

**Project X Collaboration Meeting
325 MHz Cryomodule
Design Status and Plans**

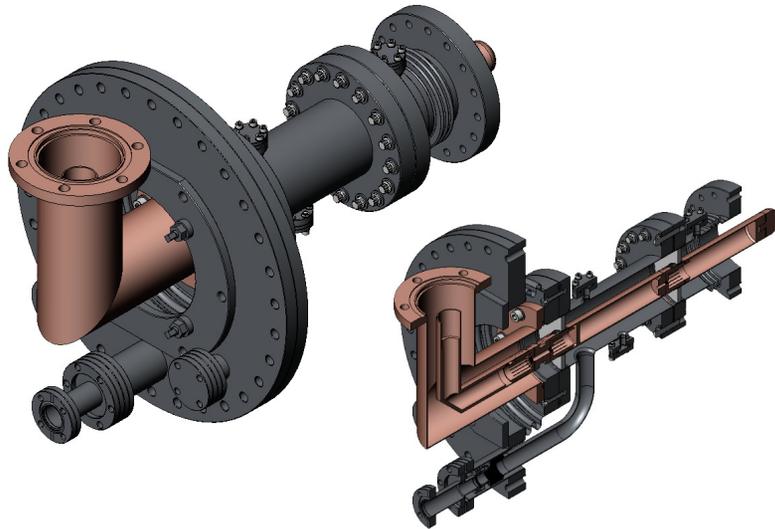
Thomas H. Nicol
September 11-12, 2009



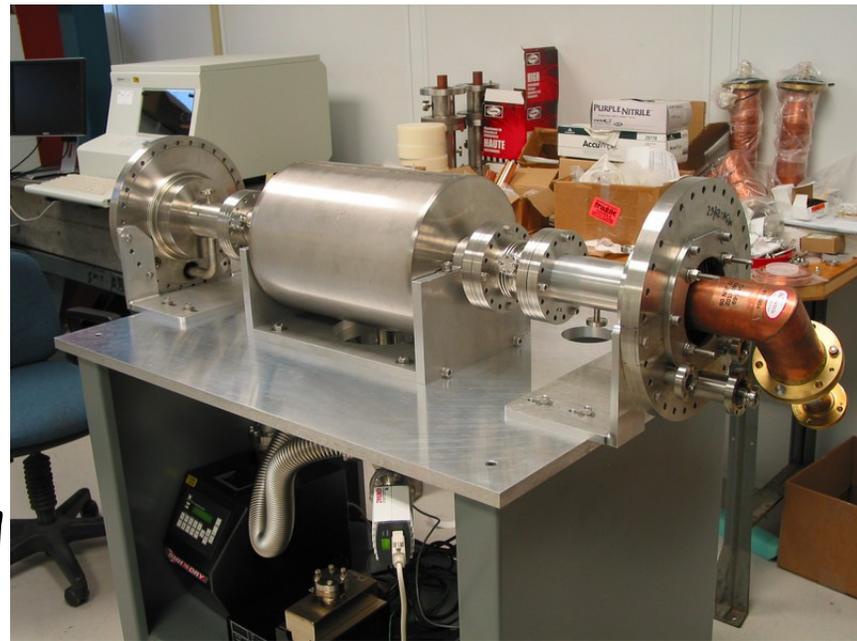
-
- Completed hardware and prototypes
 - Conceptual design ideas
 - Analysis examples
 - Cost estimate example
 - Schedule and resource overview
 - Summary

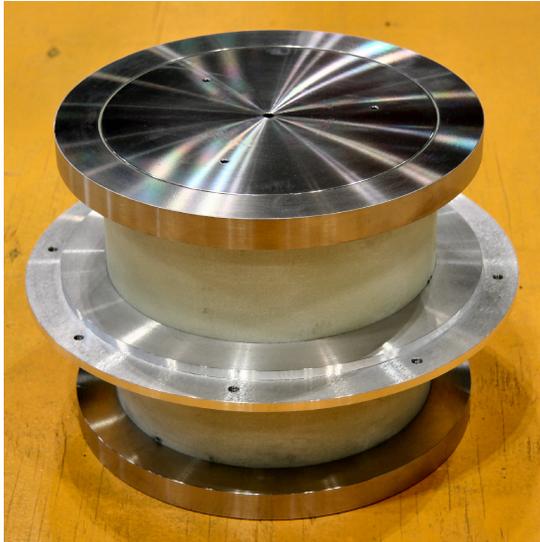


Complete
and nearly
ready for
installation
in MDB

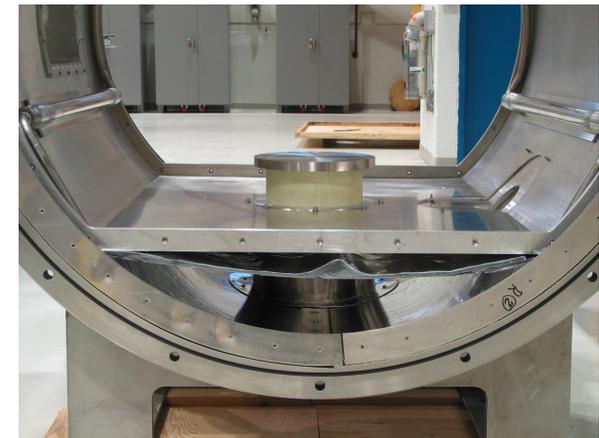


3 Fermilab-designed couplers complete and tested. 1 SBIR-produced coupler in-house and being tested.





2 supports built to date, one proof-tested to failure, one installed in the test cryostat.





2 cavities in-house, one from Zanon, one from Roark. 2 are in-process in India. An order for 10 more is in-process (bids just received).

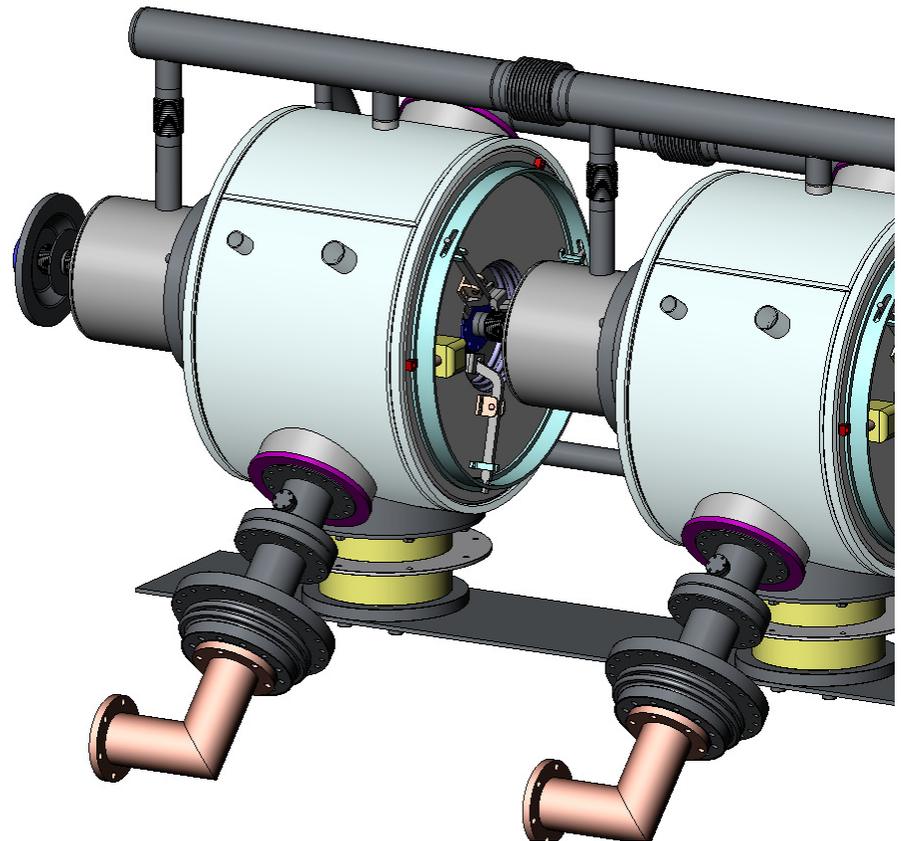
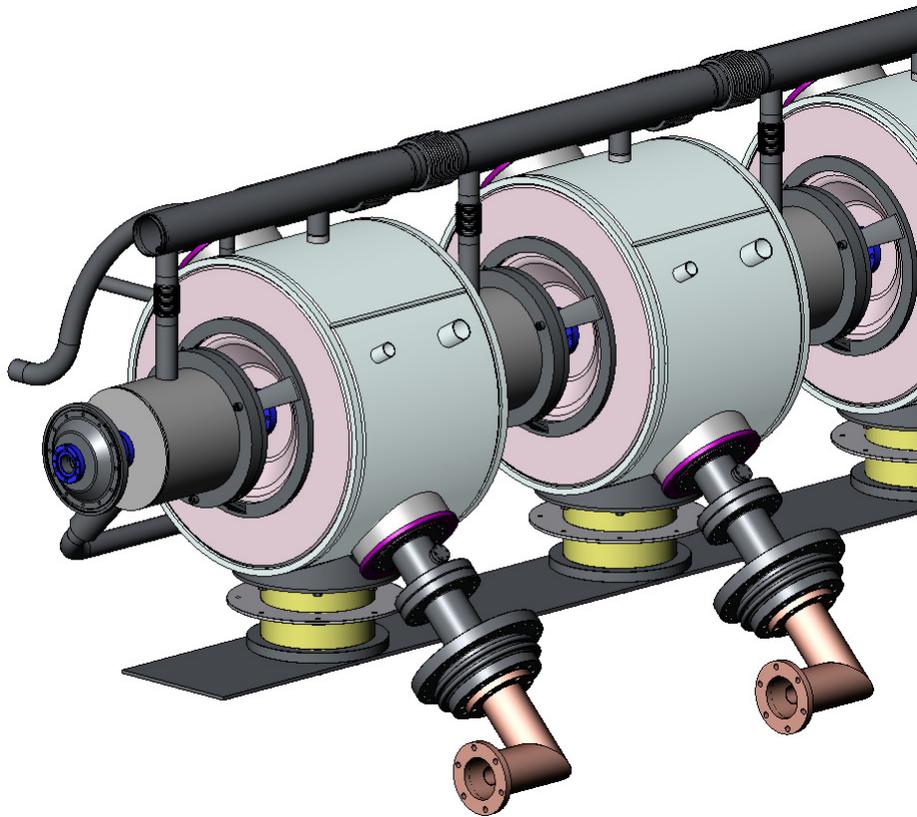


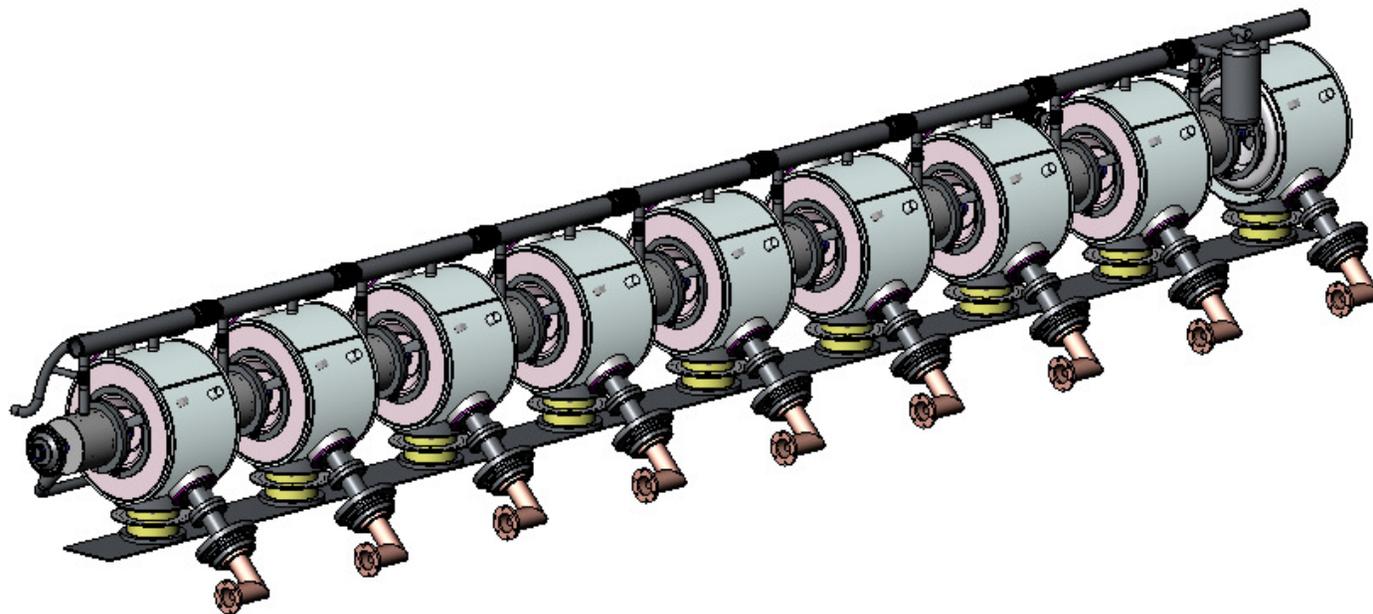
Parts for 2 helium vessels are in-house, one of which is being welded. One prototype tuner is being tested.

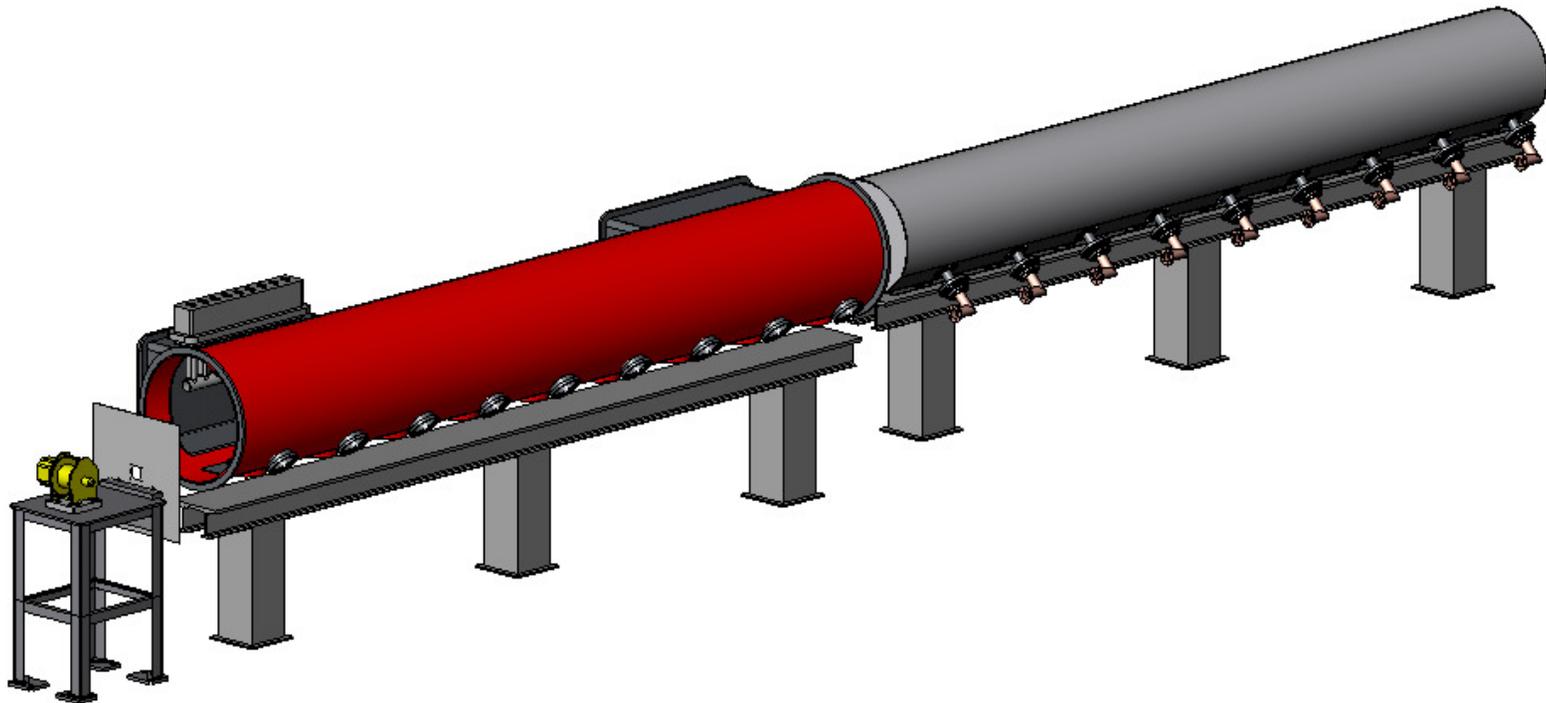


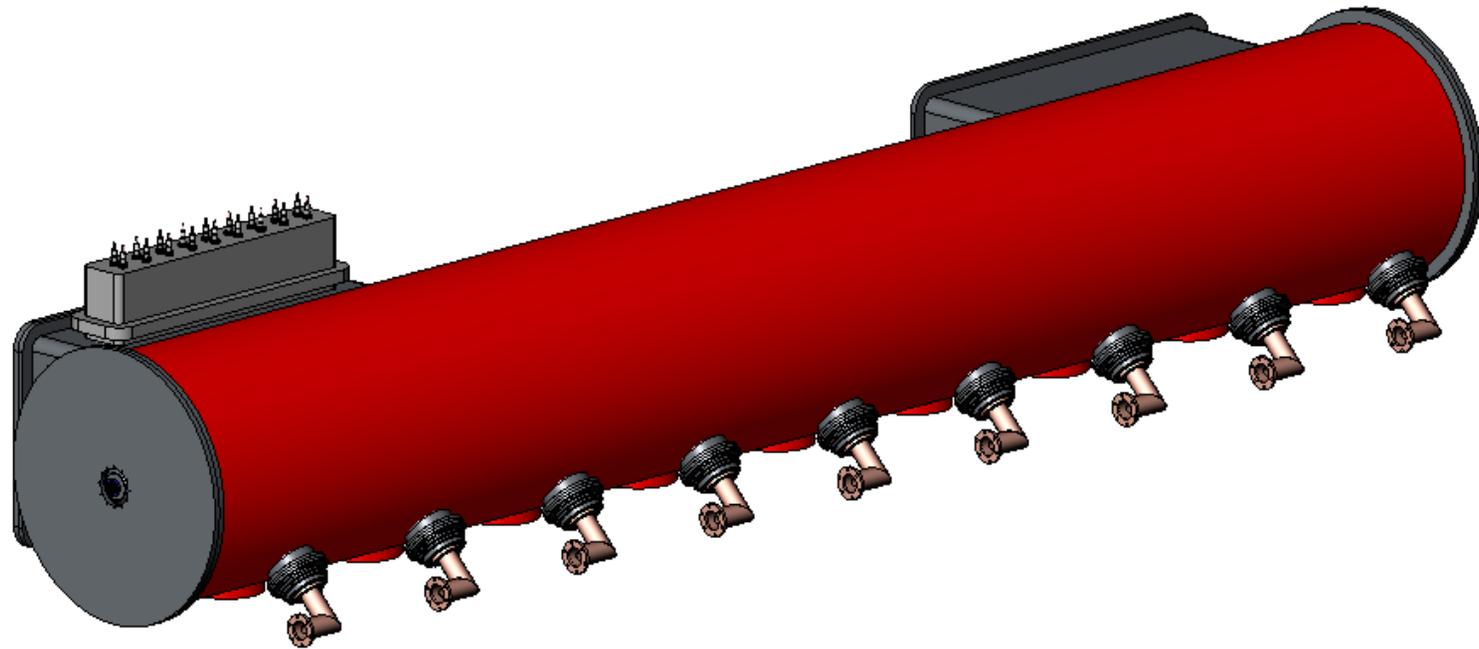
18 SSR1 solenoids have been built, about $\frac{1}{4}$ of those have been tested. One was cold tested in the test cryostat to evaluate the effectiveness of the magnetic shield.

Cryomodule Design Original Concept

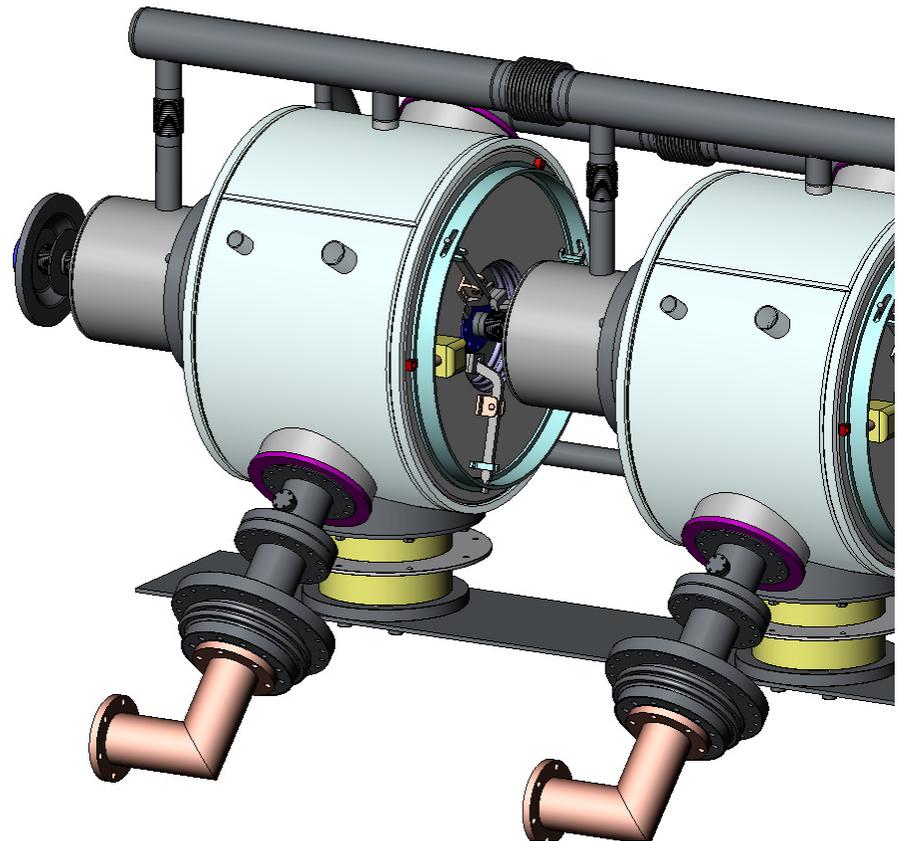
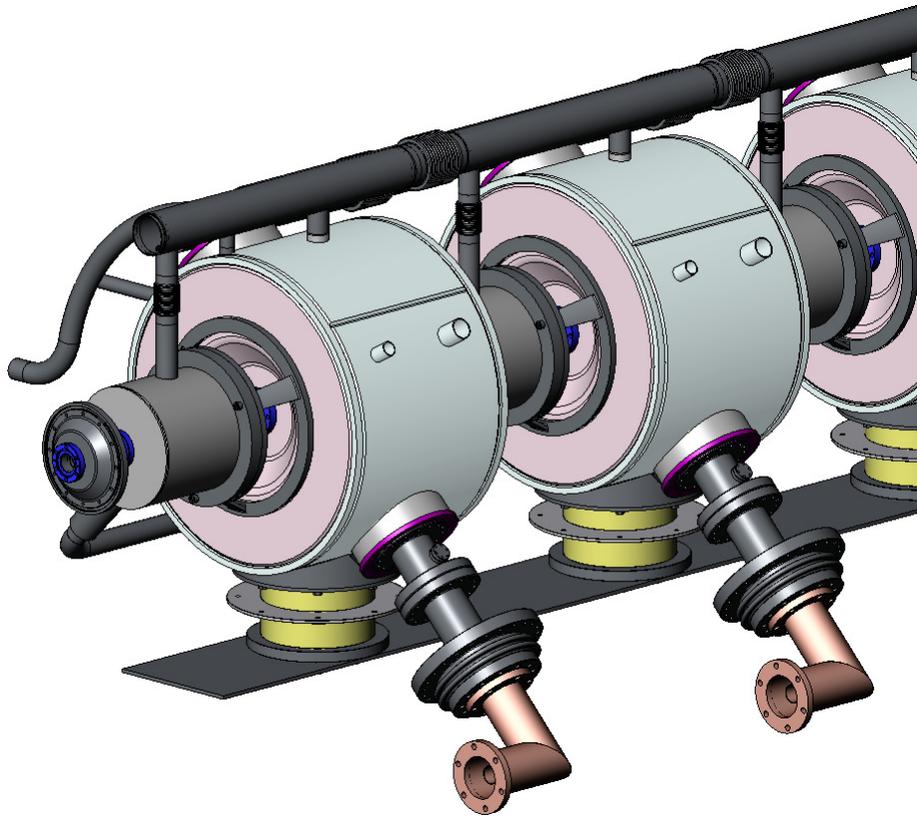


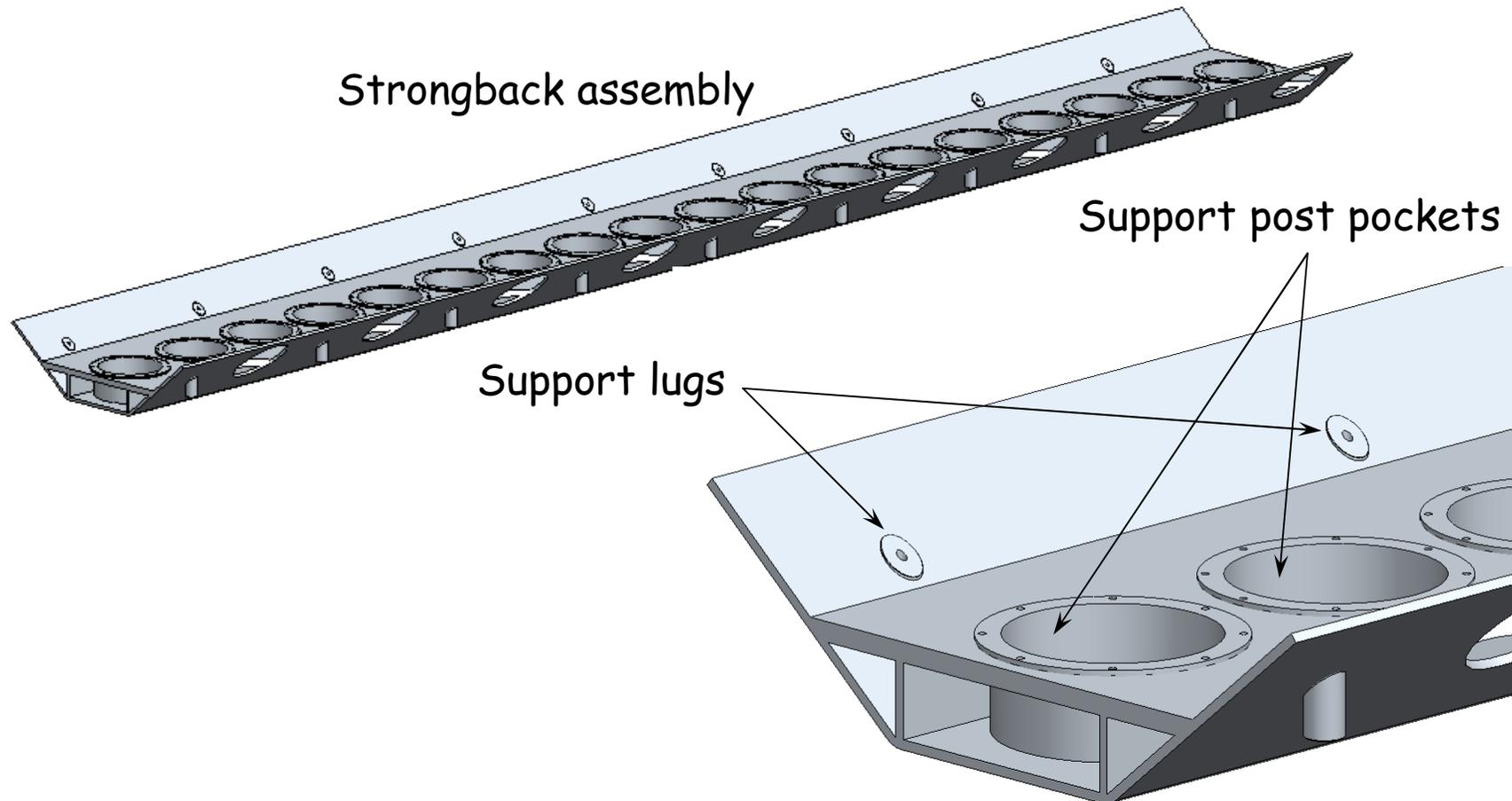


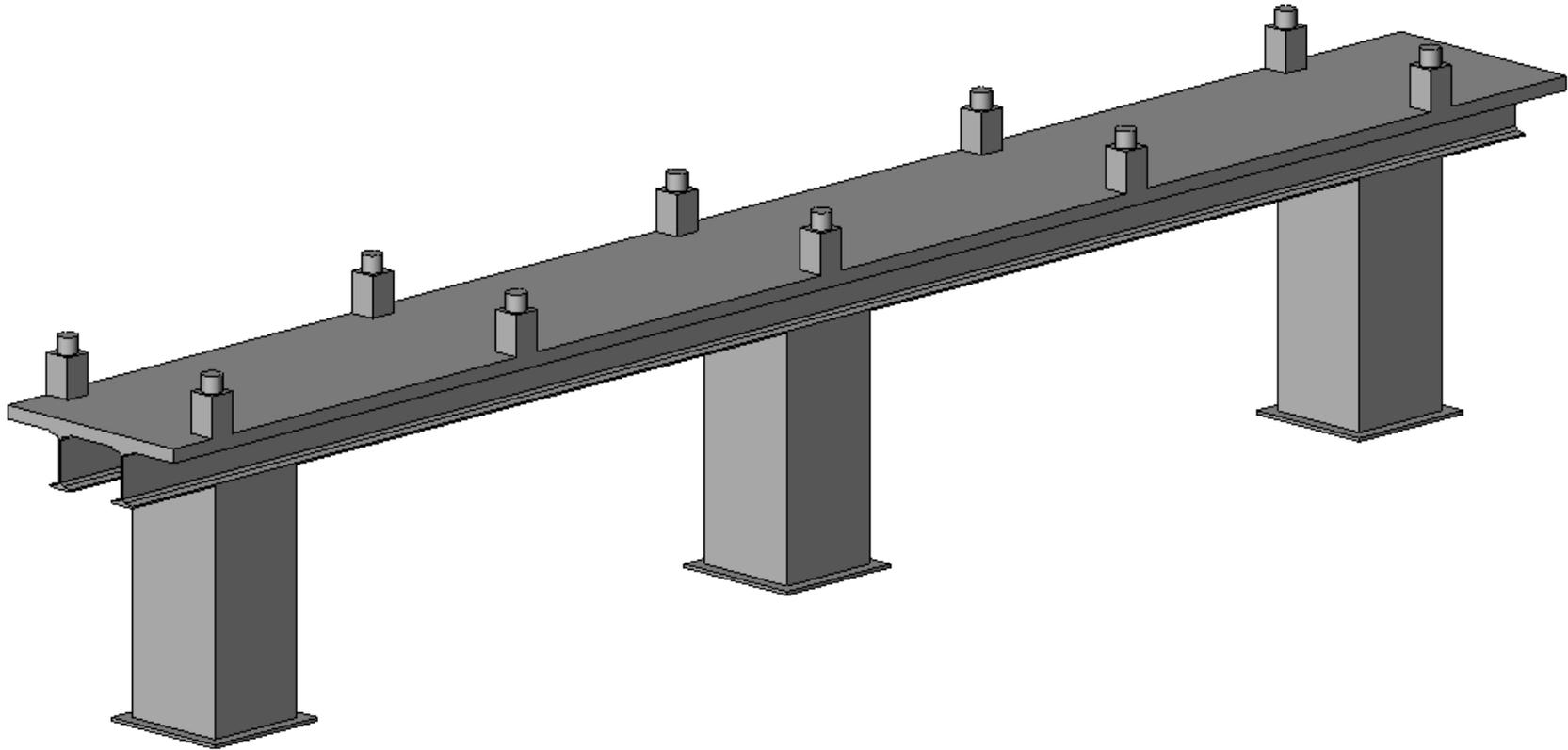


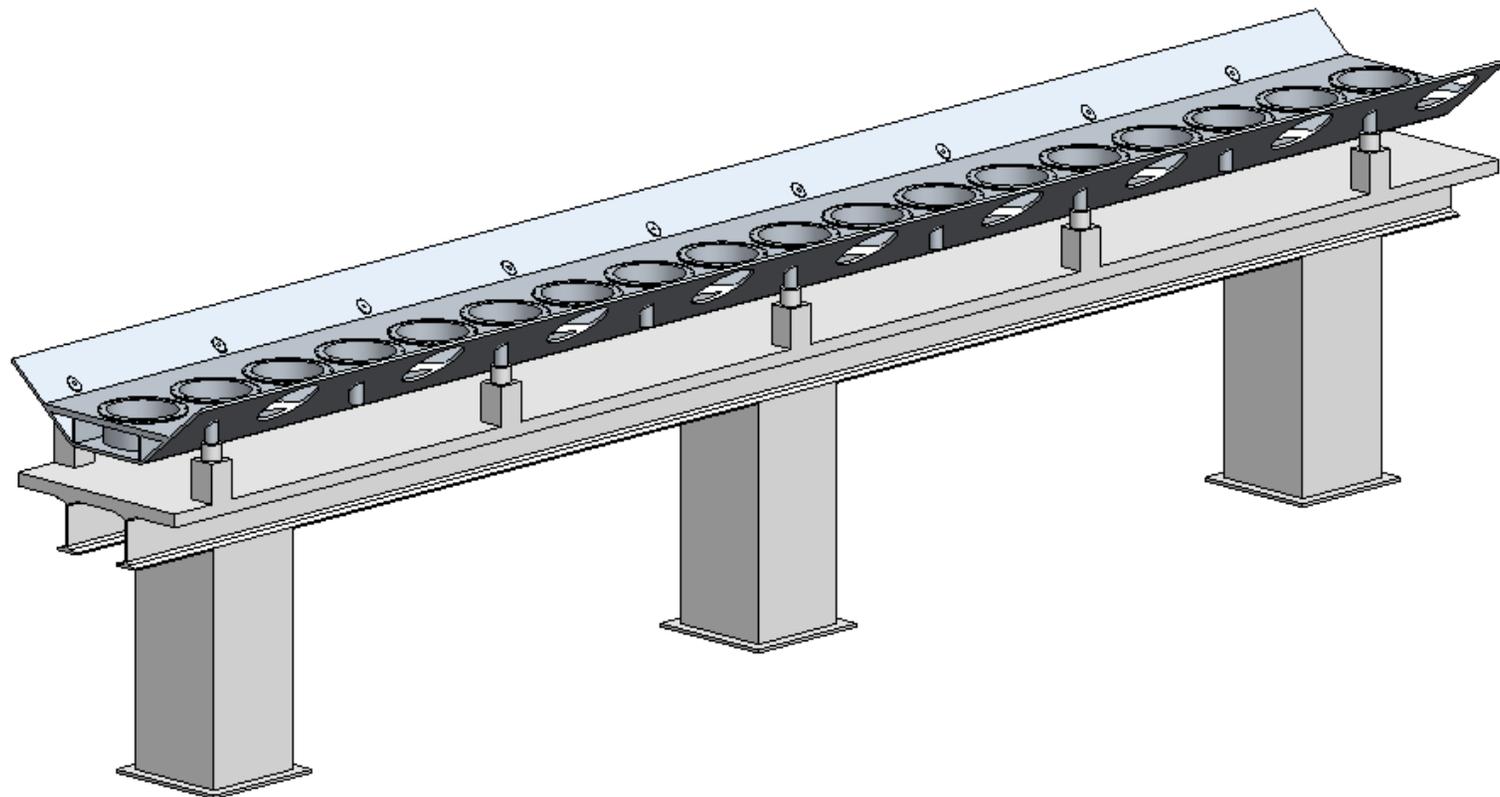


Original Concept What Was Wrong?

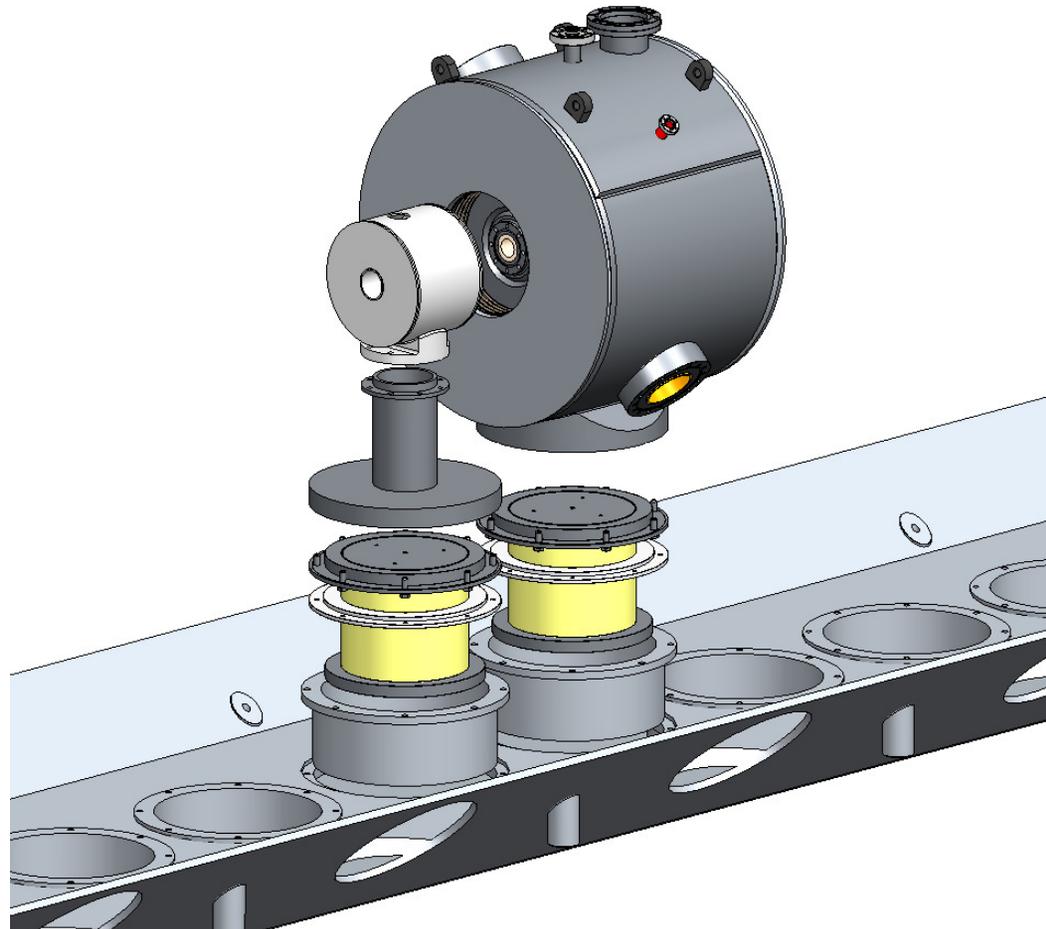


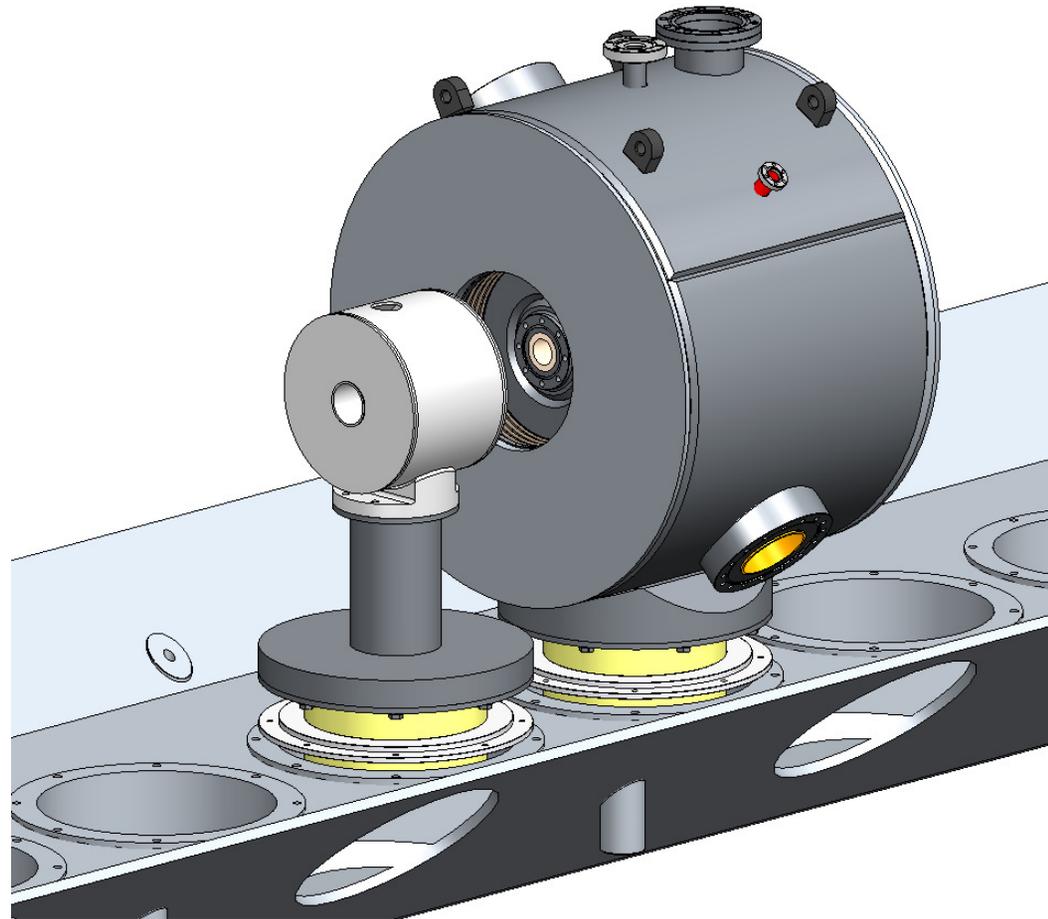




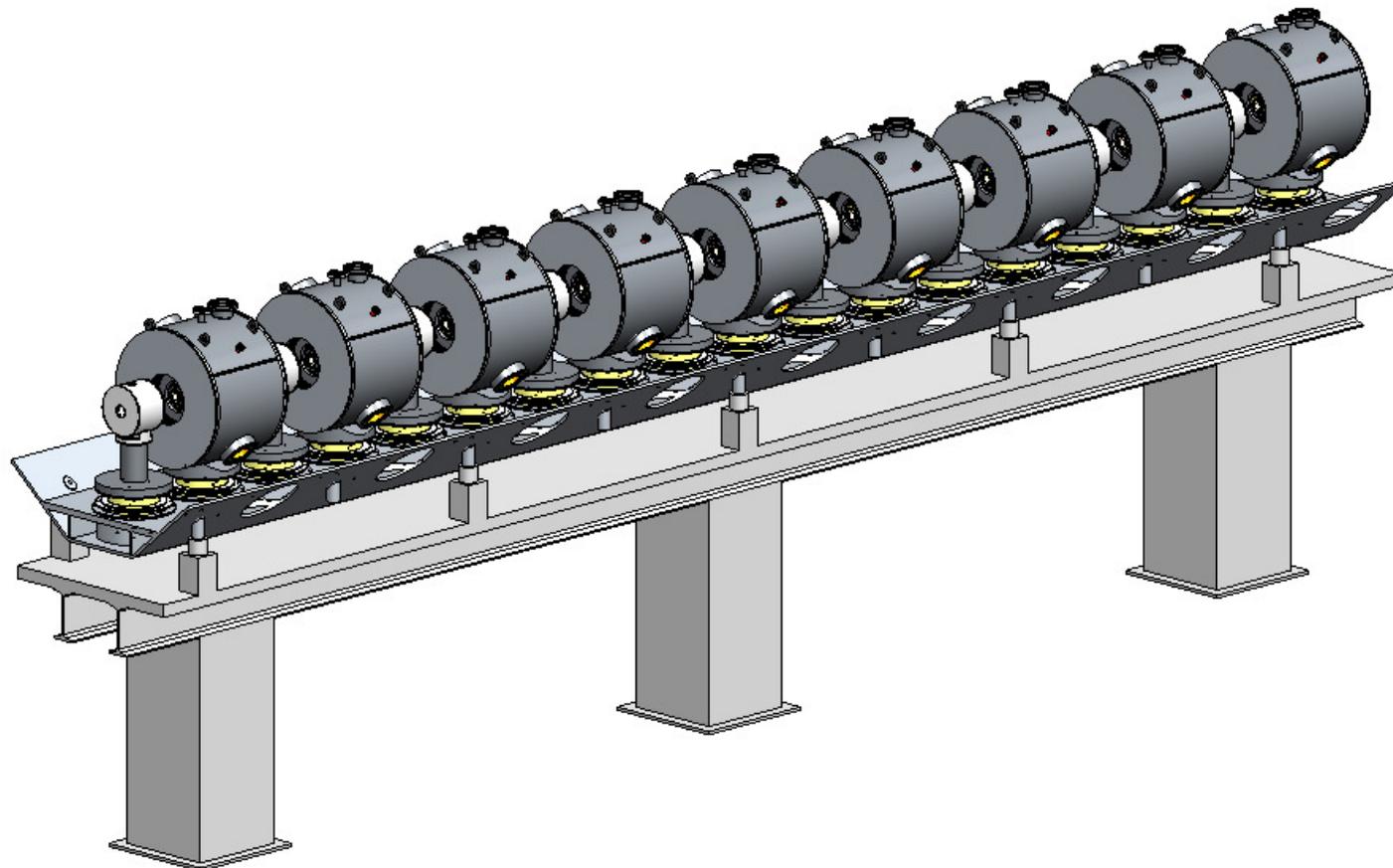


Mounting Scheme (exploded)

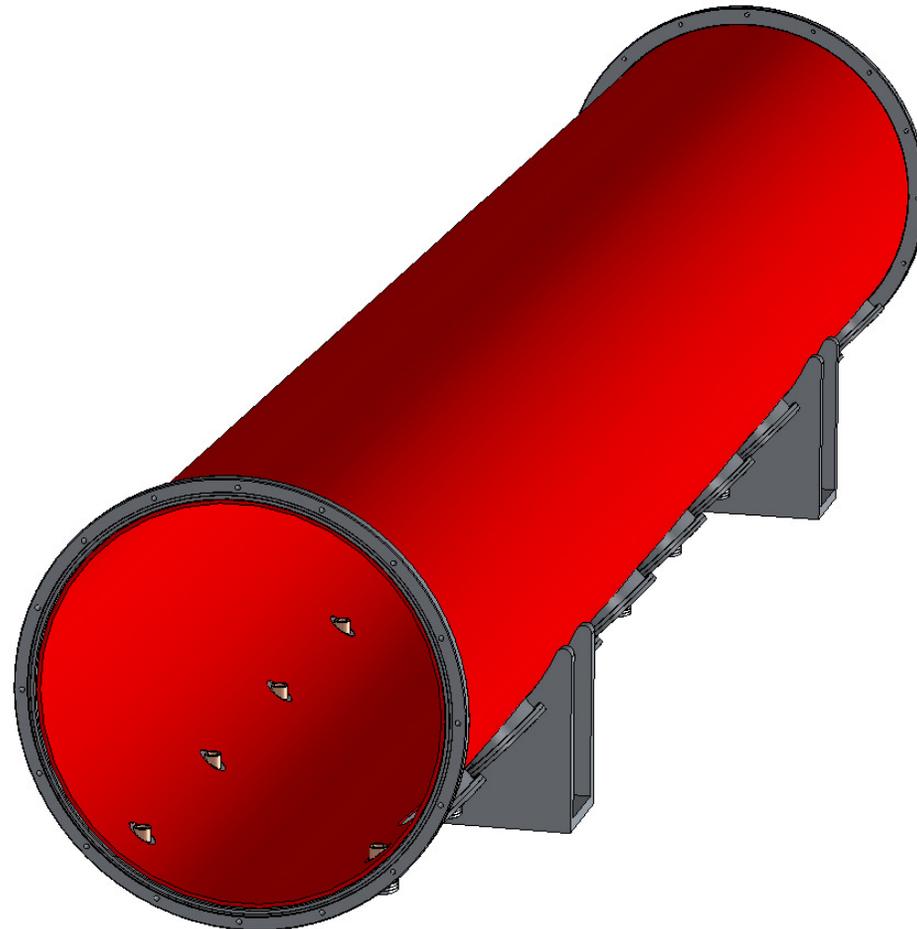


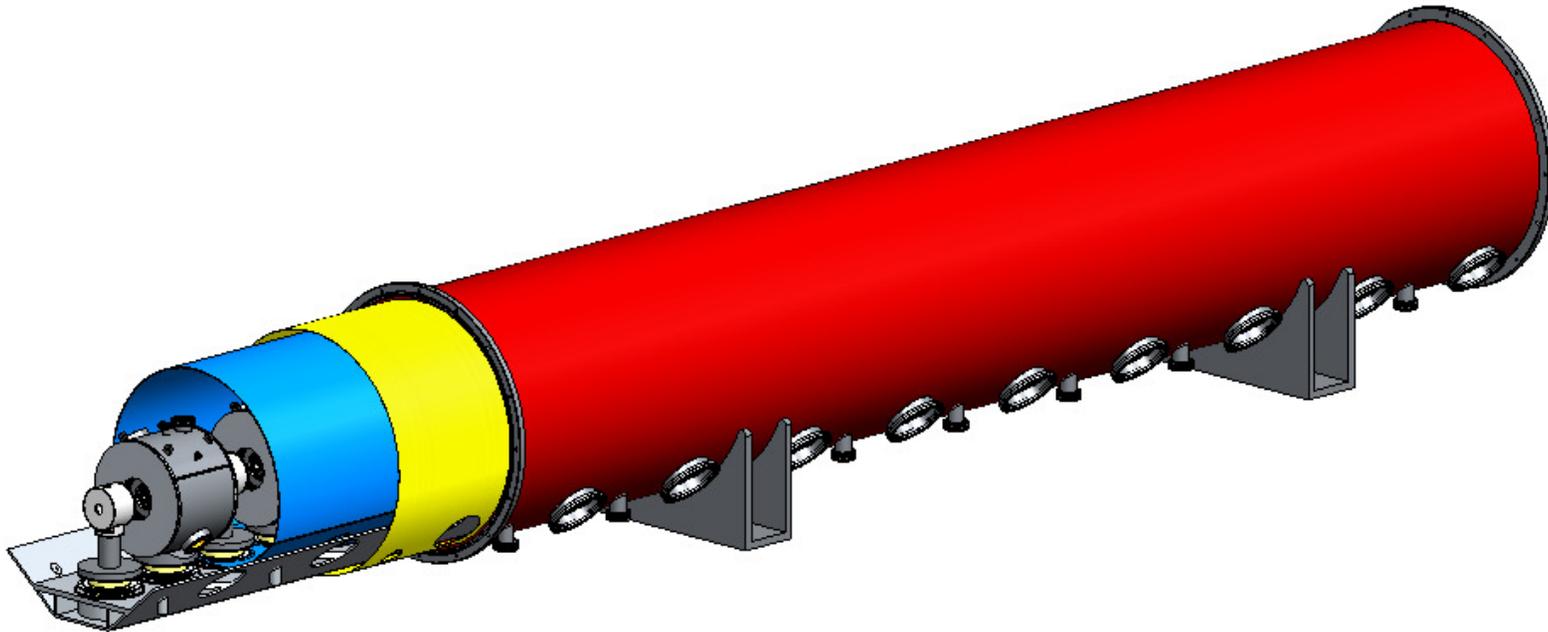


Cavity String and Strongback

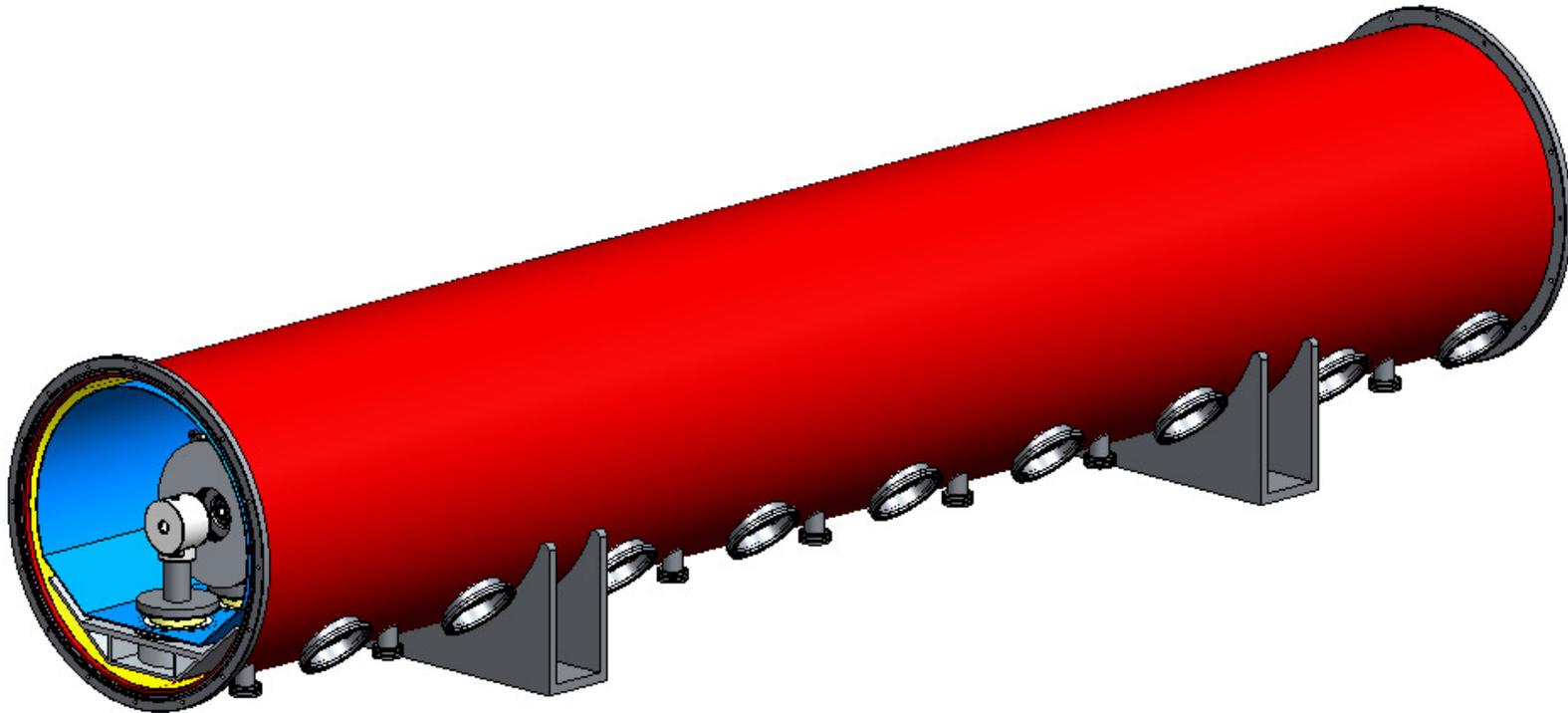


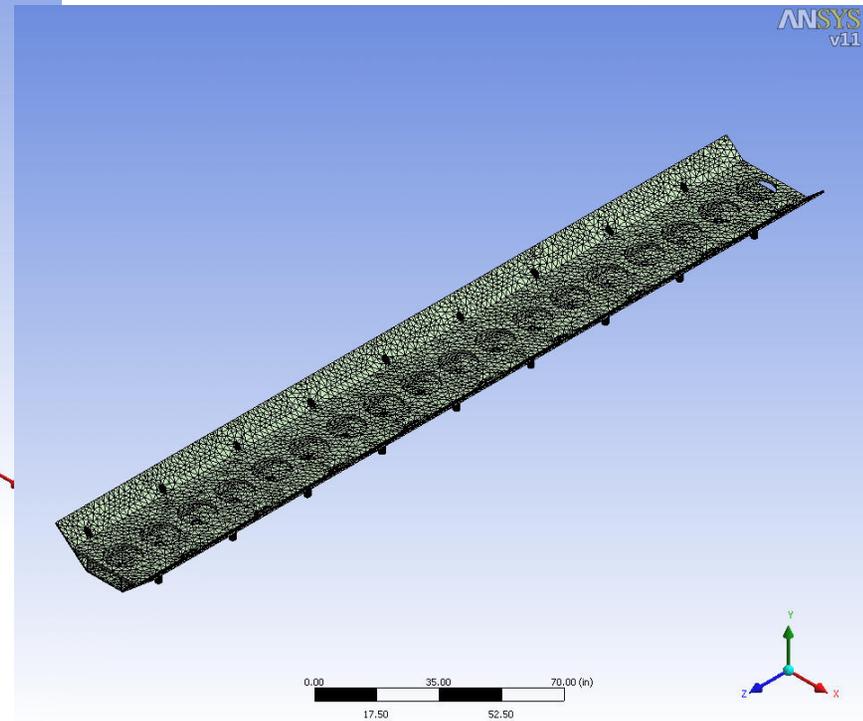
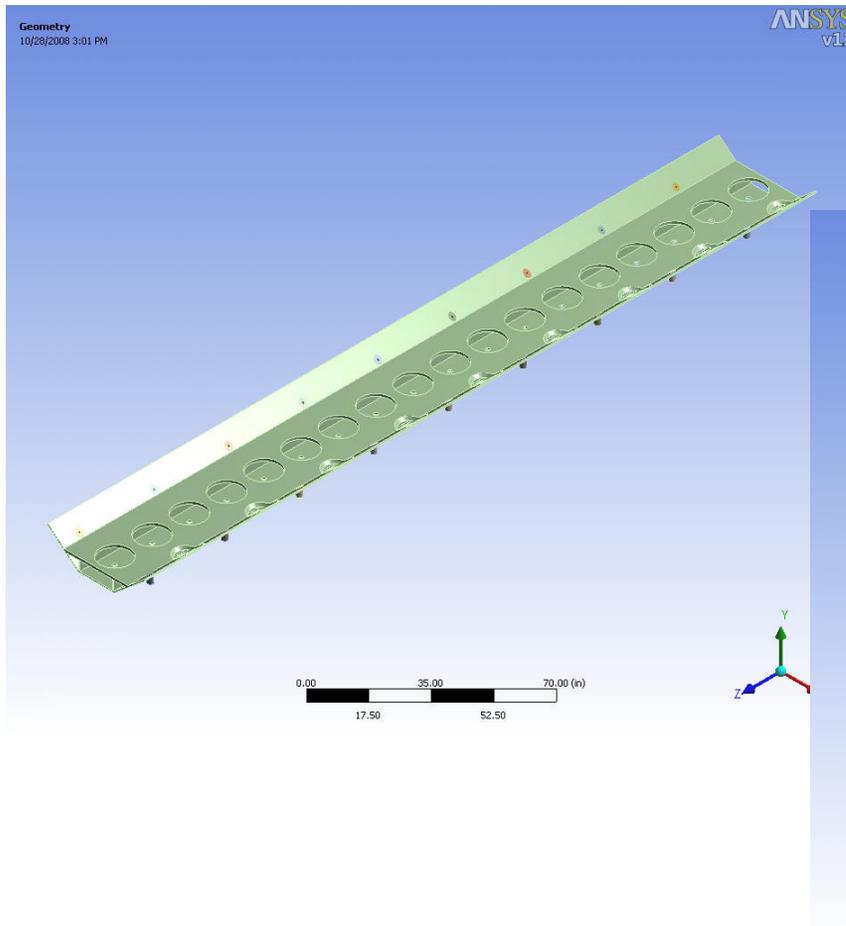
Vacuum Vessel with Internal Strongback Supports



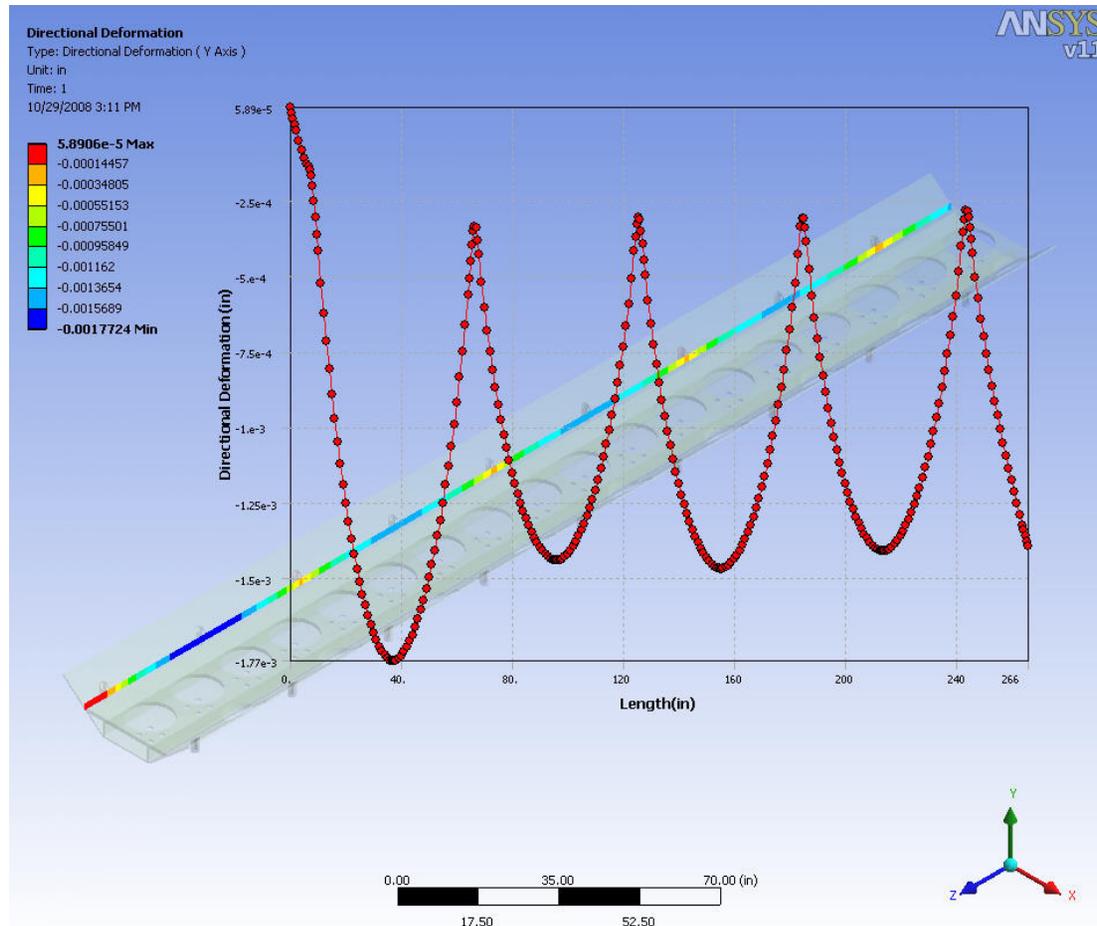


Imagine the cold mass suspended by Big Bertha and the vacuum vessel rolling over the outside.





Strongback Deflection (aluminum)





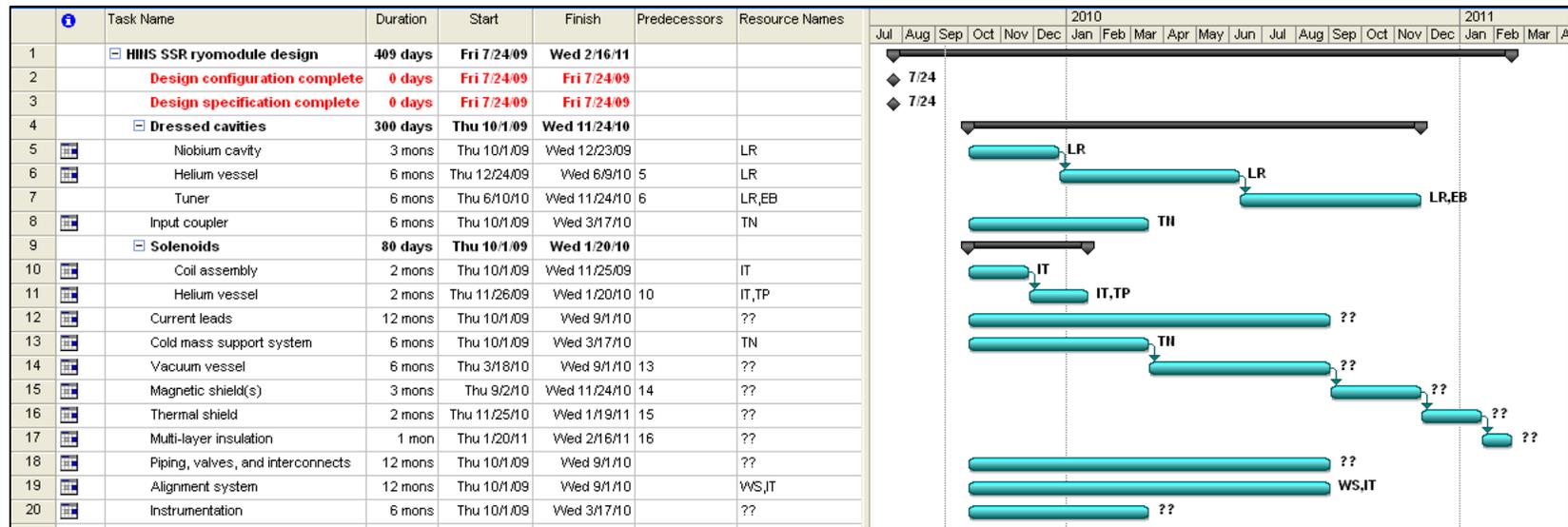
ITEM	Unit	M&S Cost	Qty	M&S Total	Cat 1 FTE-yr	Cat 2 FTE-yr	Cat 3 FTE-yr	Cat 4 FTE-yr	Labor	Total	Basis
SSR1 cryomodules			2	<< Number of units							
Vacuum vessel	ea	\$105,000	1 /CM	\$105,000						\$105,000	ILC cost estimate
Internal piping	ea	\$55,000	1 /CM	\$55,000						\$55,000	ILC cost estimate
Raw niobium	ea	\$25,000	9 /CM	\$225,000						\$225,000	HINS SSR1 high RRR and reactor grade
Cavity fabrication	ea	\$100,000	9 /CM	\$900,000						\$900,000	HINS SSR1 fab at Zanon and Roark
Helium vessel	ea	\$10,000	9 /CM	\$90,000						\$90,000	Engr estimate, \$5K parts, \$5K fabrication
Processing	ea	\$5,000	9 /CM	\$45,000	0.08		0.08	0.08	\$266,250	\$311,250	1 tech, 1 engr, 1 phys, 1 month per cavity
Testing	ea	\$5,000	9 /CM	\$45,000	0.08		0.08	0.08	\$266,250	\$311,250	1 tech, 1 engr, 1 phys, 1 month per cavity
Solenoids	ea	\$17,500	9 /CM	\$157,500						\$157,500	HINS purchase (3@\$16,100 ea)
Supports	ea	\$4,500	18 /CM	\$81,000						\$81,000	HINS purchase (3@\$3,500 ea)
Magnetic shield	ea	\$120,000	1 /CM	\$120,000						\$120,000	HINS purchase (1@\$44,000 ea) (shorter)
Thermal shield	ea	\$16,000	1 /CM	\$16,000						\$16,000	ILC cost estimate
MLI	ea	\$11,000	1 /CM	\$11,000						\$11,000	ILC cost estimate
Couplers	ea	\$20,000	9 /CM	\$180,000						\$180,000	HINS purchase (3@\$9,500+\$4,500)
Tuners	ea	\$15,000	9 /CM	\$135,000						\$135,000	Engr estimate
Current leads	pr	\$2,800	13 /CM	\$36,400						\$36,400	HINS purchase (15@\$2,700 pr)
Instrumentation	lot	\$1,000	1 /CM	\$1,000						\$1,000	Engr estimate
Interconnect parts	ea	\$20,000	1 /CM	\$20,000						\$20,000	Engr estimate, bayonets, valves, etc.
Assembly	ea	\$10,000	1 /CM	\$10,000	2.00		1.00	0.50	\$372,500	\$382,500	4 techs, 2 engrs, 1 phys for 6 months
Installation	ea	\$10,000	1 /CM	\$10,000	0.67		0.33	0.17	\$124,167	\$134,167	4 techs, 2 engrs, 1 phys for 2 months
Parts, assy, install, etc.	ea			\$2,242,900	4.17		2.83	2.17	\$1,029,167	\$3,272,067	
Parts, assy, install, etc.	lot			\$4,485,800	8.33		5.67	4.33	\$2,058,333	\$6,544,133	
EDIA	lot					4.00	4.00	1.00	\$1,015,000	\$1,015,000	2 drftrs, 2 engrs, 1/2 phys for 2 years
Spares allocation										\$3,200,000	1 spare module
Grand total SSR1 cryomodules										\$10,759,133	



**Project X Front End Cost Estimate Through Triple Spoke Resonators
Estimate in \$FY2009**

System	Aug 2009 estimate	Cost drivers
Grand total Ion source and LEBT	\$8,760,000	Ion source
Grand total RF quad	\$1,777,500	M&S purchase
Grand total bunching SSR0 cryomodules	\$3,670,767	Raw niobium and cavity fabrication (> 50%)
Grand total SSR0 cryomodules	\$10,022,200	Raw niobium and cavity fabrication (> 50%)
Grand total SSR1 cryomodules	\$10,759,133	Raw niobium and cavity fabrication (> 50%)
Grand total SSR2 cryomodules	\$17,317,400	Raw niobium and cavity fabrication (> 50%)
Grand total TSR cryomodules	\$27,964,133	Raw niobium and cavity fabrication (> 50%)
Grand total	\$80,271,133	

SSR1 Cryomodule Schedule and Resources





- Progress is being made on key components for HINS SSR1 cryomodules and development support hardware that will directly benefit development of their Project X counterparts.
- We need to continue moving forward in the design development, prototyping, testing, and production of HINS components.
- Given a concerted effort aimed at moving the design forward, the time to complete an SSR1 cryomodule design is on the order of 18 months assuming the addition of 3-4 full time engineers and a similar number of designers or design drafters.
- Sufficient resources must be allocated to all aspects of the project – R&D, engineering, design and drafting, prototyping, testing, and production...