right)^{\mp 1} \beta$$

Structure's coupling coefficient

The number of manifolds

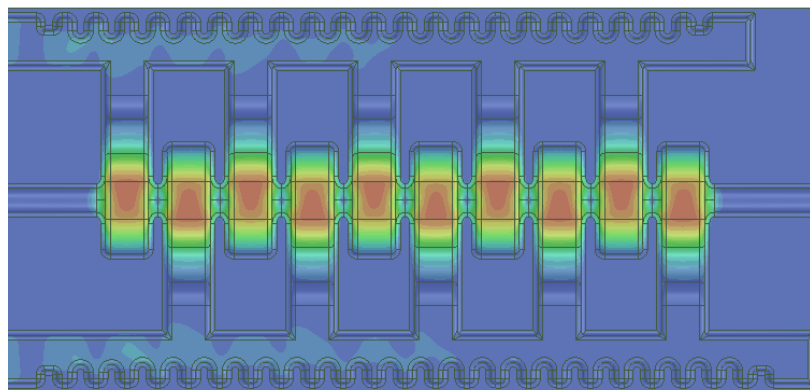
Port 3's reflection of a T-junction

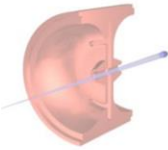
Cell's coupling coefficient



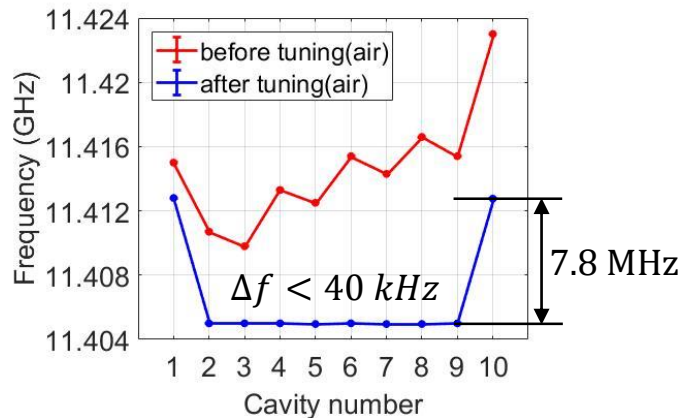
➤ Parallel-coupled structure based on corrugated waveguides

Parameters of 125 MV/m	
Pulse length	40 ns
Input power	100 MW
Iris aperture	2.75 mm
Max E-field	330 MV/m
Max Sc	12 MW/mm ²
Average shunt impedance	90 MΩ/m

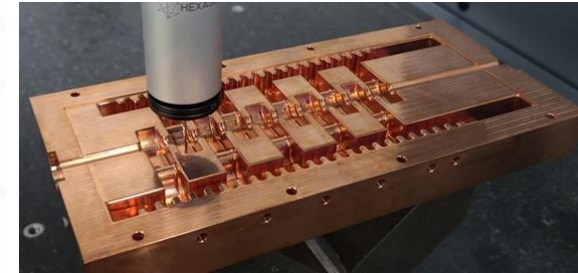
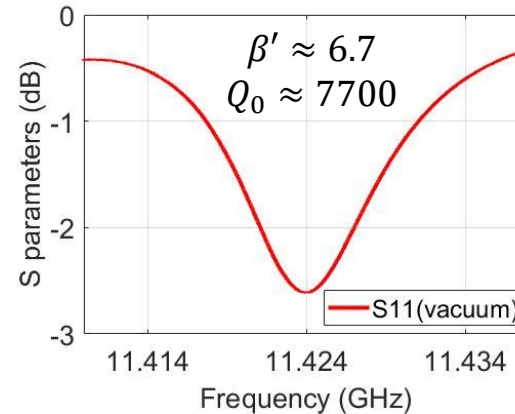




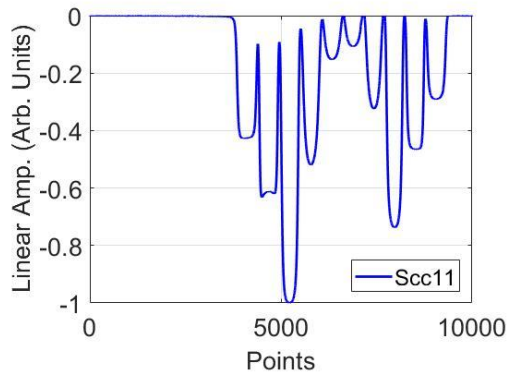
1. Frequency tuning



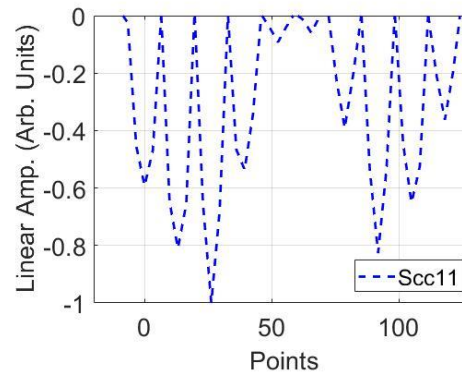
2. S-parameter (whole structure)



3. E-field distribution measurement (non-resonant method)



Measurement

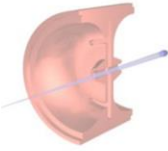


Simulation

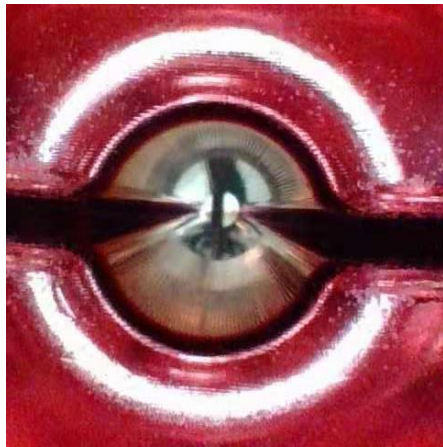
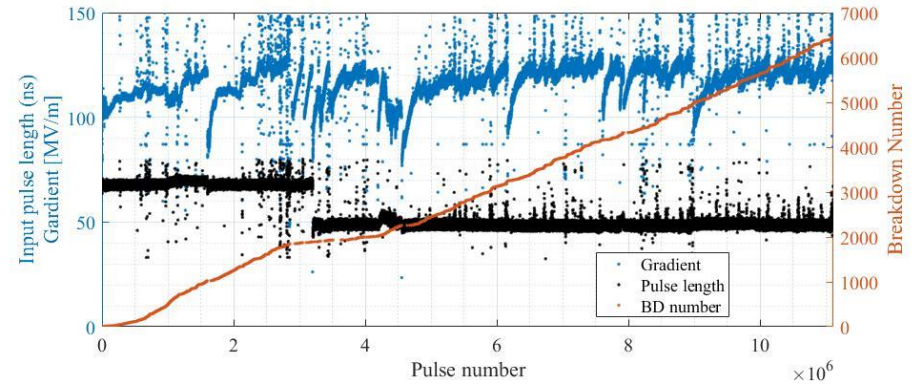
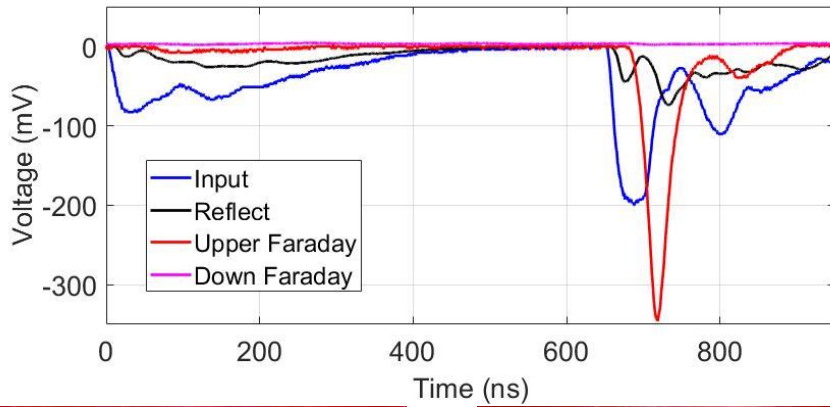
The relative change of the total reflection during bead-pulling can not indicate the field distribution directly due to inter-cavity power coupling.



High power tests



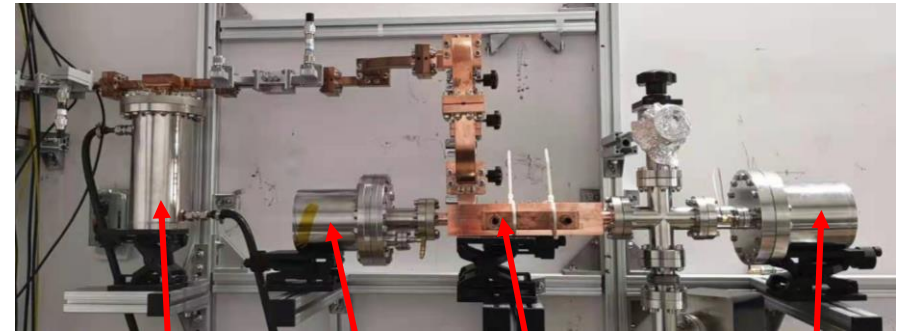
- 1×10^7 pulses, 125 MV/m achieved at 40 ns, BDR $\sim 5 \cdot 10^{-4}$ /pulse
- Conditioning based on two-stage pulse compression is ongoing...



Cell 1 (left)



Cell 5 (left)



Pulse compressor Faraday cup Parallel-coupled structure Faraday cup