STATUS OF AHF

Copies of transparencies for talk,
EHF Workshop
Padova, Italy
19.10.1988

George R. Swain
Los Alamos National Laboratory
Los Alamos, NM, USA

Los Alamos Plan of Action

1. Participation in PSR Commissioning & Upgrade
   - 'hands-on' experience
2. New Specifications
   - 60 GeV, 25 μAmp
   - 1.6 GeV, 1200 μAmp
3. Menu of Accelerator Designs
   - present emphasis on single-ring design
4. Collaboration with TRIUMF
   - hardware development & PSR
5. Hadron Facility Hardware Development
   - limited by budget & manpower constraints

Special Features of Los Alamos Design

- High Energy (60 GeV) on Mesa Top
  - requires 2.2 Tesla Magnets
- Low Energy (1.6 GeV) for Neutrons & Neutrinos
  - uses entire LAMPF beam (1200 μAmp)
  - simplify space-charge & instability problems
- Minimum Number of Rings !
  - minimize operation (manpower) cost

Operation and Maintenance Cost

- Manpower Estimate From Roy Billinge, CERN, Nov '87
- Cost Based on Los Alamos Experience ($145k/man year)

Design (TRIUMF Nomenclature)	People	Annual Cost
- D (Main Ring Only	60	$ 8.7 Million
- D+E	100	$14.5 Million
- B+D (LAMPF II)	130	$18.9 Million
- B+D+E	170	$24.7 Million
- B+C+D+E (EHF)	210	$30.5 Million
- A+B+C+D+E (TRIUMF KAON)	260	$37.7 Million

AHF Menu

	Main	Full-size Booster		1/2-size Booster		1/4-size Booster	
	Only	Boost	MR	Boost	MR	Boost	MR
Rep Rate (Hz)	6	6	6	12	6	24	6
np (x10**~~12~~ 13)	2.6	2.6	2.6	1.3	2.6	0.65	2.6
Inj E (GeV)	2.2	1.6		1.6		1.6	
Energy (GeV)	60	10	60	10	60	6	60
nux	13.2	13.3	12.4	14.2	12.4	7.2	12.4
nuy	12.7	12.7	14.2	12.2	14.2	6.2	14.
Gamma T	22i	22i	8	∞	8	∞	22i
εn (π mm-mrad)	10.5	18	18	9	9	2.7	2.7
long (eV-s)	.14	.10	.10	.10	.10	.10	.10
Volts/turn (MV)	7.7	2.8	6.9	1.3	6.9	0.7	7.1
rf power (MW)	6.9	1.3	7.9	0.5	6.0	.26	6.4
df/f (%)	4.8	7.2	0.4	7.2	0.4	6.6	0.9
Sync Tune	0.06	0.07	0.009	0.04	0.009	0.02	0.01
Z/n (max)(Ohm)	71	98	-10	103	-10	154	-10

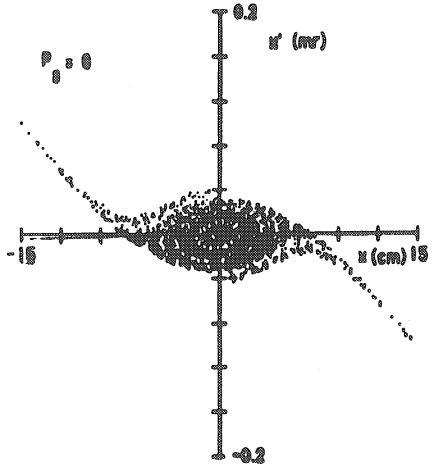
60 GeV at Los Alamos

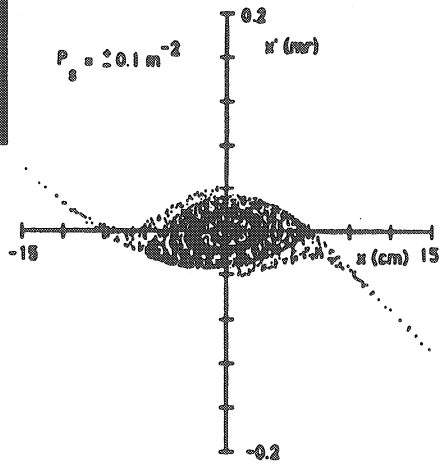
- Requires 2.1-2.2 Tesla Magnets
  - Cost Effective ?
  - 6 Hz ?
- 2.2 Tesla Field Has Large Sextupole Component
  - Beam Stability ?
  - Slow Extraction ?

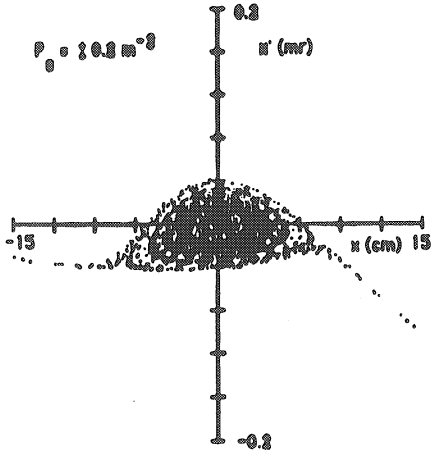
Sextupole correction:
Dave Neuffer
Hal Butler

Effect of Sextupole

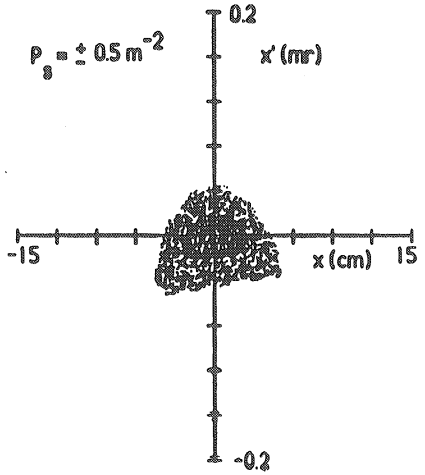
Half-Integer Slow Extraction in LAMPF II







Extraction Suppressed With 15th Harmonic Sextupole



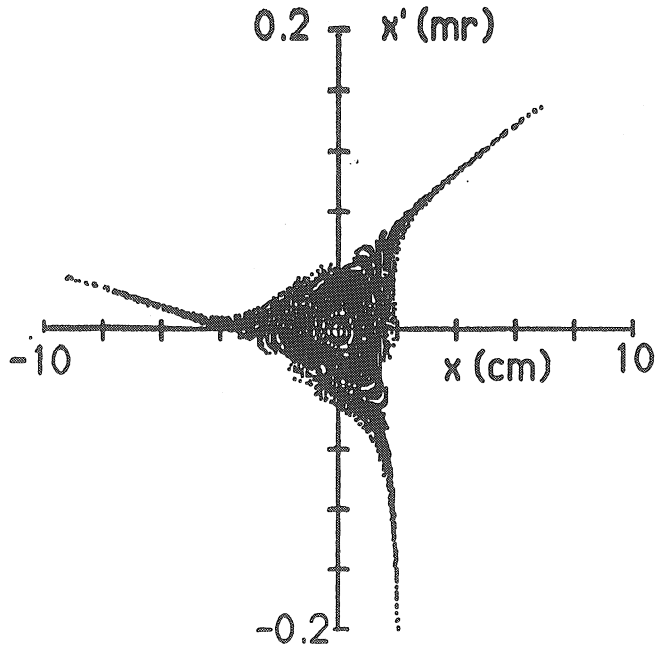
Los Alamos

Crossing ν=.33

LAMPFII MAIN RING Q_x=7.33

With 22 nd Harmonic Error Sextupole
Due to Dipole Errors and zeroth
Harmonic sextupoles

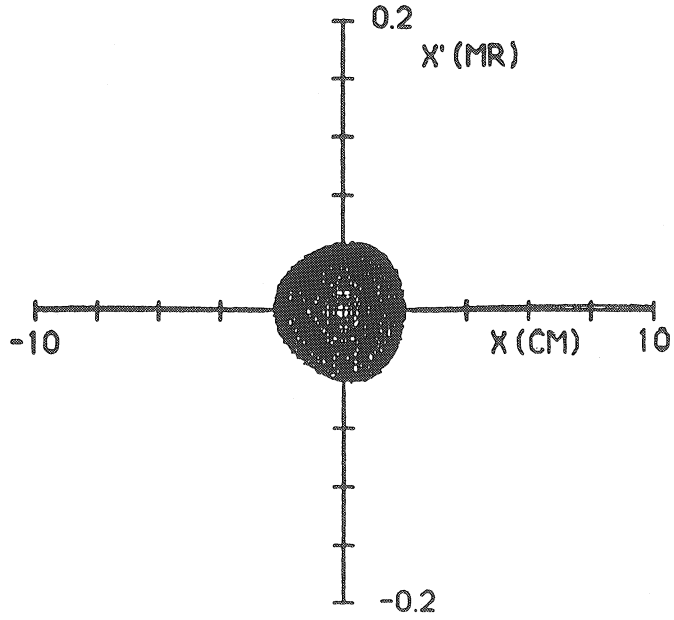
Beam emittance 1 mm-mr



LAMPFII MAIN RING Q_x =8.33

TRACKING WITH 25TH HARMONIC SEXTUPOLE
ERRORS DUE TO DIPOLE ERRORS AND
EXPLICIT SEXTUPOLES IN LATTICE

BEAM EMITTANCE 1 MM-MR



Los Alamos / TRIUMF Cavity Project

- Designed to work in LAMPF II or TRIUMF Main Ring
- Test in PSR starting in 1989
  - Available Volts & Tuning
  - Solid State Driver (rad hardening ?)
  - Beam Loading
  - RF Control System
  - 50 MHz Bunching
  - Painting (both Longitudinal and Transverse !)
  - Coupled-Bunch Instabilities
  - Synchrotron-Betatron Oscillations

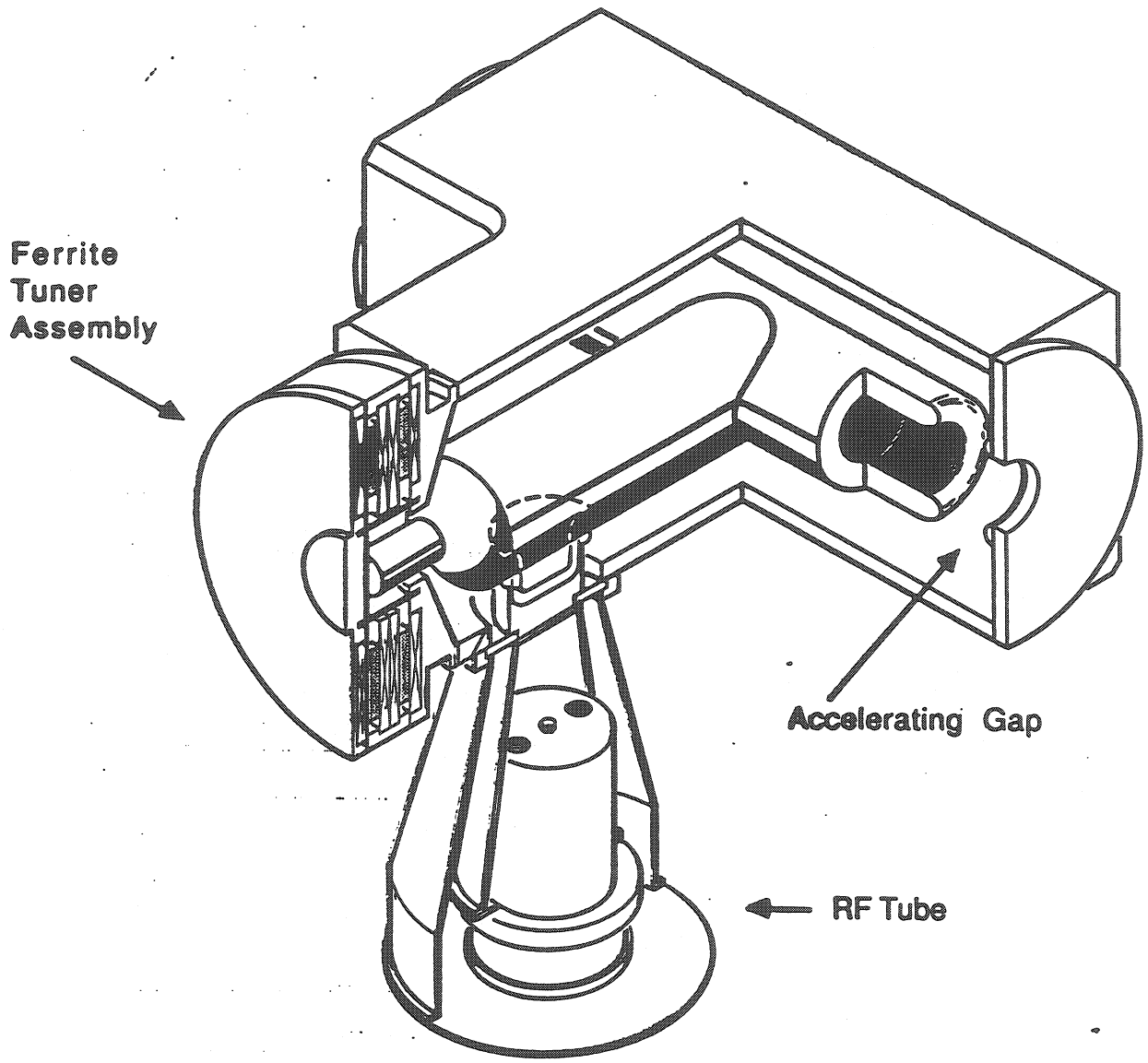
RF CAVITY

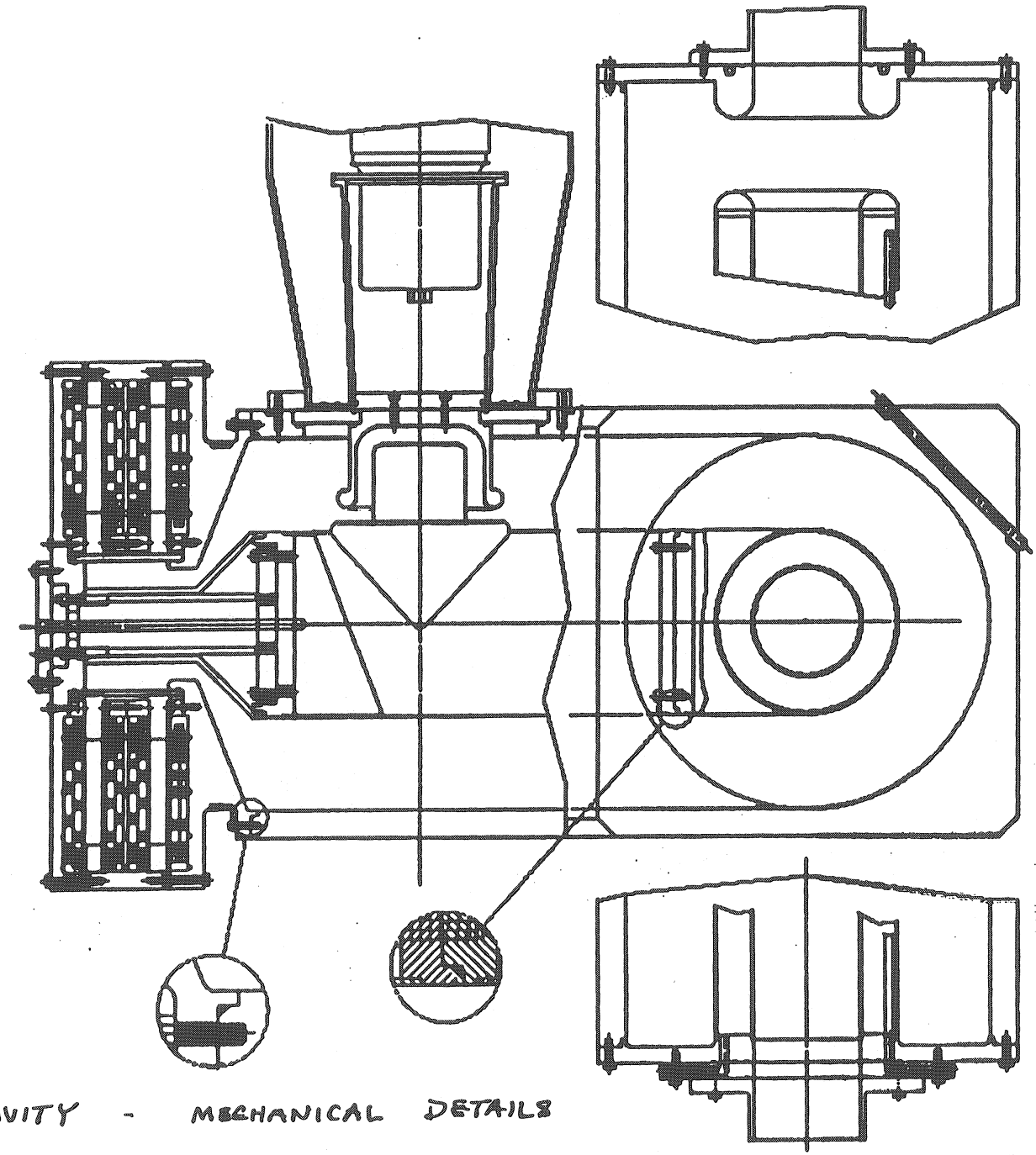
DESIGN OBJECTIVIES – AND CONSTRAINTS:

Restrict power to ferrite	200 kV on accelerating gap
	Use 2 present ferrite rings
Bias field stored energy low	49.333 to 50.772 MHz, corresponding to TRIUMF 61.134 to 62.917 MHz
Bias coil peak current as low as feasible	
	Shunt R/Q about 35 ohms
Adaquate cooling	
	20 kV peak rf on tube anode (24 kV dc)
Low voltage on vacuum windows	

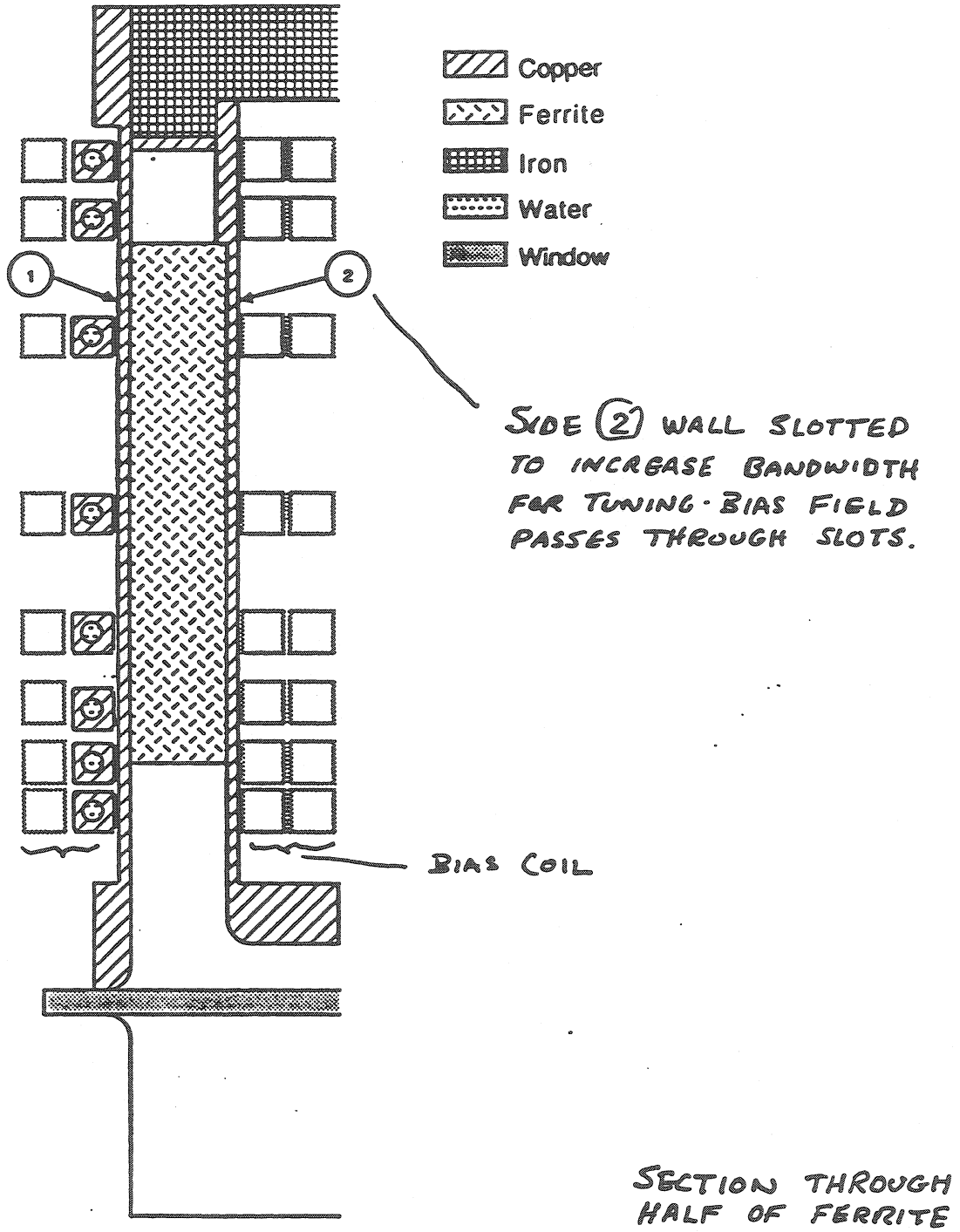
Los Alamos:

Rod Smythe (UC)
Carl Friedrichs
George Swain
George Karady (ASU)
Linda Walling


Ferrite
Tuner
Assembly
Accelerating Gap
RF Tube



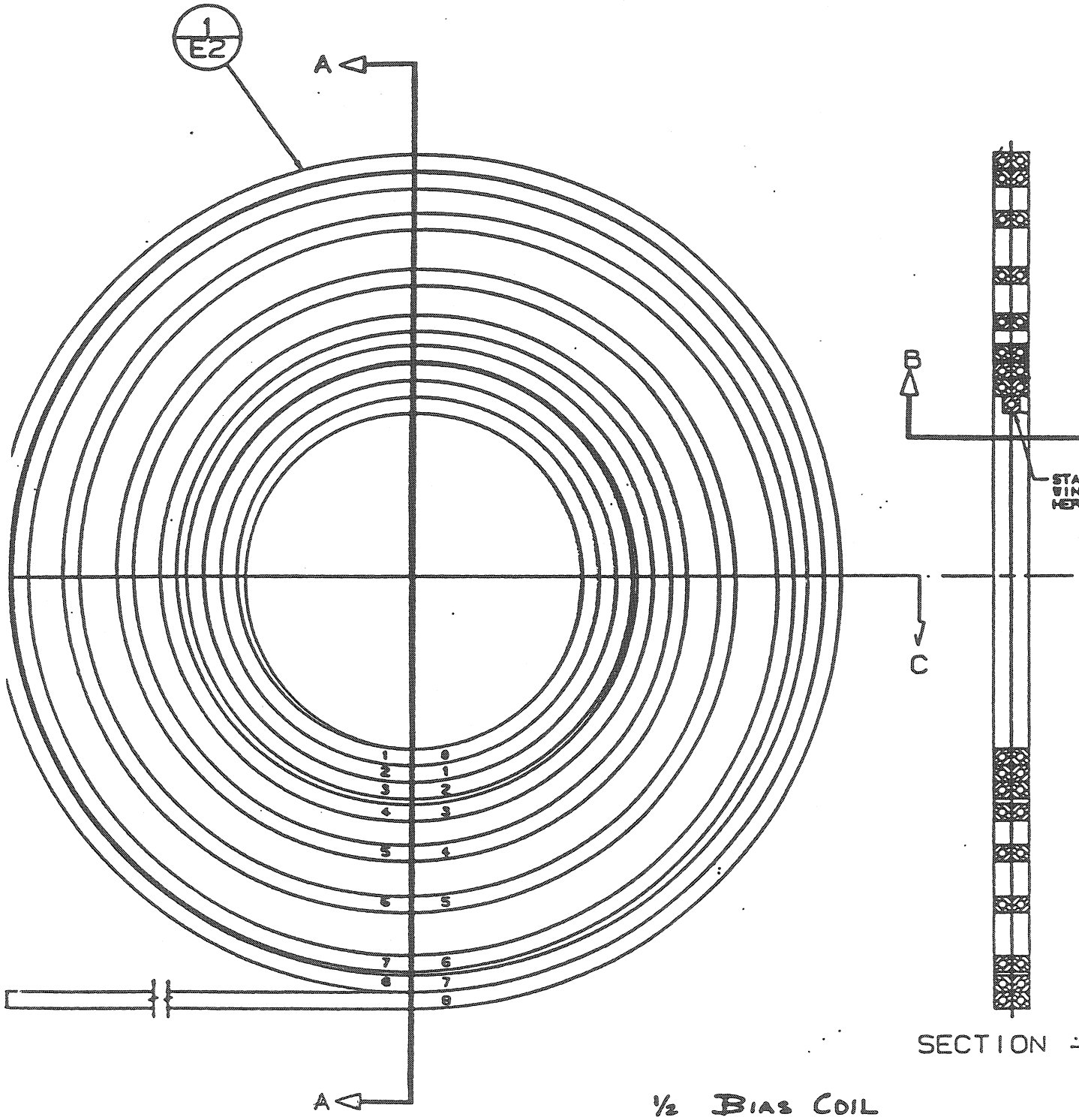
RF CAVITY - MECHANICAL DETAILS



SECTION THROUGH HALF OF FERRITE TUNER FOR RF CAVITY

10 cm

SECTION C-C



SECTION

½ BIAS COIL
(4 COILS PER TUNER)

AHF MAIN RING RF CAVITY
Some First Thoughts

G. Swain - LANL

Main Ring:

Energy range: 2.2 to 60 GeV
Circumference: 1300 m
Rep. rate: 6 Hz
Fraction of period used for acceleration: 0.333

RF System:

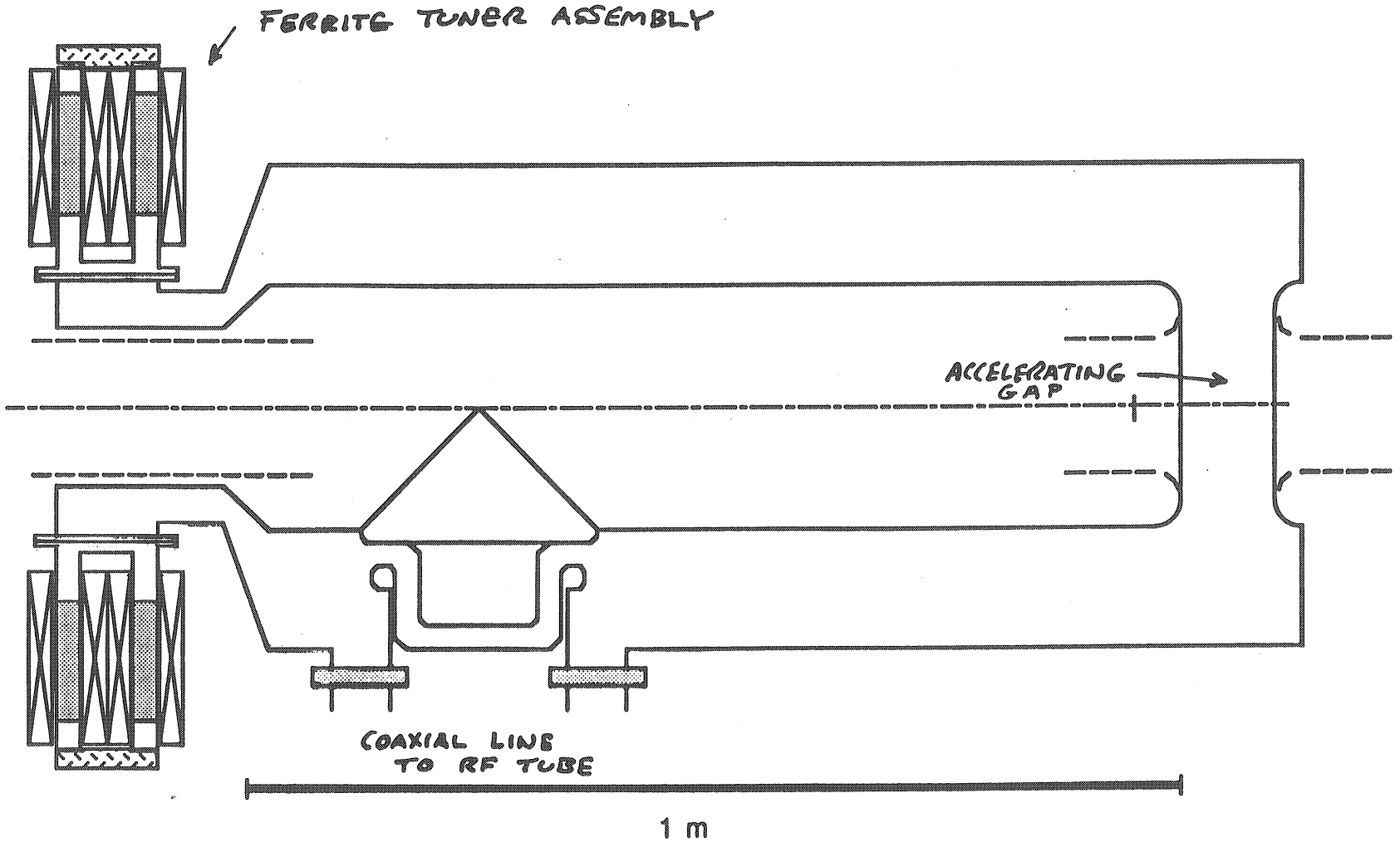
Frequency range: 50.313 to 52.753 MHz
> Harmonic number h: 229
Maximum voltage per accelerating gap: 200 kV
> Number of rf cavities: 40

Maximum voltage on coupling capacitor: 100 kV

Maximum average power dissipation in ferrite in tuner: 1 W/cm^3

Bias coil:

Conductor size: 1.27 cm (0.5 inch)
> Maximum current per conductor: 1500 A



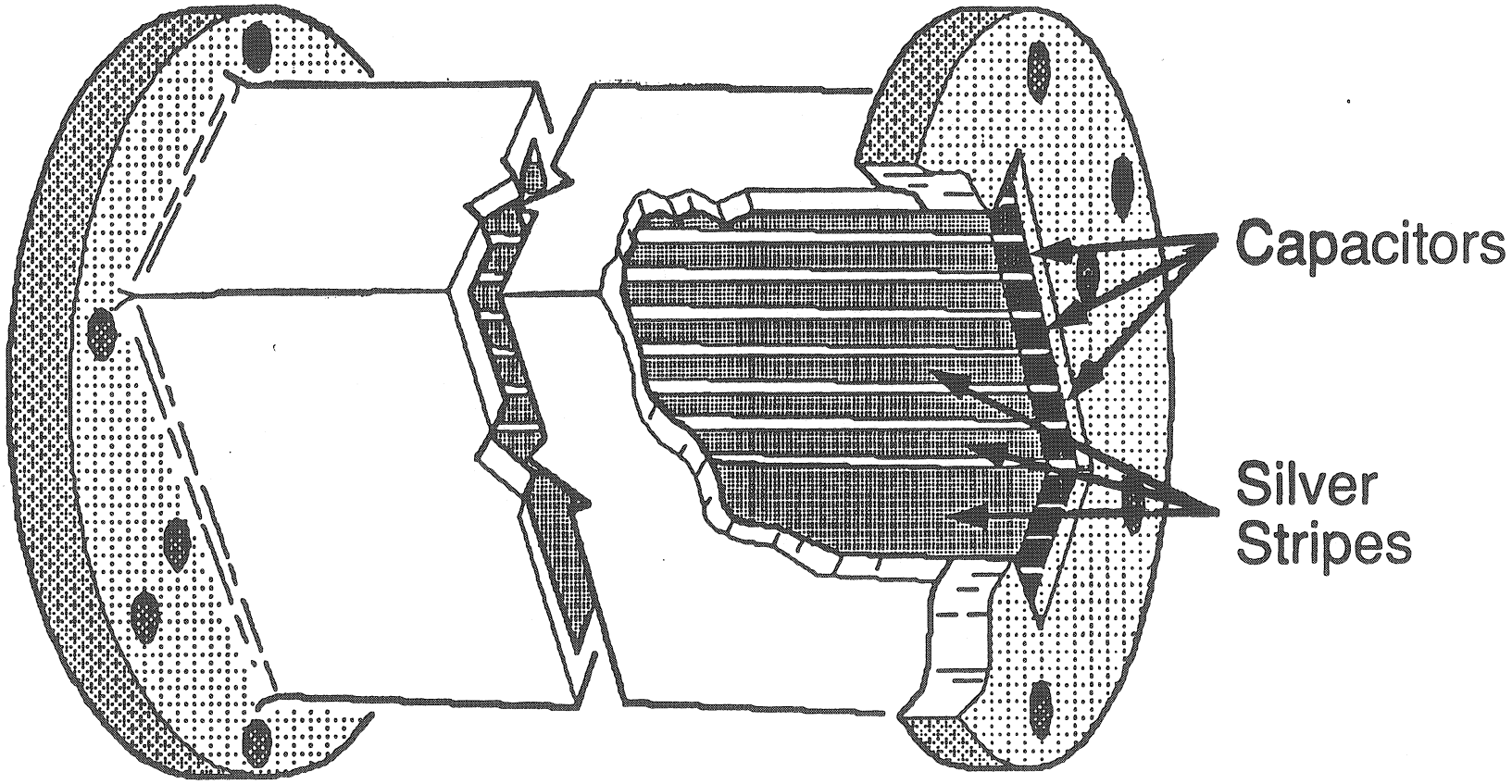
cdwg8810.1

AHF Main Ring
Cavity Concept

Ceramic Vacuum Chamber

- Design of Choice at TRIUMF and Los Alamos
- Solves Impedance and Eddy Current Heating Problems
- Same Cost as Thin-Wall Stainless Pipe
- Recent Progress
  - first sample with lumped capacitors
  - Impedance to be measured
- In Next Year
  - kicker pipe with flanges
  - test of distributed capacitors
  - 1 meter unit - with all connections and flanges
  - 3 meter curved prototype

Ceramic Vacuum Chamber



Kicker Development

- Bring Fast Kicker Technology to Los Alamos
- Fast Kickers Required in All Rings
  - Ring-to-Ring Transfer
  - Fast Abort
- Start With Prototype PSR Kicker
  - 10.6 x20 cm Aperture Ferrite Kicker
  - Ceramic Vacuum Pipe with Internal Stripe
  - Fermilab Style Power Supply
  - Modular - add modules for larger kick
- Install First Module in PSR as Diagnostic
  - For Tune & Tune Spread Measurement

Prototype PSR / AHF Kicker