SDC-92-385

SDC
SOLENOIDAL DETECTOR NOTES

SDC COLLABORATION MEETING
SSCL

OCTOBER 22-24, 1992

AGENDA
SDC Collaboration Meeting
October 22 - 24, 1992

Thursday, October 22

Morning Session

Auditorium

8:30 a.m.	SSCL Status and Plans for FY93	F. Gilman
9:00 a.m.	Report from Spokesperson	G. Trilling
9:30 a.m.	Report from Project Manager	T. Kirk
10:00 a.m.	Report on Cost/Schedule Status	D. Etherton
10:30 a.m.	Break	
11:00 a.m.	Progress in Technicolor Model Building	S. Dawson
12:00 noon	Calculations of the SDC Radiation Environment	A. Palounek
12:30 p.m.	Lunch	
	Executive Board Meeting - Upstairs Conf. Room	

Afternoon Session

1:30 p.m.	Subgroup Meetings (Major task is to go over DOE Review Parallel Session Presentations and prepare final transparencies and notebooks for reviewers)
6:30 p.m.	Group Dinner - Chili Peppers on Hampton
9:00 p.m.	Resource Committee - Upstairs Conf. Room

Friday, October 23

Morning Session

9:00 a.m.	Subgroup Meetings

Afternoon Session

1:30 - 3:00 p.m.	Institutional Board Meeting - Auditorium

Saturday, October 24

Morning Session

9:00 a.m.	Technical Board Meeting - Upstairs Conf. Room
12:30 p.m.	Adjourn

PRESENTATION BY:

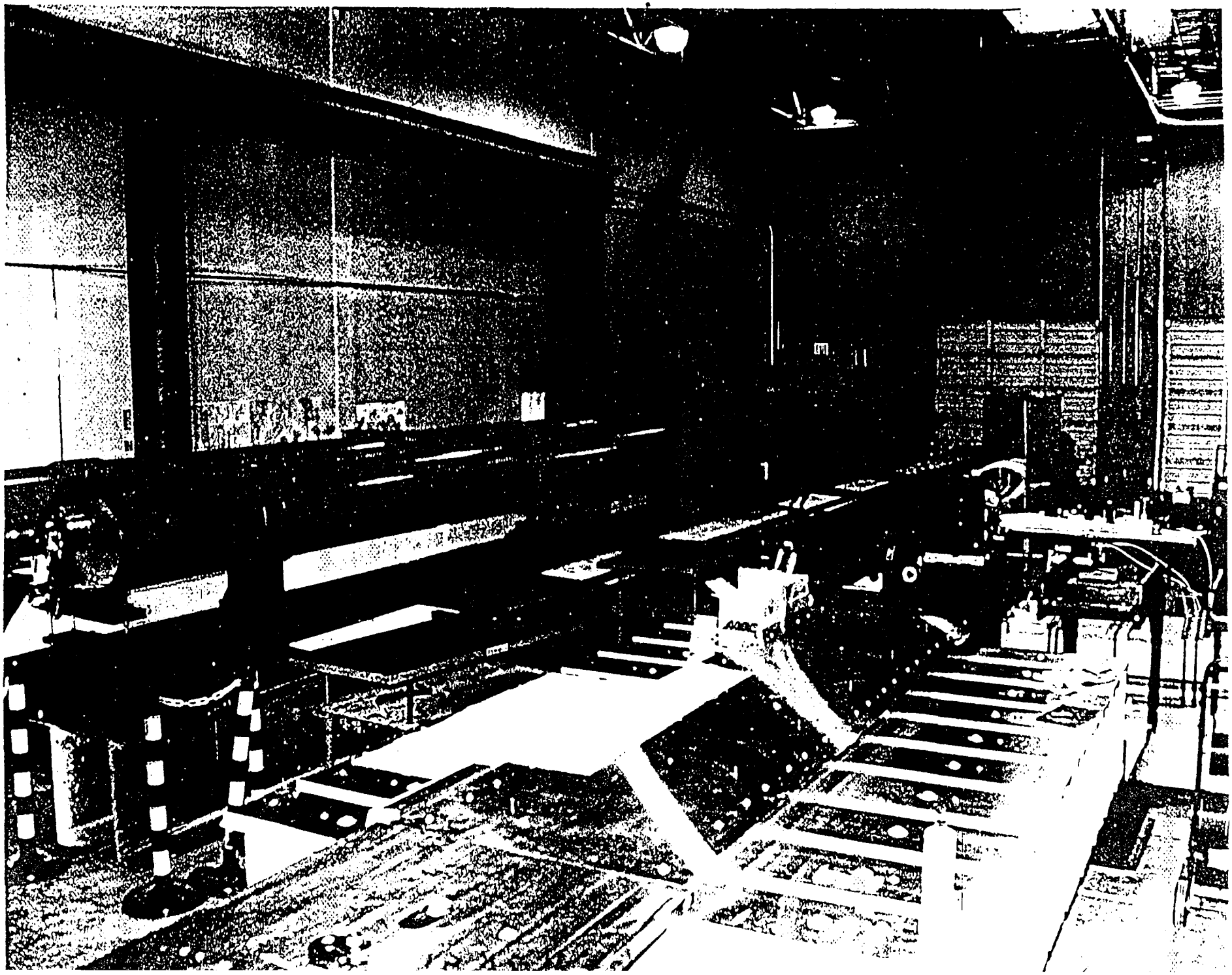
F. GILMAN

F. Gi

Superconducting Magnet Industrialization

Six types of magnets:	Collider dipole magnets	(8076)	($1.2B)
	Collider quadrupole magnets	(1699)	($136M)
	Special collider dipole magnets	(731)	($111M)
	Special collider quadrupole magnets	(127)	($30M)
	HEB dipole magnets	(929)	($96M)
	HEB quadrupole magnets	(561)	($74M)

Approach: For all but special collider quadrupole magnets, SSCL will team with industrial contractor for development and production.



Collider Dipole Magnet

Vendors Selected – 23 Oct. 90

Leader General Dynamics Corporation
Follower Westinghouse Electric Corporation

- Leader build 15 prototype, 35 pre-production, and 251 LRIP
- Follower build 0 prototype 35 pre-production, and 251 LRIP
- First production magnet due June 1994

COLLIDER QUADRUPOLE MAGNETS

Vendor selected May 3, 1991

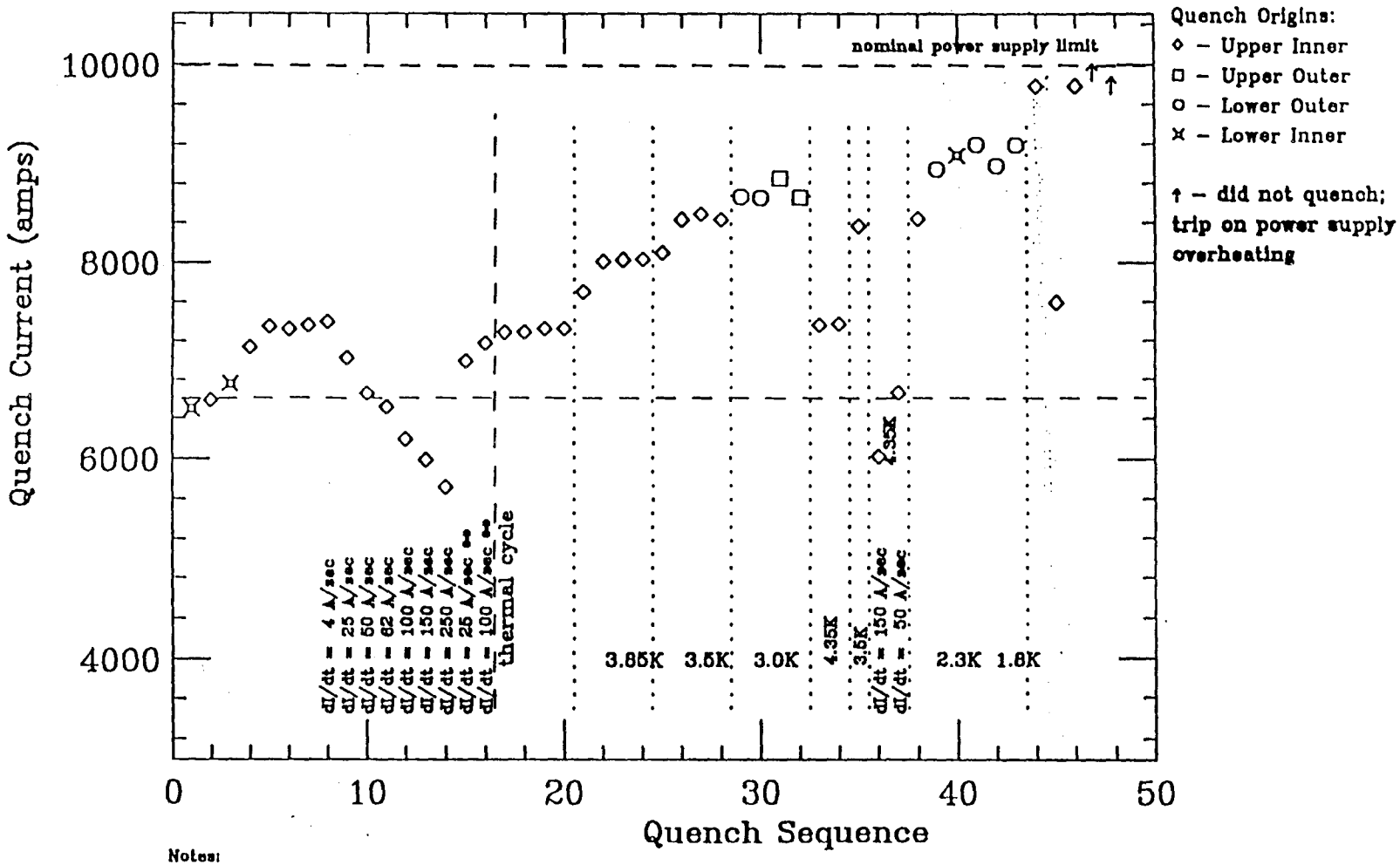
BABCOCK & WILCOX

- 147 Superconducting Magnets
- Eventually 1,664 Quadrupoles

First Delivery: Fall, 1994

File: [JCT.DCA322]dca322_qourr.top 920826

DCA322: Current at Quench
Full Length 50mm Aperture SSC Dipole – FNAL



Notes:

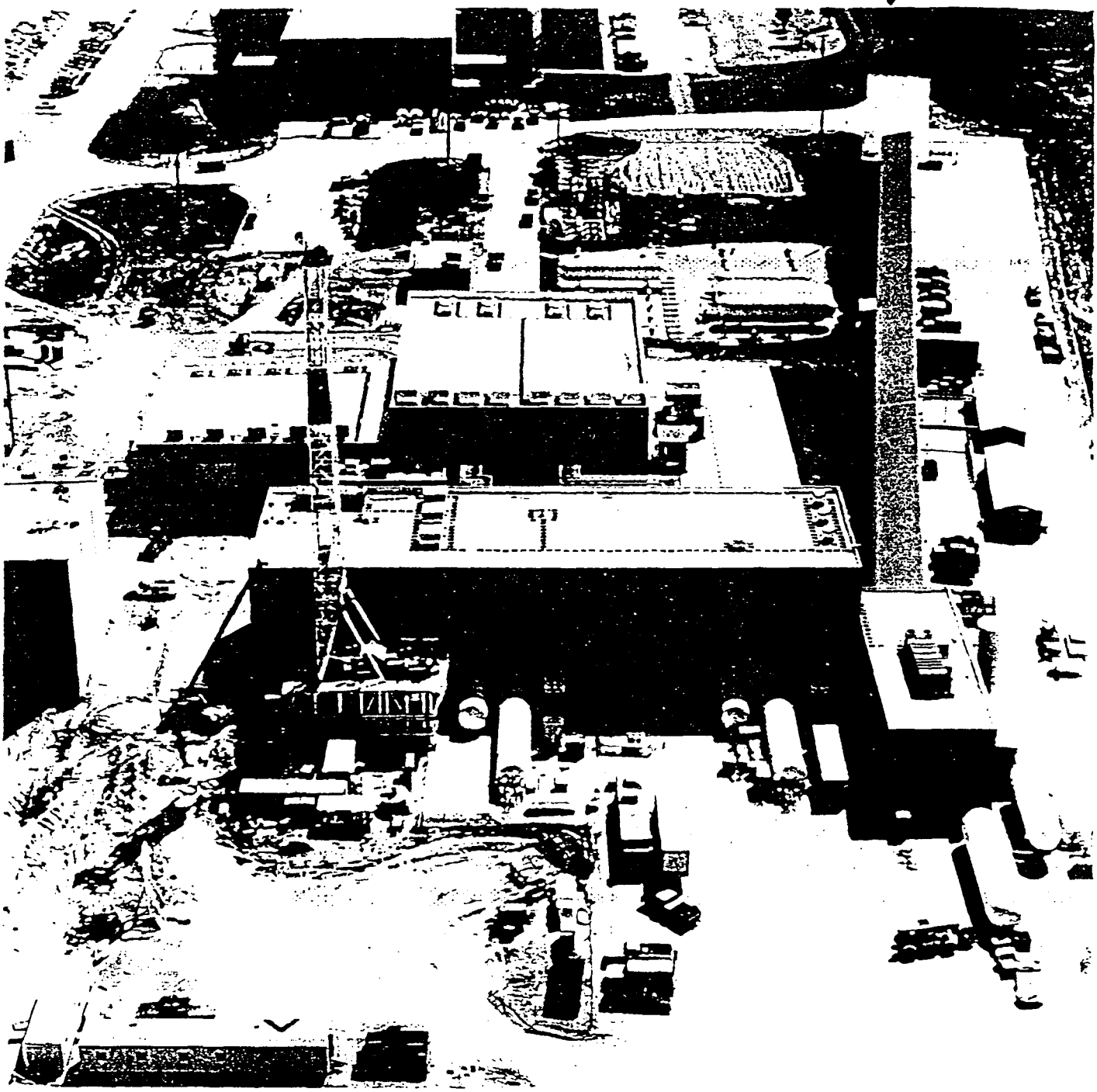
(1) – first quench during strain gauge run to quench: steps at 16 A/sec to 6000A; ramp at 4A/s to current steps above 6000A

(2) – ramp sequence modified: ramp to 5900A at 16A/sec, wait 10min; ramp to quench at 1A/sec for quenches 2-5

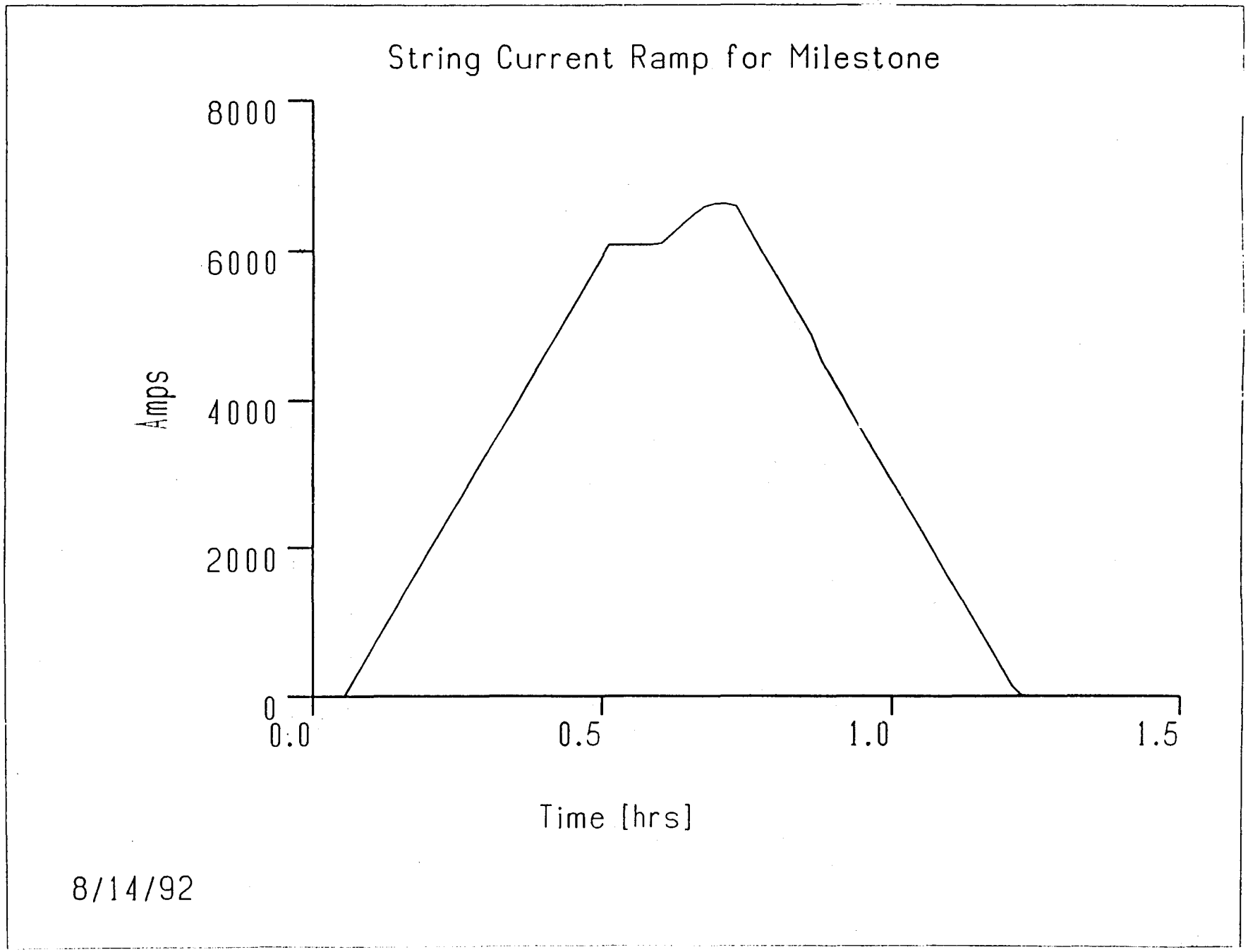
String test – SSC magnets, including correct radius.

note curve!

ASST



TONS. CAP.
TONS. CAP.


String Current Ramp for Milestone
8000
6000
4000
2000
0
Amps
0.0
0.5
1.0
1.5
Time [hrs]
8/14/92

Conventional Facilities Overview

Total Cost:	$1.2 Billion	
Real Estate:	16,553 Acres	1,272 Parcels
Buildings:	102 Structures	2.1 Million SF
Excavation:	7.5 Million CY	400,000 LF Tunnels
Electrical Demand:	185 MW	

Conventional Construction: Current Status

Parsons-Brinckerhoff/Morrison-Knudsen selected as Architect-Engineer/Construction Manager in 1990

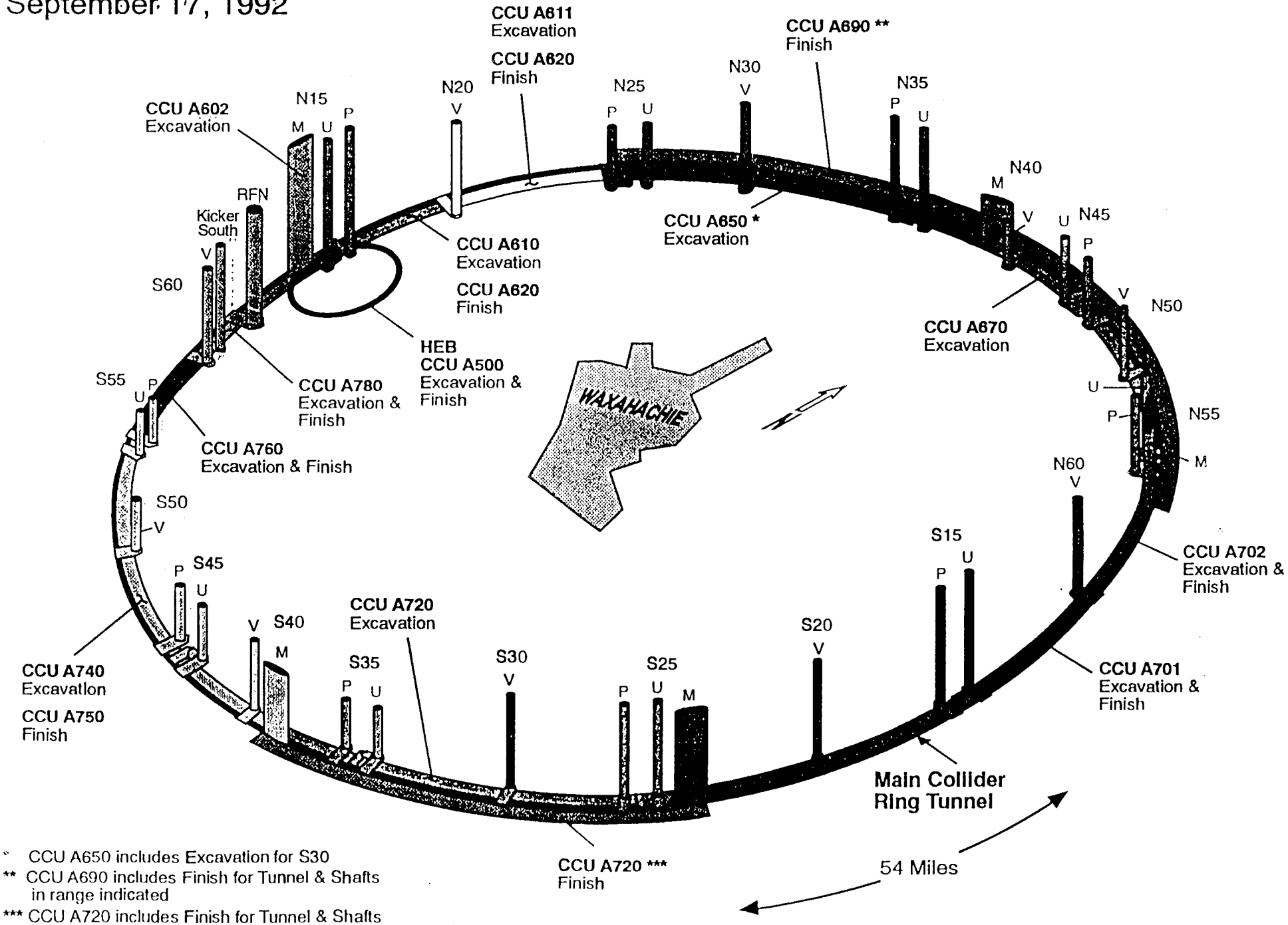
Draft master plan completed

Substantial design underway

Numerous facilities under construction

SS Collider Tunnel and Shaft Subcontract Breakdown

September 17, 1992



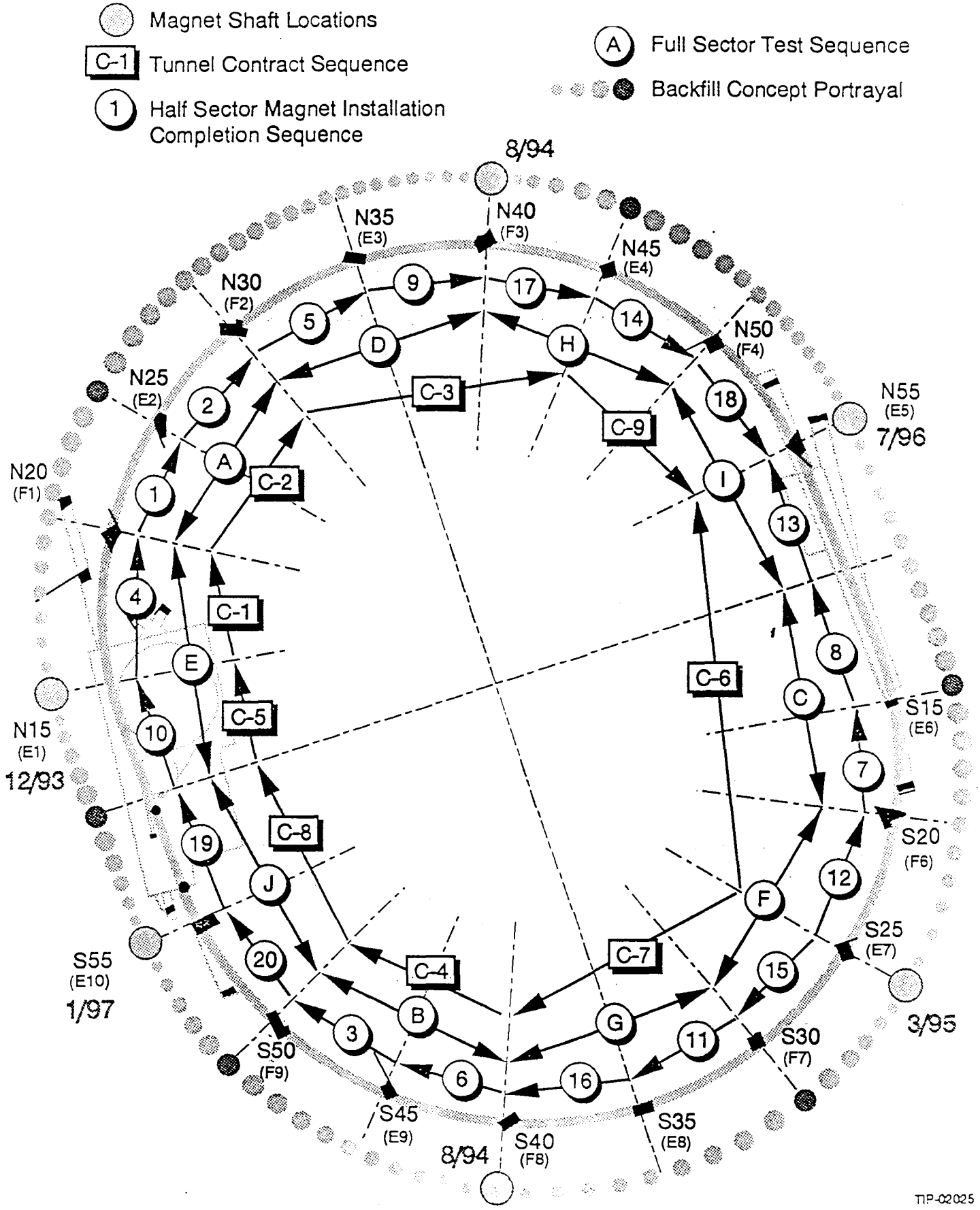
* CCU A650 includes Excavation for S30

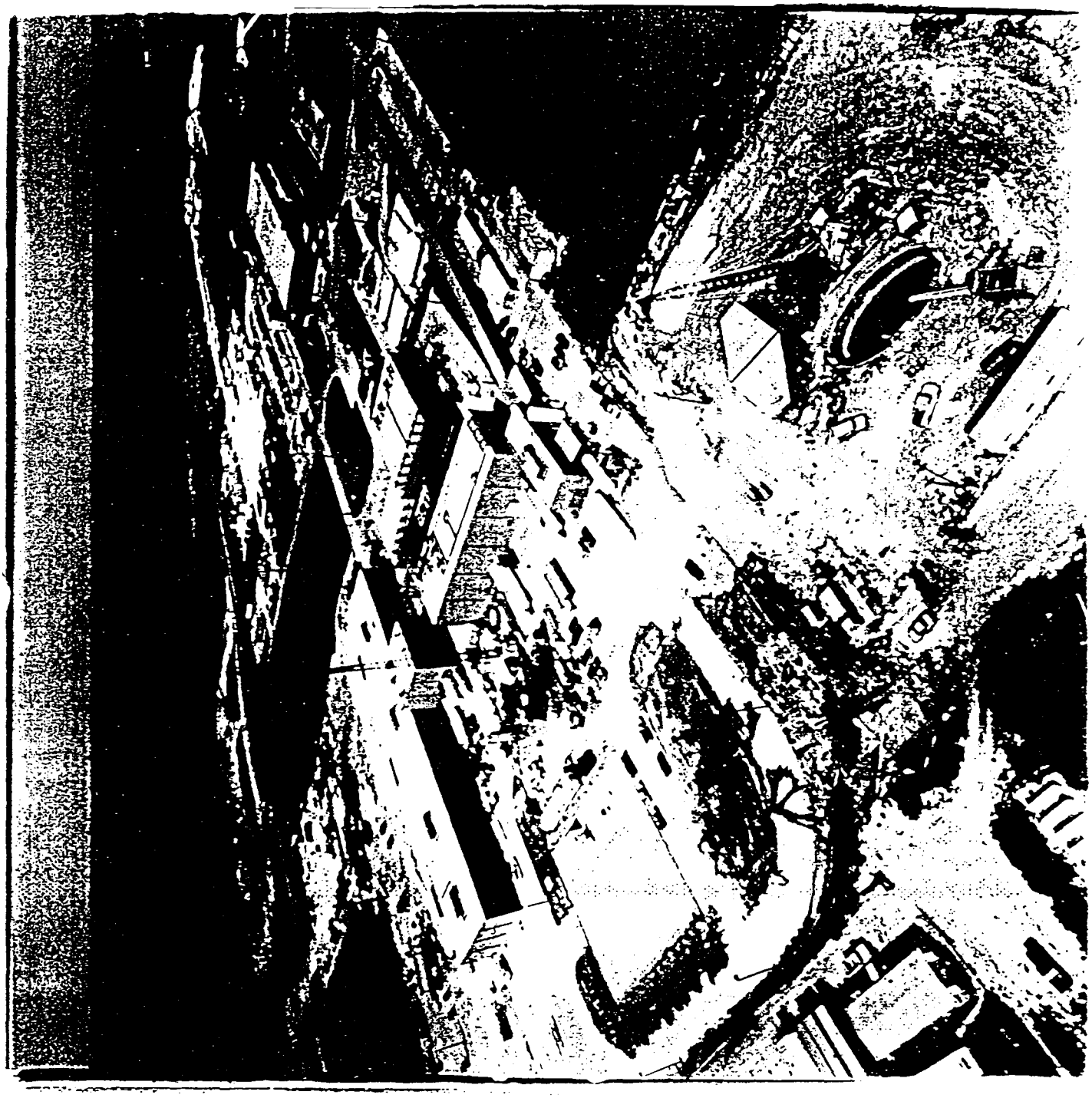
** CCU A690 includes Finish for Tunnel & Shafts in range indicated

*** CCU A720 includes Finish for Tunnel & Shafts in range indicated

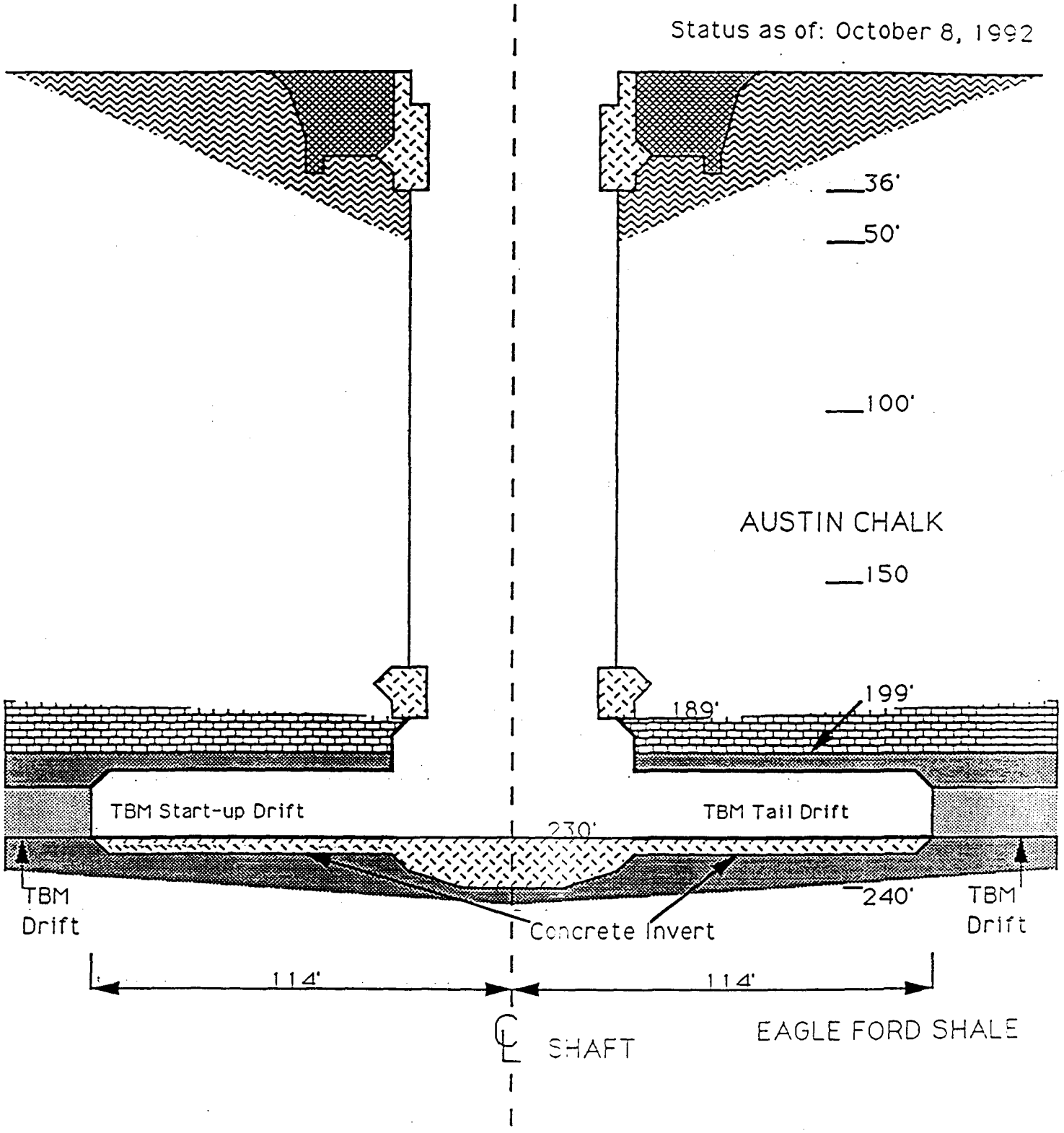
09/17/92

Tunnel Construction and Magnet Installation

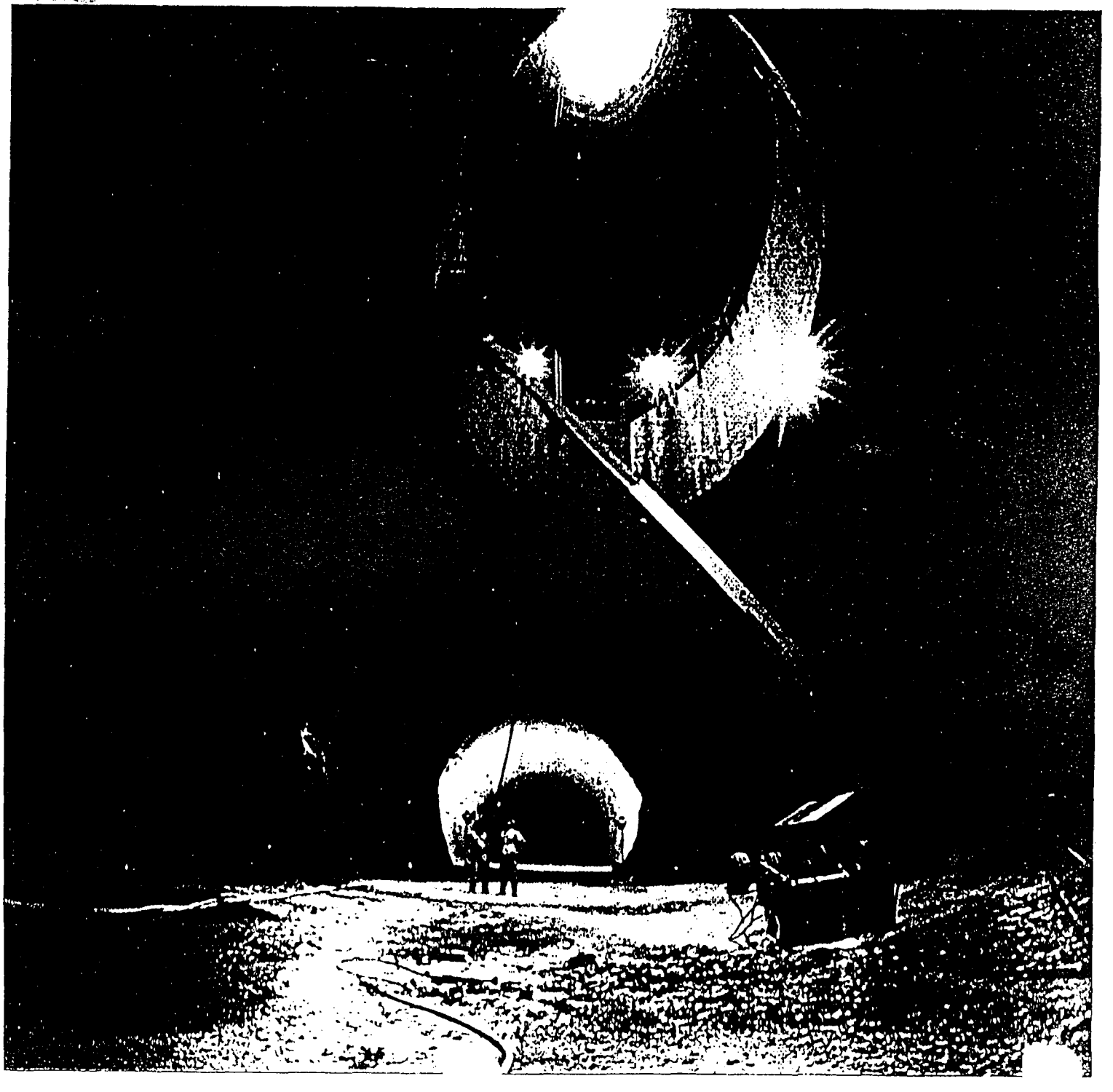


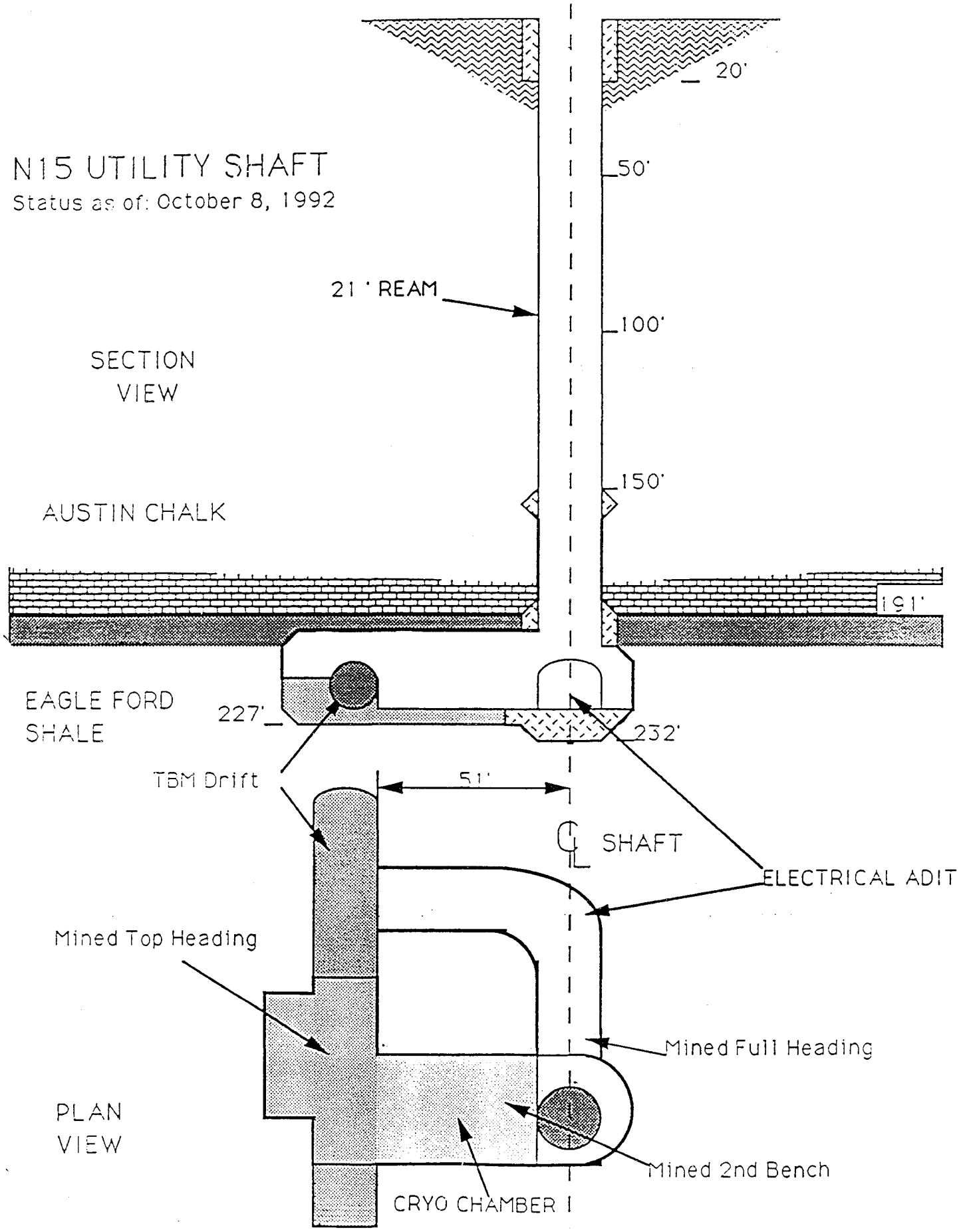


N15 MAGNET DELIVERY SHAFT



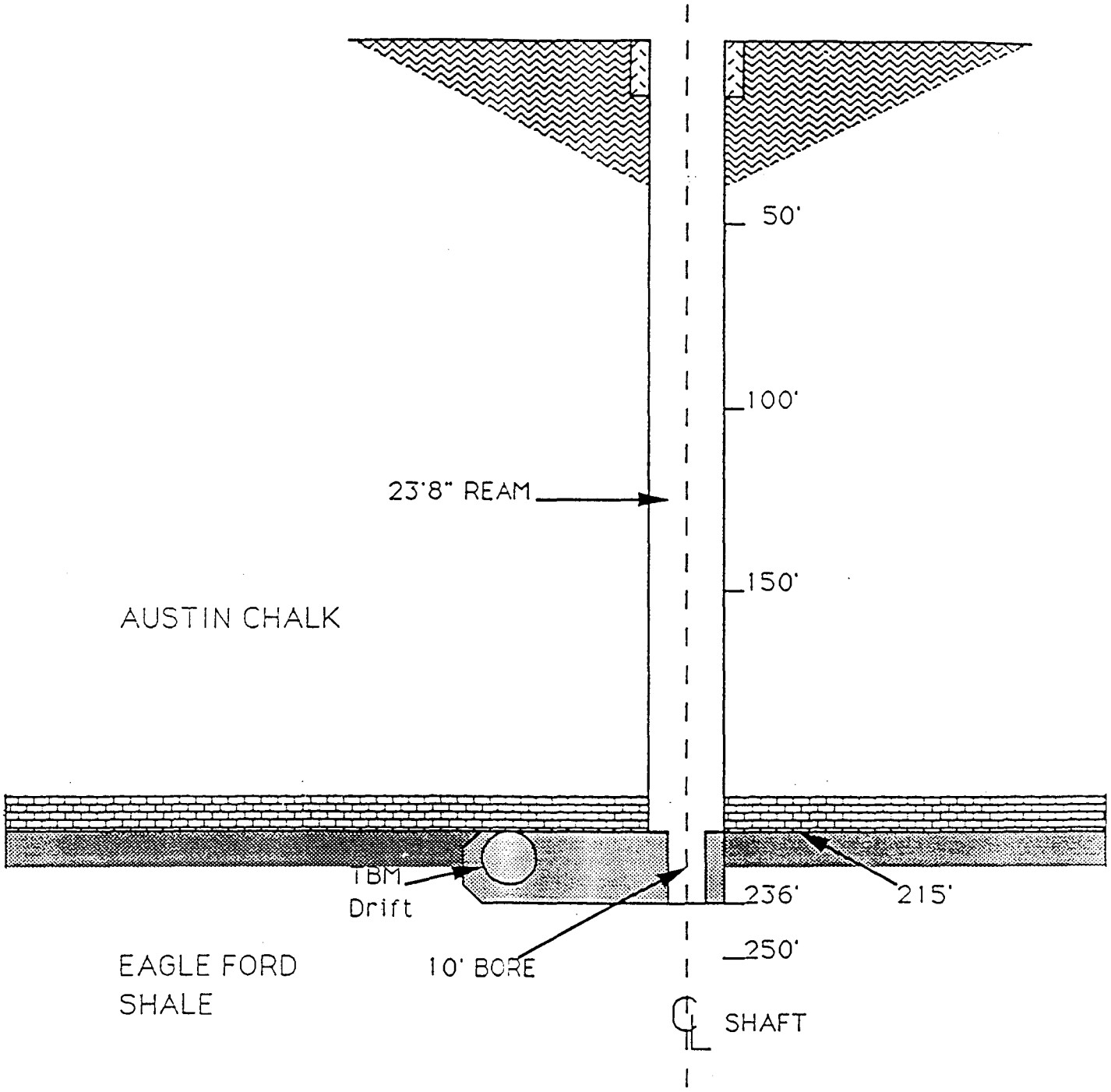
Magnet Delivery Shaft 9m x 18m x 72 m deep




N15 UTILITY SHAFT
Status as of: October 8, 1992
SECTION VIEW
21' REAM
20'
50'
100'
150'
AUSTIN CHALK
191'
EAGLE FORD SHALE
227'
232'
TBM Drift
51'
SHAFT
ELECTRICAL ADIT
Mined Top Heading
Mined Full Heading
PLAN VIEW
Mined 2nd Bench
CRYO CHAMBER I

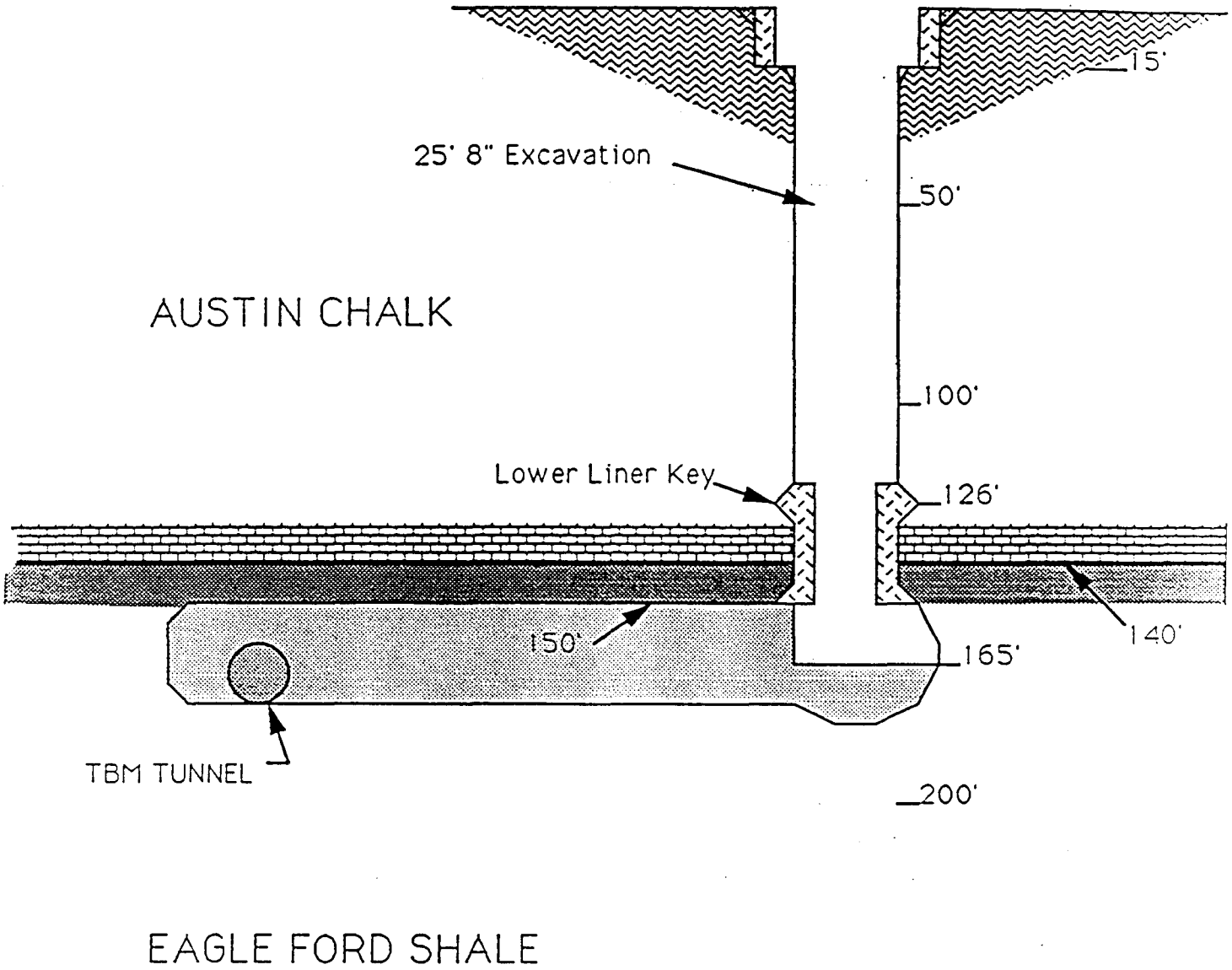
N15 PERSONNEL SHAFT

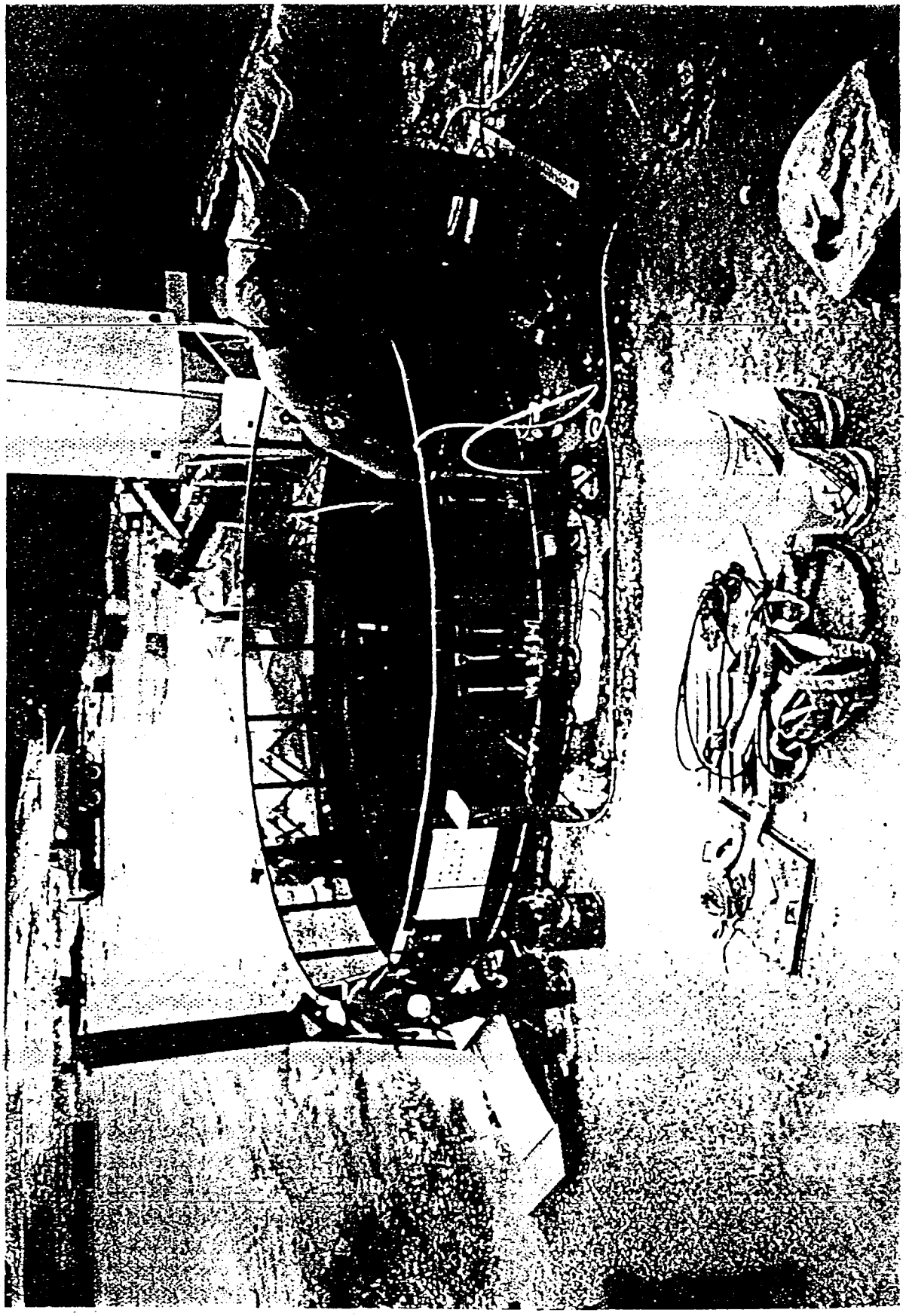
Status as of: October 8, 1992



N20 VENTILATION SHAFT

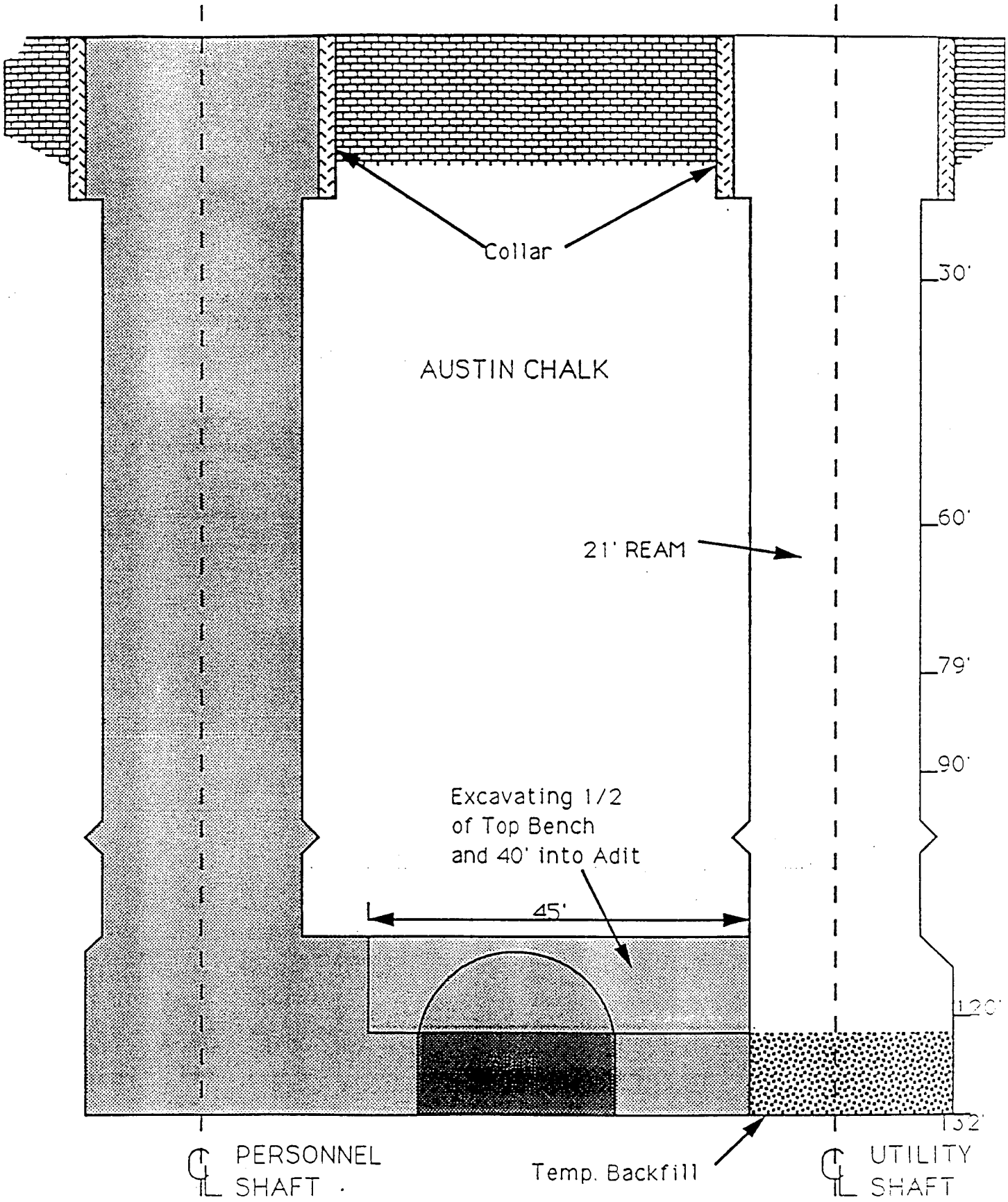
Status as of October 8, 1992

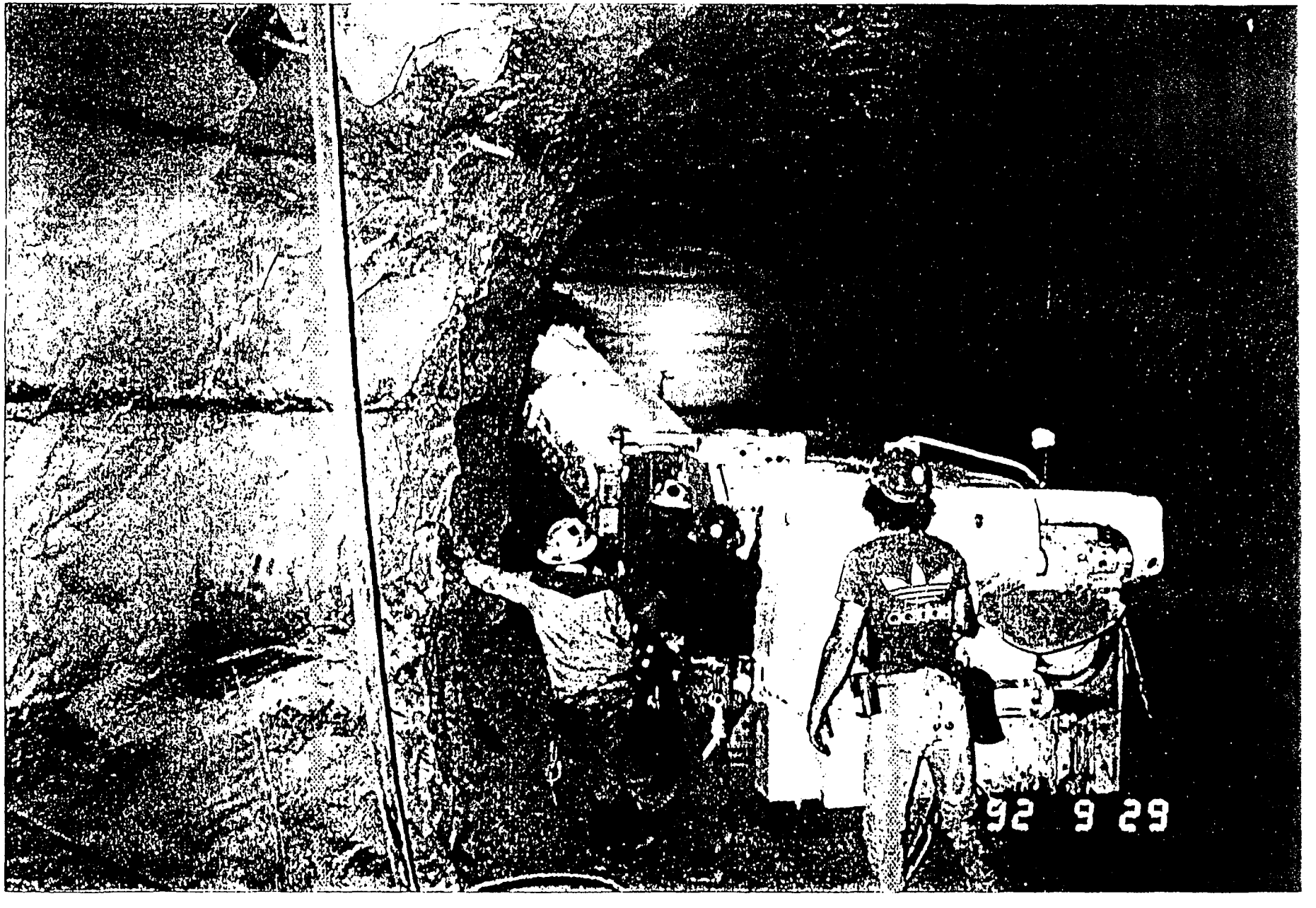


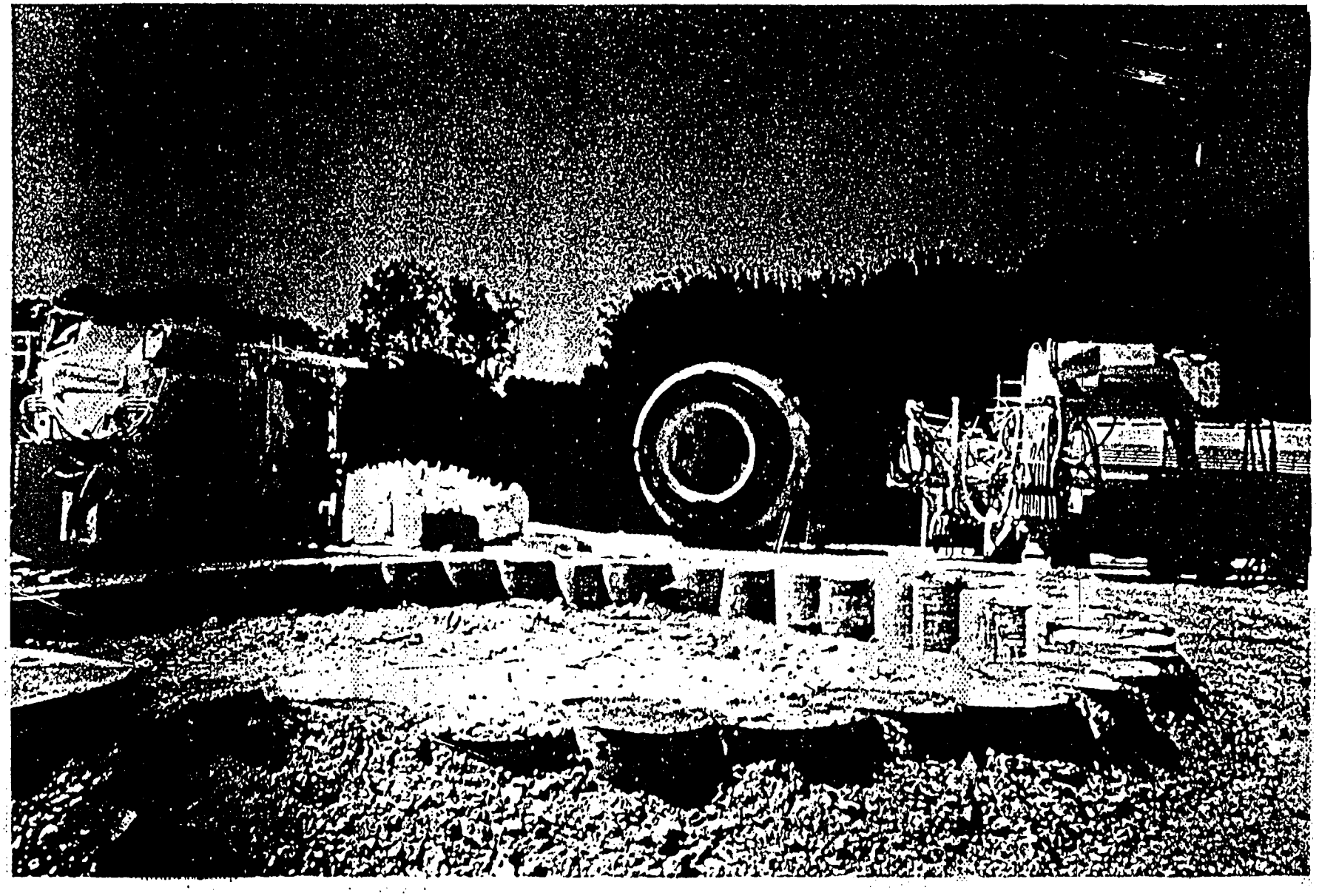


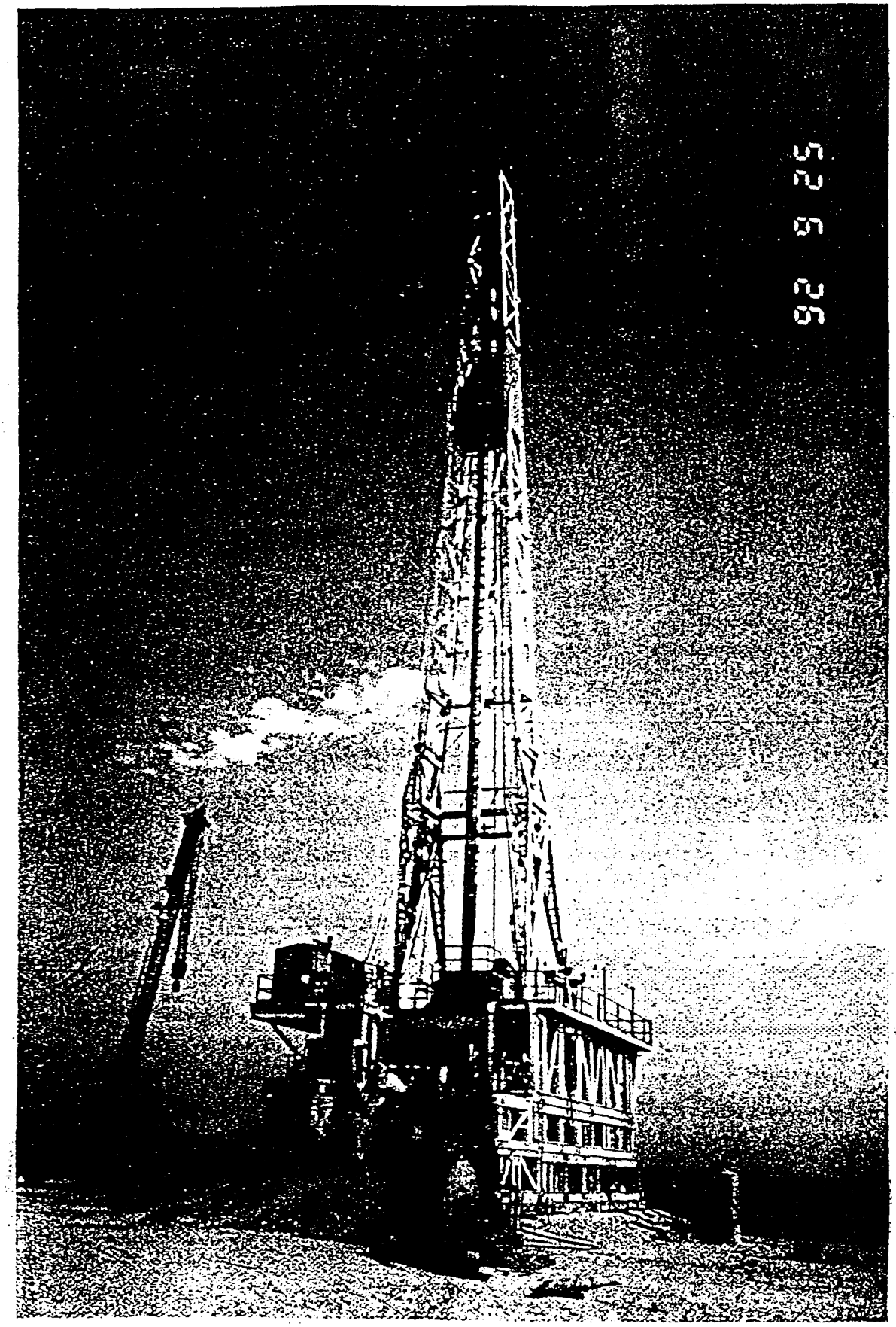
N25 PERSONNEL AND UTILITY SHAFTS

Status as of: October 8, 1992



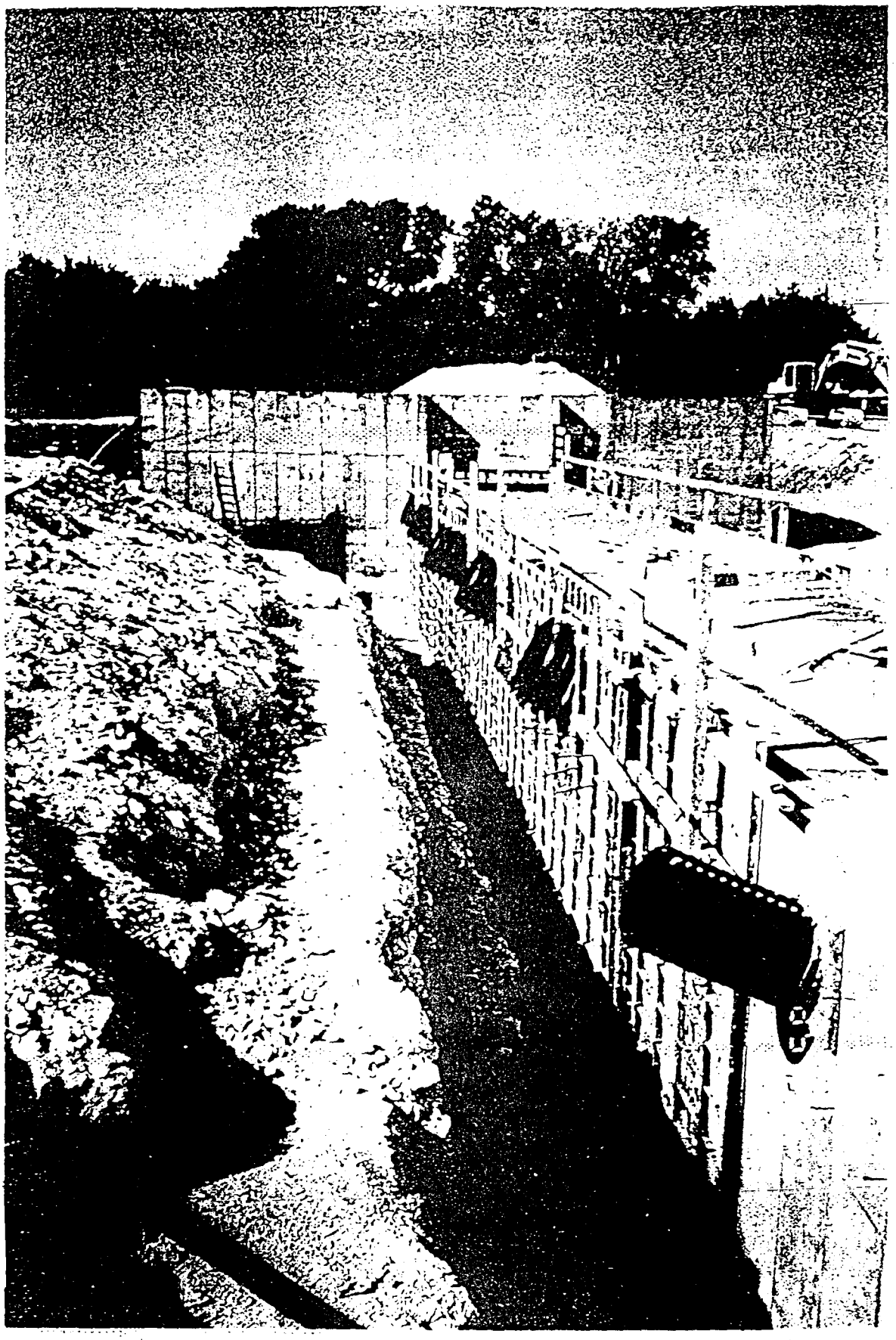

92 9 29




92 8 25

Contract	*BCE ($M)*	*EAC ($M) (Bid Amount)*
N15-N20	20.4 ('92)	23.1
N20-N25	18.5 ('93)	15.8
N25-N40	49.0 ('93)	23.9
N40-N55	46.9 ('93)	27.1
S40-S55	41.9 ('94)	24.2
TOTAL	**176.7**	**114.1**

$$100 \times \frac{114.1}{176.7} = \mathbf{64.6\%}$$



PRESENTATION BY:

G. TRILLING

Remarks from SDC Spokesperson

October 22, 1992

G. H. Trilling

New Applications for Membership in SDC

Colorado State University

University of New Mexico

Note: A committee appointed by IB Chairperson Goshaw and chaired by Paul Taras has recommended some improvements in the admission process. This will be discussed in the Institutional Board meeting.

SDC NUMBERS IN EACH COUNTRY
(Physicists and Engineers)

COUNTRY	INSTITUTIONS	NO. COLLABORATORS
Armenia	1	3
Belarus	2	7
Brazil	1	5
Bulgaria	1	2
Canada	8	26
China	2	36
Czechoslovakia	2	5
France	1	21
Georgia	1	8
Israel	1	2
Italy	3	30
Japan	25	101
Romania	1	5
Russia	3	89
United Kingdom	4	15
United States	58	565
Uzbekistan	2	12
Total Collaborators		932

Some Happenings since August Meeting

Sept. 1-2
Review and technological decision on calorimeter FE electronics (digital solution chosen).

Sept. 11-12
HEPAP Meeting at SSCL with reports from SSC Project, SDC, GEM

Sept.14-18
Preparation sessions for DOE Review

Sept. 29- Oct. 5
Visit to Russia by Gilchriese, Thurston, and GT

Oct. 14-16
Muon Barrel Toroid Preliminary Design Review (Bob Bell, Chair)

October 19
Revised detector cost (Etherton)

Comments on MBT - PDR

(from J. Cherwinka on oral comments from Committee)

The general concept is sound and is expected to work well.

No major flaws were uncovered in the design or analysis work presented.

Suggestions were made on how to tune and further check the work presented.

Areas needing further work were identified.

Ideas to consider were presented.

Comments were made on Russian design alternatives and work plan.

Updated Cost and Funding Information

U.S. SOURCES	
SSC Project	$298M
HEP Program	$40M
TNRLC university support	$20M
NON-U.S. SOURCES	
In-kind contributions	$231M
TOTAL FUNDING	$589M
DETECTOR COST (incl. FY91,FY92)	$609M
Shortfall	*$20M*

Estimated Total Contributions
Non-U.S. Collaborators

(measured in U.S. equivalent cost offsets in FY92$)

Canada	$25.0M
Commonwealth of Independent States	$32.9M
France	$13.7M
Italy	$16.7M
Japan	$116.2M
People's Republic of China	$10.7M
United Kingdom	$15.9M
TOTAL	$231M

Comments on Funding

Roy Schwitters has requested that DOE not make a detailed review of funding next week (focusing principally on technical/management/cost issues). This in part reflects the fact that levels of non-U.S. support are still rather uncertain.

We have developed an International Funding Plan which defines in a preliminary way the division of responsibilities among countries of the collaborating institutions. Through this plan we estimate a non-U.S. in-kind contribution of $231M (~40% of the detector). Exactly half of this amount is projected to be contributions from the Japanese SDC group. Thus the most crucial issue in the implementation of this plan will be the decision of the Japanese government relative to support of the SSC (to be made in early 1993).

Even with optimistic U.S. and non-U.S. projections we have a $20M shortfall. This may grow in the DOE review. Unless we find new savings or more funds, staging may become a necessity.

Letter from Schwitters to Cipriano:

..."Due to remaining uncertainties in foreign funding and the relationship of the SDC funding profile to those of the SSC Project as a whole, we propose that the review process proceed in two phases. The first phase, scheduled for the week of October 26, 1992, will cover technical aspects of SDC design and construction, management, and the overall cost including options for staging or reducing the scope of the detector to conform with potential resources. The next phase, for which the Laboratory and collaboration should be ready by the Spring of 1993, will examine the detailed financial plan and funding profile for SDC, including international and domestic funding sources outside the SSC Project. We will, of course, want to hear in October as much as possible about SDC's expectations for foreign and other non-SSC project resources...."

U.S. DEPARTMENT OF ENERGY
DOE Solenoidal Detector Collaboration Technical/Cost/Schedule/Management
REVIEW COMMITTEE
October 26-30, 1992

Dan Lehman, Chairman (DOE)
Robert Diebold (DOE)
P.K. Williams (DOE)

Observers
John O'Fallon (DOE)

Report Coordinators
Jay Marx (LBL)
Art Robinson (LBL)
Doug Vaughan (LBL)

Support (DOE)
Linda Staples
Anna Bennington
Casey Clark
Robbie Green

SC 1
Physics
* Charlie Prescott (SLAC)
Tom Himel (SLAC)
William Marciano (BNL)
Steve Olsen (UofHA)
(P) [P.K. Williams (DOE)]

SC 2
Tracking Systems
WBS 1
* Bill Reay (CSU)
David Lee (LANL)
Jay Ritchie (UT-Austin)
Ray Stefanski (FNAL)
William Spaulding (FNAL)
(P) Eugene Colton (DOE)

SC 3
Calorimetry
WBS 2
* Dave Hitlin (Cal Tech)
Mike Albrow (FNAL)
Jim Brau (UofOR)
Wit Busza (MIT)
Bernie Gittleman (Cornell)
Peter Kroon (BNL)
(P) Pat Rapp (DOE)

SC 4
Muon System
WBS 3
* Sam Aronson (BNL)
Dick Edelstein (CMU)
Hans Jostlein (FNAL)
Herman Stredde (FNAL)
Frank Taylor (MIT)
(P) Marvin Gettner (DOE)

SC 5
Superconducting Magnet
WBS 4
* Jay Benesch (CEBAF)
Tom Mann (ANL)
Bruce Montgomery (MIT)
Robert Simmons (PPPL)
(P) Eddie Sims (DOE)

SC 6
Electronic Systems and On-Line Computing
WBS 5 & 6
* Ed Platner (BNL)
Gunther Haller (SLAC)
Dan Marlow (Princeton)
Leo Paffrath (BNL)
David Quarrie (CEBAF)
Frank Shively (Santa Fe)
(P) William Watson (DOE)

SC 7
Hall Conventional Facilities, Subsystem Installation & Test, and Detector Integration
WBS 7, 8 & 9.6
* Tom Ludlam (BNL)
Bob Bell (SLAC)
(P) Jim Carney (DOE)
Gene Dretko (DOE)

SC 8

Project Management
WBS 9.1—9.4

Cost, Schedule, Funding, & Collaboration Resources

* Marty Breidenbach (SLAC)
Tony Chargin (LLNL)
[Derek Lowenstein (BNL)]
[Jay Marx (LBL)]
[Tom Ludlam (BNL)]
[Charlie Prescott (SLAC)]
Ray Fricken (DOE)
Greg Haas (DOE)
Dave Sutter (DOE)
(P) Steve Tkaczyk (DOE)

SC 9
Environment and Safety
WBS 9.5
*George Whitlock (DOE)
[Bob Bell (SLAC)]
Roy Lee (DOE)
(P) [Jim Carney (DOE)]

LEGEND
* Chairperson
(P) Report Points-of-Contact
SC Subcommittee
[ ] Part-time Subcommittee member

Italics indicate changes/additions from previous matrix.

37

Distribution of Responsibilities

TRACKING SYSTEMS	
Silicon Tracker	Italy, Japan, U.K. & U.S.
Barrel Outer Tracker	U.S.
Intermediate Tracker	Canada & U.K.
SUPERCONDUCTING SOLENOID	
Coil, Power Supply	Japan
Cryogenics	Japan & U.S.
CALORIMETRY	
Central Calorimetry	France, Italy, Japan, PRC, Russia & U.S.
Forward Calorimetry	Canada
MUON SYSTEM	
Iron Toroids	Russia & U.S.
Chambers	Japan, Russia & U.S.
Trigger Counters	Italy, Japan, Russia & U.S.

Distribution of Responsibilities (Continued)

FRONT-END ELECTRONICS	
Barrel OuterTracker	Canada, Japan & U.S.
Central Calorimetry	France, Italy & U.S.
Muon System	Japan & U.S.
DATA ACQUISITION SYSTEMS	
Silicon Tracker	Italy & U.K.
Barrel Outer Tracker	U.S.
Intermediate Tracker	Canada & U.K.
Calorimetry	Canada, France & U.S.
Muon System	Japan & U.S.
Event Builder,Level 3 Farm	Japan & U.S.
Other Items	Canada, France, Japan & U.S.
TRIGGER	
Silicon Tracker	Italy & U.K.
Barrel Outer Tracker	Japan & U.S.
Intermediate Tracker	Canada & U.K.
Calorimetry	Canada, France & U.S.
Muon System	Japan & U.S.
Global Level 1 & 2	France, Italy, Japan & U.S.

PRESENTATION BY:

T. KIRK

Distribution of Responsibilities (Continued)

OTHERS	
On-Line Computation	Japan & U.S.
Control System	U.S.
Installation	All
Test Beam Program	All
Conventional Facilities	U.S.
Overall Project Management	U.S.

Principal Goals for the Meeting

Rehearse and prepare for next week's review.

Pursue discussions of next fiscal year's activities.

SDC Monthly Report Checkpoints

Areas where a bit more work could really help some of the reports (others are already excellent!) include:

- Format of headers (technical staff and author)
- For idle areas, the notation "no activity this month" is better than no report or response, i.e. "missing report"
- Spelling and syntax (yes, this is still a problem here and there . .)

SDC Project Manager's Report

— SDC Full Group Meeting —

Dallas, Texas

October 22, 1992

- News
- October 26-30 DOE Review
- MOUs
- Monthly Reports

PM Report - page 2

News

- Muon Barrel Toroid Preliminary Design Review carried out October 14-16 at SSCL
  - — good presentations
  - — very experienced committee
  - — positive outcome, design Oked, some items need further work
- Interlaboratory Agreement and Attachment nearing approval with IHEP - Beijing and SSCL
  - — will provide Barrel Hadron Absorber Prototype
  - — DOE has raised some issues with the Attachment
- Japanese Science Council visited SSCL on September 28
  - — very important group, they advise the Prime Minister
  - — they were very impressed (letter to Roy from Prof. Sadao Nakajima)
- Funding of SDC management positions by DOE HEPD is moving *slowly* . . .

PM Report - page 3

October 26-30 DOE Review

- *Please* get your transparency masters (identified with your session number and your name) to your parallel session chairman ASAP!
- Session Chairmen, *please* see that a complete, ordered set of transparency masters are available to SDC support secretaries (Sandy Birmingham and Debra Joe Spangler) ASAP!
- All presenters who are addressing *schedule data* should be sure they have the official versions produced by Dave Etherton; ditto for *costs*.
- Please note the information sent to you by mail, especially the October 19 version of the Agenda.
- Finally, if you can, please go over the *content* of your talk with your session chair (especially, potentially controversial items).

PM Report - page 4

Memoranda of Understanding

- Only two are complete for entire subsystems (straw and fiber trackers)
- SSCL funding level is still not decided
  - — early indications of good levels are now possibly in doubt
  - — early SSCL tunneling contracts have saved funds relative to the SSC baseline
  - — there was significant underspending in FY92
- No funds will be dispersed without an agreed-upon MOU
  - — disagreement in one subsystem area needn't compromise others (multiple MOUs/institution can be allowed)
  - — MOUs need to correlate explicitly with WBS and IPS
  - — Deliverables and reporting will be enforced
- If we have significant underfunding from SSCL, FY93 may have allocations in two segments
  - — first 6 months at full strength
  - — second 6 months by institutional performance

PM Report - page 5

Monthly Reports

- The monthly report is decent and improving
  - — submitted text is interesting and about the right length
  - — figures submitted are *very useful*
  - — organization and editing is pretty good

but . . .

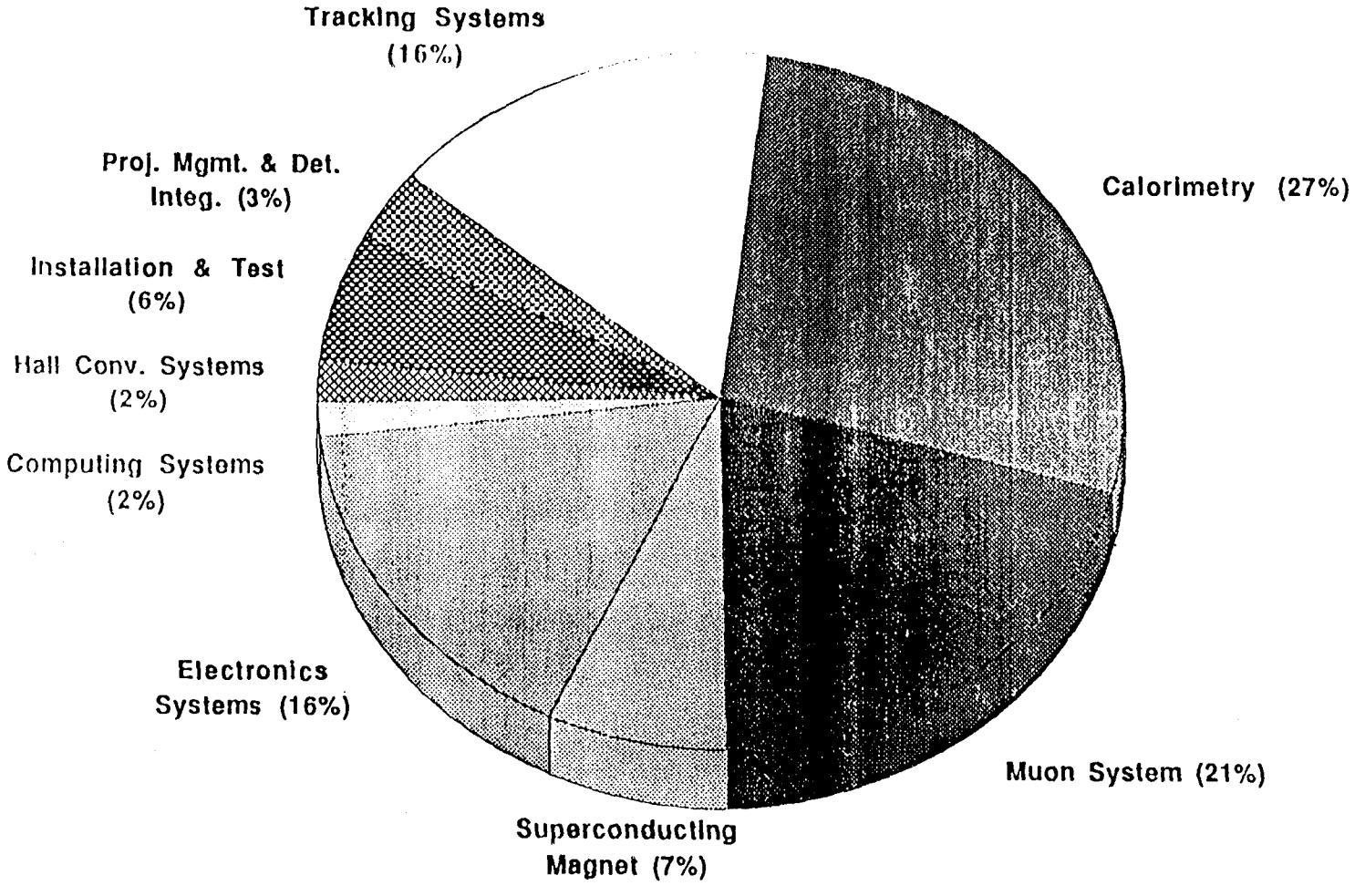
- We have a way to go to have a truly good documentation of the SDC Project
  - — some reports are still *missing*
  - — *cost reports* are sketchy to poor for many institutions
  - — a *few more figures* could help
  - — a few words on the *significance* of the reported work also helps comprehension

keep on truckin', folks . . .

PRESENTATION BY:

D. ETHERTON

SDC U.S. Equivalent Cost Estimate

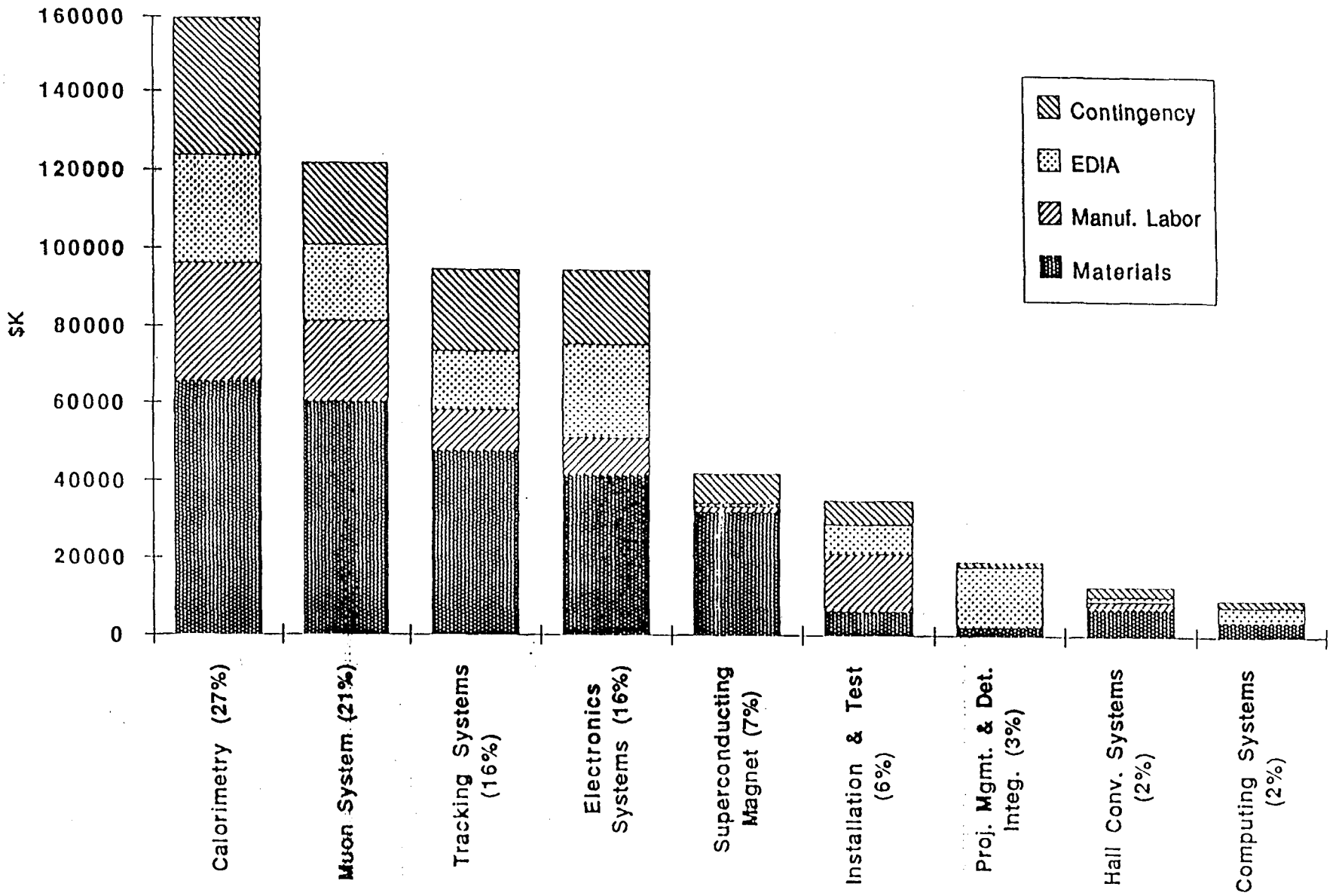


Total Estimated Cost = $589M FY92

SDC Pie Chart

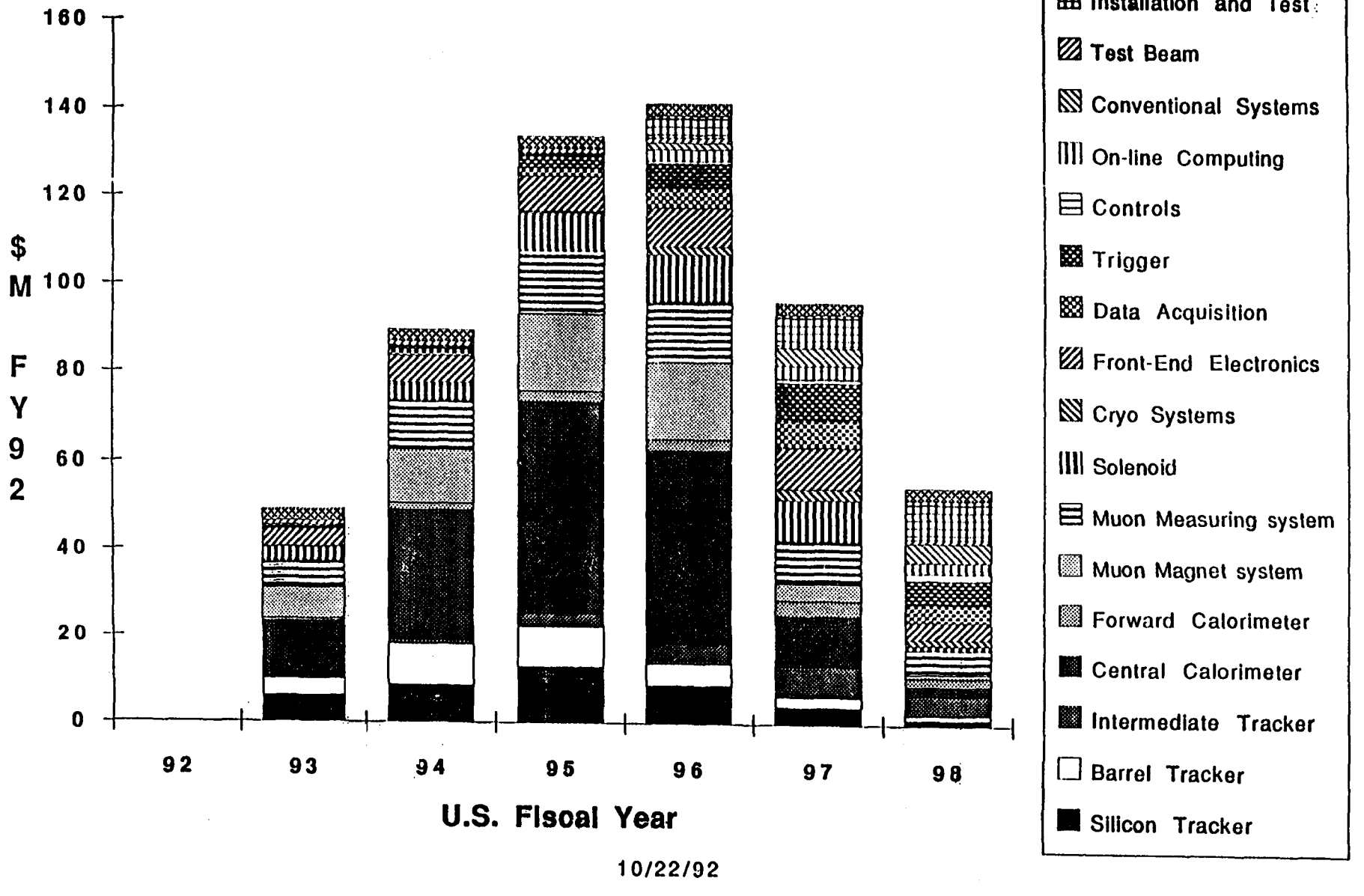
10/22/92

SDC U.S. Equivalent Cost Estimate (FY92 Dollars)

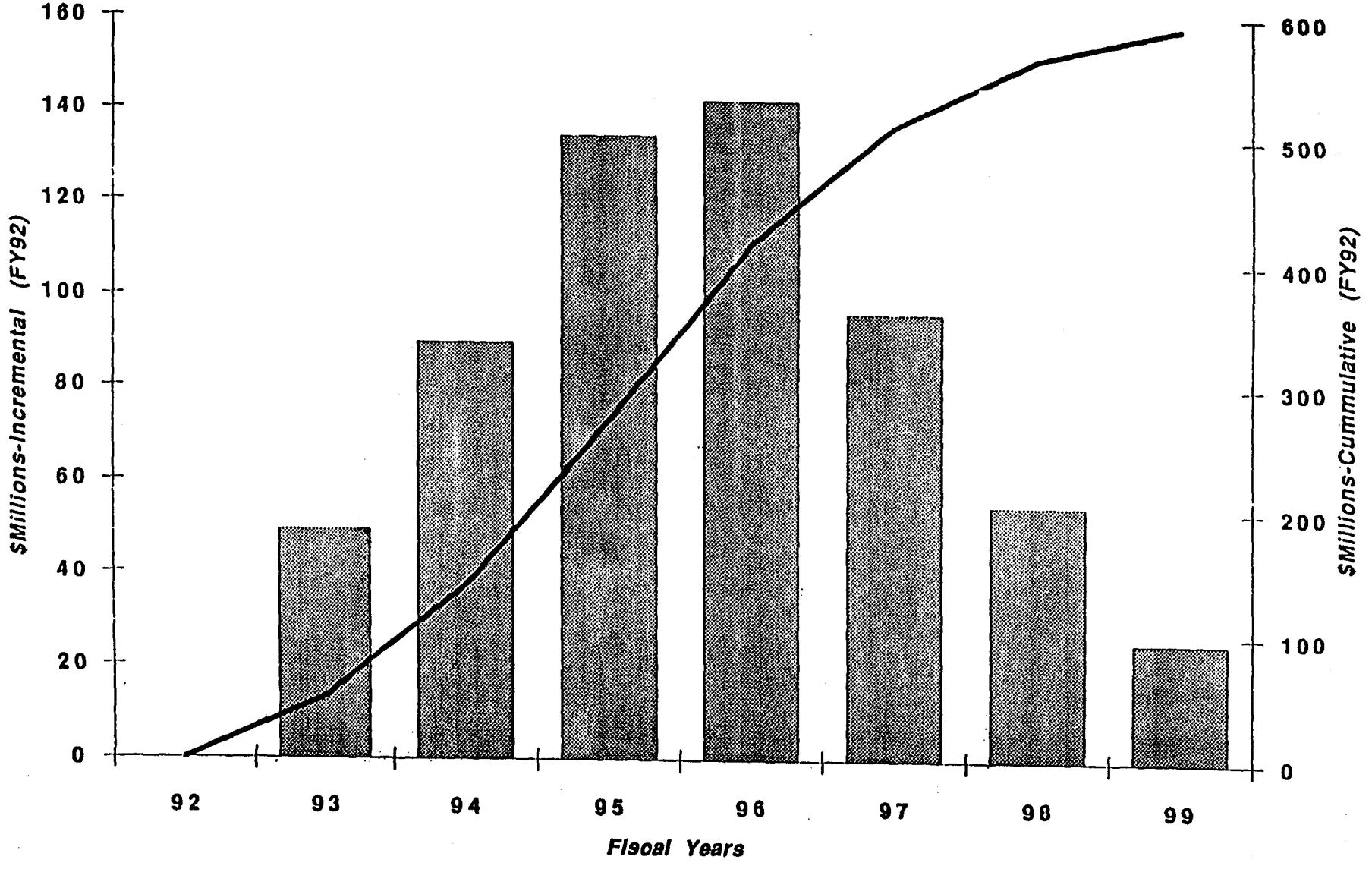


10/22/92

SDC Detector
Subsystem Funding Profiles

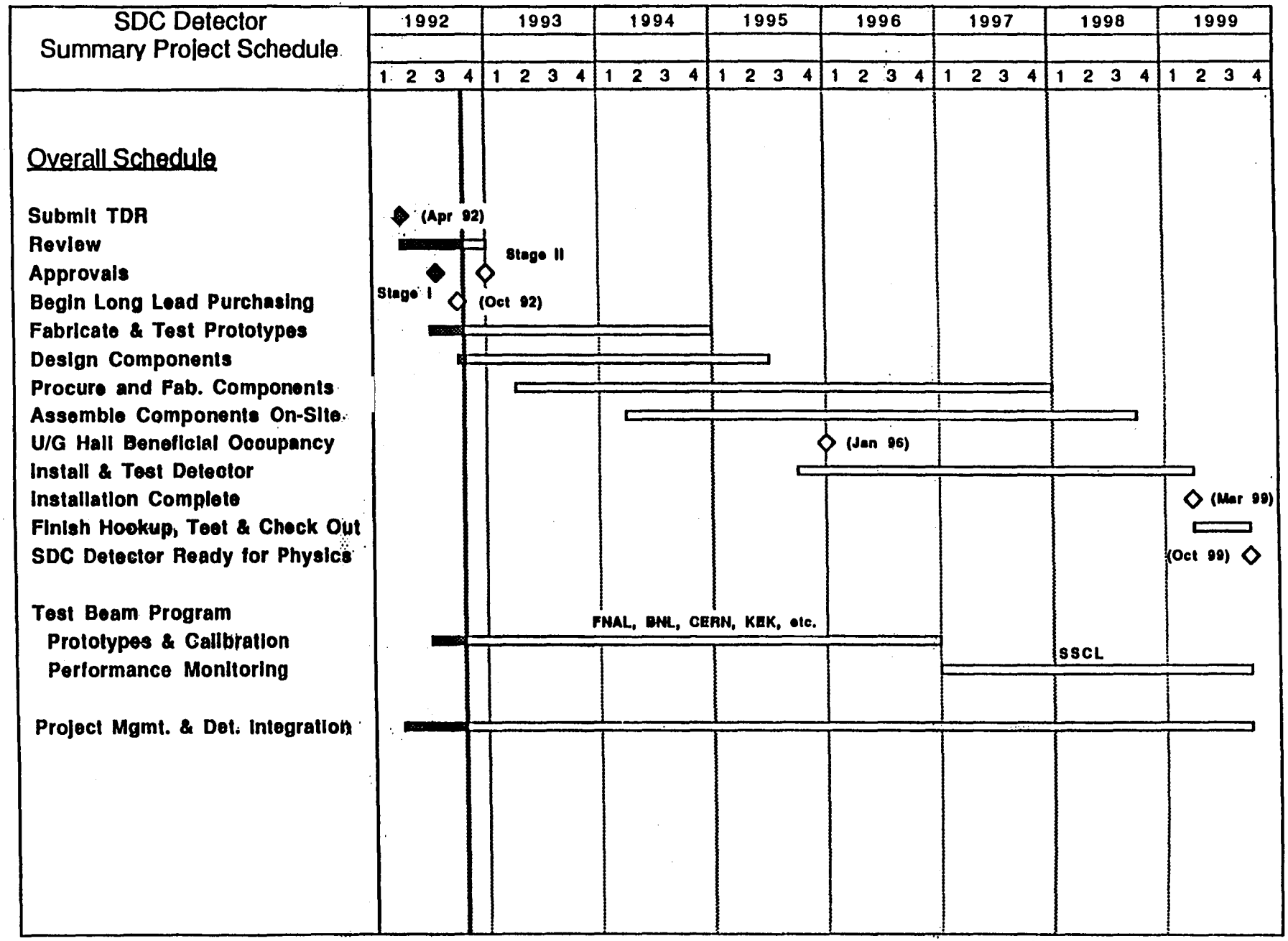


SDC Detector Funding Profile



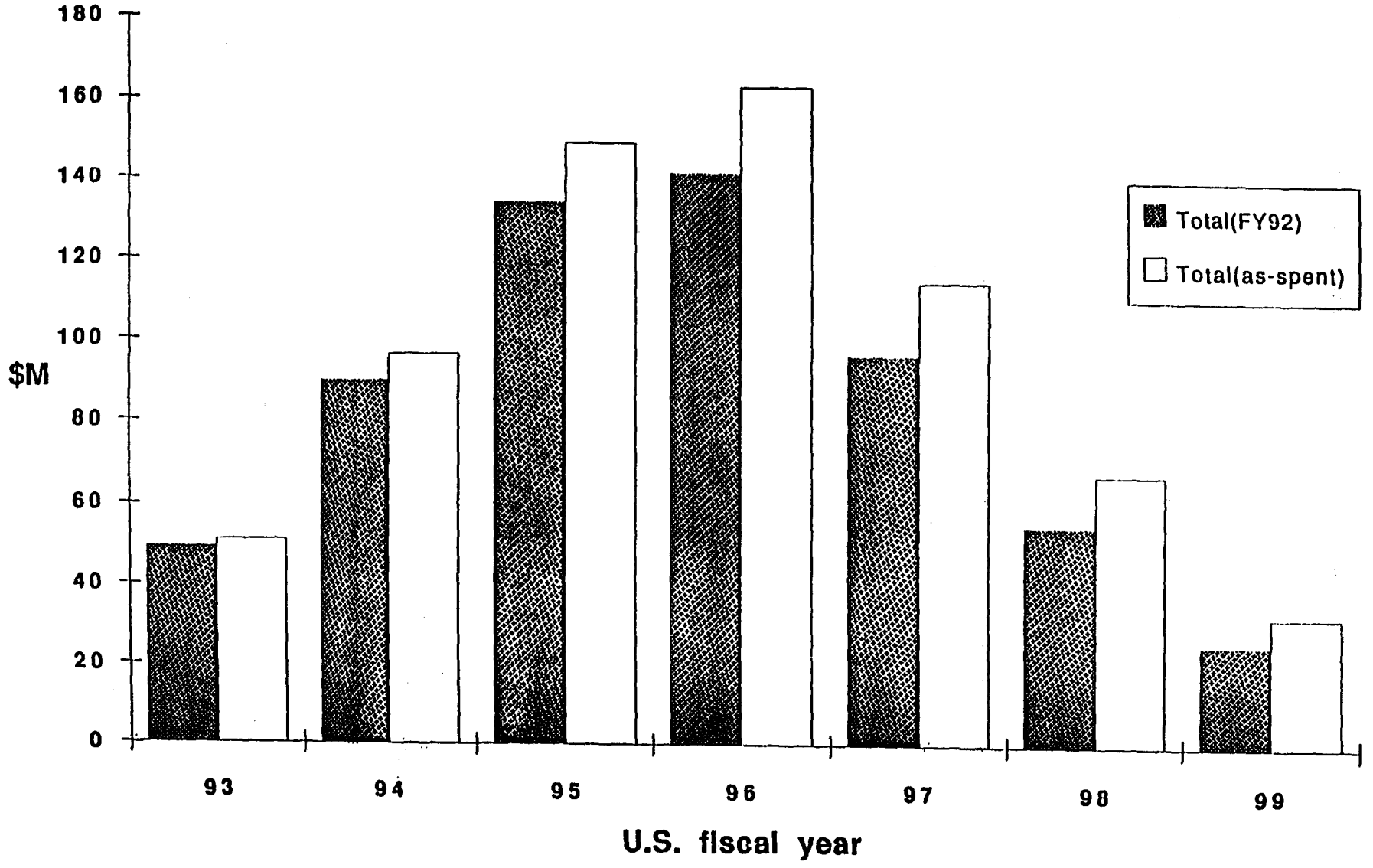
10/22/92

Tota `hart



Thursday, October 22, 1992

SDC Detector
Required Funding Profile



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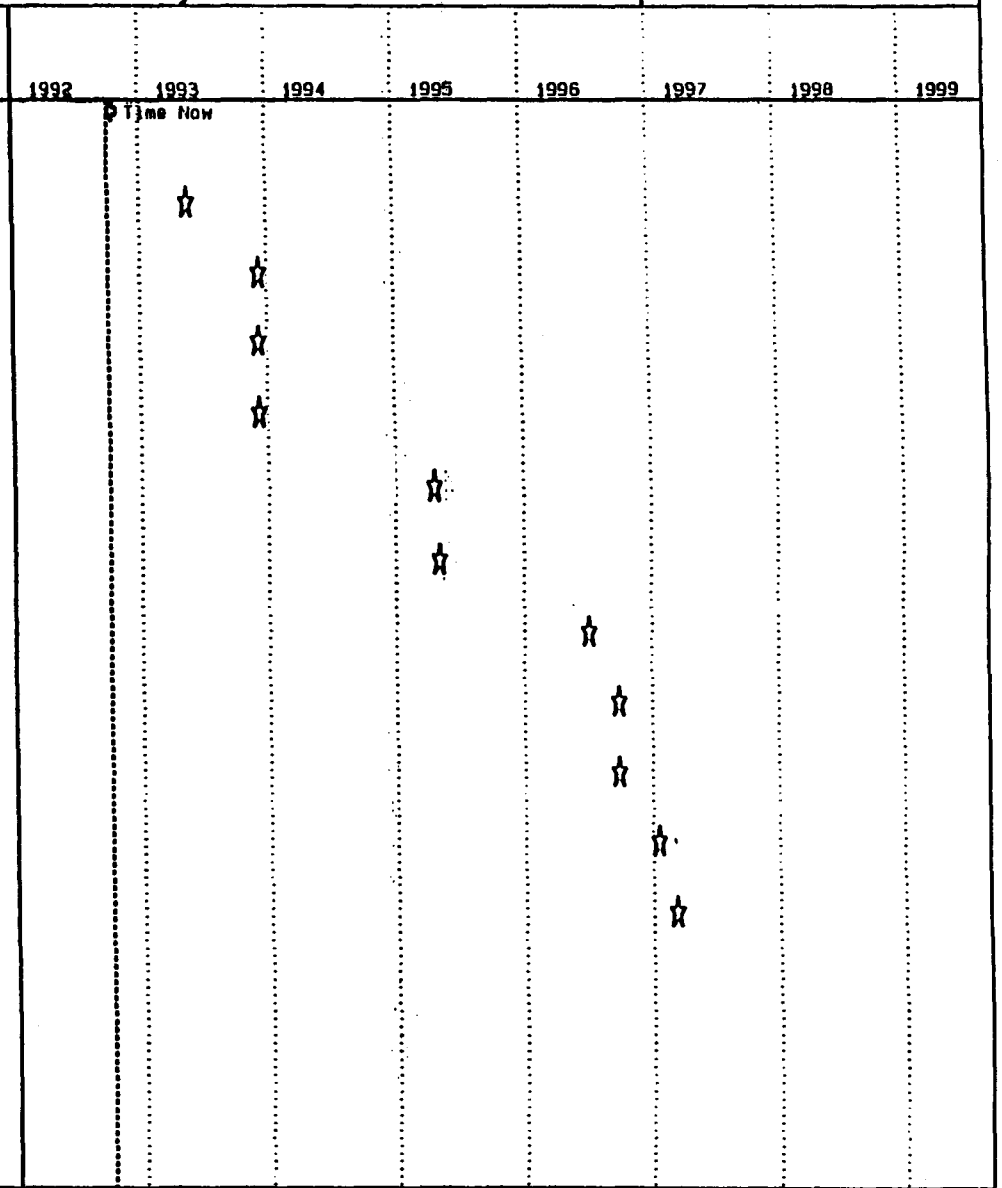
Project: SDC39N3
Report: SDCMILE1
Status as of: 01OCT92
Current Date: 21OCT92
Page: 1

LEVEL III SUMMARY BASELINE SCHEDULE

3.2 Muon Measurement System

SOLENOIDAL DETECTOR COLLABORATION

Summary Description	Milestone Date
MAJOR MILESTONES	
FINISHED PDR-BARREL REGION	MAY-93
FINISHED CDR-BARREL REGION	DEC-93
FINISHED CDR-INTERMEDIATE REG.	DEC-93
FINISHED CDR-FORWARD REGION	DEC-93
FINISHED ASSEMBLY OFFSITE-BR	APR-95
FINISHED SHIPMENT-BARREL REG.	MAY-95
READY TDH-BARREL PHASE I	JUL-96
FINISHED ASSEMBLY SSCL-BR	SEP-96
READY TDH-BARREL PHASE II	SEP-96
STARTED TDH-INTERMEDIATE	JAN-97
STARTED TDH-FORWARD	MAR-97



Legend Milestones: ☆ Baseline

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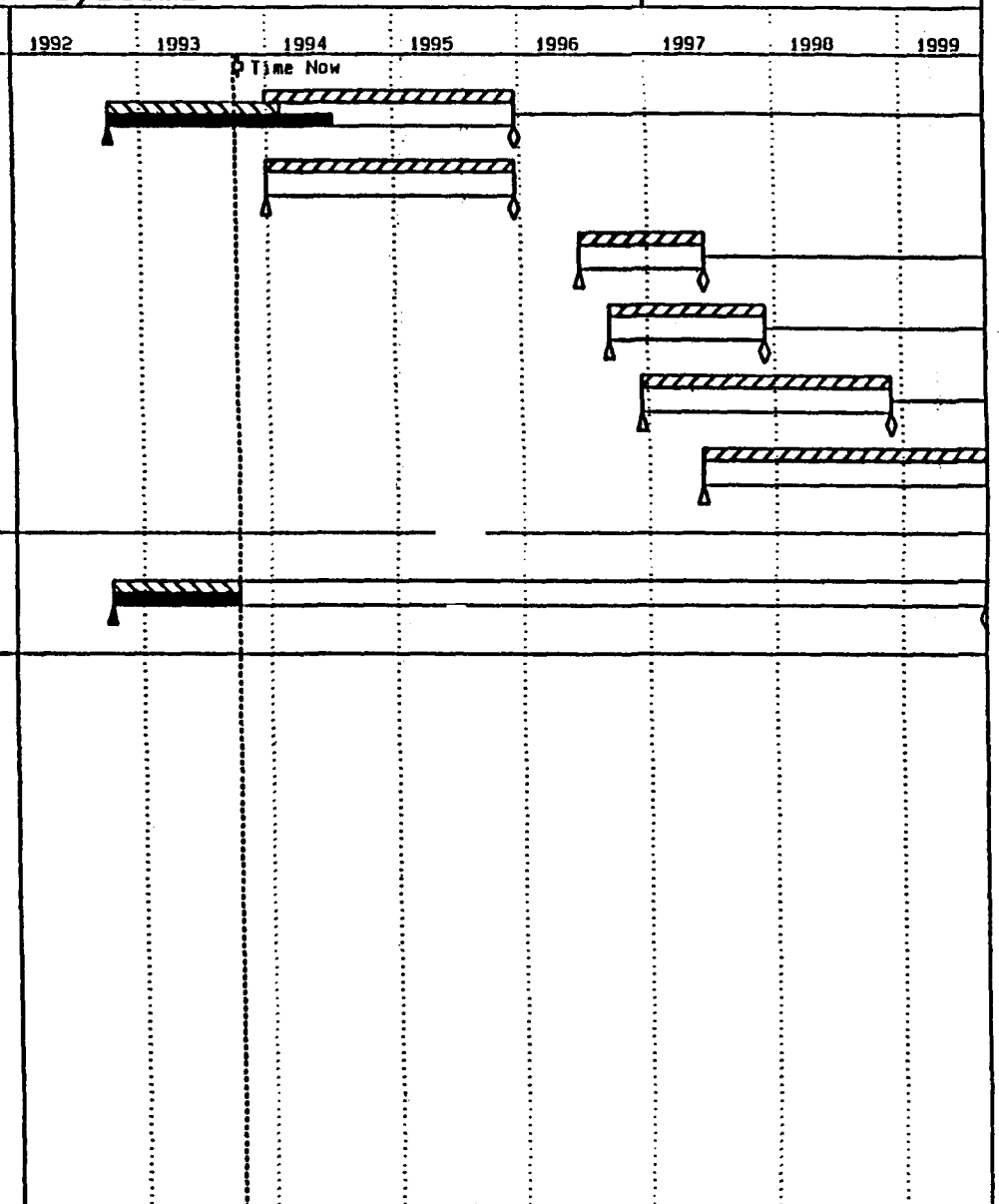
Project: SDCB3STA
Report: SDCBAR2
Status as of: 01OCT93
Current Date: 22OCT92
Page: 2

LEVEL III SUMMARY BASELINE SCHEDULE

5.3 Trigger Systems

SOLENOIDAL DETECTOR COLLABORATION

Summary Description	Baseline Start/Finish Projected Start/Finish		%Comp
DESIGN	01OCT92 01OCT92A	18DEC95 18DEC95	42 177
PROTOTYPE DEVELOPMENT	28DEC93 28DEC93	15DEC95 15DEC95	
PROCUREMENT	17JUN96 17JUN96	11JUN97 11JUN97	
FABRICATE	11SEP96 11SEP96	02DEC97 02DEC97	
REMOTE OFF-SITE ASSEMBLY	11DEC96 11DEC96	27NOV98 27NOV98	
ASSEMBLE AT SSCL	03JUN97 03JUN97	27SEP99 27SEP99	
5.3.3 Project Management			
MANAGEMENT	01OCT92 01OCT92A	01SEP99 01SEP99	14 100



Legend
- Baseline
- % Complete of Total
- % Comp of Planned to date
- Critical
- Projected/Actual Start
- Projected/Actual Finish
- Float
- Milestones: Baseline, Projected, Actual

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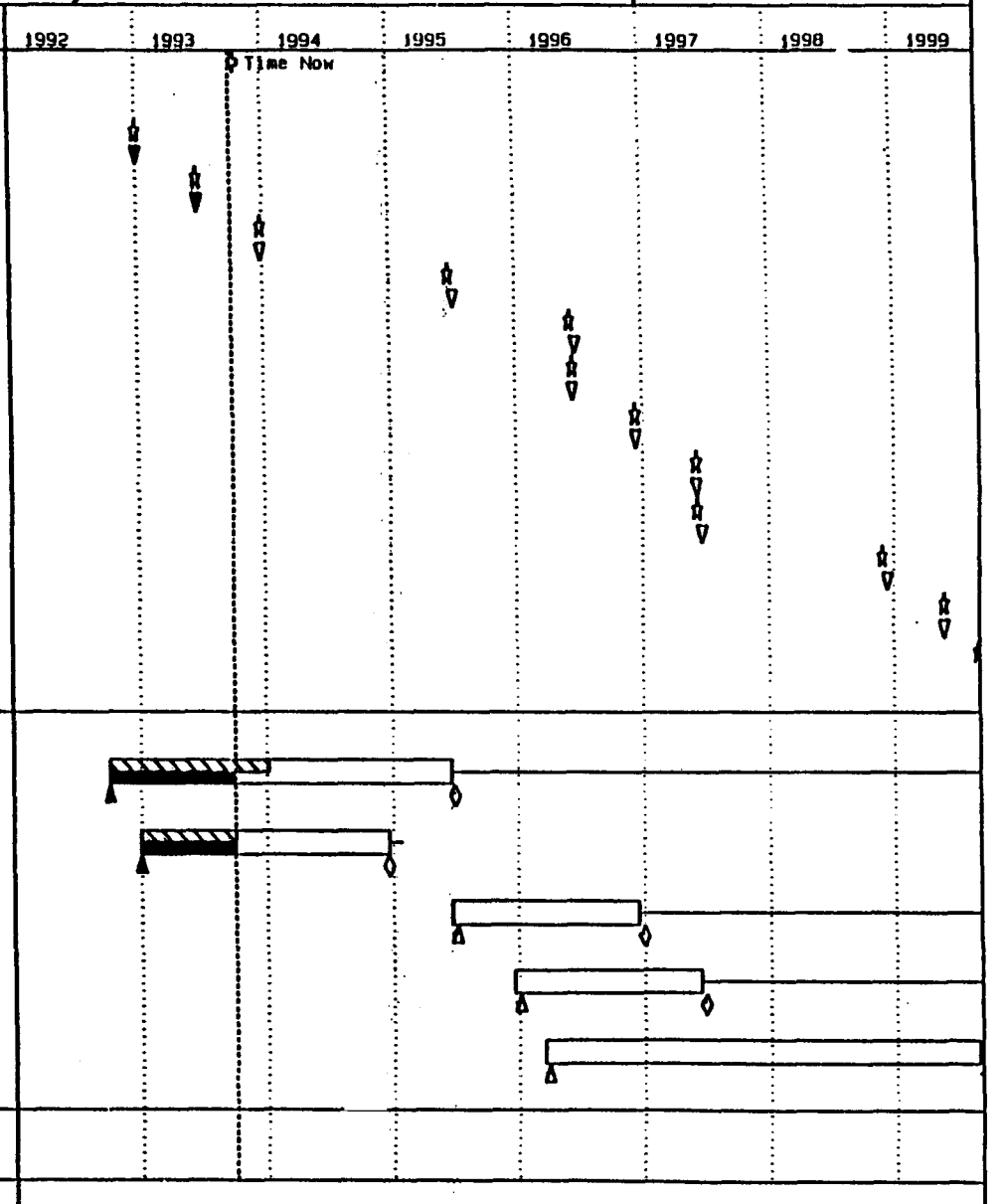
Project: SDCB3STA
Report: SDCBAR2
Status as of: 01OCT93
Current Date: 22OCT92
Page: 1

LEVEL III SUMMARY BASELINE SCHEDULE

5.3 Trigger Systems

SOLENOIDAL DETECTOR COLLABORATION

Summary Description	Baseline Start/Finish	Projected Start/Finish	%Comp
MILESTONES			
Start Final Design (L1)		30DEC92	
		31DEC92A	
Test Trigger System		25JUN93	
		25JUN93A	
Start Final Design (L2)		27DEC93	
		27DEC93	
Complete Design (L1)		20JUN95	
		05JUL95	
Delivery of Prototype (L1)		07JUN96	
		21JUN96	
Complete Design (L2)		14JUN96	
		14JUN96	
Delivery of Prototype (L2)		10DEC96	
		10DEC96	
Delivery of Trigger System		02JUN97	
		02JUN97	
Integration & Test Begins		04JUN97	
		18JUN97	
Integration With DAQ & FE Begins (L1)		27NOV98	
		11DEC98	
Integration With DAQ & FE Begins (L2)		25MAY99	
		25MAY99	
Commissioning Completed		01SEP99	
		08SEP99	
5.3.1 First Level Trigger			
DESIGN	01OCT92	19JUN95	46
	01OCT92A	30JUN95	97
PROTOTYPE DEVELOPMENT	31DEC92	20DEC94	38
	31DEC92A	20DEC94	100
PROCUREMENT	21JUN95	12DEC96	
	06JUL95	30DEC96	
FABRICATE	19DEC95	11JUN97	
	05JAN96	25JUN97	
REMOTE OFF-SITE ASSEMBLY	15MAR96	24AUG99	
	29MAR96	08SEP99	
5.3.2 Second Level Trigger			



Legend
- Baseline
- % Complete of Total
- % Comp of Planned to date
- Critical
- Projected/Actual Start
- Projected/Actual Finish
- Float
- Milestones: Baseline, Projected, Actual

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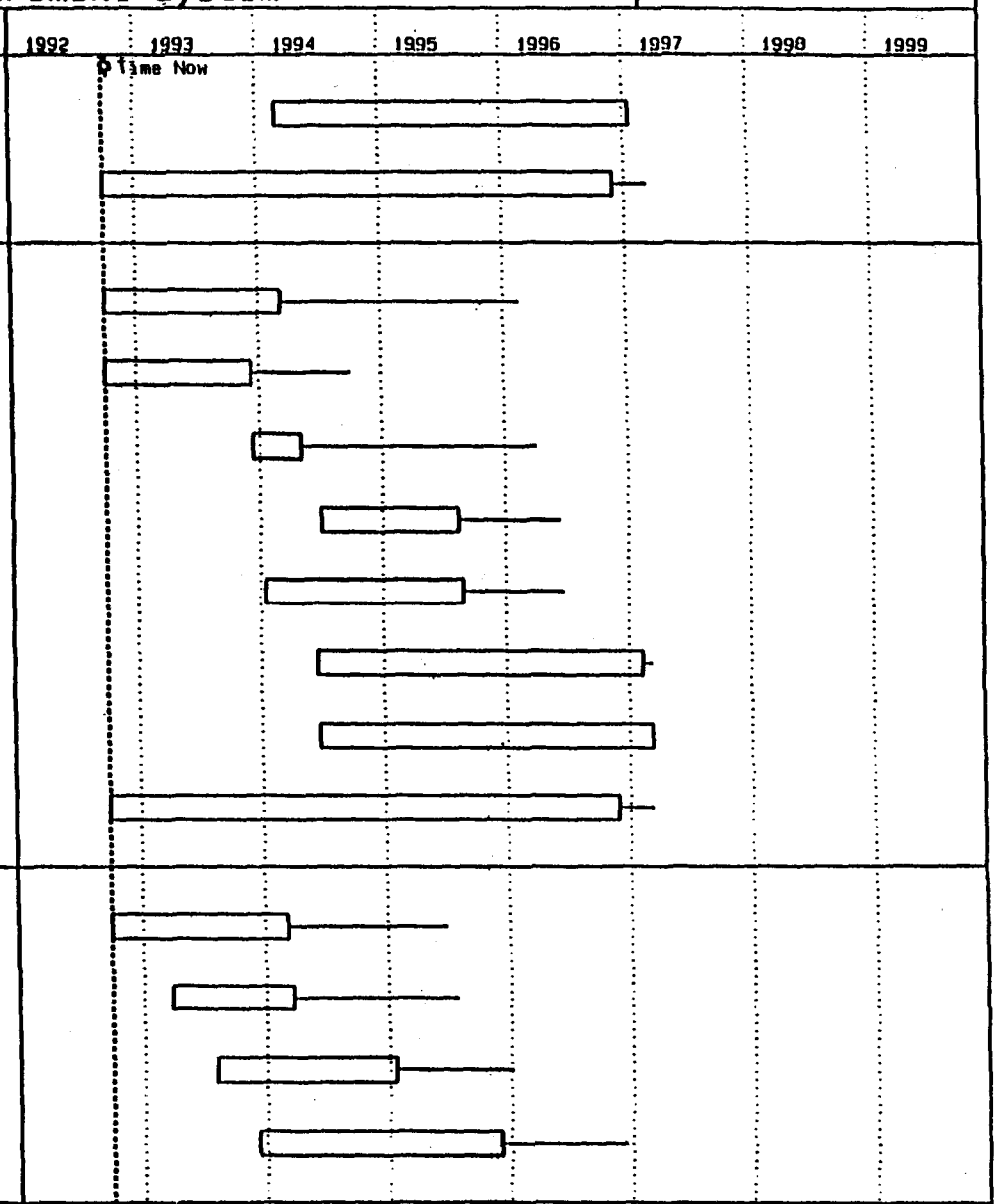
Report: SOCBAIIIC
Status as of: 01OCT92
Current Date: 21OCT92
Page: 3

LEVEL III SUMMARY BASELINE SCHEDULE

3.2 Muon Measurement System

SOLENOIDAL DETECTOR COLLABORATION

Summary Description	Baseline Start/Finish	Projected Start/Finish	%Comp
TEST AND CHECKOUT AT SSCL	28FEB94	16JAN97	
	28FEB94	16JAN97	
MANAGEMENT	01OCT92	26NOV96	
	01OCT92	26NOV96	
3.2.3 Forward Region (Summary)			
DESIGN	01OCT92	07MAR94	
	01OCT92	07MAR94	
PROTOTYPE DEVELOPMENT	01OCT92	08DEC93	
	01OCT92	08DEC93	
PROCUREMENT	13DEC93	02MAY94	
	13DEC93	02MAY94	
REMOTE OFF-SITE ASSEMBLY	01JUL94	11AUG95	
	01JUL94	11AUG95	
SHIP TO SSCL	13JAN94	25AUG95	
	13JAN94	25AUG95	
ASSEMBLE AT SSCL	15JUN94	07FEB97	
	15JUN94	07FEB97	
TEST AND CHECKOUT AT SSCL	21JUN94	07MAR97	
	21JUN94	07MAR97	
MANAGEMENT	01OCT92	26NOV96	
	01OCT92	26NOV96	
3.2.4 Global (Summary)			
DESIGN	01OCT92	07MAR94	
	01OCT92	07MAR94	
PROCUREMENT	25MAR93	21MAR94	
	25MAR93	21MAR94	
SHIP TO SSCL	02AUG93	19JAN95	
	02AUG93	19JAN95	
ASSEMBLE AT SSCL	09DEC93	30NOV95	
	09DEC93	30NOV95	



Legend: Baseline; % Complete of Total; % Comp of Planned to date; Critical; Projected/Actual Start; Projected/Actual Finish; Float; Milestones: Baseline, Projected, Actual

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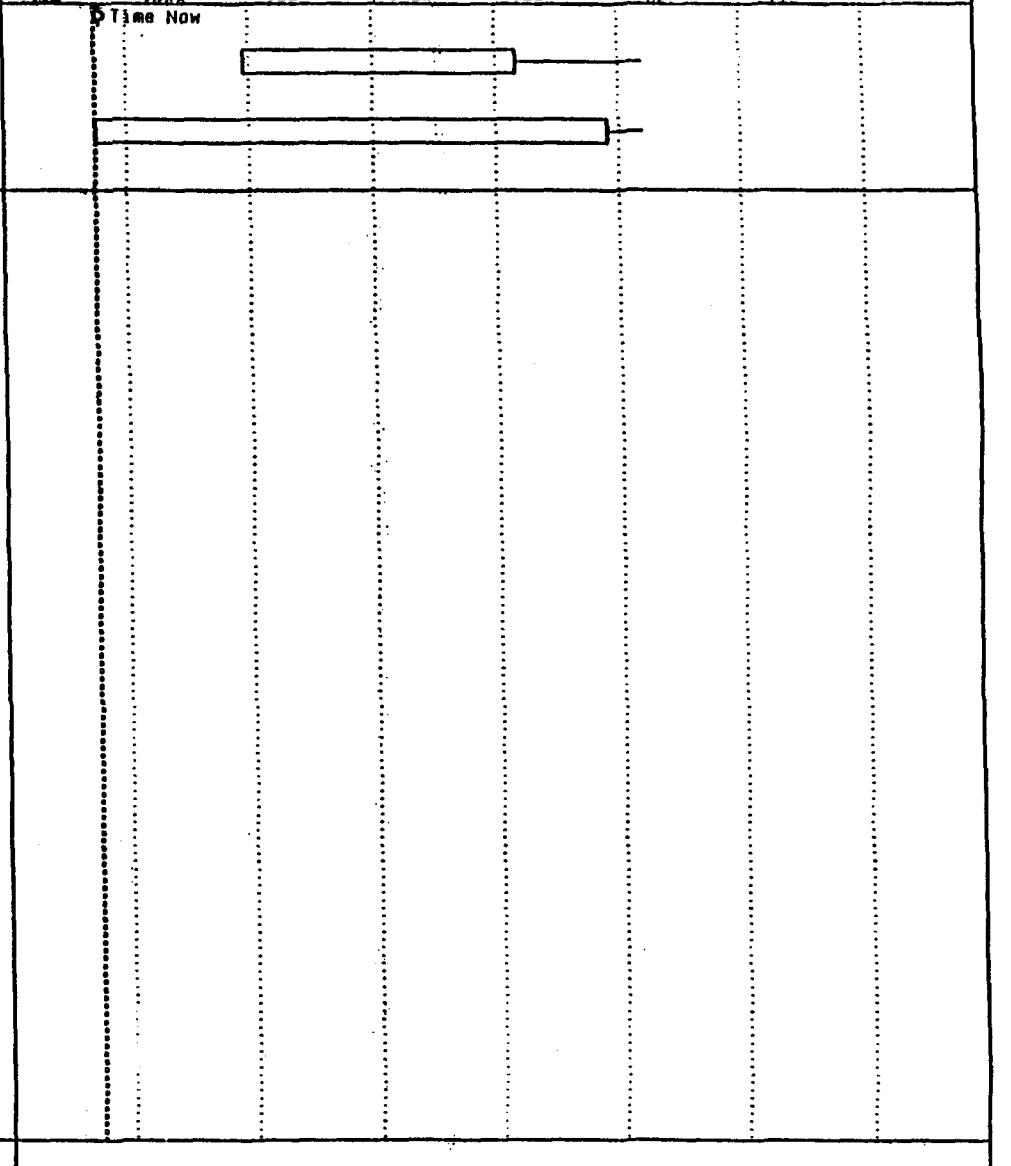
Project: SOC32N3
Report: SOCBAR1C
Status as of: 01OCT92
Current Date: 21OCT92
Page: 4

LEVEL III SUMMARY BASELINE SCHEDULE

3.2 Muon Measurement System

SOLENOIDAL DETECTOR COLLABORATION

Summary Description	Baseline Start/Finish	Projected Start/Finish	%Comp
TEST AND CHECKOUT AT SSCL	15DEC93	27FEB96	
	15DEC93	27FEB96	
MANAGEMENT	01OCT92	26NOV96	
	01OCT92	26NOV96	



Legend
- Baseline
- % Complete of Total
- % Comp of Planned to date
- Critical
- Projected/Actual Start
- Projected/Actual Finish
- Float
- Milestones: Baseline, Projected, Actual

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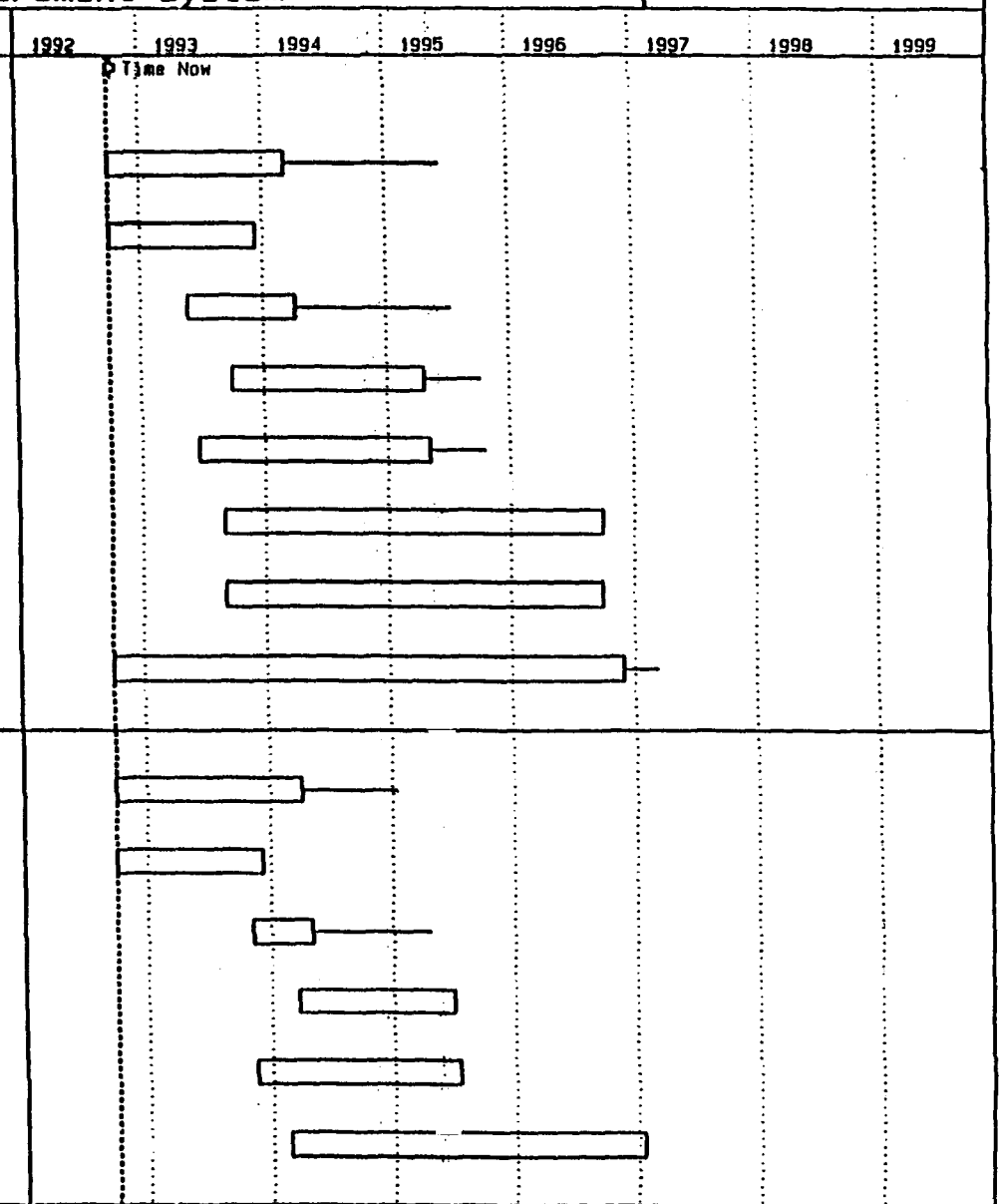
Project: SDC3203
Report: SDCBARIC
Status as of: 01OCT92
Current Date: 21OCT93
Page: 2

LEVEL III SUMMARY BASELINE SCHEDULE

3.2 Muon Measurement System

SOLENOIDAL DETECTOR COLLABORATION

Summary Description	Baseline Start/Finish	Projected Start/Finish	%Comp
3.2.1 Barrel Region (Summary)			
DESIGN	01OCT92	07MAR94	
	01OCT92	07MAR94	
PROTOTYPE DEVELOPMENT	01OCT92	08DEC93	
	01OCT92	08DEC93	
PROCUREMENT	20MAY93	04APR94	
	20MAY93	04APR94	
REMOTE OFF-SITE ASSEMBLY	28SEP93	19APR95	
	28SEP93	19APR95	
SHIP TO SSCL	18JUN93	03MAY95	
	18JUN93	03MAY95	
ASSEMBLE AT SSCL	30AUG93	26SEP96	
	30AUG93	26SEP96	
TEST AND CHECKOUT AT SSCL	03SEP93	26SEP96	
	03SEP93	26SEP96	
MANAGEMENT	01OCT92	26NOV96	
	01OCT92	26NOV96	
3.2.2 Intermediate Region (Summary)			
DESIGN	01OCT92	04APR94	
	01OCT92	04APR94	
PROTOTYPE DEVELOPMENT	01OCT92	08DEC93	
	01OCT92	08DEC93	
PROCUREMENT	09NOV93	02MAY94	
	09NOV93	02MAY94	
REMOTE OFF-SITE ASSEMBLY	22MAR94	29JUN95	
	22MAR94	29JUN95	
SHIP TO SSCL	15NOV93	14JUL95	
	15NOV93	14JUL95	
ASSEMBLE AT SSCL	22FEB94	16JAN97	
	22FEB94	16JAN97	



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- Float
- Milestones: Baseline, Projected, Actua

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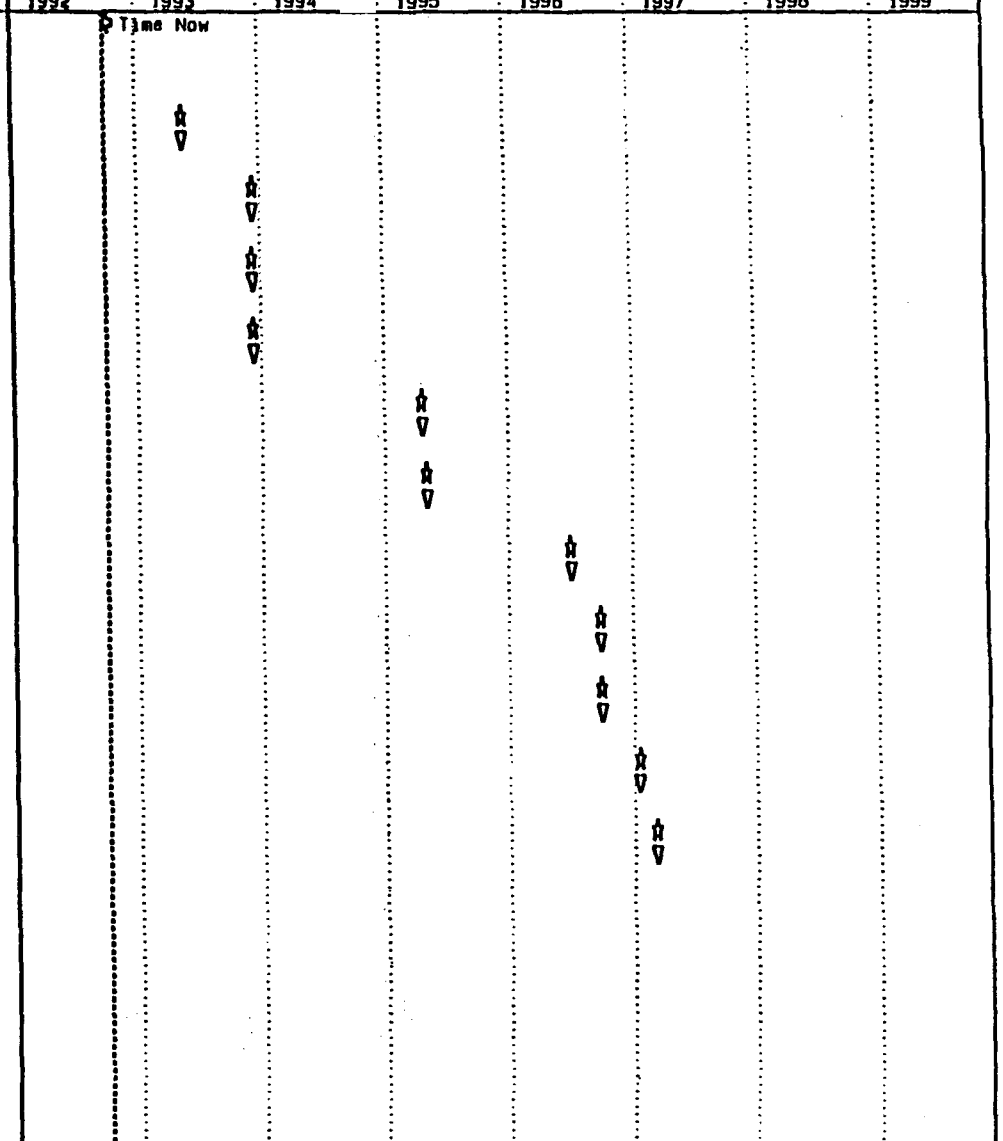
Project: SDC3203
Report: SDCBARIC
Status as of: 01OCT92
Current Date: 21OCT92
Page: 1

LEVEL III SUMMARY BASELINE SCHEDULE

3.2 Muon Measurement System

SOLENOIDAL DETECTOR COLLABORATION

Summary Description	Baseline Start/Finish	Projected Start/Finish	%Comp
MILESTONES			
FINISHED POR-BARREL REGION		19MAY93	
		19MAY93	
FINISHED COR-BARREL REGION		08DEC93	
		08DEC93	
FINISHED COR-INTERMEDIATE REG.		08DEC93	
		08DEC93	
FINISHED COR-FORWARD REGION		08DEC93	
		08DEC93	
FINISHED ASSEMBLY OFFSITE-BR		19APR95	
		19APR95	
FINISHED SHIPMENT-BARREL REG.		03MAY95	
		03MAY95	
READY TOH-BARREL PHASE I		03JUL96	
		03JUL96	
FINISHED ASSEMBLY SSCL-BR		26SEP96	
		26SEP96	
READY TOH-BARREL PHASE II		26SEP96	
		26SEP96	
STARTED TOH-INTERMEDIATE		16JAN97	
		16JAN97	
STARTED TOH-FORWARD		07MAR97	
		07MAR97	



Legend
- Baseline
- % Complete of Total
- % Comp of Planned to date
- Critical
- Projected/Actual Start
- Projected/Actual Finish
- Float
- Milestones: Baseline, Projected, Actual

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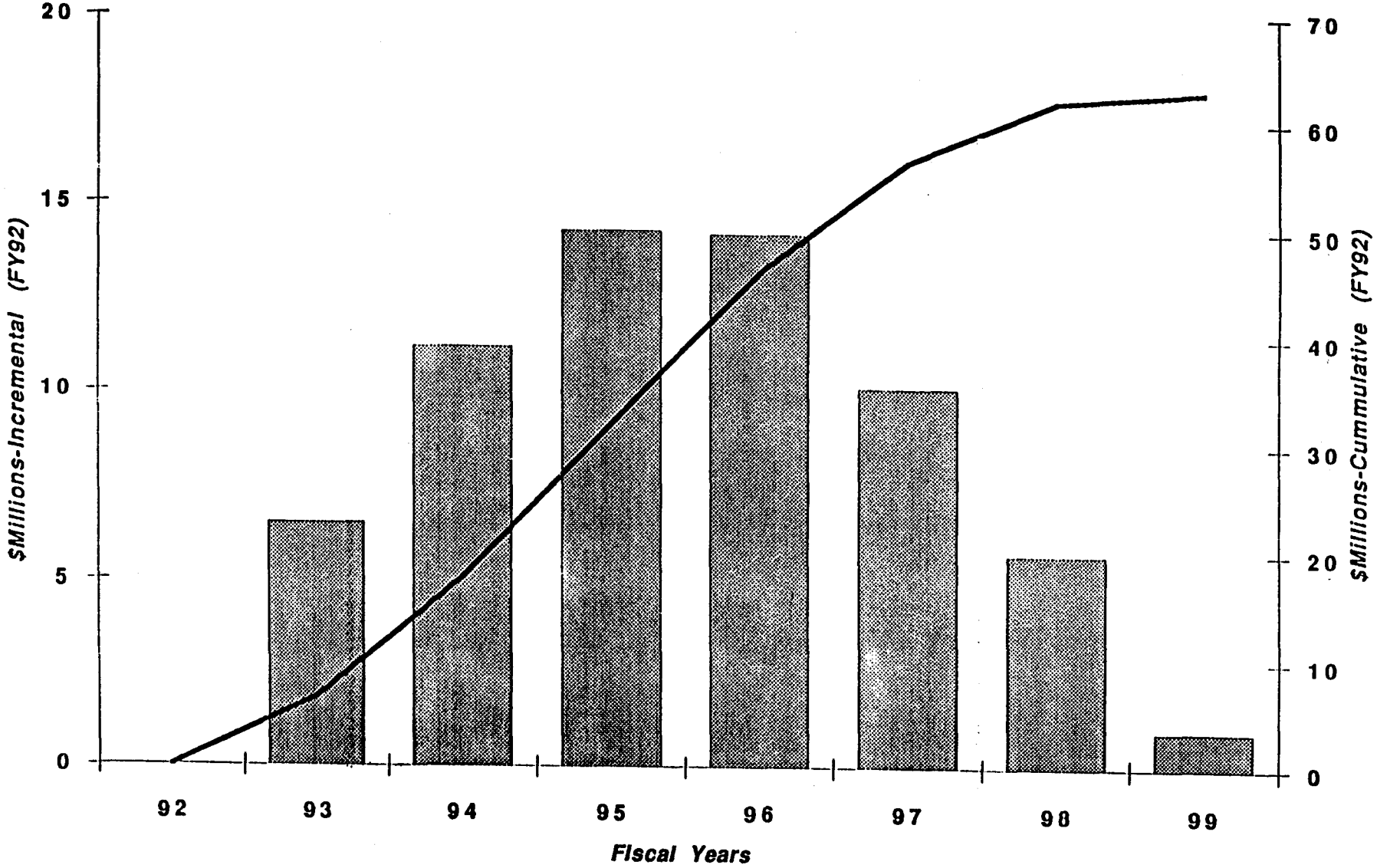
Muon Measurement System (WBS 3.2)
Funding Profile



10/22/92

2 PChart

SDC U.S. COST ESTIMATE SUMMARY (FY92)

WBS #	DESCRIPTION	1-Apr-92 TDR $M	19-Oct-92 COST EST. $M	DELTA FROM TDR $M
1	Tracking Systems	88.3	94.3	6.0
1.1	Silicon Tracker	41.2	42.1	0.9
1.2	Barrel Tracker	31.5	31.6	0.1
1.3	Intermediate Angle Tracker	16.1	21.0	4.9
2	Calorimetry	162.4	159.8	-2.6
2.1	Barrel Calorimeter	90.6	88.1	-2.6
2.2	End Cap Calorimeter	59.2	61.7	2.5
2.3	Forward Calorimeter	12.5	10.0	-2.6
3	Muon System	115.8	121.7	5.9
3.1	Magnet System	59.6	58.7	-1.0
3.2	Muon Measurement System	56.2	63.0	6.8
4	Superconducting Magnet	42.4	41.9	-0.5
4.1	Superconducting Solenoid	33.9	35.0	1.1
4.2	Cryogenic Systems	8.5	6.9	-1.6
5	Electronics Systems	97.0	94.7	-2.3
5.1	Front-End Electronics	43.9	42.6	-1.3
5.2	Data Acquisition System	20.4	20.4	0.0
5.3	Trigger Systems	28.8	27.8	-1.0
5.4	Ancillary System Controls (ASC)	3.9	3.9	0.0
6	Computing Systems	9.3	9.3	0.0
6.1	On-line Computing	9.3	9.3	0.0
7	Conventional Systems	14.2	12.7	-1.5
7.1	Conventional Mechanical Utilities	2.5	1.6	-0.9
7.2	Electrical Utilities	1.7	1.0	-0.7
7.3	Safety Systems	3.6	2.4	-1.2
7.4	Structural Support & Access Systems	6.4	5.5	-0.9
7.5	Accelerator Related Systems	0.0	2.3	2.3
8	Subsystem Installation & Test	36.2	35.0	-1.1
8.1	Test Beam Program	8.9	6.5	-2.4
8.2	Installation & Test	27.3	28.5	1.3
9	Project Mgmt. & Det. Integ.	18.4	19.1	0.8
9.1	Project Planning	3.4	3.7	0.3
9.2	Project Tracking	2.7	3.4	0.8
9.3	Document Control	1.6	1.0	-0.6
9.4	Quality Assurance	1.0	1.0	-0.1
9.5	Env't, Safety & Health Administration	1.9	1.8	0.1
9.6	Detector Integration	7.8	8.2	0.4
	SDC Cost Estimate Total	584.4	589.0	4.5
	FY 91 & 92 R&D Expenditures	20.0	20.0	0.0
	SDC Total Estimated Cost	604.4	609.0	4.5

D. Etherton

10/22/92

PRESENTATION BY:

S. DAWSON

PROGRESS (?) IN

TECHNICOLOR

MODEL BUILDING

SALLY DAWSON

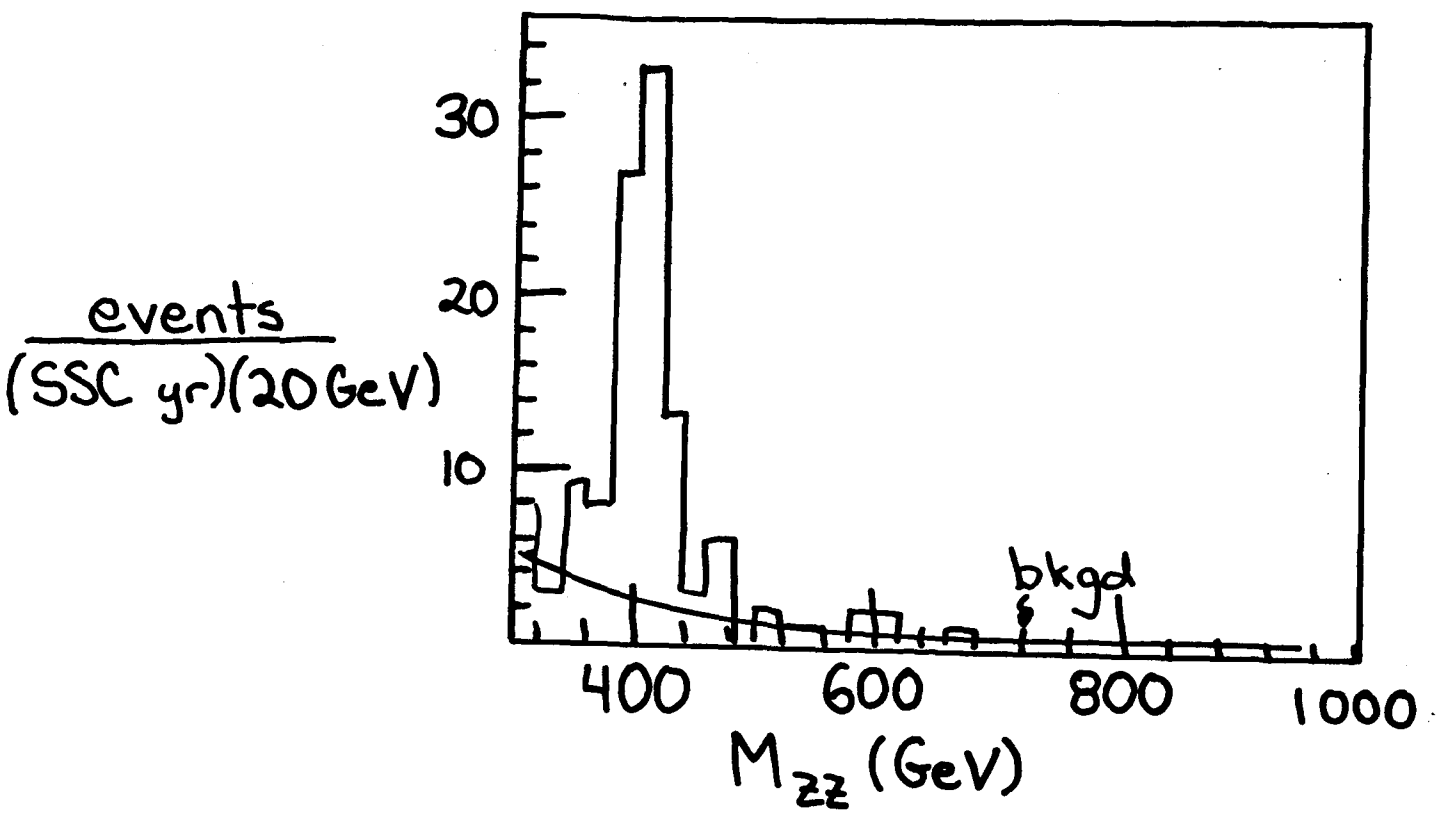
SDC Collaboration Meeting

Searching for new physics...

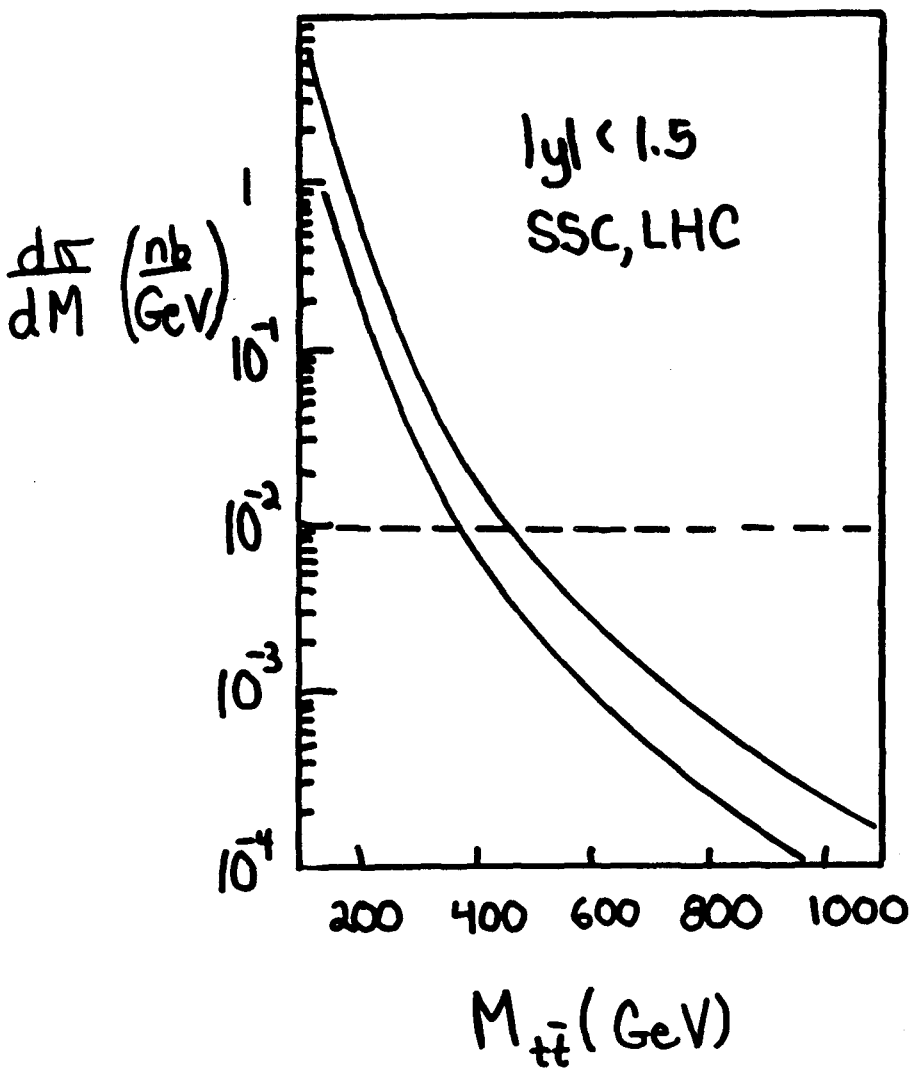
Best cases: a) Resonance

b) Large rate

Ex: Higgs → ZZ, $M_H = 400$ GeV



Ex: Top quark Production



10^5 events/yr

@ $\mathcal{L} = 10^{33}/cm^2/sec$

I. Generic Technicolor

Copy QCD: $\langle u\bar{u} + d\bar{d} \rangle \Rightarrow m_\pi \neq 0$

$SU(2)_L \times SU(2)_R \Rightarrow SU(2)_V$

Simple model:

- Technifermions: $\begin{pmatrix} U \\ D \end{pmatrix}$

- Strongly interacting TC gauge group, $SU(N)_{TC}$

Global $SU(2)_L \times SU(2)_R \Rightarrow SU(2)_V$

→ 3 Goldstone Bosons, $W_L^\pm, Z_L$

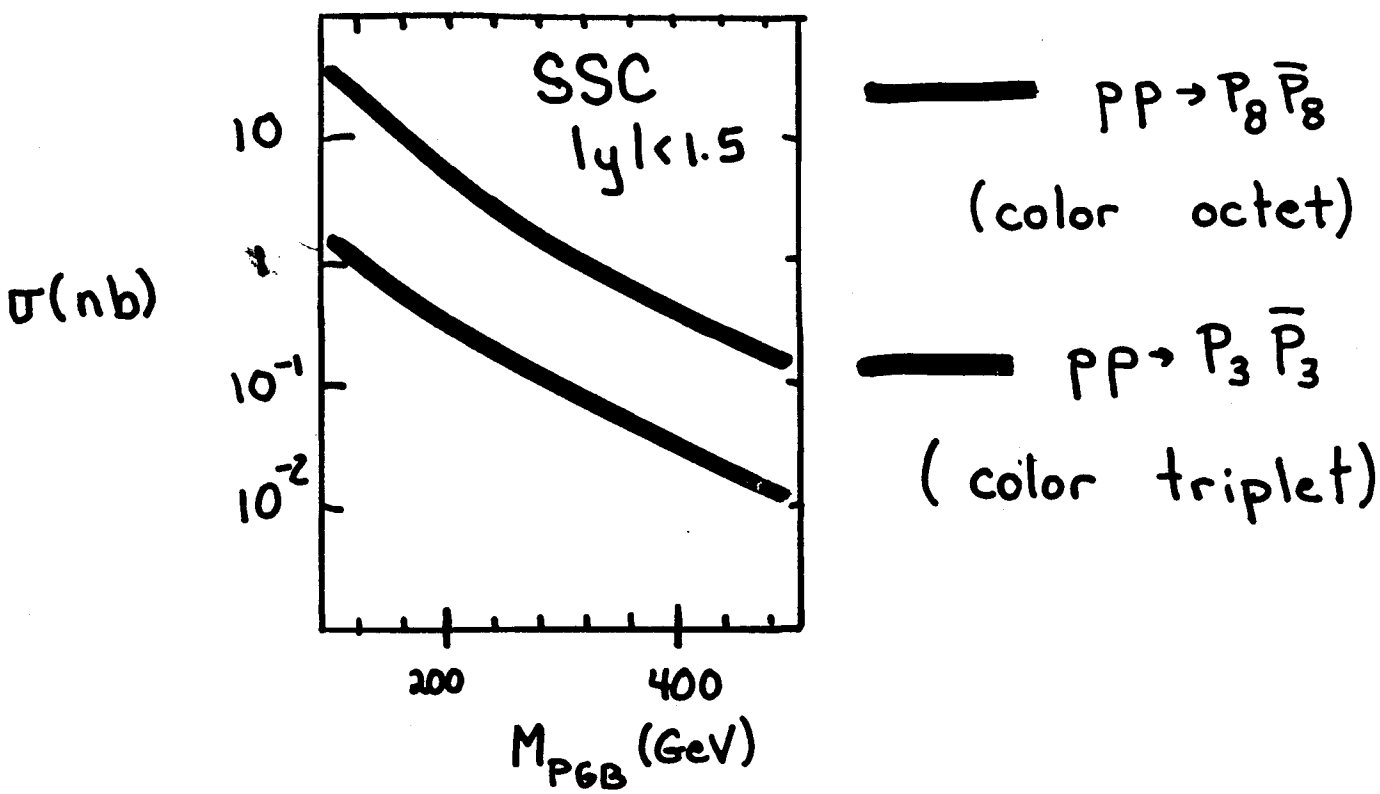
→ Scaled up ρ, ω, η etc

$\rho = 1$ automatically

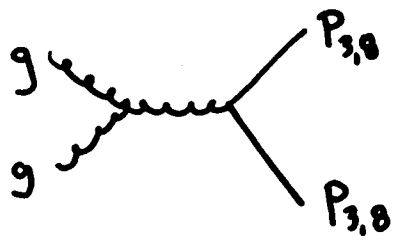
QCD	TC
$SU(3)_c$	$SU(N_{TC})$
Quarks $\begin{pmatrix} u \\ d \end{pmatrix}$	Techni-quarks $\begin{pmatrix} U \\ D \end{pmatrix}$
$\langle u\bar{u} + d\bar{d} \rangle \sim \Lambda^3_{QCD}$	$\langle U\bar{U} + D\bar{D} \rangle \sim \Lambda^3_{TC}$
$\boxed{SU(2)_L \times}$	$\boxed{SU(2)_R \rightarrow SU(2)_V}$
$\pi^\pm, \pi^0$	$\pi^\pm, \pi^0 \rightarrow W^\pm_L, Z_L$
$f_\pi = 93$ MeV	$F_\pi = v = 246$ GeV
$\Lambda_{QCD} \sim 160$ MeV	$\Lambda_{TC} \sim 1$ TeV

Many Testable Consequences

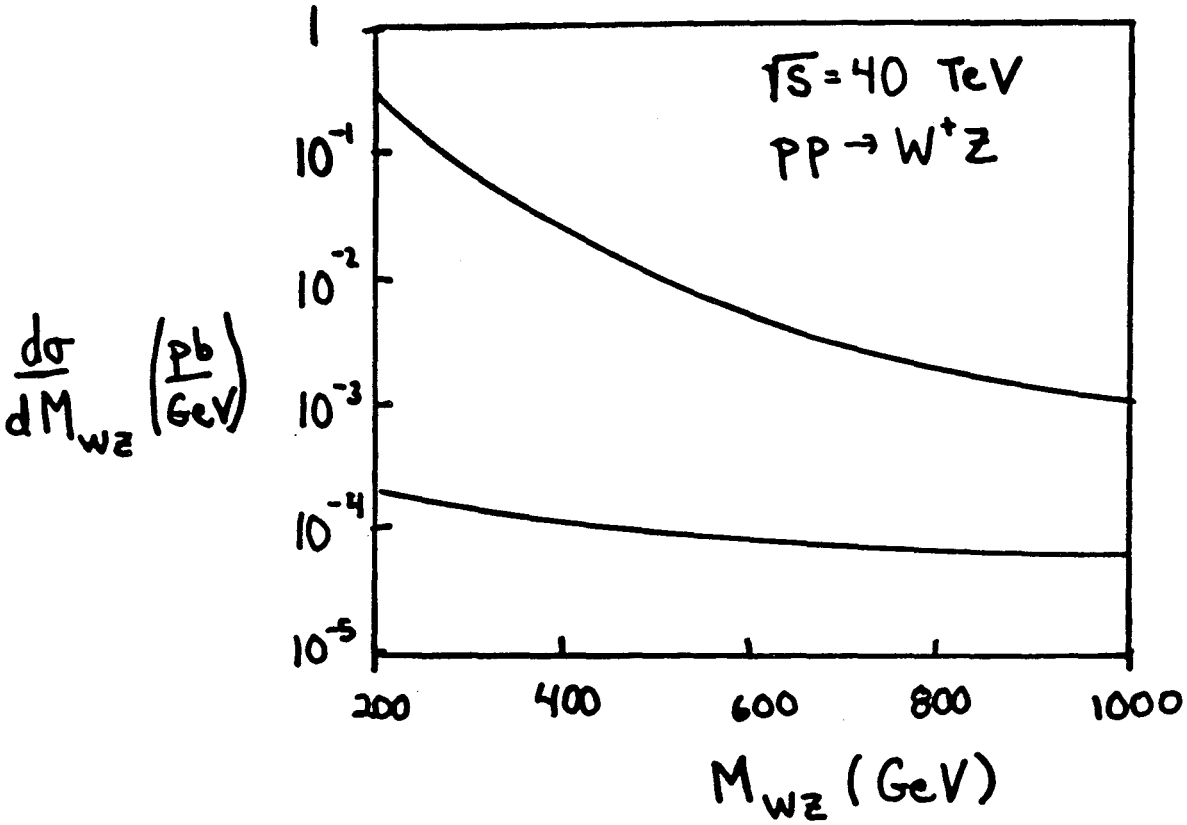
- Broken global symmetries →
  Pseudo-goldstone Bosons (PGBs)



- Large Rates
- Relatively Independent of Model



Resonant vs Non-Resonant $\mathcal{L}$'s:



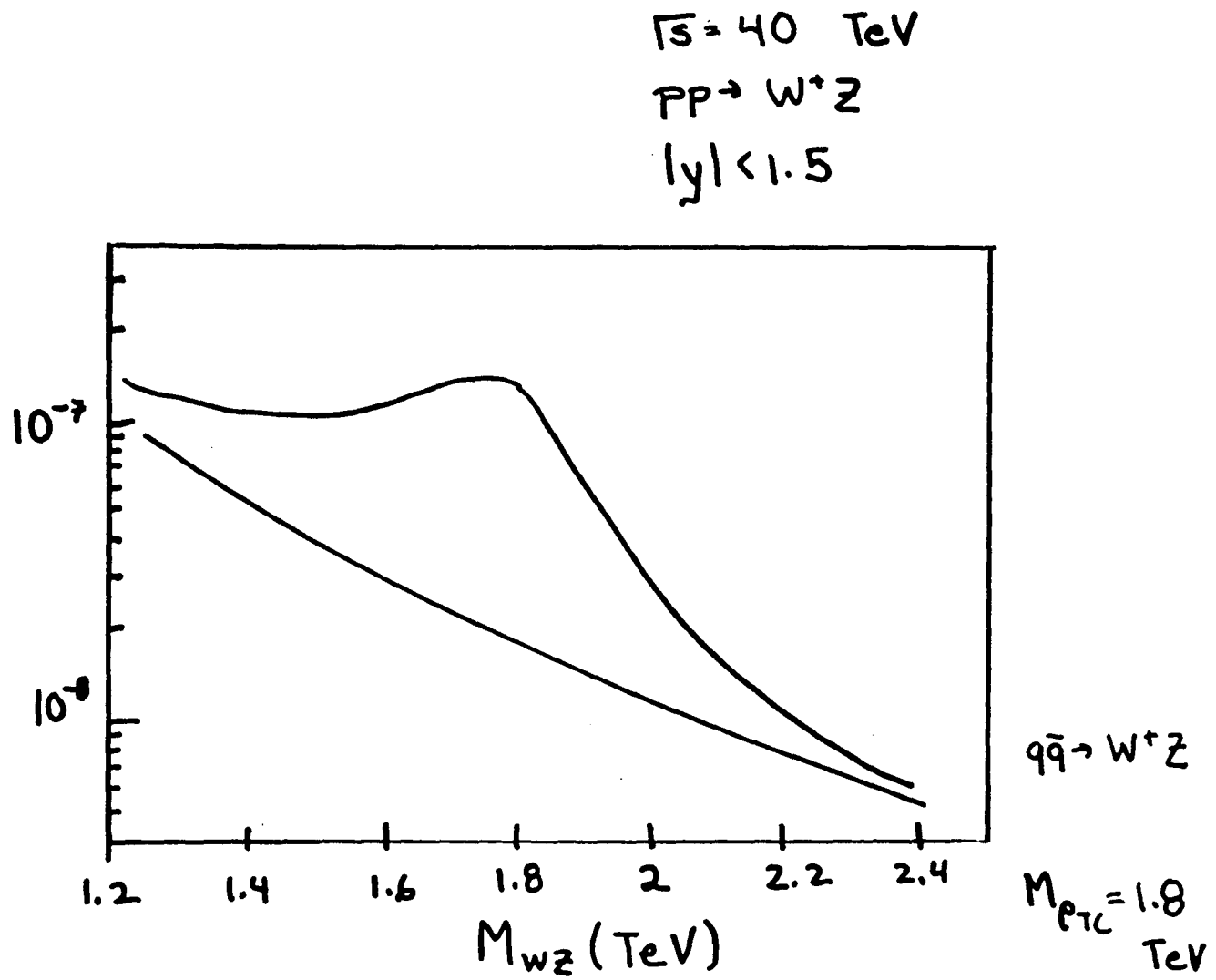
$q\bar{q} \to W^+Z$

$M_{\rho_{TC}} \sim 1.5$ TeV

$N_{TC} = 3$

$N_{TF} = 4$

$W^+Z \to W^+Z$


√s = 40 TeV
pp → W⁺Z
|y| < 1.5
10⁻⁷
10⁻⁸
1.2
1.4
1.6
1.8
2
2.2
2.4
M_WZ (TeV)
qq̄ → W⁺Z
M_ρTC = 1.8 TeV

Technicolor $\mathcal{L}$'s:

$$SU(N_{TF}) \times SU(N_{TF}) \to SU(N_{TF})$$

- Global symmetry + embedding of SM gives all

- Goldstone bosons, π_i, ($N_{TF}^2 - 1$ of them)

  Non-linear realization, $\Sigma = e^{\left(\frac{2i\pi \cdot T}{F}\right)}$

Expand in $\frac{s}{\Lambda_{TC}^2}$:

$$\mathcal{L}_2 = \frac{F^2}{4} \mathrm{Tr}\left(D_\mu \Sigma D^\mu \Sigma^\dagger\right)$$

M_W fixes $F = (246 \text{ GeV}) \sqrt{\frac{2}{N_{TF}}}$

$$D_\mu \Sigma = \partial_\mu \Sigma + \frac{i}{2\sqrt{\frac{N_{TF}}{2}}} g W_\mu \Sigma - \frac{i}{2\sqrt{\frac{N_{TF}}{2}}} g' B_\mu \Sigma \tau_3$$

- Valid below resonances

Problem: Some partial waves grow with N_{TC} (Cahn & Suzuki)

Singlet: $a_0 = \frac{N_{TC}^2}{64\pi} \frac{s}{v^2}$

$N_{TF} = 8$, $a_0 = \frac{1}{2}$ @ $\sqrt{s_c} = 310$ GeV

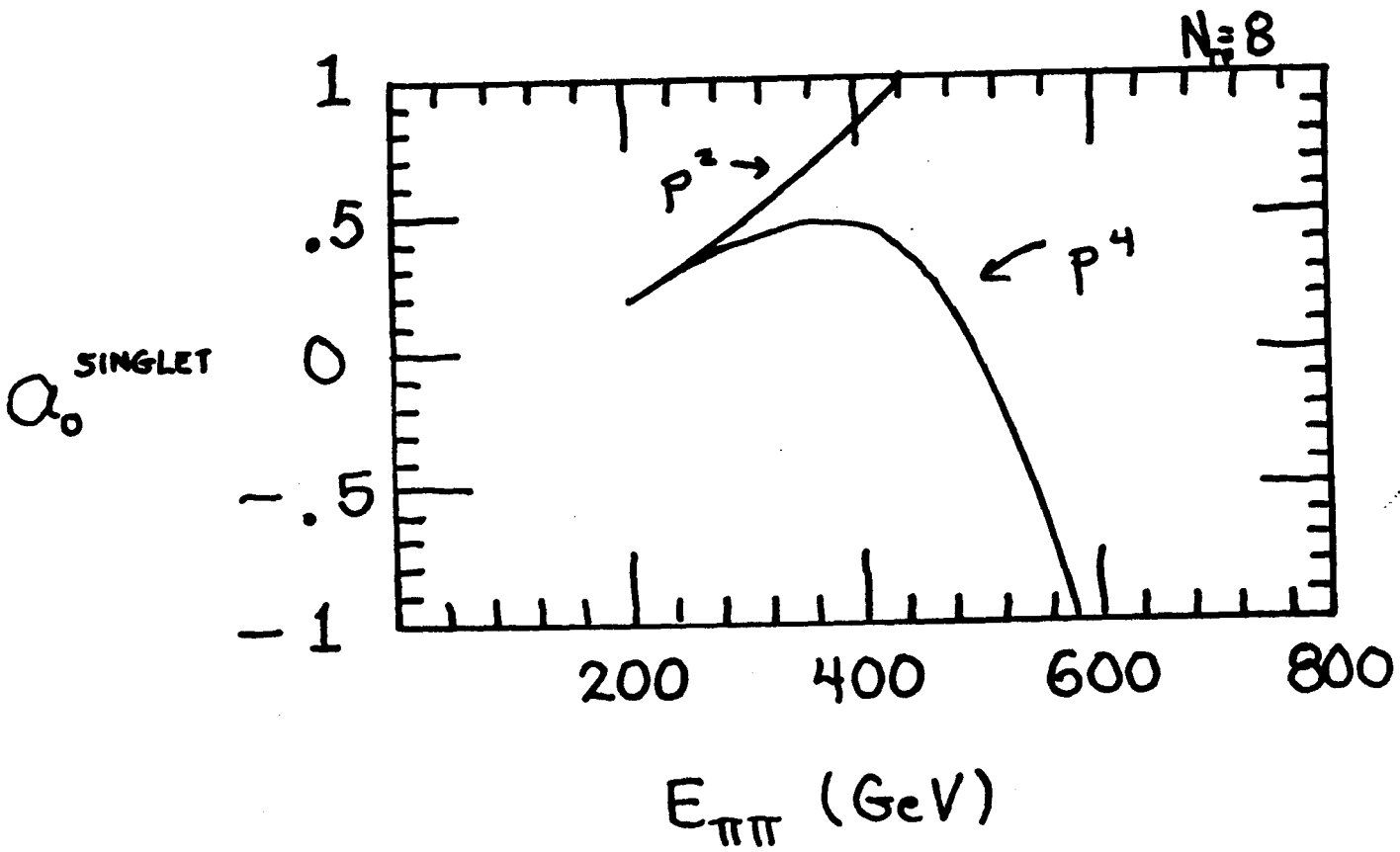
Compare: SM has global $SU(2) \times SU(2)$

$\rightarrow \sqrt{s_c} \sim 1.2$ TeV

TC $\Rightarrow$ New physics at lower scales than SM.

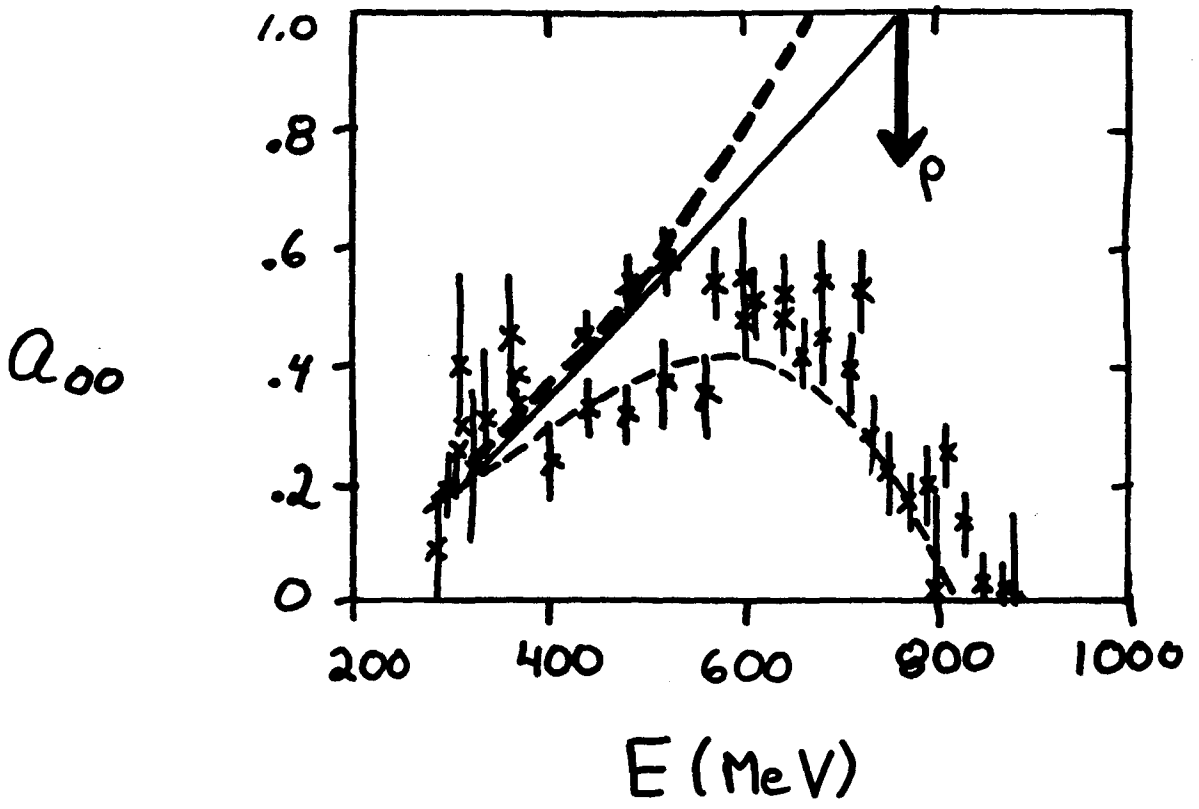
[cf: $m_{\rho_{TC}} \sim 800$ GeV $N_{TF} = 8$, $N_{TC} = 4$]

Unitarity problems NOT cured by adding more terms in energy expansion.



Remember $\pi\pi$ Scattering.....

(Donoghue, Ramirez, Valencia)



— $O(s)$

— $O(s^2)$ w/ $L_1 > 0$, $L_2 = 0$ "Scalar"

— $O(s^2)$ w/ $L_1 = -L_2$ "vector"

OPTIMIST: Can distinguish between "ρ" and "σ" theories in QCD

OLD PROBLEMS

Top Quark mass: $M_{TOP} \sim \dfrac{\Lambda_{TC}^3}{\Lambda_{ETC}^2}$

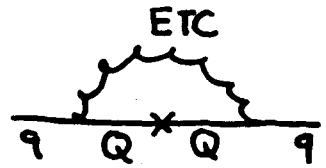
$M_{TOP} \sim 100$ GeV , $\Lambda_{TC} \sim 1$ TeV

$\rightarrow \Lambda_{ETC} \sim 3$ TeV

$\Rightarrow$ FCNC

Solutions: Walking, crawling TC

Enhance $\langle Q\bar{Q} \rangle \sim \Lambda_{TC}^3 \left(\dfrac{\Lambda_{ETC}}{\Lambda_{TC}} \right)^{\gamma}$

$m_f \sim$ 

$\rightarrow$ Can increase Λ_{ETC} & still get big M_{TOP}

- Multi-scale models

Standard Model: $\mathcal{L} \sim c \frac{H}{v} \bar{\Psi}\Psi$

fermion masses $\longrightarrow m_f \approx c$

Introduced **Extended** TC group

$$G_{ETC} \xrightarrow[\Lambda_{ETC}]{} G_{TC} \xrightarrow[\Lambda_{TC}]{} SM$$

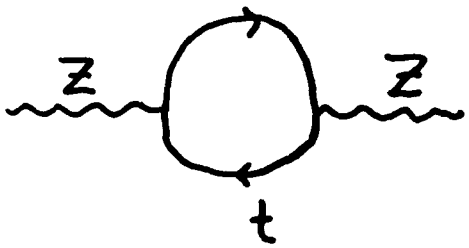
$$\mathcal{L} = \underbrace{\frac{1}{\Lambda_{ETC}^2} \bar{Q}Q\,\bar{q}q}_{m_f = \frac{\langle \bar{Q}Q \rangle}{\Lambda_{ETC}^2} \sim \frac{\Lambda_{TC}^3}{\Lambda_{ETC}^2}} + \underbrace{\frac{1}{\Lambda_{ETC}^2} \bar{s}d\,\bar{s}d}$$

$\Delta M(K_L - K_S) \longrightarrow \Lambda_{ETC} \gtrsim$ 500 TeV

The Alterative...

PRECISION MEASUREMENTS

cf. LEP



$M_{TOP} = 150^{+23}_{-26}$ GeV

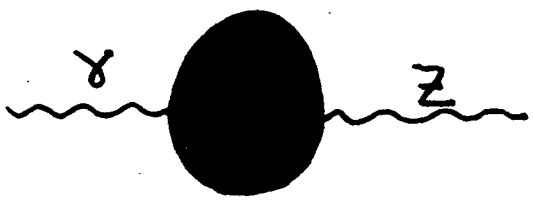
[Langacker, PDG]

$$\mathcal{L}_{eff} = -\frac{\alpha}{2\sin(2\theta_W)} S \, B^{\mu\nu} W_{\mu\nu}$$

Do Similar analysis for 3, 4 gauge boson couplings

PRECISION MEASUREMENTS

confront TECHNICOLOR



$$\Delta\mathcal{L} = -\frac{\alpha}{2\sin(2\theta_W)}\, S\, \mathrm{Tr}(\Sigma B^{\mu\nu} \Sigma^{+} W_{\mu\nu})$$

U(1) gauge field

SU(2) gauge field

Precision EW data ⇒ (Altarelli)

$$S = .15 \pm 1.6 \qquad (@ M_Z)$$

S runs....

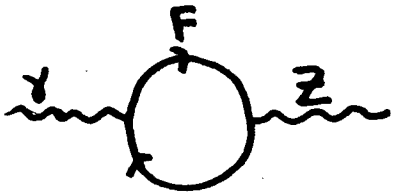
$$S(\mu_1) - S(\mu_2) = \frac{1}{6} \ln\left(\frac{\mu_1}{\mu_2}\right)$$

eg: $S(1.5\ \mathrm{TeV}) = .5$

What is S in TC Models?

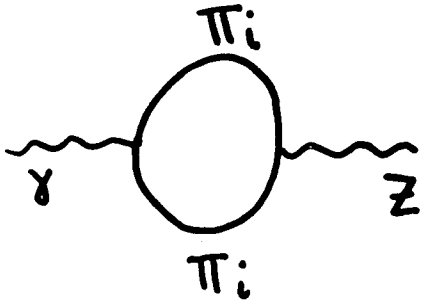
Consider $N_{TC} = 4$, $N_{DOUBLETS} = 4$

1.



$$S(M_Z) = \frac{N_{TC} N_D}{6\pi} \rightarrow \underline{.85}$$

2.



$$S(M_Z) \sim \frac{8}{3\pi} \ln\left(\frac{\Lambda_{TC}}{M_\pi}\right) \rightarrow \underline{1.7}$$

$(\Lambda_{TC} \sim 1.5 \text{ TeV}, M_\pi \sim 200 \text{ GeV})$

3. Just rescale QCD..... $\pi \rightarrow e \nu \gamma$

$$S \sim \underline{2.}$$

cf. exp $S(M_Z) = .15 \pm 1.6$

Close squeeze...

But... ambiguity in computing S in TC models

Contributions from heavy ρ + large-N scaling:

$$F_\rho = 246 \text{ GeV} \sqrt{\frac{2}{N_{TF}}}$$

$$M_{\rho_{TC}} = 2 \text{ TeV} \sqrt{\frac{6}{N_{TC} N_{TF}}}$$

$$S(\mu) = \left(\frac{4\pi F_\rho^2}{M_\rho^2}\right) + \frac{1}{6\pi} \ln\left(\frac{M_\rho}{\mu}\right)$$

Ex: $N_{TC} = 3,\ N_{TF} = 2 \Rightarrow S(M_Z) = .35$

$N_{TC} = 4,\ N_{TF} = 8 \Rightarrow S(M_Z) = .37$

Dugan and Randall: S negative in models with large mass splittings.

But.... Walking TC changes things.....

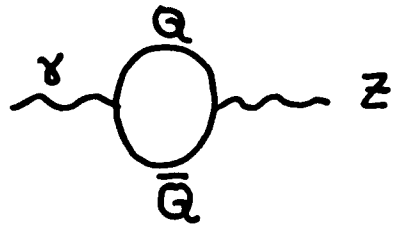
"Old TC"

$$S^{TC}_{QCD} \sim \left(\frac{4.5\, v^2}{N_D M^2_{TF}} - .015\right) N_D N_{TC} - .03 N_{}$$

$$\rightarrow \underbrace{.1\, N_D N_{TC}}$$

Walking TC: (Sundrum & Hsu)

$\langle Q\bar{Q} \rangle$ enhanced $\rightarrow$

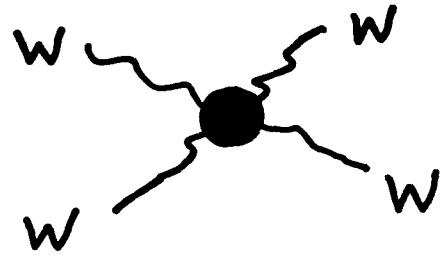


$$S^{TC}_{Walking} \sim \left(\underbrace{\frac{4.5\, v^2}{N_D M^2_{TF}}}_{\sim .1} - \underbrace{.07c}_{c \sim 1}\right) N_D N_{TC} - .03 N_{}$$

Big Cancellation

- TC models severely restricted by S

- SSC measures



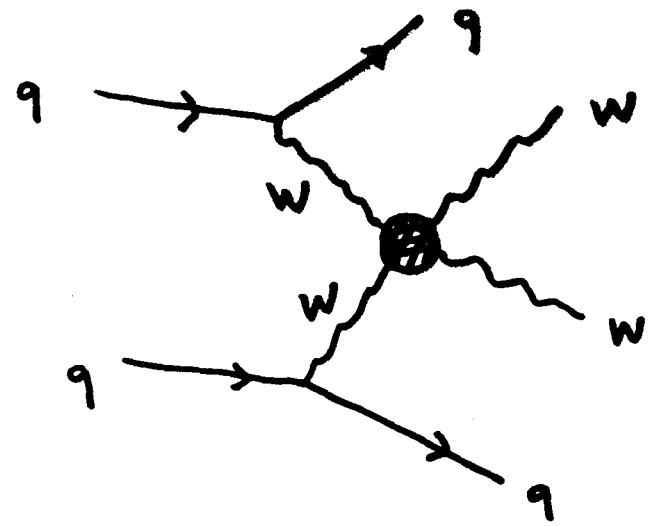
5 New terms @ $\frac{S^2}{\Lambda_{TC}^4}$

- Measure $\begin{cases} W^+W^+ \\ W^+Z \\ W^+W^- \\ ZZ \end{cases}$

- Restrict Coefficients

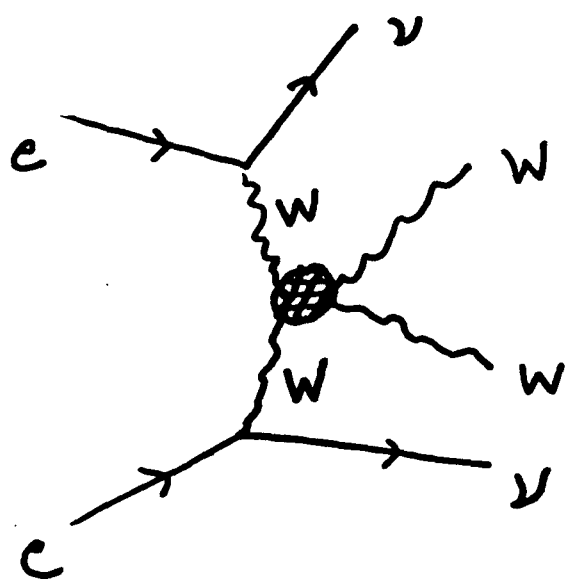
- Match with theory

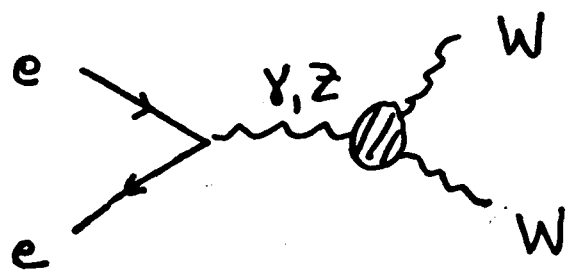
Hadron Colliders



Strong Interaction

e^+e^- Machines



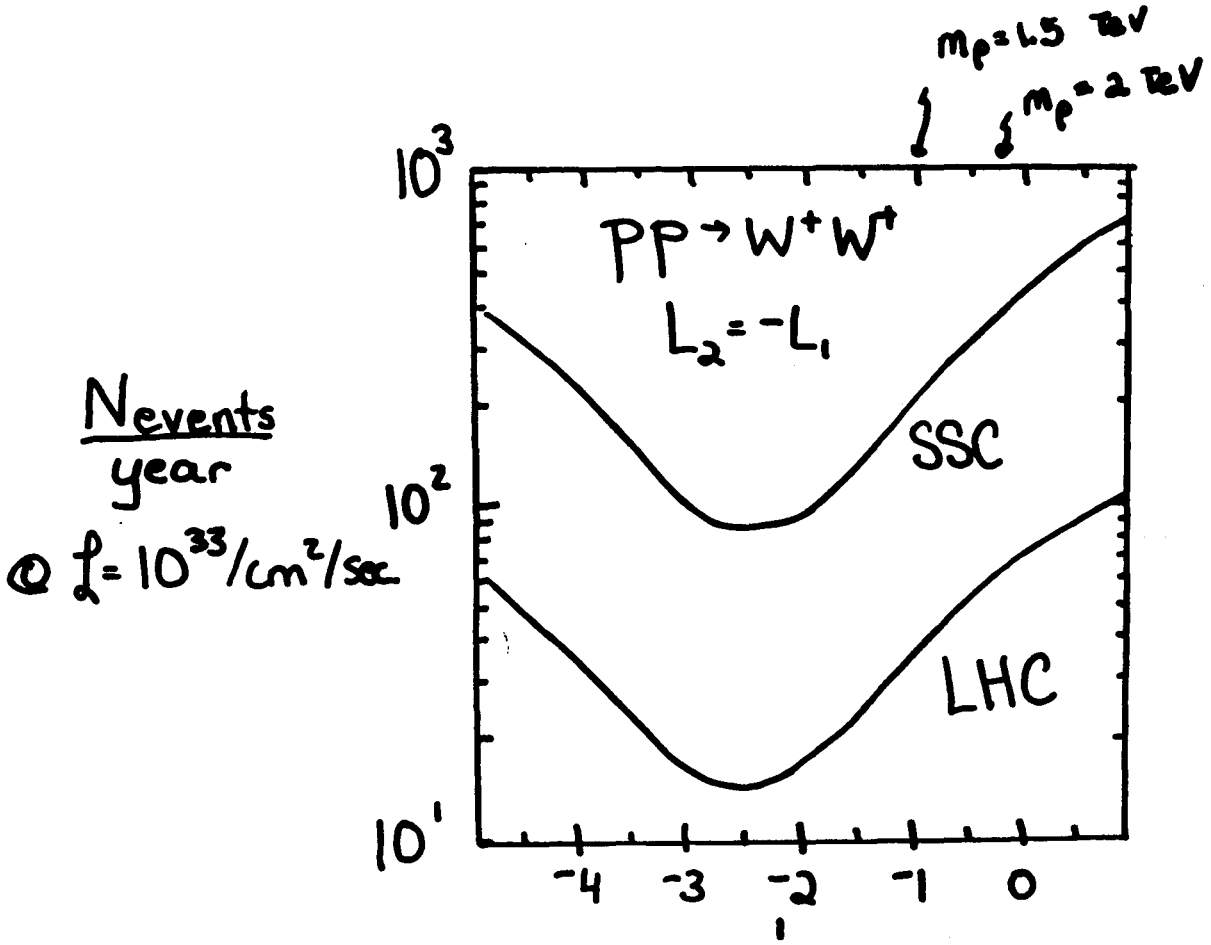


• Assume global $SU(2)_L \times SU(2)_R$ broken only by hypercharge

5 new terms at $O(s^2)$:

$$\frac{L_1}{16\pi^2}\left[\mathrm{Tr}\left(D^\mu \Sigma D_\mu \Sigma^\dagger\right)\right]^2 + \frac{L_2}{16\pi^2}\left[\mathrm{Tr}\left(D^\mu \Sigma D_\nu \Sigma^\dagger\right)\right]^2$$

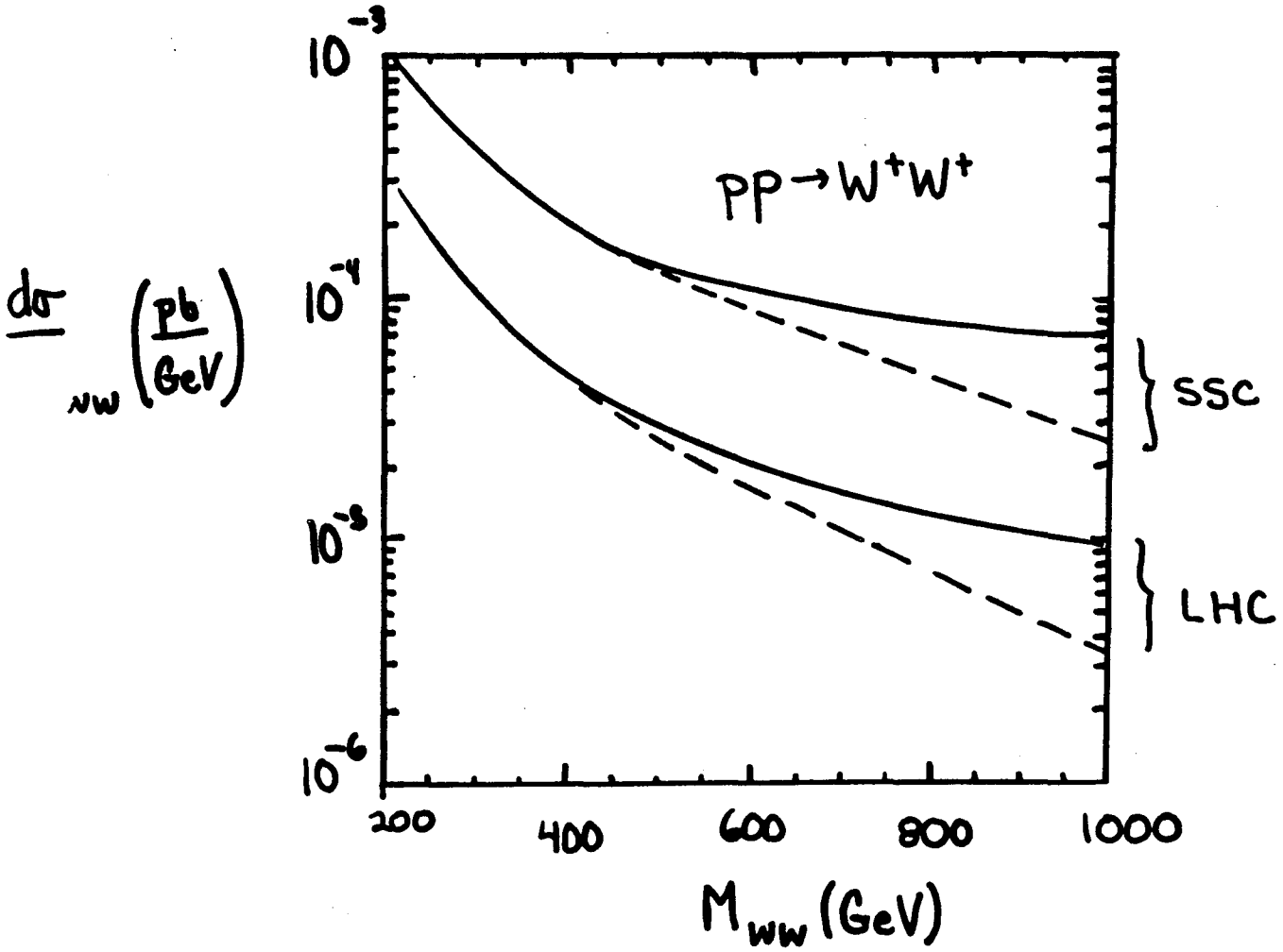
$W^+W^+ \to W^+W^+$ sensitive to $|L_1, L_2| \gtrsim 1$.



[Bagger, Dawson, Valencia]

.5 TeV < M_{WW} < 1 T

"Reasonable" models vary within ~ factor of 2 at 1 TeV



- $\frac{S}{v^2}$ $\mathcal{L}_{CHIRAL}$
- $\left(\frac{S}{v^2}\right)^2$ $\mathcal{L}_{CHIRAL}$ w/ $L_1 = -L_2$

  ~ "2 TeV ρ"

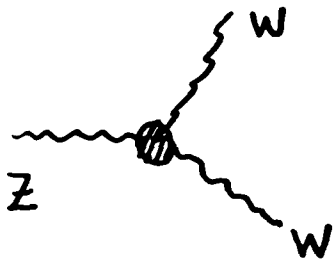
$$gg' \frac{L_{10}}{16\pi^2} \mathrm{Tr}\left(\Sigma B^{\mu\nu} \Sigma^{+} W_{\mu\nu}\right)$$

$$L_{10} = -\pi S$$

Altarelli: $L_{10}(1.5\ \mathrm{TeV}) = .5 \pm 1.6$

$$-ig \frac{L_{qL}}{16\pi^2} \mathrm{Tr}\left(W^{\mu\nu} D_\mu \Sigma\, D_\nu \Sigma^{+}\right)$$

$$-ig' \frac{L_{qR}}{16\pi^2} \mathrm{Tr}\left(B^{\mu\nu} D_\mu \Sigma^{+} D_\nu \Sigma\right)$$



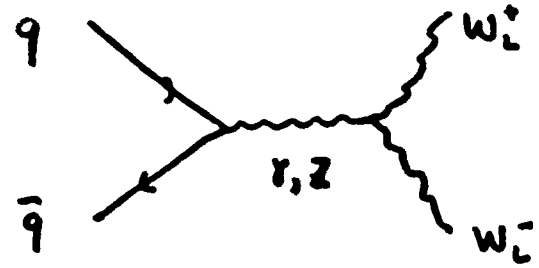
$$\mathcal{L} = -ig_V \Big[g_1^Z \left(W^{+}_{\mu\nu} W^{\mu} - W^{+\mu} W_{\mu\nu}\right) Z^{\nu} + \kappa_V W^{+}_{\mu} W^{-}_{\nu} Z^{\mu\nu} \Big] \ldots$$

Same old couplings...

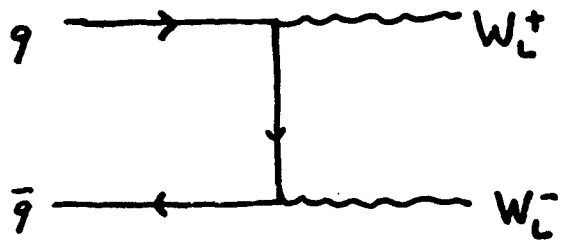
$$g_V - 1 = g^2 L_q (\ldots) - 1 \qquad \text{etc.}$$

[Holdom]

Remember Tree Level:



$$a_s \sim \frac{g^2 s}{4M_W^2}$$



$$a_t \sim -\frac{g^2 s}{4M_W^2}$$

CANCELLATION → NO rising σ!

Changing gauge boson vertices spoils cancellation

"Delayed Unitarity" (Ahn, Peskin, Lynn, Selipsky)

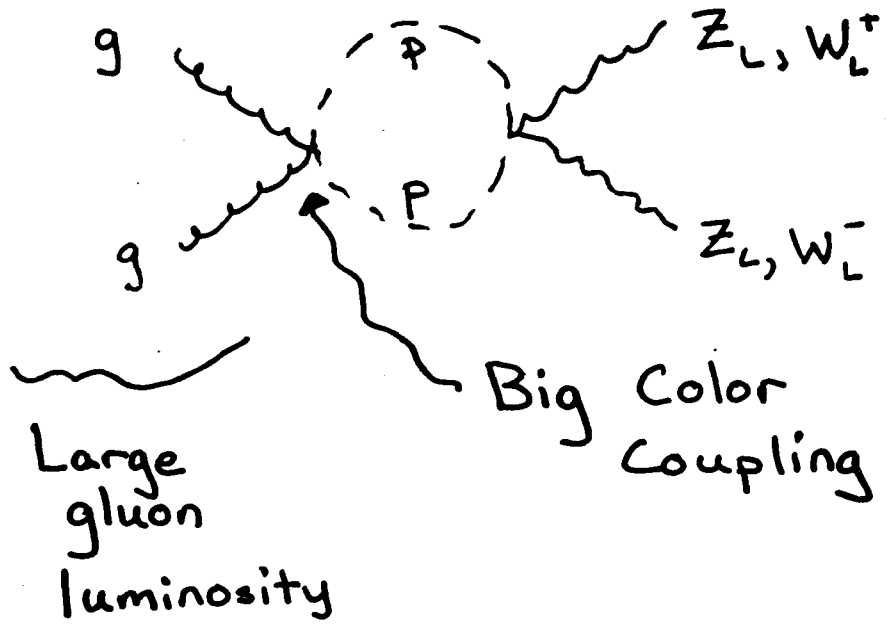
Gluon Fusion as TC Probe

Ex: Farhi-Susskind

Global symmetry: $SU(8)_L \times SU(8)_R$

$\rightarrow 8^2 - 1 = \underline{63}$ Goldstone Bosons

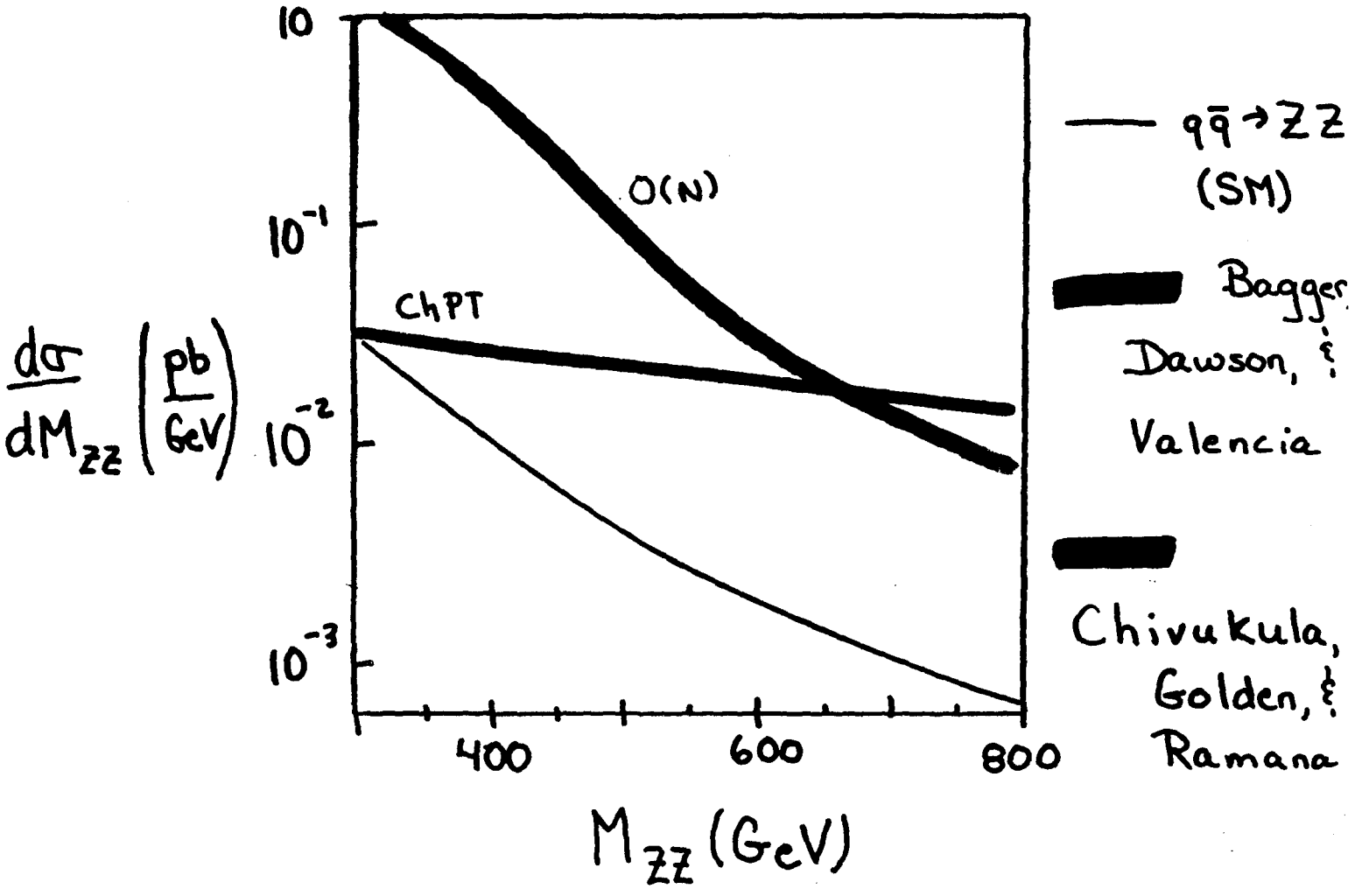
P_3, P_8 $\begin{cases} \text{Color triplet, octet GB's} \\ \text{Mass} \sim 200 \text{ GeV} \end{cases}$



But.... hard to calculate reliably

Colored Goldstone boson loops:

SSC, $pp \to ZZ$, $|y_Z| < 2.5$



Perhaps.... ZZ channel good for non-resonant signals

Techni-ρ's:

$$\mathcal{L}_{\rho\pi} = i \frac{g_\rho F^2}{m_\rho} Tr\left(\rho_{\mu\nu} \xi^\dagger D_\mu \Sigma D_\nu \Sigma^\dagger \xi\right)$$

Model independent coupling

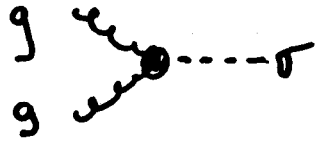
$g_\rho \leftrightarrow \Gamma_\rho$; Γ_ρ, m_ρ from large N

Techni-σ's:

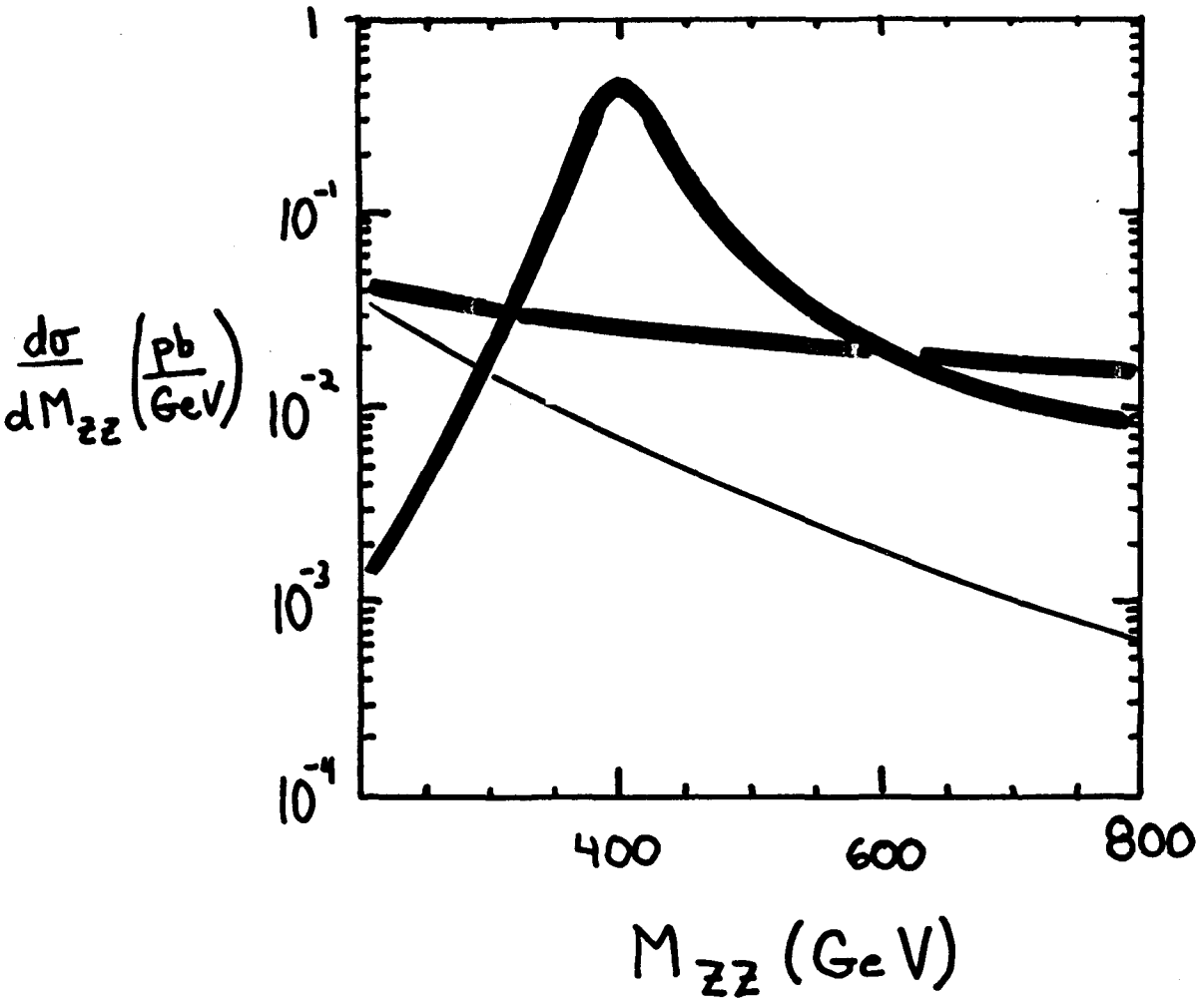
$$\mathcal{L}_{\omega\pi} = \frac{g_\sigma F^2}{m_\sigma} \sigma \, Tr\left(D_\mu \Sigma D^\mu \Sigma^\dagger\right)$$

etc..... Can couple any resonance in similar fashion

Also: $\mathcal{L} = \frac{\alpha_s h_\sigma}{m_\sigma} \sigma G_{\mu\nu} G^{\mu\nu}$



SSC, $pp \to ZZ$, $|y_Z| < 2.5$



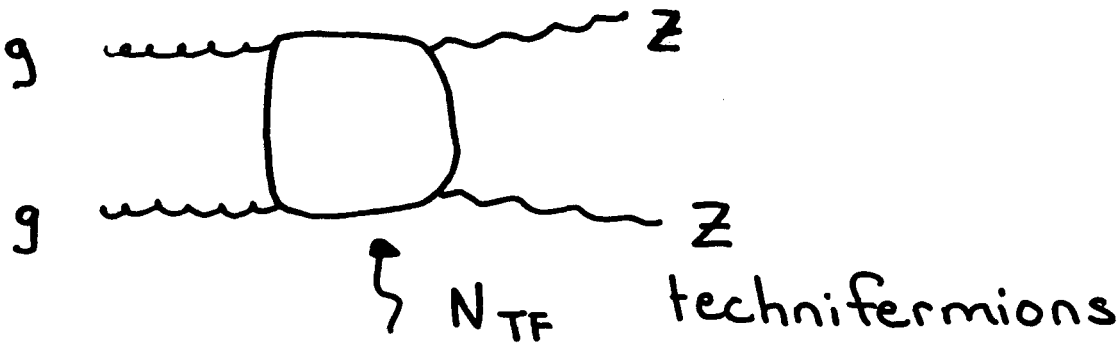
— SM, $q\bar{q} \to ZZ$

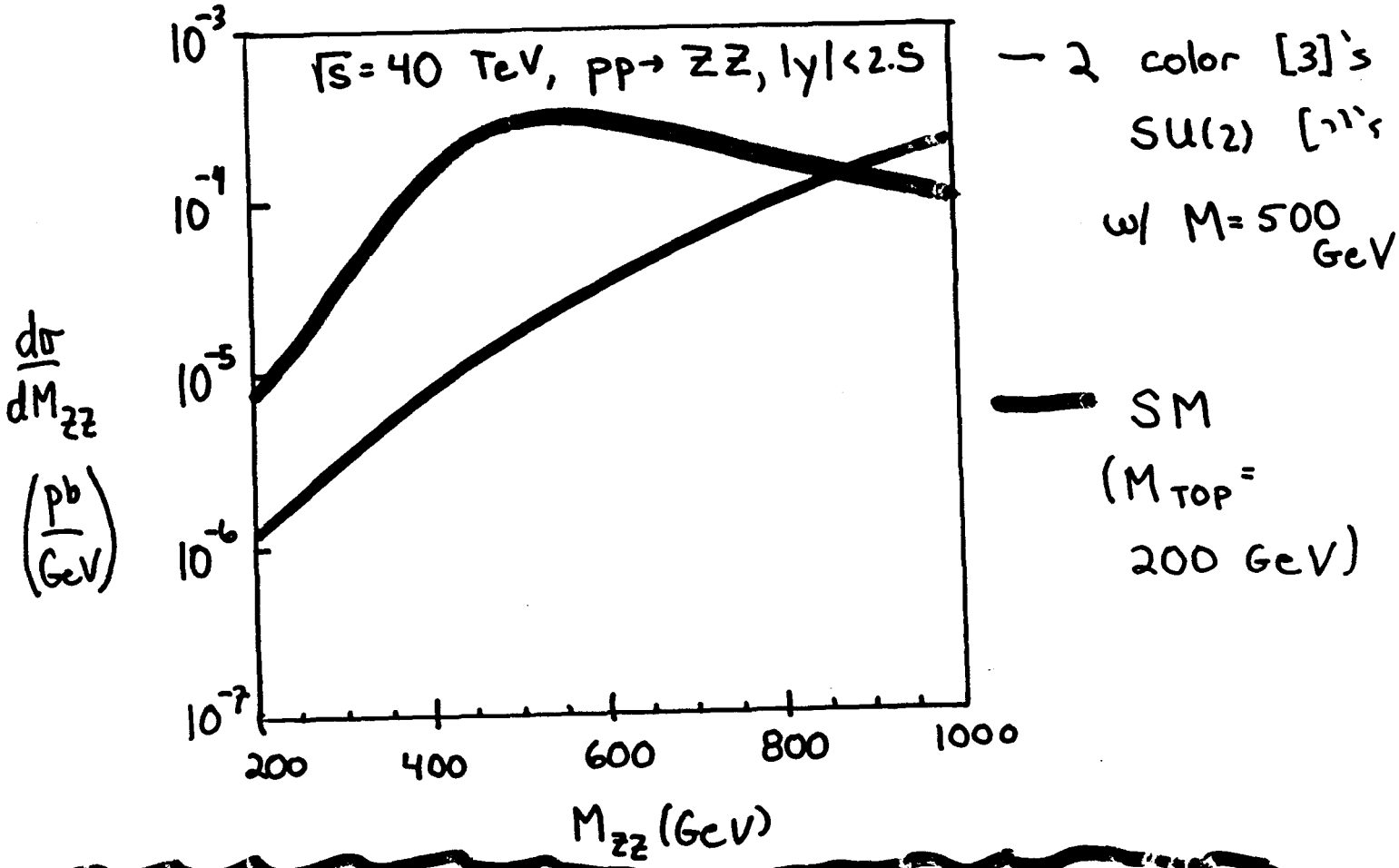
▬ Colored PGB loops

▬ σ_{TC}, $M_\sigma = 400$ GeV

$\Gamma_\sigma = 50$ GeV

Heavy fermions and $gg \to ZZ$





Bottom line: Enhanced rate in ZZ channel

CONCLUSIONS:

1. Radiative Corrections (S) restrict TC models severely.

2. TC models have enhanced signal in ZZ channel from $gg \to ZZ$.

PRESENTATION BY:

A. PALOUNEK

CALCULATIONS OF

THE SDC RADIATION ENVIRONMENT

A. P. T. Palounek, L. S. Waters, T. E. England, H. G. Hughes,
H. Lichtenstein, R. E. Prael, W. B. Wilson, and H. J. Ziock

Los Alamos National Laboratory

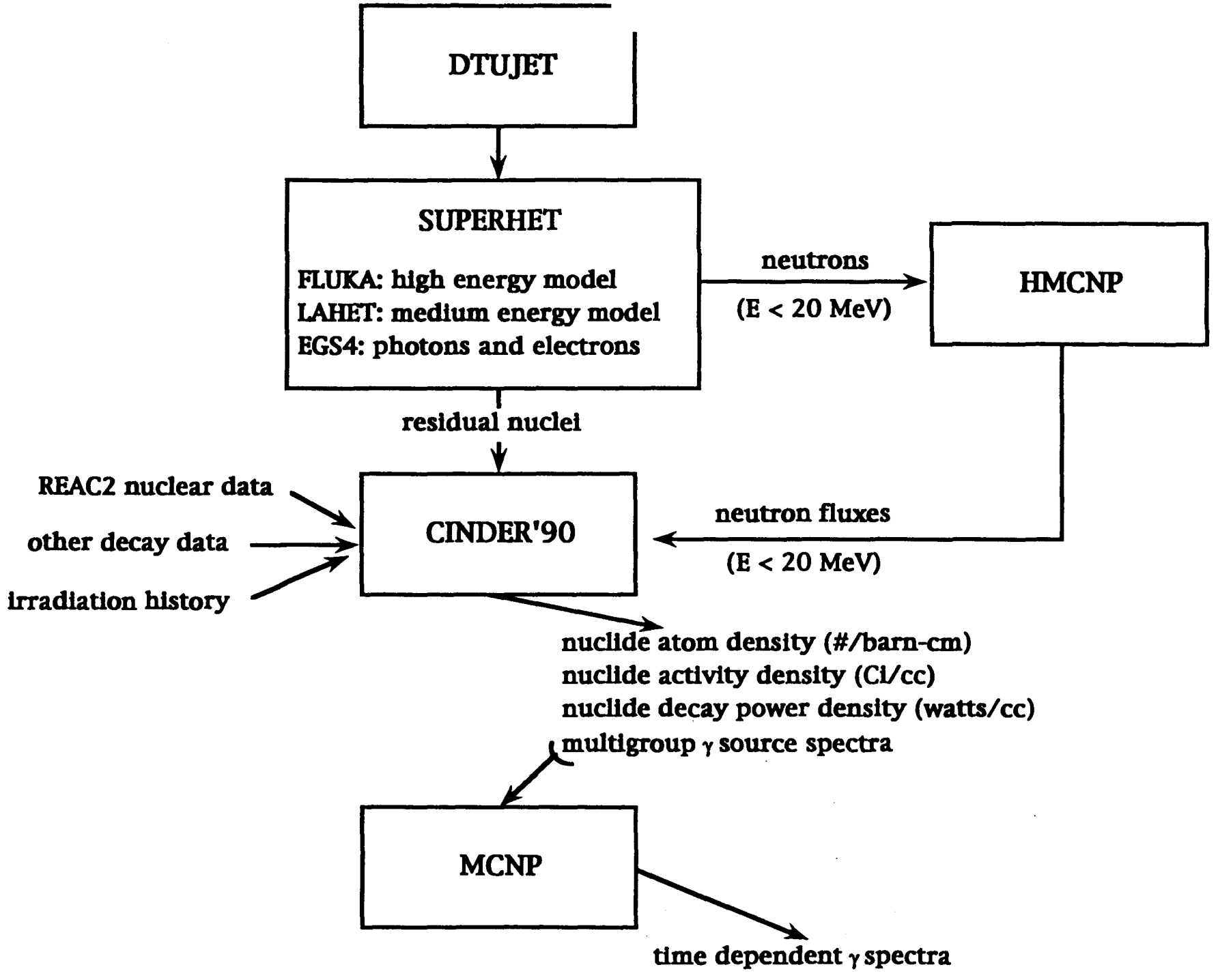
SDC Collaboration Meeting

22 October, 1992

- **SSC detector design must address the issues of radiation background, radiation damage to detector components, and radiation safety.**

- **Los Alamos has begun radioactivation calculations for the SDC and related beamline components.**

- **The primary concern now: SHIELDING.**


DTUJET
SUPERHET
FLUKA: high energy model
LAHET: medium energy model
EGS4: photons and electrons
neutrons
(E < 20 MeV)
HMCNP
residual nuclei
REAC2 nuclear data
other decay data
irradiation history
CINDER'90
neutron fluxes
(E < 20 MeV)
nuclide atom density (#/barn-cm)
nuclide activity density (Ci/cc)
nuclide decay power density (watts/cc)
multigroup γ source spectra
MCNP
time dependent γ spectra

- **Neutral Particle Fluences**

- **Background**

  shielding

  safety

- **Residual Nuclei**

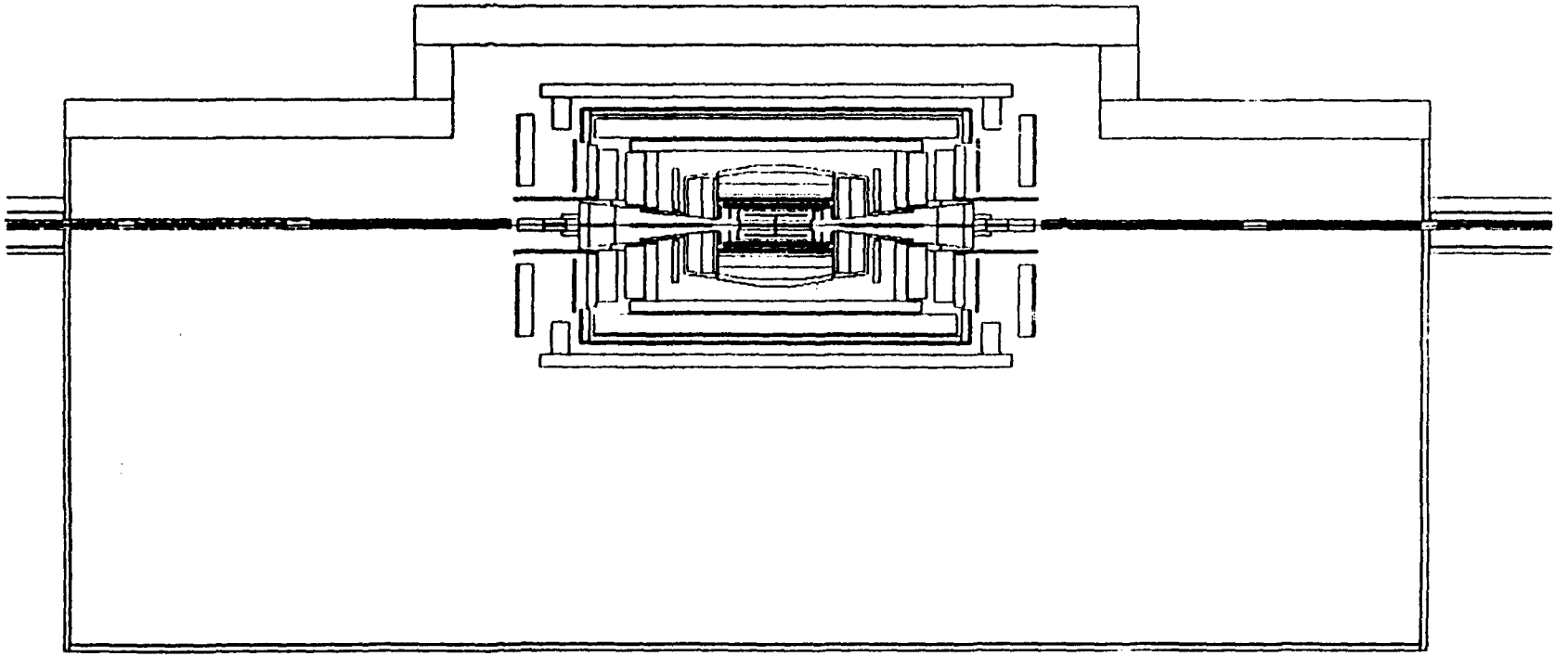
  long-term storage

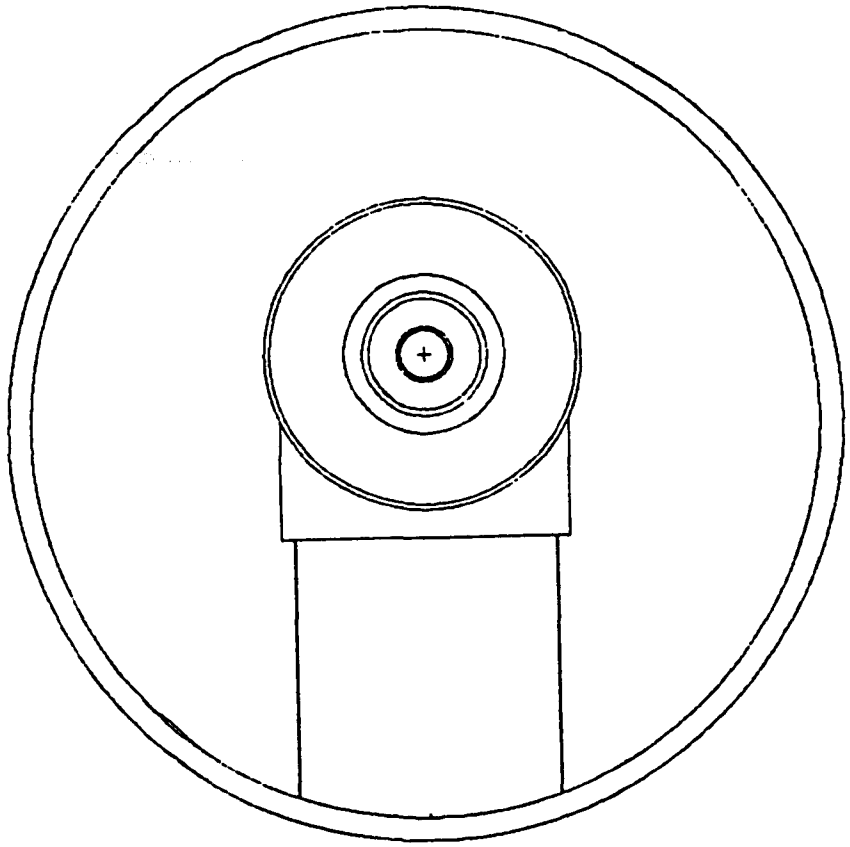
  heating

  life

  background

- **Time-dependent γ spectra**

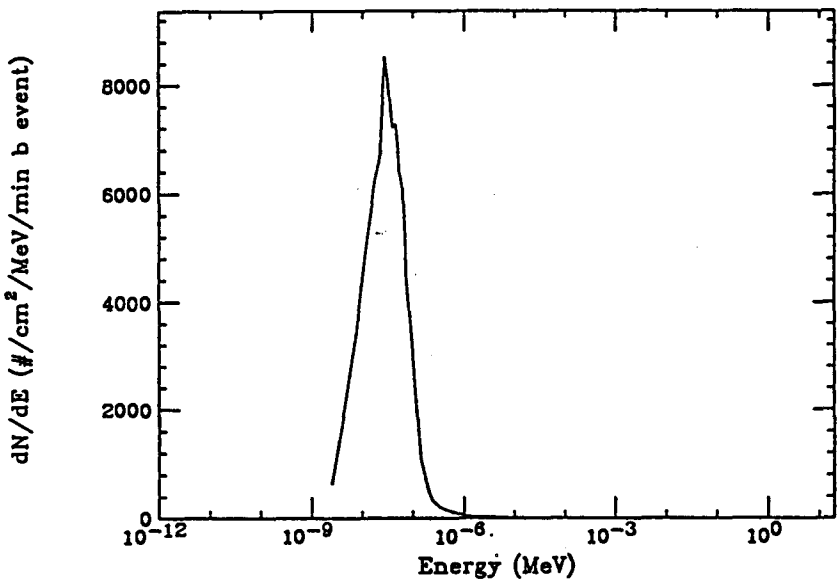




beampipe	r=2.1055 - 2.2305cm	SS304LN
liq. He	r=2.2305 - 2.485cm	liquid He^4
coil	r=2.485 - 4.936cm	24.25% Nitronic 40 .75% liquid He^4 40.6% copper 34.4% TiNb
spacer	r=4.936-5.493cm	Cartridge Brass
collar	r=5.493-7.020cm	99% Nitronic 40 1% He^4
yoke	r=7.020-13.335 cm	~ iron
shell	r=13.335-13.812 cm	SS304LN
insulation	r=13.812-34.83 cm	2.5% N_2He^4
		10.0% mylar 5.0% Aluminum 18% SS316
post	radius=12.5cm wall thickness 1.6cm	Aluminum
cradle	50 cm long	SS316
cryostat	34.83 - 36.83	SS316

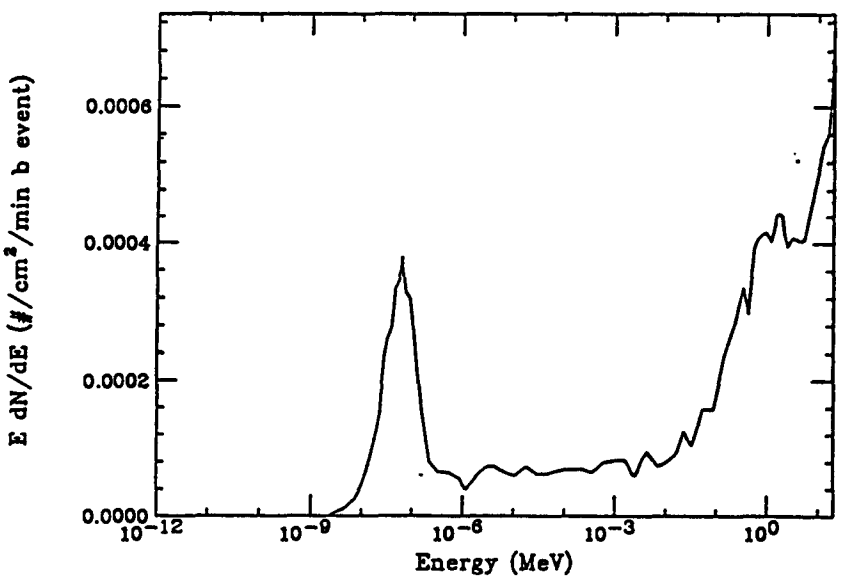
Table 1: Note the cold mass sits 6 cm above the center of the cryostat wall. All percents are by volume.

cell 1 central beryllium beampipe volume=2131.038

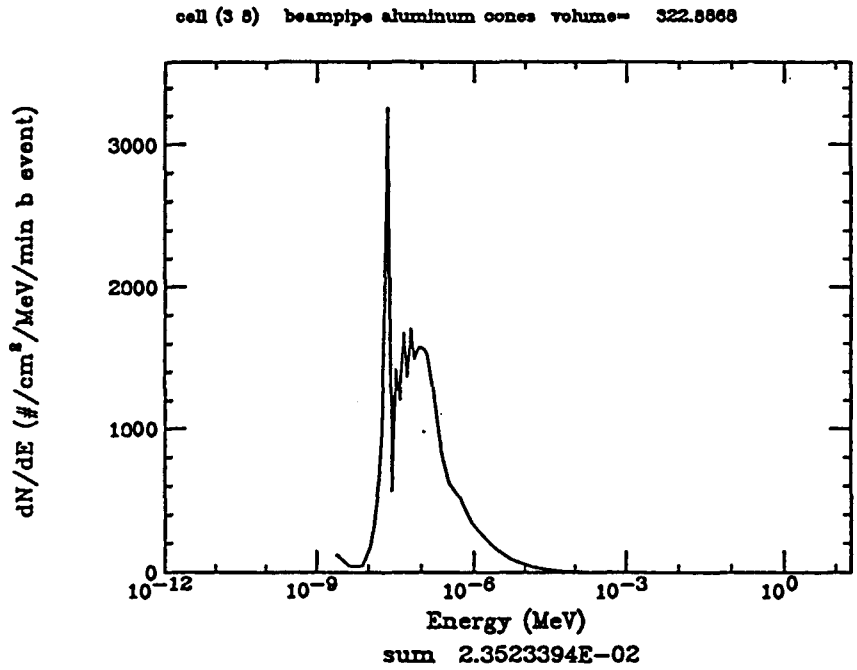


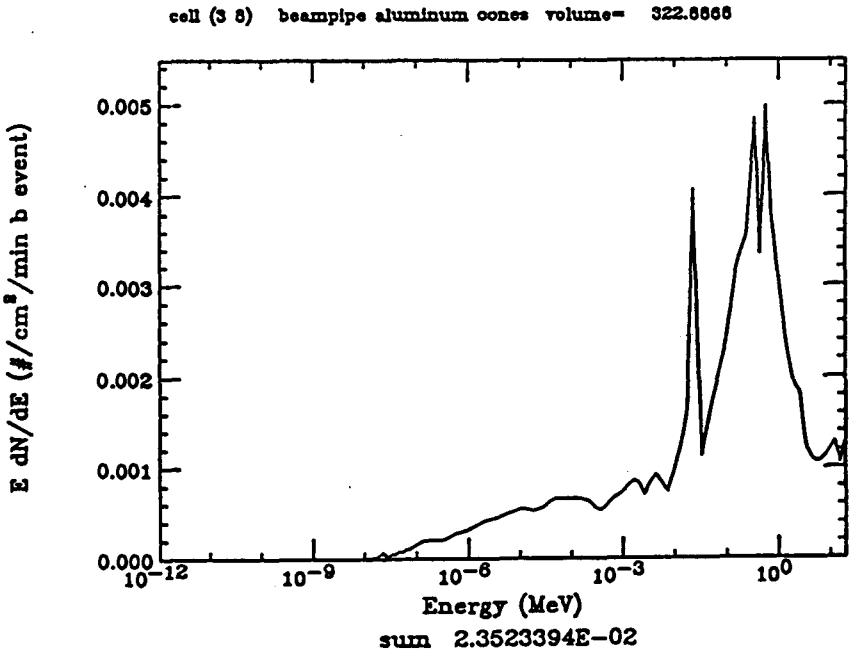
sum 3.7505380E-03

cell 1 central beryllium beampipe volume=2131.038

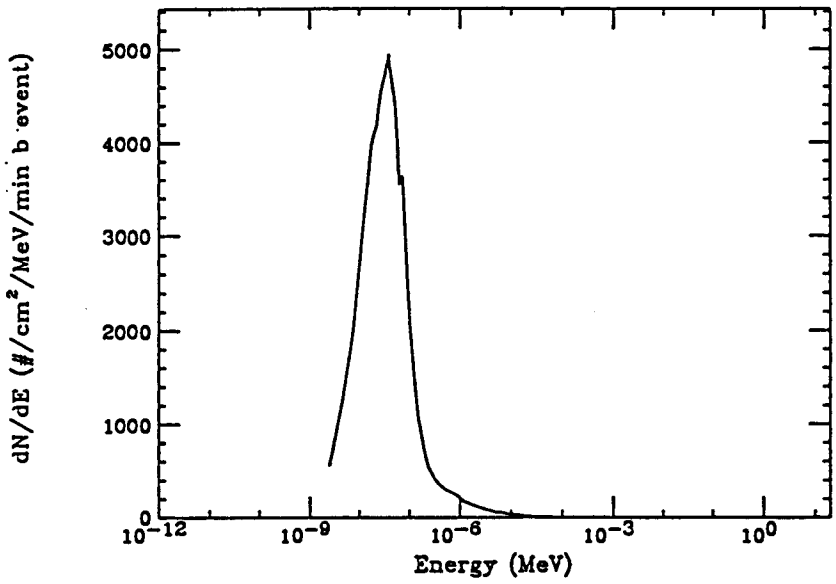


sum 3.7505380E-03


cell (3 5) beampipe aluminum cones volume= 322.8868
dN/dE (#/cm²/MeV/min b event)
3000
2000
1000
0
10⁻¹²
10⁻⁹
10⁻⁶
10⁻³
10⁰
Energy (MeV)
sum 2.3523394E-02

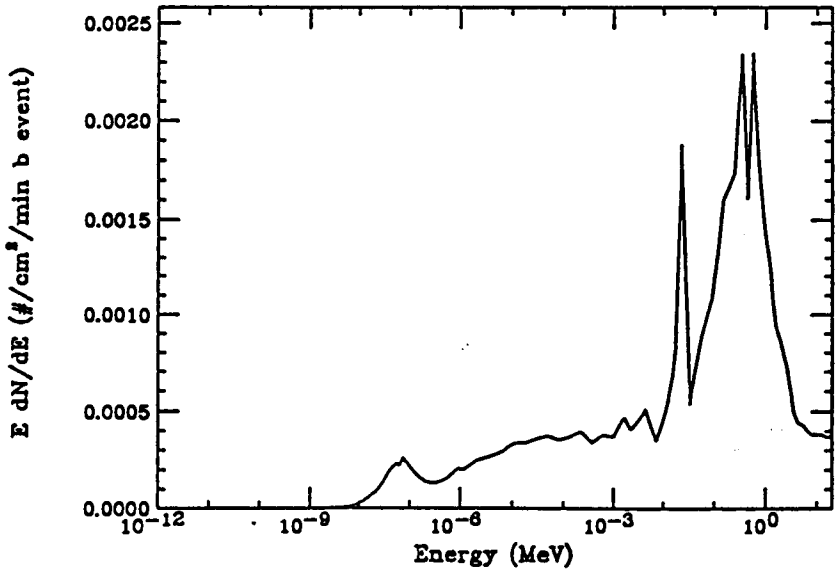

cell (3 5) beampipe aluminum cones volume= 322.8868
E dN/dE (#/cm²/min b event)
0.005
0.004
0.003
0.002
0.001
0.000
10⁻¹²
10⁻⁹
10⁻⁶
10⁻³
10⁰
Energy (MeV)
sum 2.3523394E-02

cell (2 7) beampipe steel cones volume= 3849.528

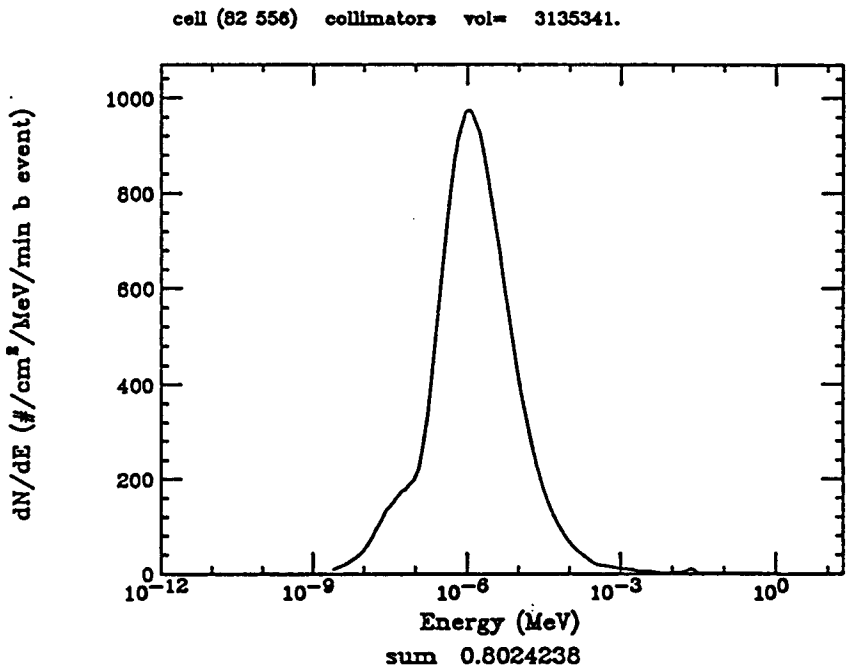


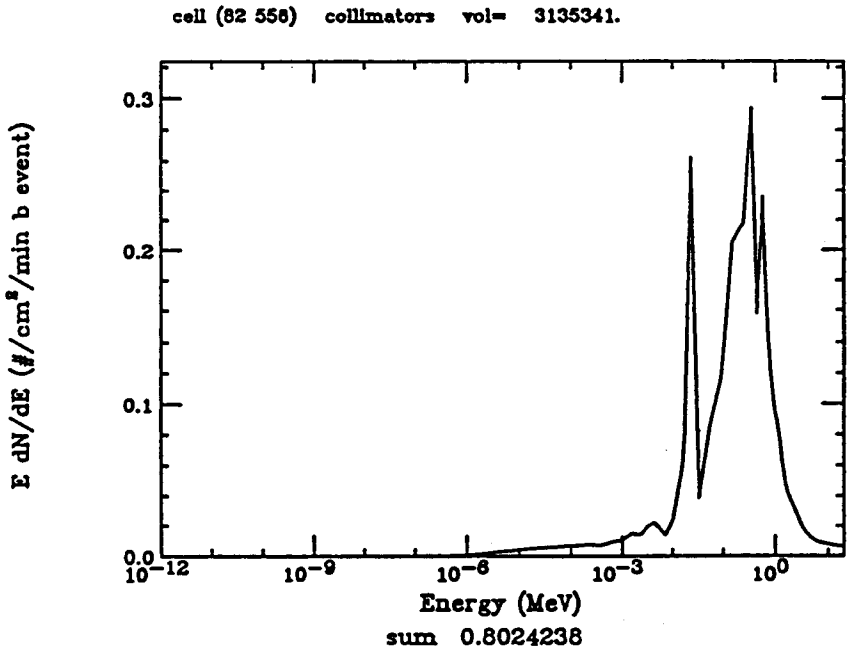
sum 1.1855396E-02

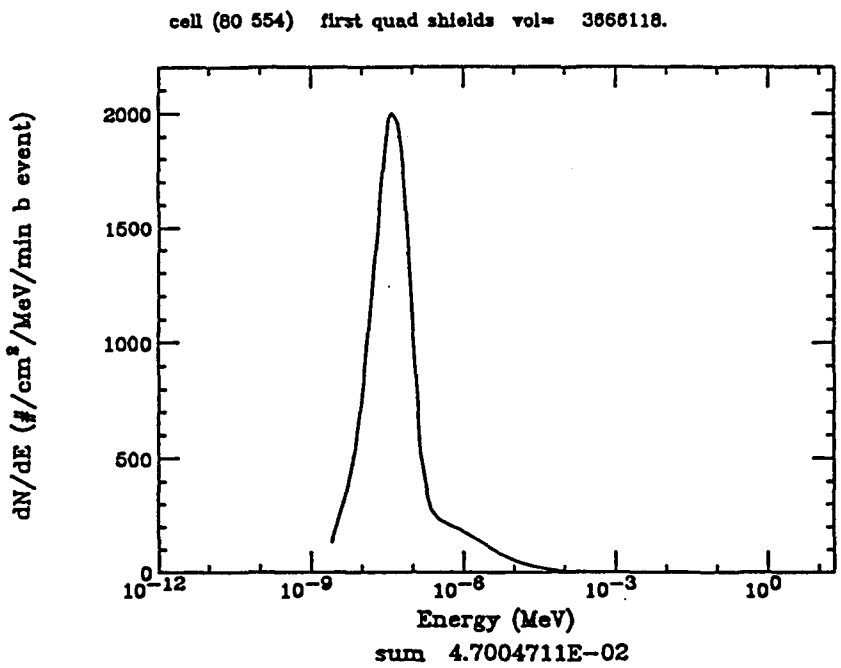
cell (2 7) beampipe steel cones volume= 3849.528

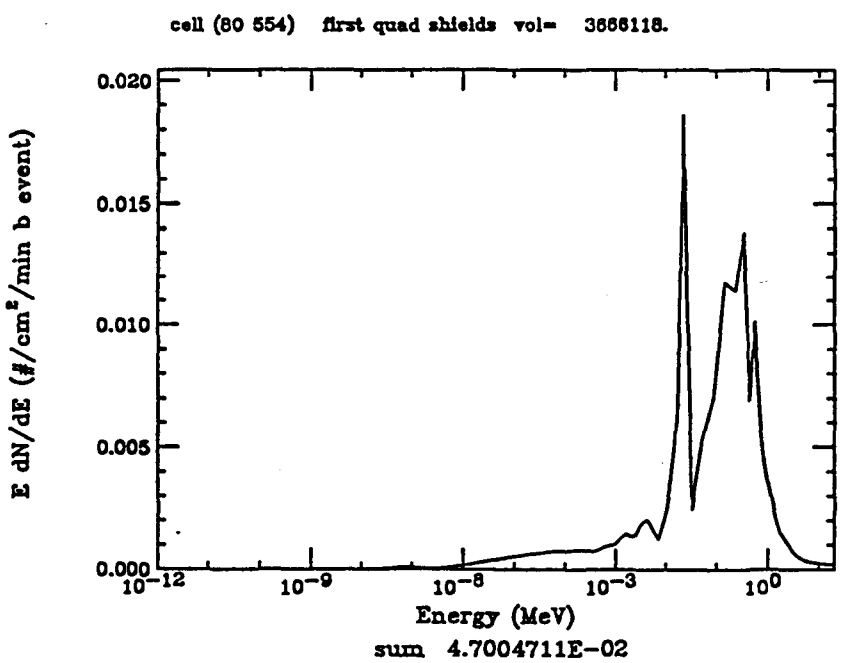


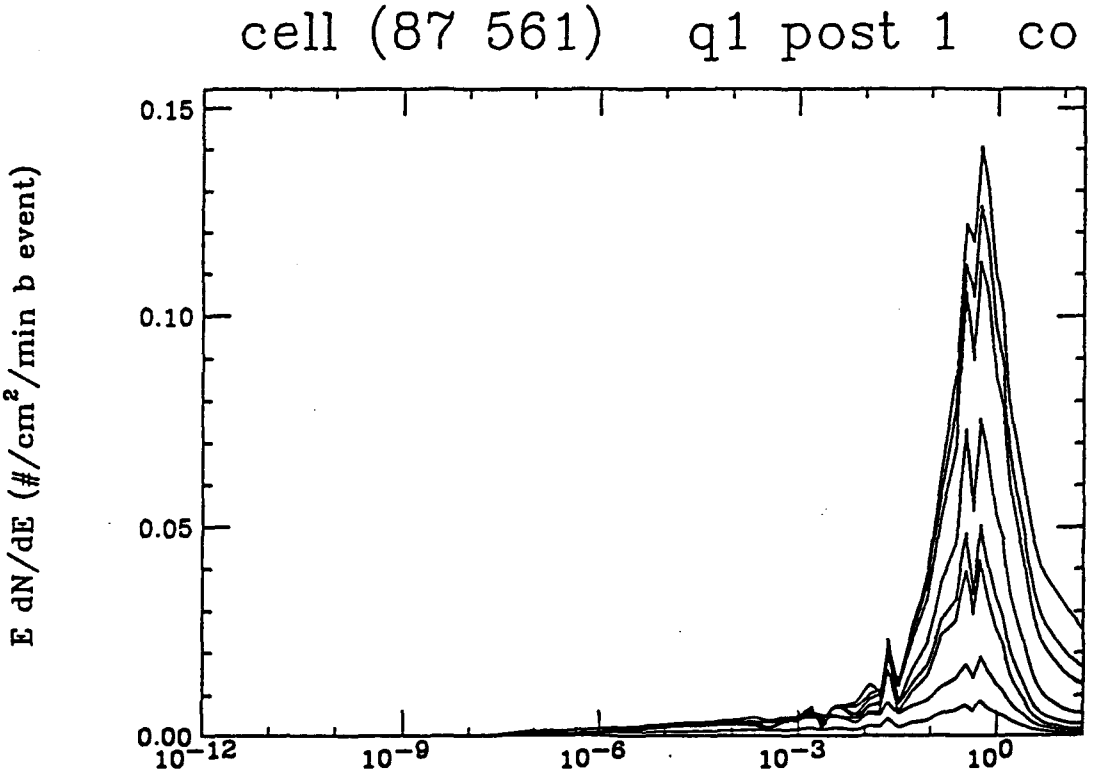
sum 1.1855396E-02

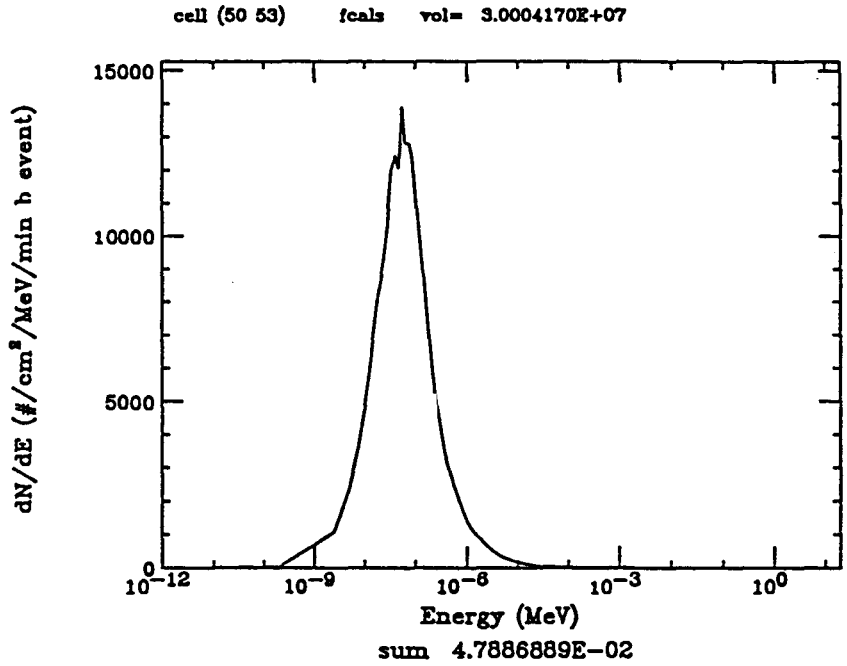

cell (82 556) collimators vol= 3135341.
dN/dE (#/cm²/MeV/min b event)
1000
800
600
400
200
0
10⁻¹²
10⁻⁹
10⁻⁶
10⁻³
10⁰
Energy (MeV)
sum 0.8024238

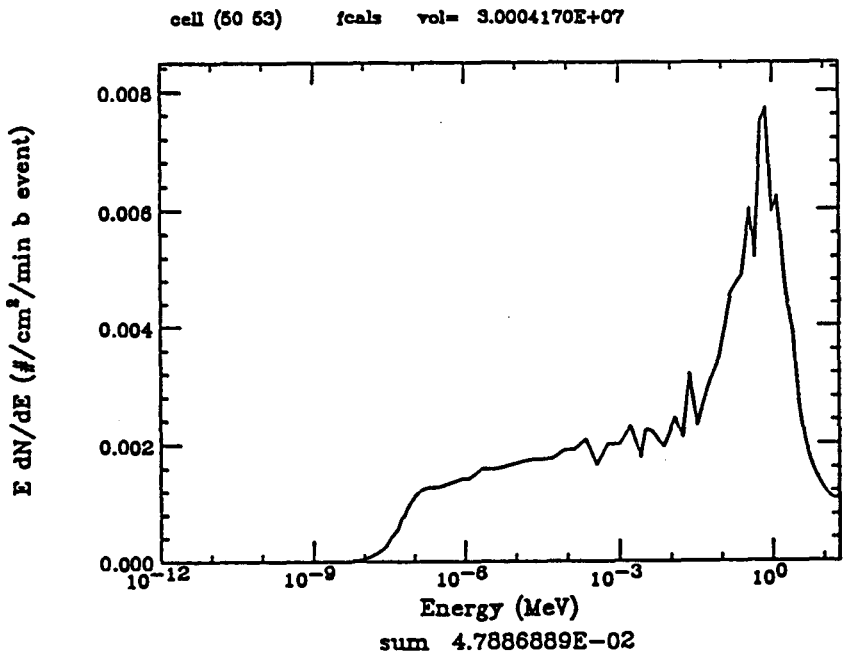

cell (82 556) collimators vol= 3135341.
E dN/dE (#/cm²/min b event)
0.3
0.2
0.1
0.0
10⁻¹²
10⁻⁹
10⁻⁶
10⁻³
10⁰
Energy (MeV)
sum 0.8024238

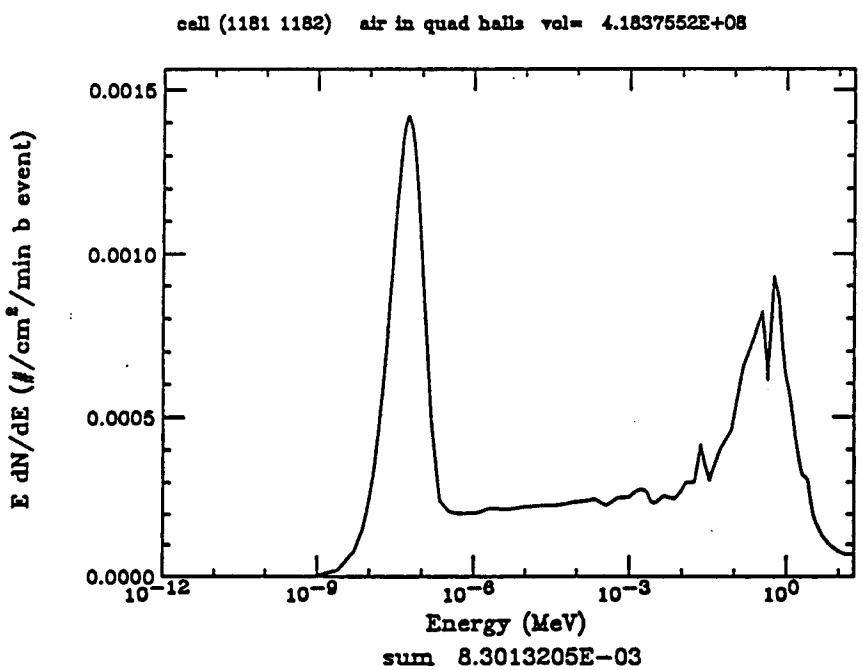

cell (80 554) first quad shields vol= 3666118.
dN/dE (#/cm²/MeV/min b event)
2000
1500
1000
500
0
10⁻¹²
10⁻⁹
10⁻⁶
10⁻³
10⁰
Energy (MeV)
sum 4.7004711E-02


cell (80 554) first quad shields vol= 3666118.
E dN/dE (#/cm²/min b event)
0.020
0.015
0.010
0.005
0.000
10⁻¹²
10⁻⁹
10⁻⁶
10⁻³
10⁰
Energy (MeV)
sum 4.7004711E-02

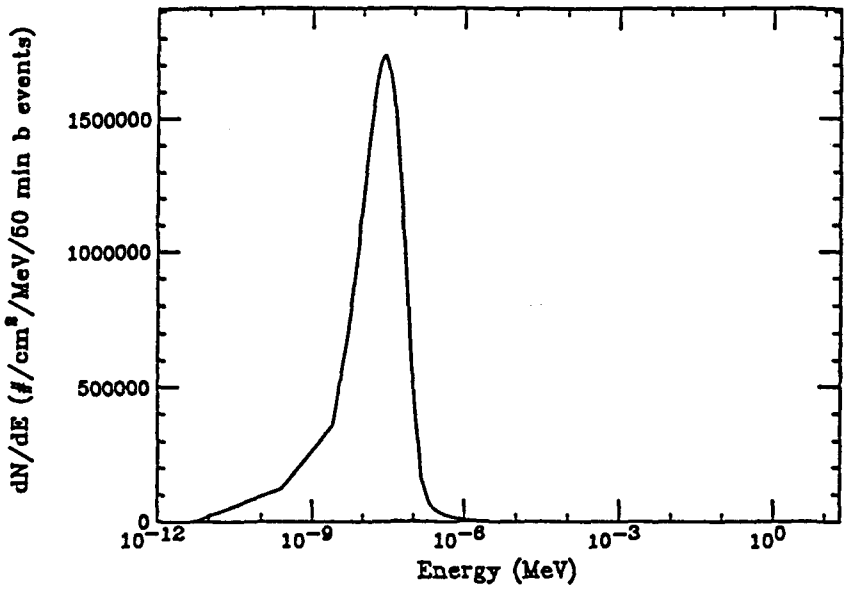

cell (87 561) q1 post 1 co
E dN/dE (#/cm²/min b event)
0.15
0.10
0.05
0.00
10⁻¹²
10⁻⁹
10⁻⁶
10⁻³
10⁰


cell (50 53) fcals vol= 3.0004170E+07
15000
10000
5000
0
dN/dE (#/cm²/MeV/min b event)
10^-12
10^-9
10^-6
10^-3
10^0
Energy (MeV)
sum 4.7886889E-02

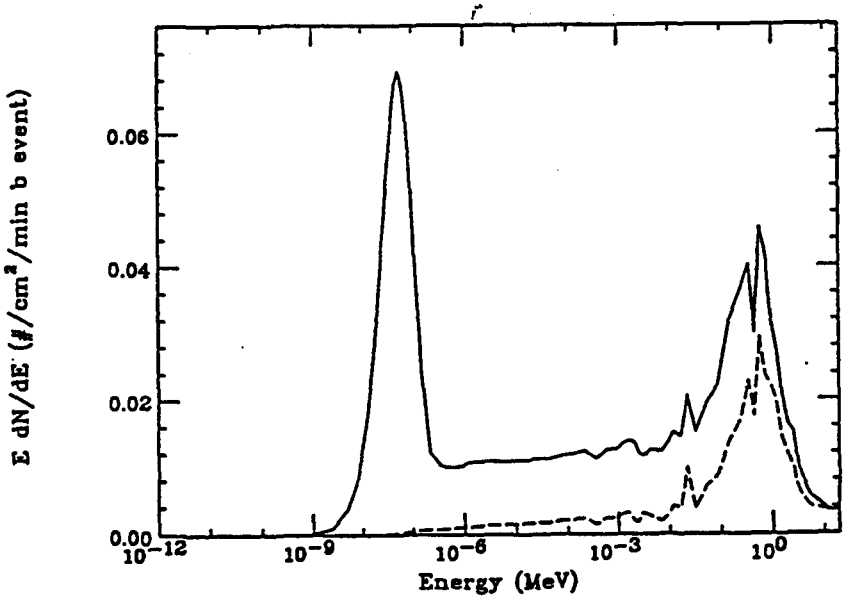

cell (50 53) fcals vol= 3.0004170E+07
0.008
0.006
0.004
0.002
0.000
E dN/dE (#/cm²/min b event)
10^-12
10^-9
10^-6
10^-3
10^0
Energy (MeV)
sum 4.7886889E-02


cell (1181 1182) air in quad halls vol= 4.1837552E+08
0.0015
0.0010
0.0005
0.0000
E dN/dE (#/cm²/min b event)
10⁻¹²
10⁻⁹
10⁻⁶
10⁻³
10⁰
Energy (MeV)
sum 8.3013205E-03

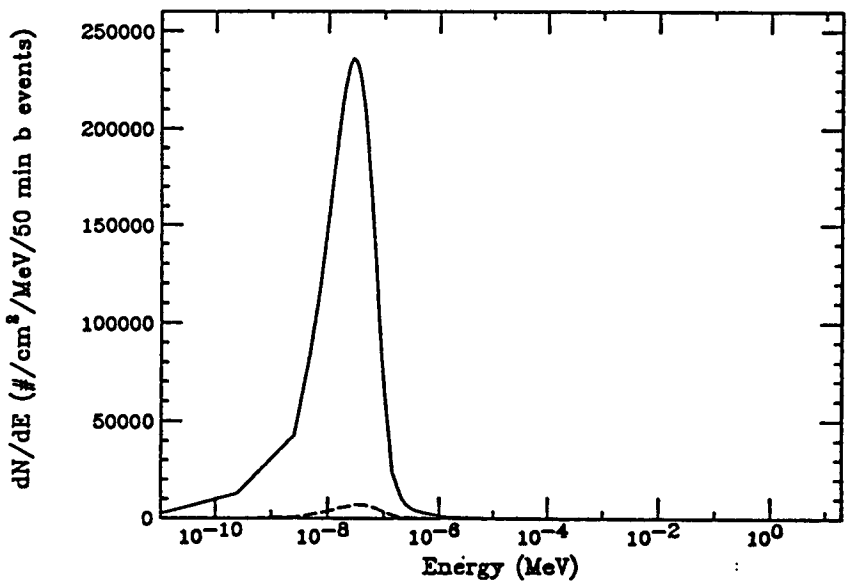
air fluence in the quad halls, w/ and w/o concrete



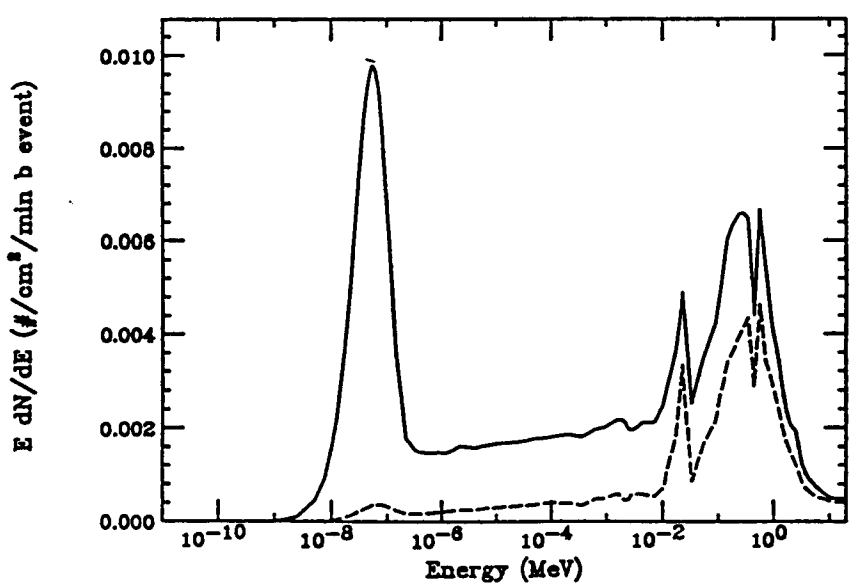
air fluence in the quad halls, w/ and w/o concrete

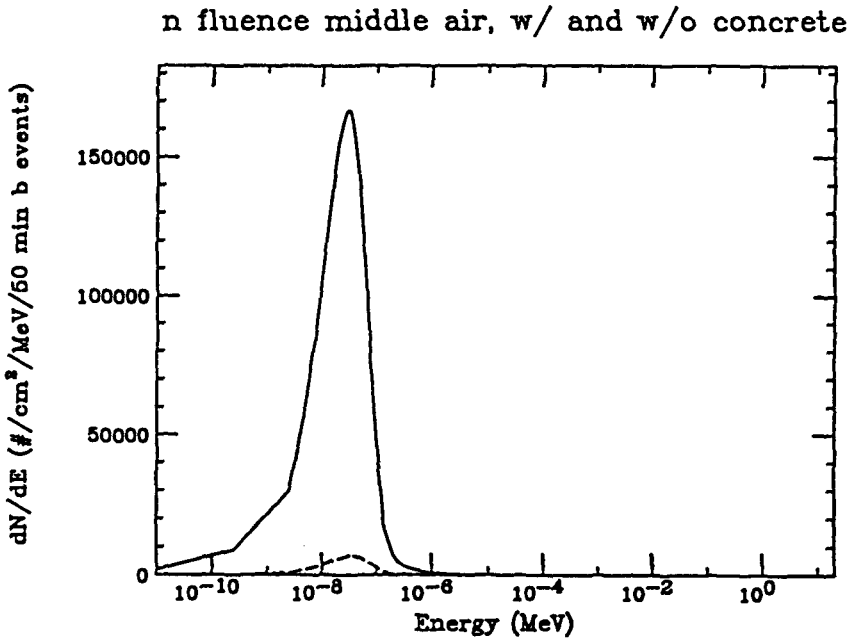


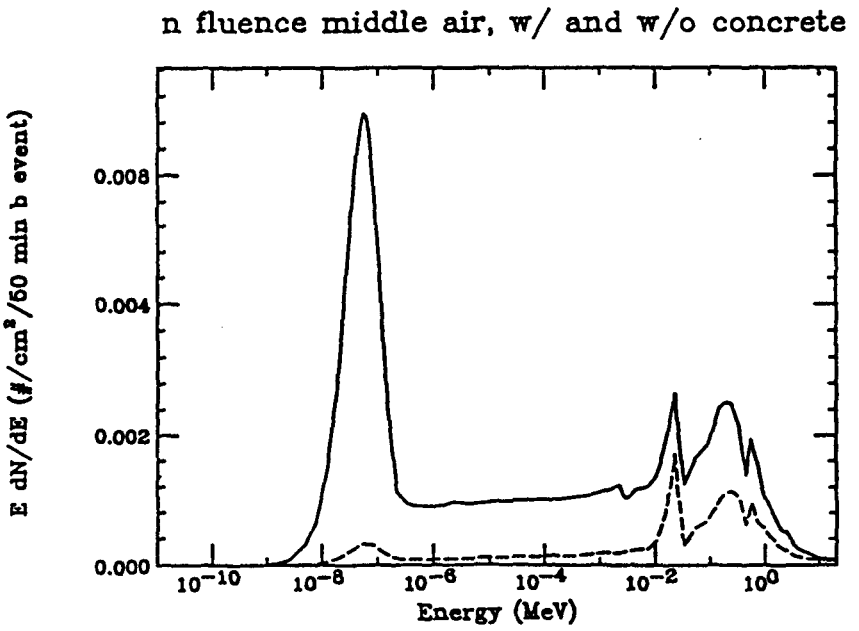
n fluence outer air on ends, w/ and w/o concrete



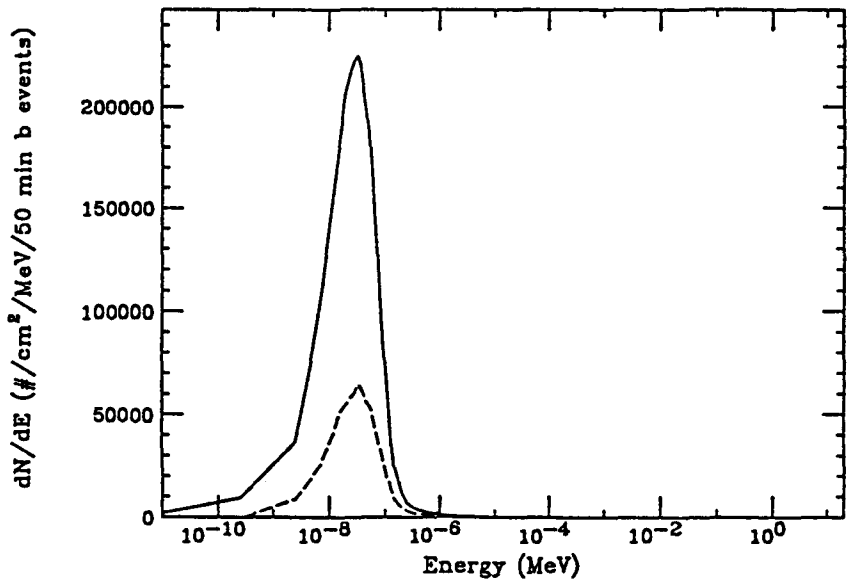
n fluence outer air on ends, w/ and w/o concrete



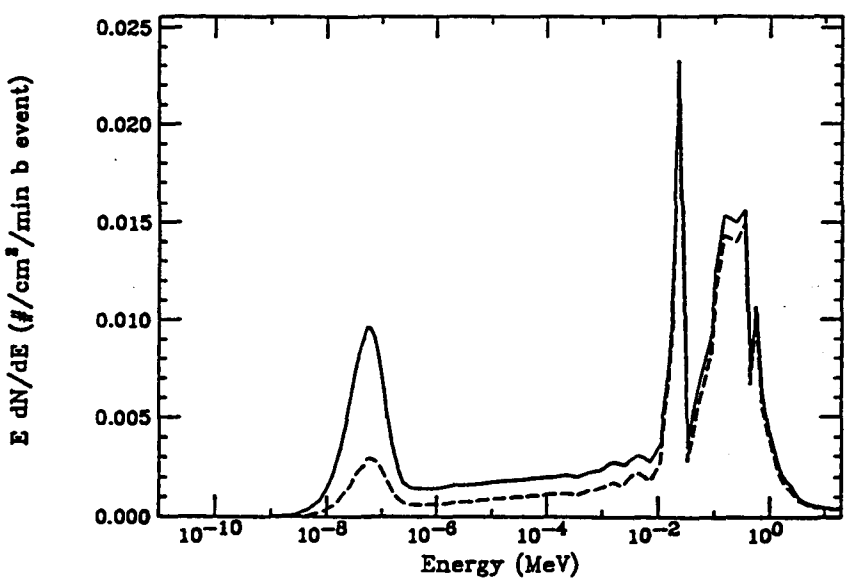

n fluence middle air, w/ and w/o concrete
dN/dE (#/cm²/MeV/50 min b events)
150000
100000
50000
0
10⁻¹⁰
10⁻⁸
10⁻⁶
10⁻⁴
10⁻²
10⁰
Energy (MeV)


n fluence middle air, w/ and w/o concrete
E dN/dE (#/cm²/50 min b event)
0.008
0.004
0.002
0.000
10⁻¹⁰
10⁻⁸
10⁻⁶
10⁻⁴
10⁻²
10⁰
Energy (MeV)

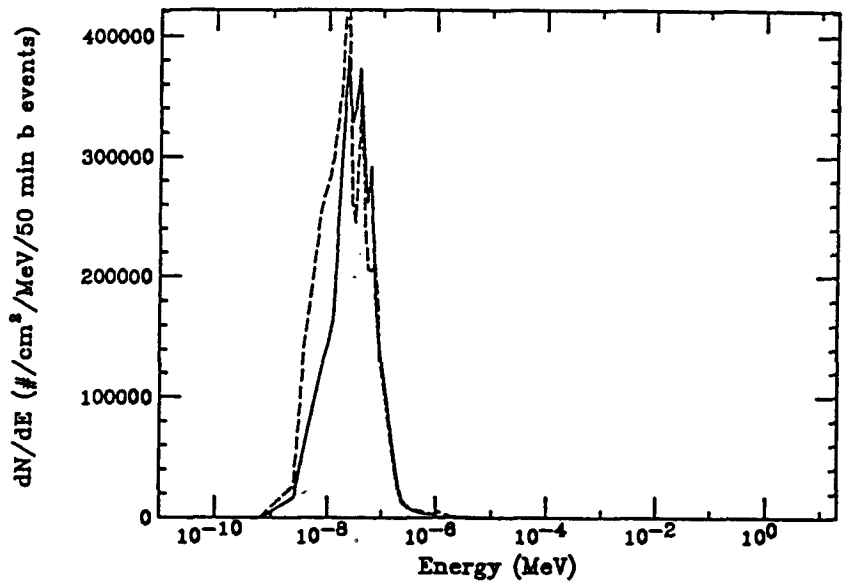
air within detector, w/ and w/o concrete



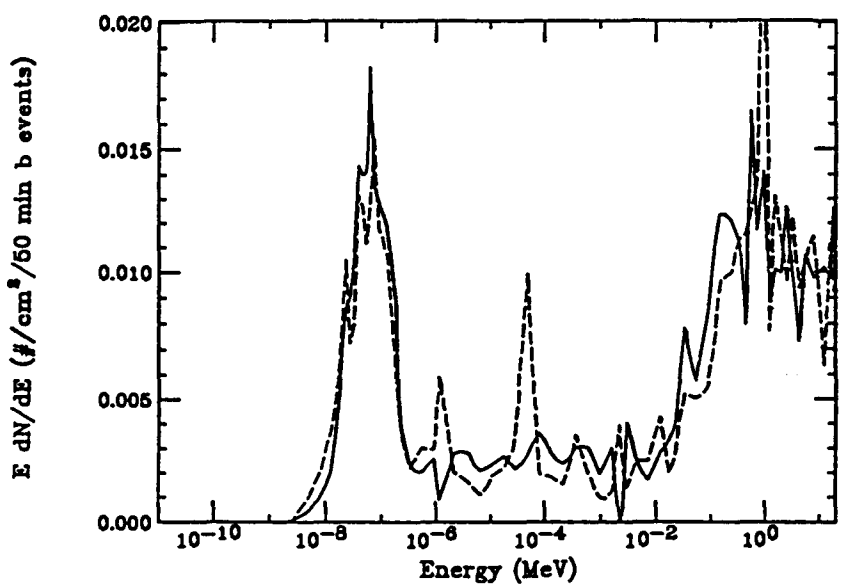
air within detector, w/ and w/o concrete



fluence r=4cm to r=9 cm, z=+/- 278 cm

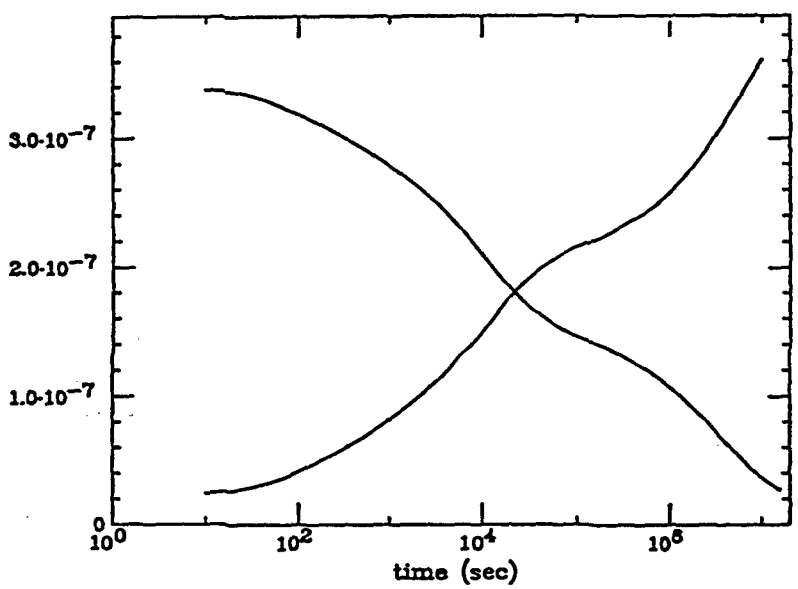


fluence r=4cm to r=9 cm, z=+/- 278 cm

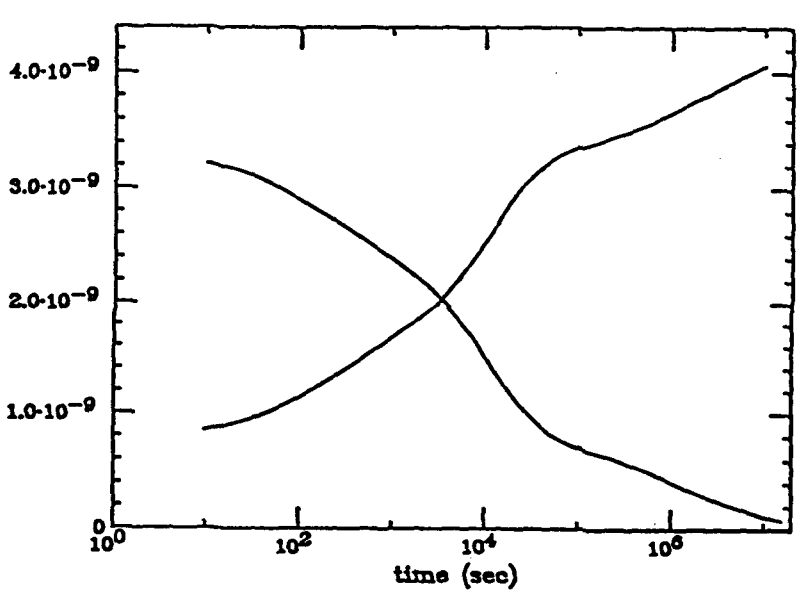


Material	Region	Description
Be	1	beryllium beampipe
DryAir	55,56,57,58	air
Al5083	3	aluminum beampipe
FORCAL	8	forward calorimeter
F21010	9	first quad shield
	10	second quad shield
	11	collimator before quad
	12	support shield
Fe304L	2, 4, 5, 6, 7	steel parts of beampipe
QCOILS	15,23,31,39,47	quadrupole coils
COLLAR	17,25,33,41,49	quadrupole collars
QYOKES	18,26,34,42,50	quadrupole yokes
316SS	19,27,35,43,51	quadrupole skins
	21,29,37,45,53	quadrupole supports
	14,22,30,38,46,54	quadrupole cryostats
QADINS	20,28,36,44,52	quadrupole insulation
BRASS	16,24,32,40,48	quadrupole brasses
EndPlt	13	quadrupole endplate

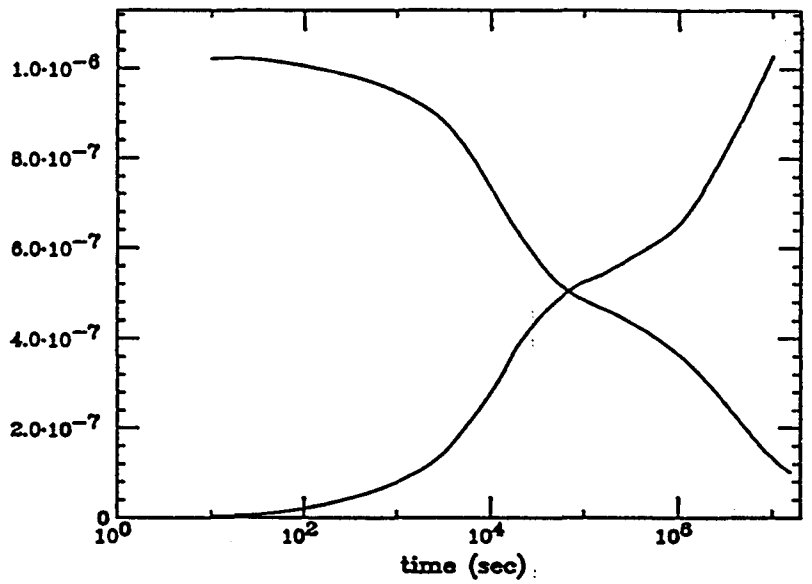
Activity Density (Curies/cc) in Quadrupole End Plate



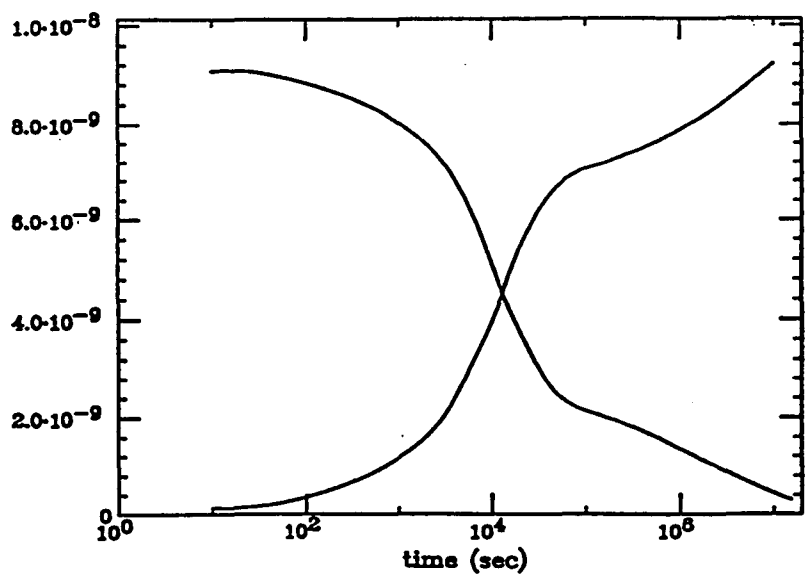
Decay Power Density (watts/cc) in Quadrupole End Plate



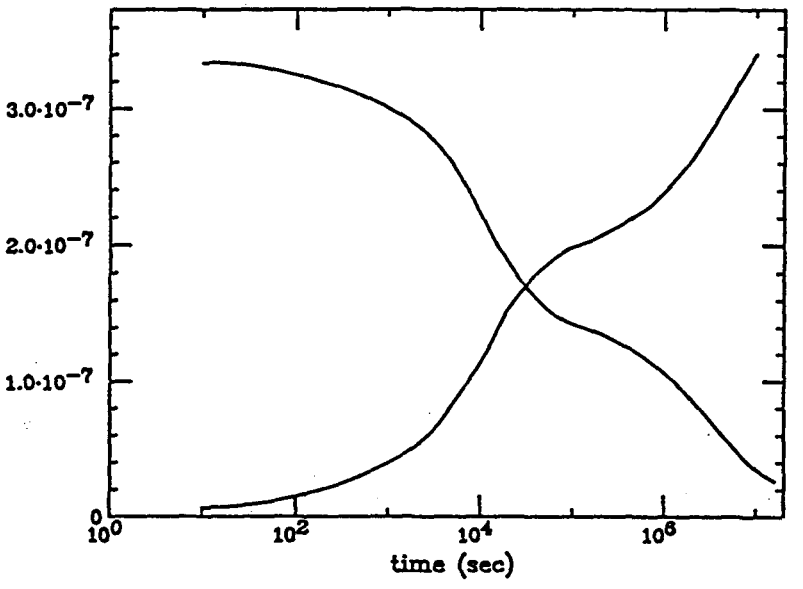
Activity Density (Curies/cc) by in Quadrupole Skins



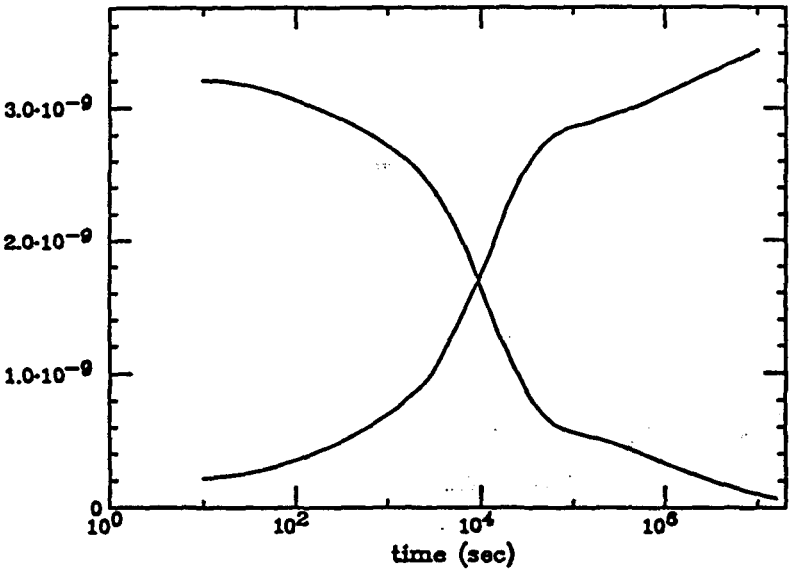
Decay Power Density (watts/cc) in Quadrupole Skin



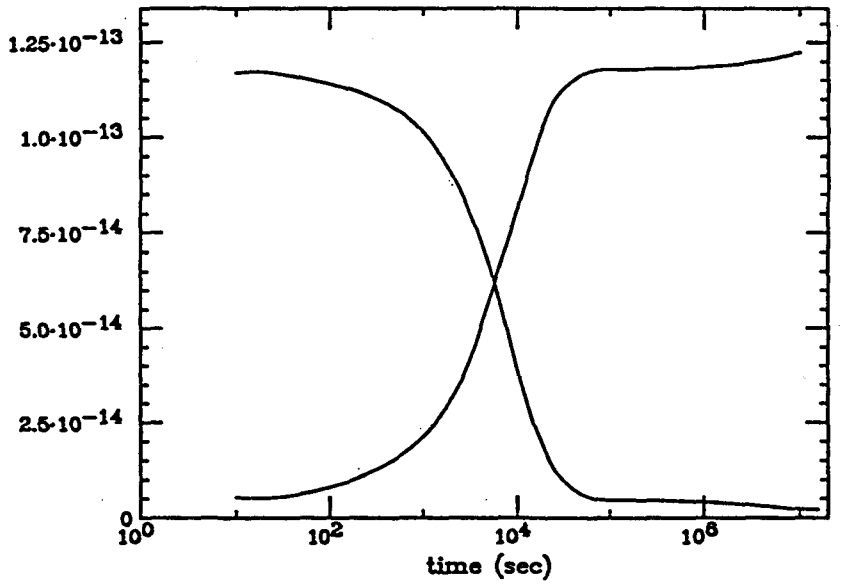
Activity Density (Curies/cc) in Forward Calorimeter



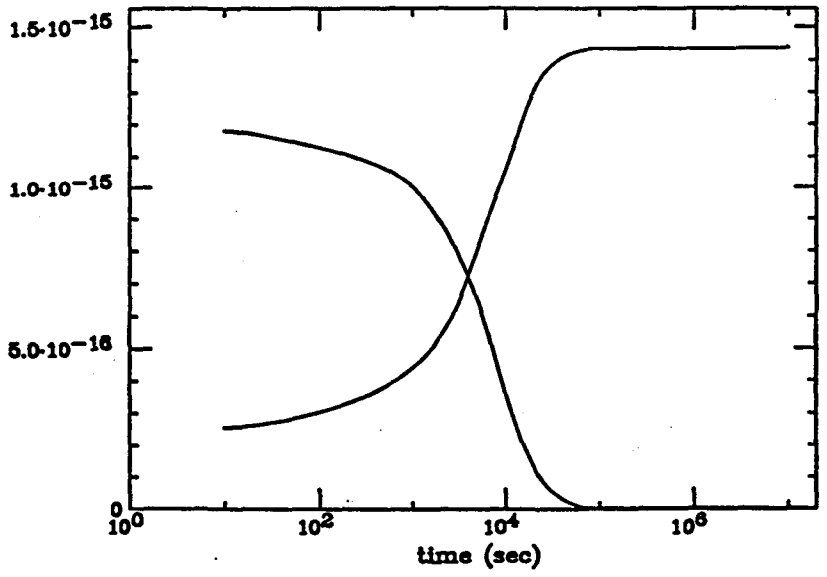
Decay Power Density (watts/cc) in Forward Calorimeter



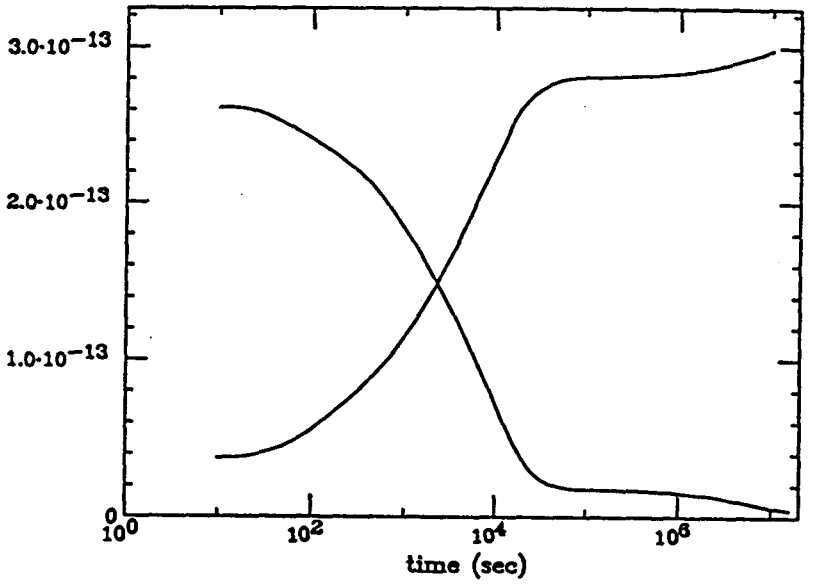
Activity Density (Curies/cc) in Mid Outer Air



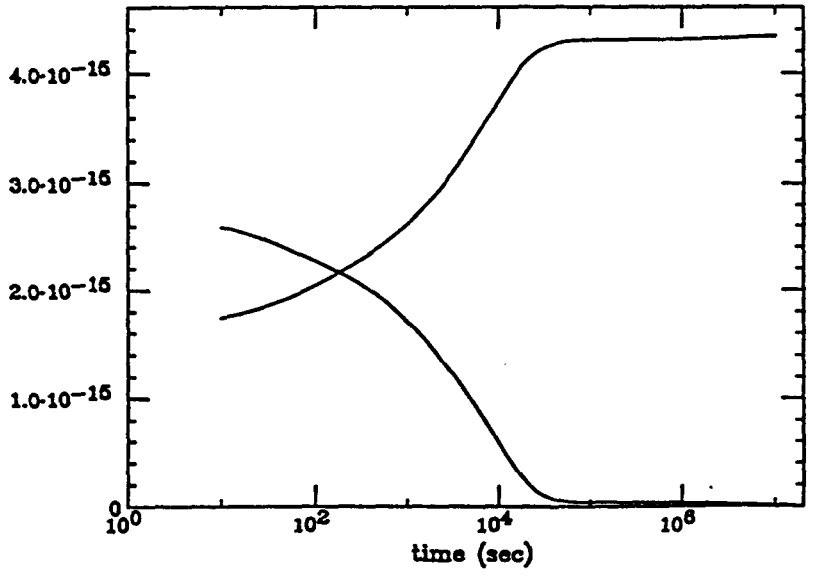
Decay Power Density (watts/cc) in Mid Outer Air



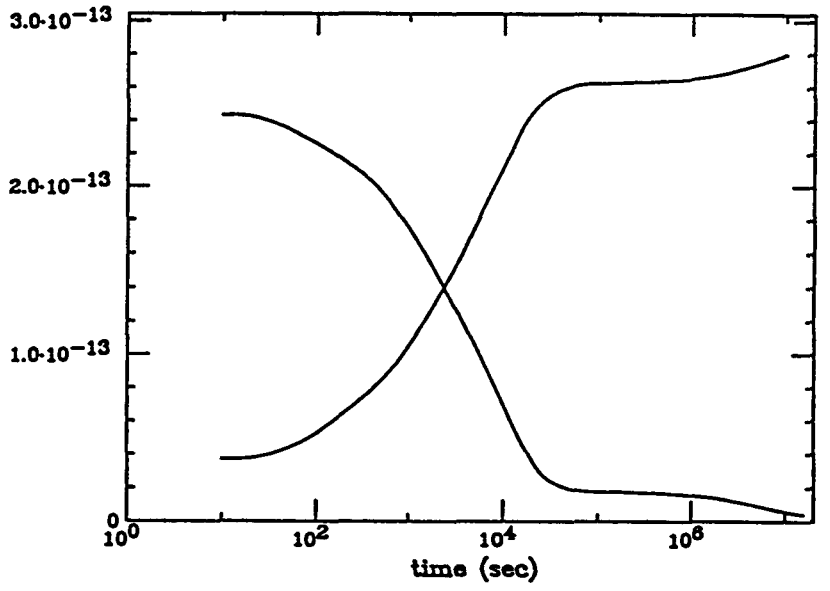
Activity Density (Curies/cc) in End Outer Air



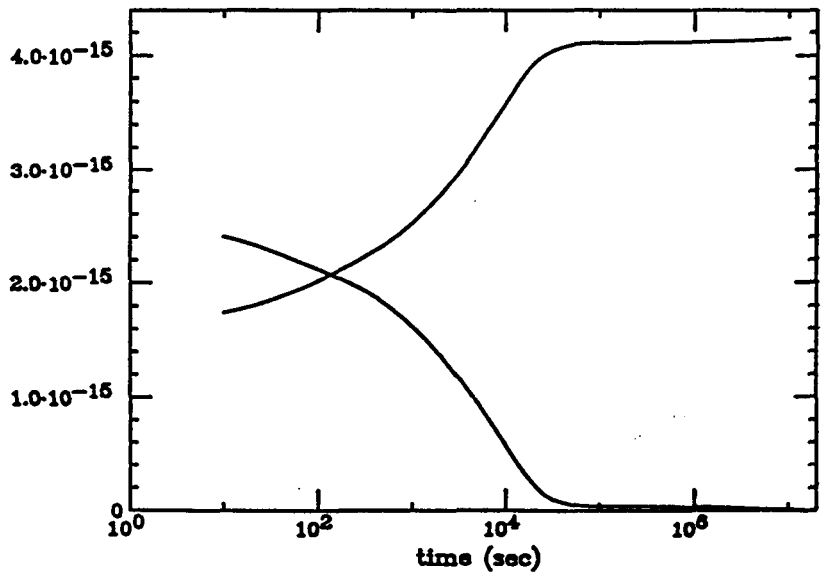
Decay Power Density (watts/cc) in End Outer Air



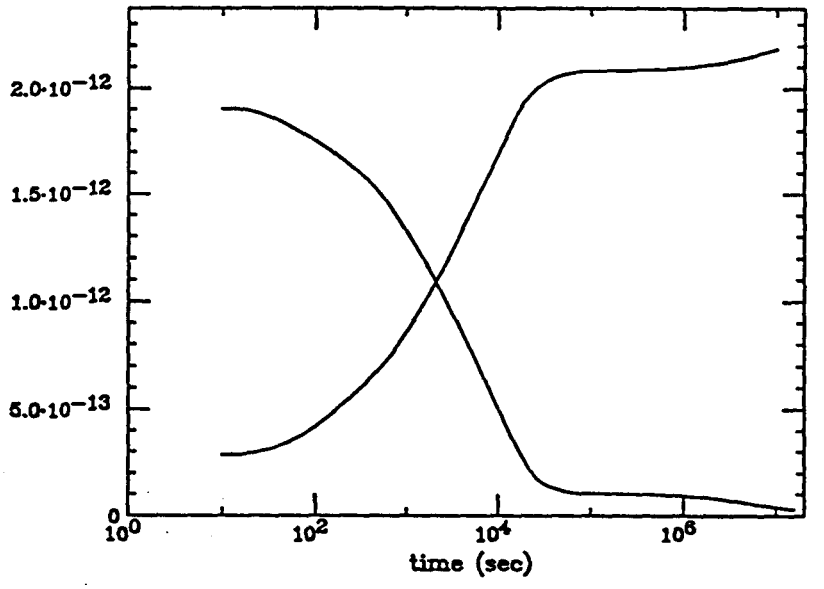
Activity Density (Curies/cc) in Air in Detector



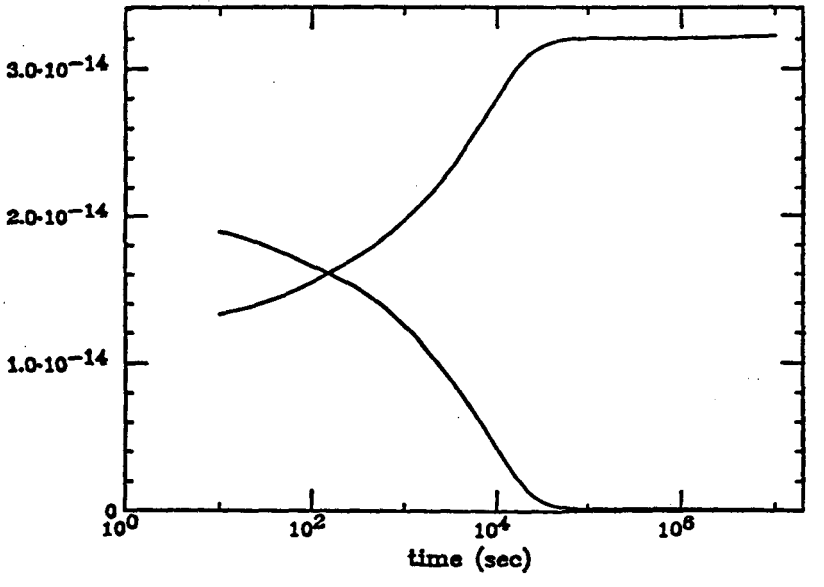
Decay Power Density (watts/cc) in Air in Detector



Activity Density (Curies/cc) in Air in Quad Halls



Decay Power Density (watts/cc) in Air in Quad Halls



The calculations have just begun. There are many questions and issues, which we will need to address.

We need input and guidance from the detector subgroups so that we properly and suitably address radiation issues, both within this calculation effort, and within the SDC as a whole.