



CM-P00050978

EHF - 87 - 41

MP-14

1 9/25/87

**Towards
an advanced hadron facility
at Los Alamos**

H. A. Thiesen

a presentation for the
European Hadron Facility Workshop
Santa Margherita, Italy
5 October, 1987

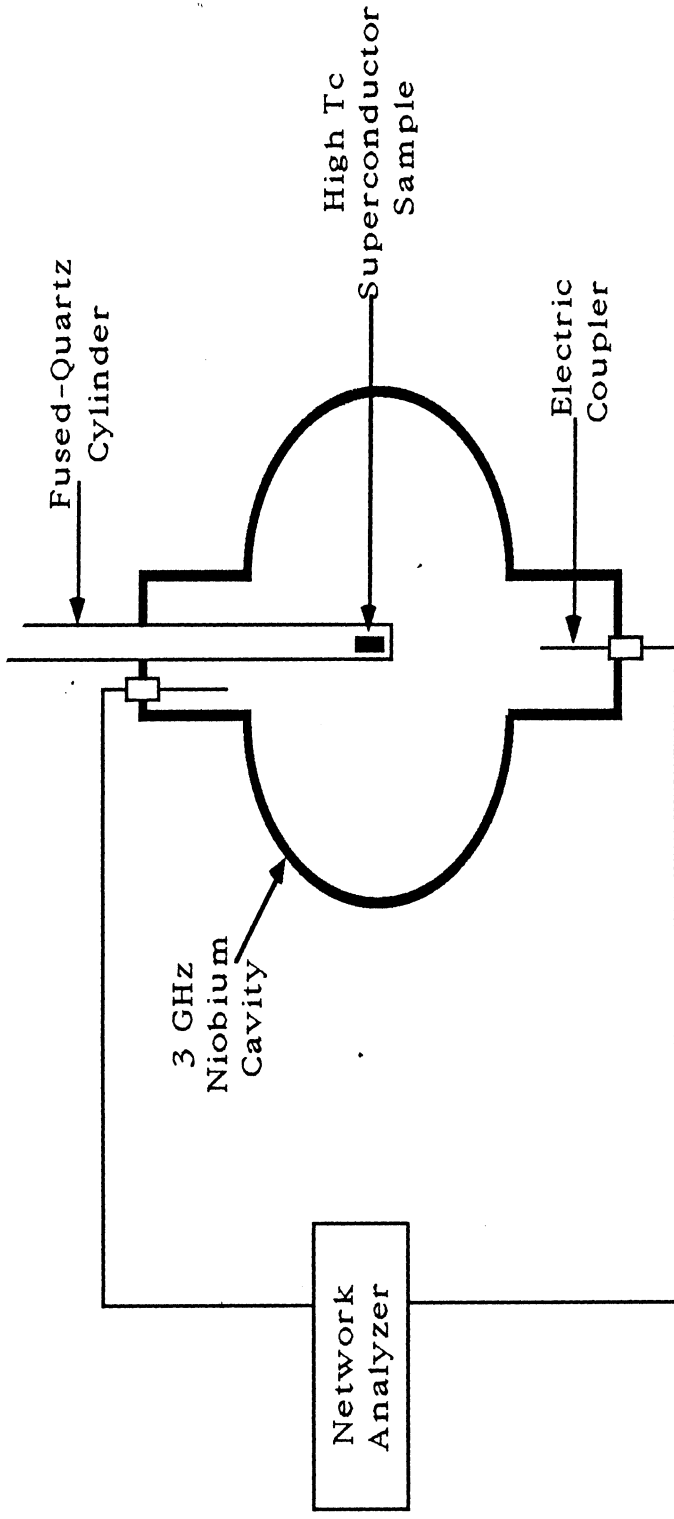
Los Alamos

Recent News From Los Alamos

- 1.- Budget Not Increased
 - * menu of new designs
2. Superconducting rf Idea
 - * bunch rotator for kaons ?
- 3.- TRIUMF/Los Alamos Collaboration
 - * rf and PSR Commissioning
- 4.- 50 MHz rf System Test, PSR 1989

3 GHz Test Cavity

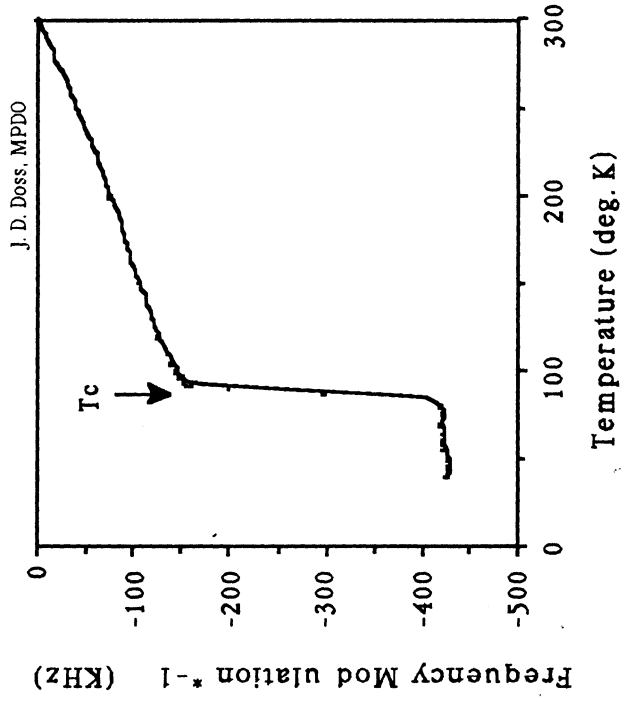
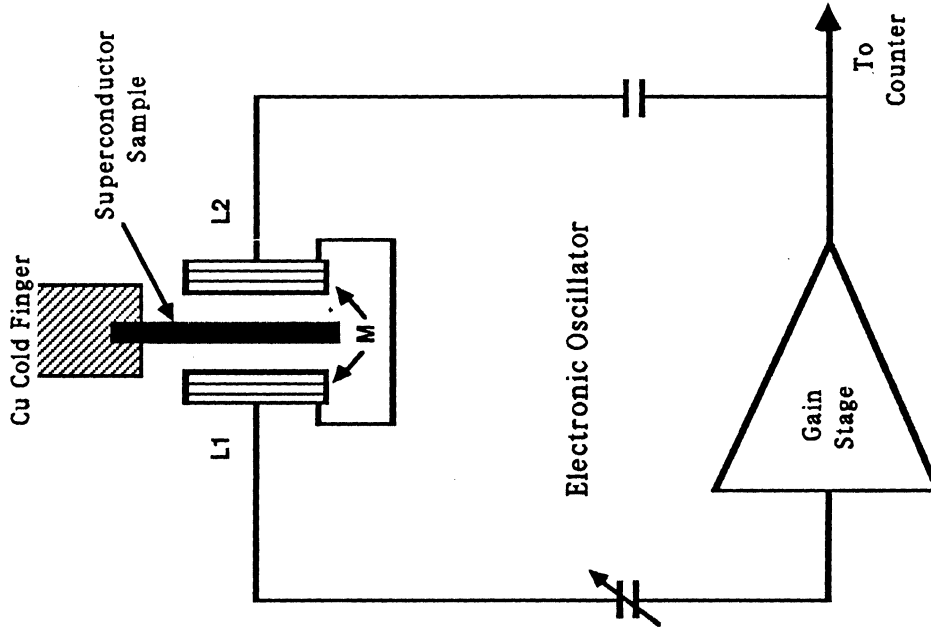
AT-MP Collaboration



With the cavity submerged in liquid helium, Q is measured with and without the sample

- Special Funding for High Tc Work Available

High Tc Superconductor Test



Eddy-Current FM Technique
For Superconductor Characterization

Oxide (High T_c) Superconductors

- Results to Date
 - * Like Copper at 3.9°K and low H
 - * Dominated by Residual Resistance
 - Temperature Independent Part
 - * worse if significant surface H
 - * need about $50 \times 10^6 \text{ A/cm}^2$
and higher H_{c1} to compete
with Niobium
- Not Very Encouraging Information !

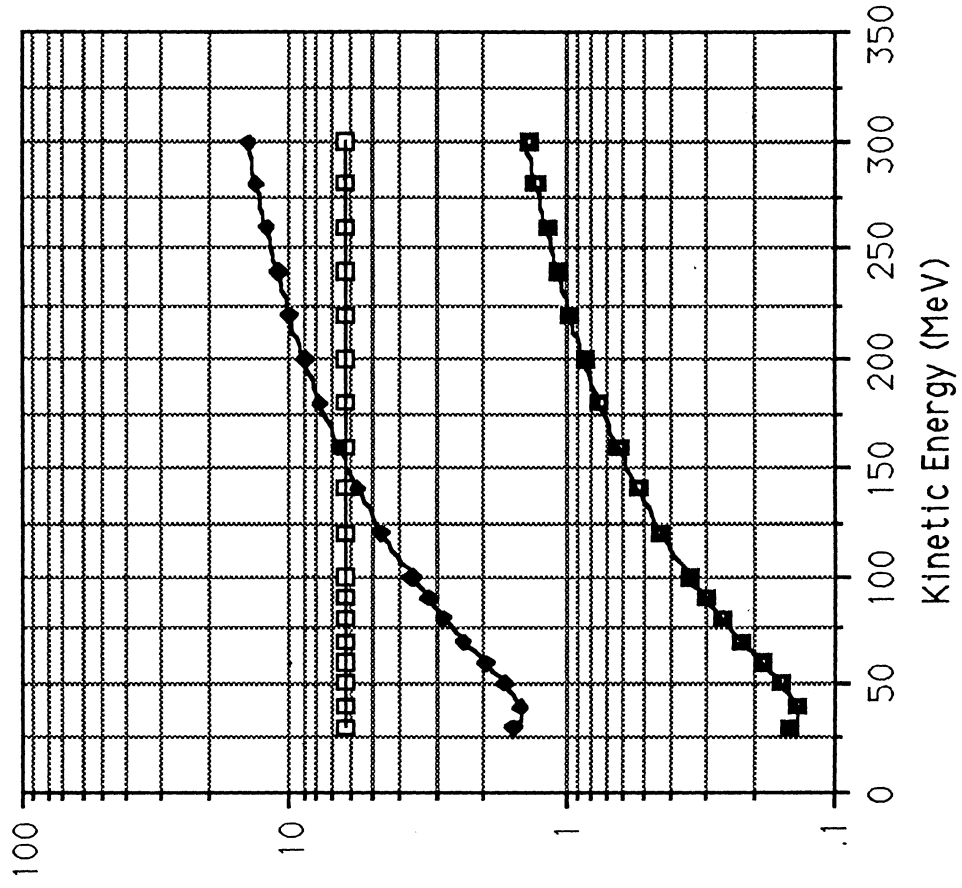
LEP Scruncher

- a niobium single cell 402.5 MHz module
- no proton buncher required
- improves LEP for Clamshell
- \$700k if purchased from INTERATOM
- we should not fabricate it here without facilities

* Can we share facilities with

- NPB
- and FEL ?

LEP Scruncher



Kaon Bunch Rotators ?

- Think again about rf Frequency
 - * 100-400 MHz ?
- Short Bunches
- rf On During Extraction
- Also Useful for rf Separators

Menu of Modular AHF Designs

- Booster Only - - - - - 6 GeV*, 10 μ Amp*
- Minimum Kaon Factory - - - - - 45 GeV*, 10 μ Amp*
- World Class Kaon Factory - - - - - 60 GeV, 25 μ Amp
- LANSCE 800 MeV Upgrade - - - - - 0.8 GeV, 1200 μ Amp
- Combined Kaon / Neutron Factory :
1.6 GeV Superconducting H⁻ Linac
& High Energy Compressor - - - - - 1.6 GeV, 600 μ Amp

* = upgradeable

- Gives Confidence to AHF Steering Committee

- Flexibility for Science, Funding & Politics

- Design Independent r&d Plan

**AHF Design Workshop
Feb 22-March 2, 1988**

- Accelerator Physics Working Meeting
- Uses LAMPF & LANSCE Experience
AT-3, AT-6, MP-5, MP-14, P-LANSCE
- 4-6 International Visitors, Expenses Paid
- Anyone Welcome
- **compare scenarios for Menu**
- (Cost Estimates Later)

**Combined Kaon / Neutron Factory
is Cost Effective**

Compare with

- 1/2 Julich SNQ

1.5xDM 1389 million

- plus EHF

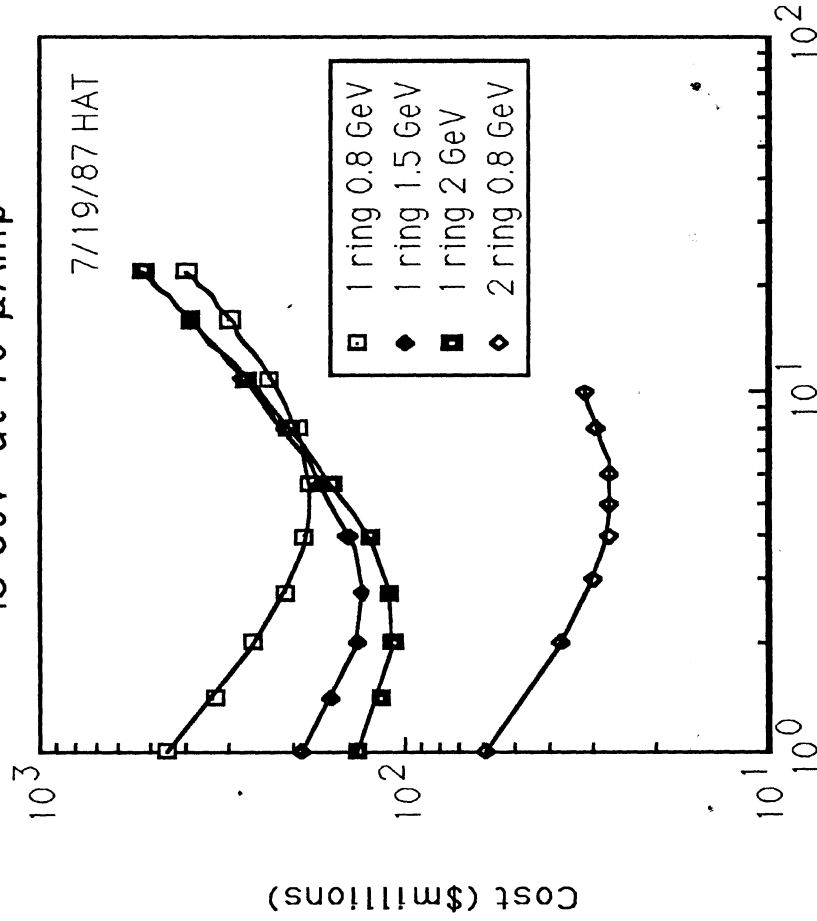
1.5xDM 867 million

AHF Estimate

- \$ 600 million

Minimum Cost Kaon Factory

Cost vs Repetition Rate
45 Gev at 10 μ Amp



rep rate (Hz)

Further Thoughts

- Full-Size Booster Attractive !
 - * Staging - In A Single Tunnel
 - * Slow Extraction From Booster
 - * Single Booster / Main Ring Power Supply
 - * A good match to Siberian Snakes
- Technical Problem - High Synchrotron Frequency
 - * Higher Energy Linac (1600 MeV ?)
 - * Lower Frequency rf (25 MHz ?)
- Cost Similar to Small Booster

AHF Needs High Beam Availability !

- LAMPF Front End Reliability Improvements
 - New "volume type" H⁻ ion source
 - RFQ replaces Cockroft-Walton ?
 - Replace 201.25 MHz tetrode rf
- Linac as Best Part of LAMPF
 - Side-coupled like 805. MHz
 - if superconducting, separate rf source for each 4-cell module
- Use Hardware & Diagnostics Experience from PSR
- Minimize Number of Rings
- High Beam Availability is Design Constraint

Painting Trouble

- Ring Acceptance = 4 x space charge emittance
+ momentum + closed orbit
- Acceptance Sufficient for 0.1% Injection Losses
in Gaussian Beam Model
- PSR Slow Loss Caused Me to Look Again At
Allowance for Beam Halo
- Painting with "Fixed Brush"
20% of input beam is 2 sigma Gaussian
- **Halo = 10 x Space Charge Emittance !**

Painting Problem: Cures ?

- A Serious Problem
 - * Losses Above 0.1% Level Intolerable
 - * Extra Aperture Doubles Magnet & PS Cost
- Stripping Collimators in Switchyard
 - * Significant loss of Linac Beam
- Paint Hollow Beams
 - * May Lead to Instability
- Paint With Moving Brush, best solution
 - * Complicated, Expensive, May Lead to Correlations
- Have We Underestimated Multiple Scattering ?
- A Subject for This Workshop ?

Design-Independent r & d Plan for AHF

- ferrite-tuned cavities & test in PSR
- ceramic vacuum chamber
- resonant magnet power supplies
- injection and extraction hardware
- beam dynamics
- superconducting cavities & separator
- high Tc superconductors
- experimental area design

International Collaboration on Kaon Factory Development ?

AHF - TRIUMF - EHF ?

- PSR Commissioning / Learning Experience
- shared r&d cost
 - * TRIUMF - driver & controls for PSR test
 - * EHF - a.c. hardware for booster cavity?
 - * I Will Accept Any Reasonable Suggestion
- peer review
- improved visibility of -
 - * scientific motivation
 - * project design

PSR Test in 1989

Install TRIUMF/AHF "Main Ring" Cavity in PSR

- Next Generation Perpendicular Bias Design
- Tuning Range Sufficient for TRIUMF Main Ring
- 200 kV, R/Q=35 Ohm, Single Gap
- Tests Cavity Hardware & Controls
- Injection "Painting" Scheme
- Beam Loading
- Coupled-Bunch Instability

TRIUMF to Bring Controls & Transistorized rf Driver

Does not improve PSR beam !

Magnet Power Supply Update

- Praeg System May Not Save Money
 - * Needs 2nd Capacitor Bank
 - * Switches Not Expensive
 - * Increases Cost by x1.5
 - * Not Made Up By rf Cost Savings
- Flattop Not As Expensive
 - * Increases cost by x 1.15
- 2nd Harmonic Interesting, But Expensive ?
- 3rd Harmonic Compatible With Flattop !
- New Study by G. Karady Underway

Ceramic Vacuum Chamber

- Next Step After Rutherford Design
 - Needed for Large Field, Rep Rate, or Beam Size
 - Integral rf Shield & Blocking Capacitors
 - **Wall Thickness -- 2 mm Possible !**
 - **Cost - Same as DESY II Design !**
 - Impedance Measurements Required
 - Goal is 3 meter Curved Pipe & Flanges
- * expected in Fall 1988

A World - Class Development

Science of AHF

- Kaon Factory Workshop
 - * Summer School 1988
 - G. Garvey
 - * Would TRIUMF or EHF Like to Join Us ?
- Materials Science
 - * Science Summer School Not Needed Now
 - * Tighter coupling of Users and Machine Builders needed !
 - * Make connection via R. Macek
- Steady Progress Required !

AHF Construction Start

- FY-1993 Not Precluded
 - * difficult if superconducting
 - * superconducting linac as upgrade ?
- 5 year Los Alamos funding plan insufficient
 - * need another source of funds !
 - * 10-15% advance development cost
pays off in earlier commissioning
and higher beam availability !
- International Collaboration on Construction
 - * may be forced by TRIUMF start ?

Summary: AHF in FY-88

- World's Best Funded Kaon Factory r&d Program
- use LAMPF & LANSCE experience
- cost effective combined kaon & neutron factory
- high beam availability needed
- need improved painting scheme or larger aperture
- menu of modular accelerator designs
- design-independent r&d plan
- test of rf hardware in PSR in 1989
- international collaboration underway
- FY-1993 construction start not precluded