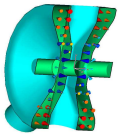
LA-UR-02-6141

# MECHANICAL DESIGN OF THE AAA $\beta$ =0.175 SPOKE RESONATOR

**Dale Schrage**
**LANL**

**Workshop on the Advanced Design of Spoke Resonators**

**Los Alamos, NM, USA**
**October 7 and 8, 2002**

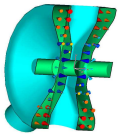


# ENGINEERING & DESIGN

- **Cavity FEA: Richard LaFave**
- **Cavity Mechanical Design: Phil Roybal**
- **Cavity Physics Design: Frank Krawczyk**
- **Advisors: Ken Shepard, Jean DeLayen, Brian Rusnak**

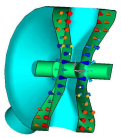
# CAVITY REQUIREMENTS

| PARAMETER | VALUE |
|---|---|
| Resonant Frequency | 350 MHz |
| Beam Current | 13 - 100 mAmps |
| # of Gaps | 2 |
| Geometric $\beta$ | 0.175 |
| Operating Temperature | 4.5 K |

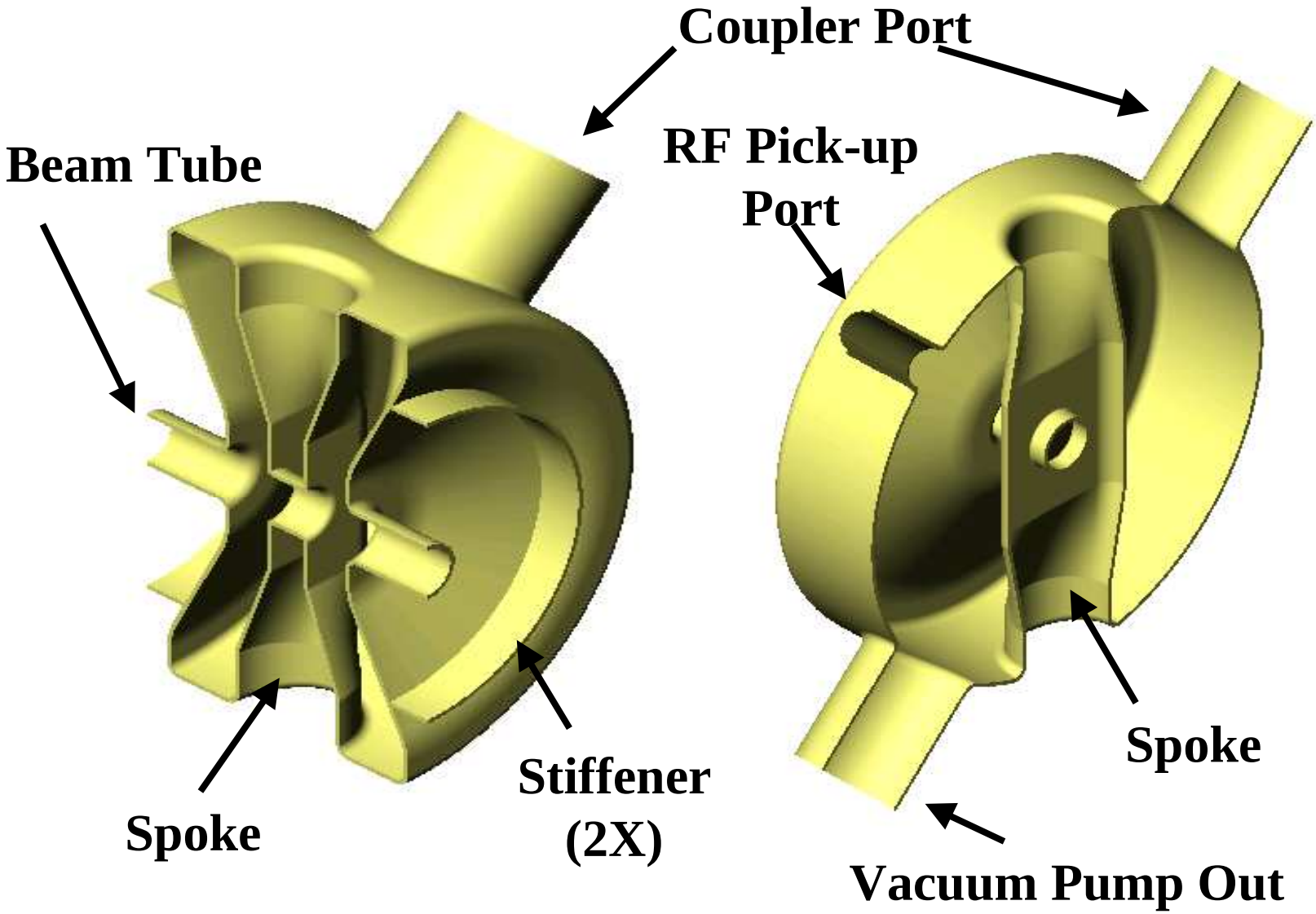


# CAVITY DESIGN PROCEDURE

1. CREATE UNIGRAPHICS MODEL
2. EXPORT TO MAFIA
3. RUN MAFIA
4. ITERATE STEPS 1, 2, & 3 UNTIL SATISFIED
5. EXPORT MODEL TO SOLIDWORKS
6. CREATE STRUCTURAL GEOMETRY
7. CREATE MESH
8. EXPORT TO COSMOS/M
9. RUN CAVITY MODULE (MICAV)
10. APPLY STRUCTURAL LOADS
11. RUN STRUCTURAL MODULE
12. TRANSFER RESULTS TO CAVITY MODULE
13. RUN CAVITY MODULE FOR FREQUENCY SHIFT

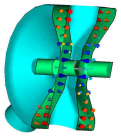


# AAA β = 0.175 SPOKE CAVITY



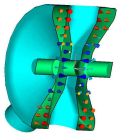
# SPECIAL FEATURES

- **ANNULAR STIFFENERS: USE TUNER FRAME FOR RIGIDITY**
- **CONFLAT™ FLANGES: MUST BE BRAZED ON**
  - **NEXT TIME CONSIDER NIOBIUM/TITANIUM IF TIME AVAILABLE FOR TESTING CONCEPT**
- **TITANIUM COLLARS: FOR TITANIUM HELIUM VESSEL, CAN BE WELDED DIRECTLY TO NIOBIUM**
  - **ALTERNATIVE IS STAINLESS STEEL HELIUM VESSEL**



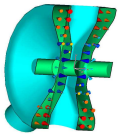
# STIFFENER CONSIDERATIONS

- **ANNULAR STIFFENERS:**
  - **CAVITY NOT STANDALONE RIGID**
  - **FACILITATES TUNING**
- **RADIAL STIFFENERS:**
  - **CAVITY IS STANDALONE RIGID**
  - **TUNING FORCES ARE HIGHER**



# STRUCTURAL ANALYSIS & TEST RESULTS

## THERE WAS GOOD AGREEMENT WITH PREDICTIONS

| | | PREDICTED | MEASURED |
|---|---|---|---|
| MANUFACTURING TUNING SENSITIVITY | kHz/mm | 770 | 747 |
| STRUCTURAL TUNING SENSITIVITY | kHz/mm | 894 | 783 |
| STIFFNESS | N/mm | $1.02\ 10^4$ | $0.52\ 10^4$ |
| BCP MATERIAL REMOVAL | kHz/μ | 3.6 | |
| VACUUM LOAD | kHz/atm | -44 | |
| THERMAL FREQUENCY SHIFT to 4K | kHz | 515 | |

**EFFECTS OF BCP, VACUUM, & TEMPERATURE WILL BE MEASURED SOON**