Preliminary Considerations of Light Ion Beam Fusion and LIBRA Reactor Design

LIBRA Team

June 1982

FPA-82-4

Presentation at KfK-Karlsruhe, FRG, 3-4 June 1982

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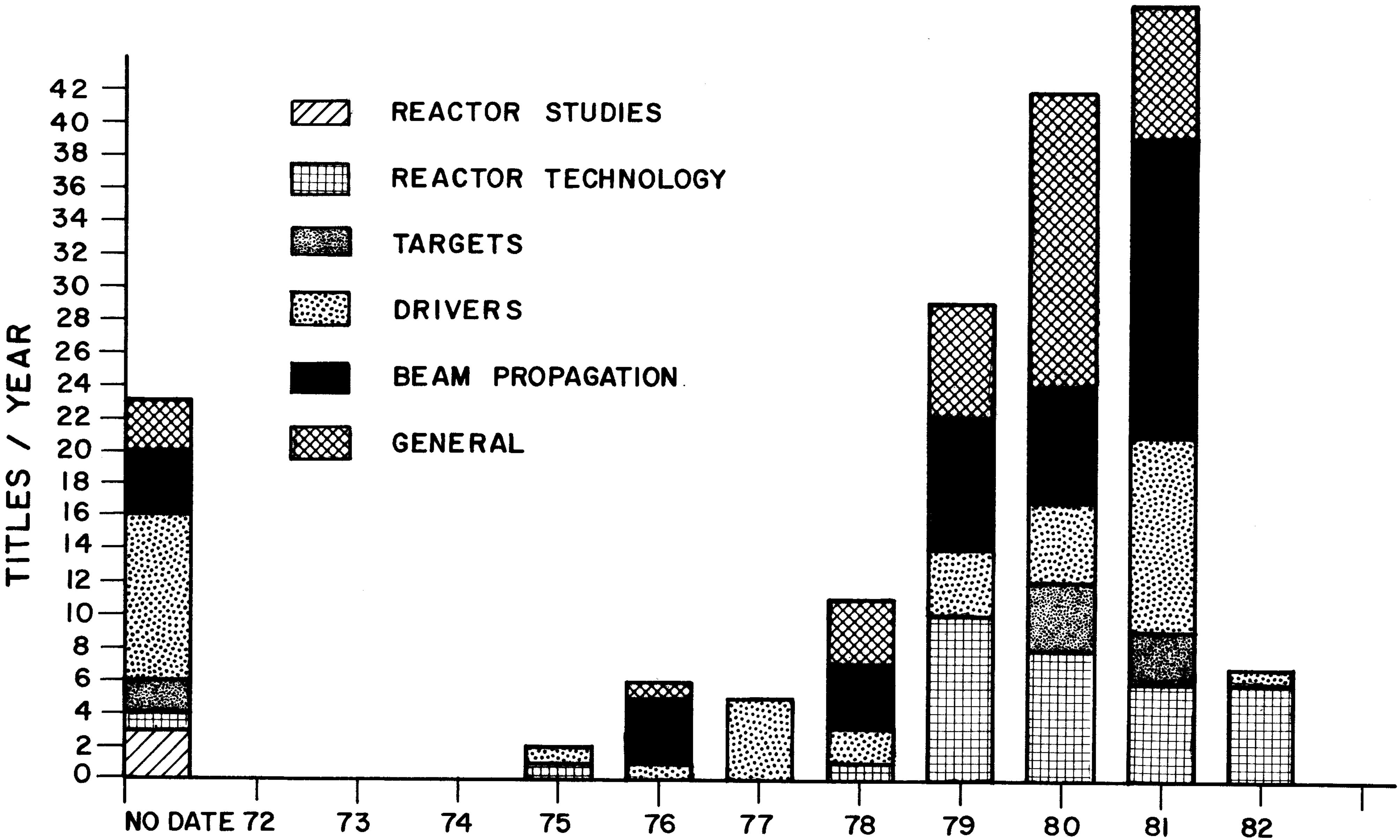
MAJOR ACTIVITIES IN LIBRA STUDY
JANUARY – MAY 1982

- **Literature Survey**
- **Review of Previous Studies**
- **Design Philosophy of LIBRA**
- **Preliminary Design Parameters of LIBRA**

BASIS FOR LIGHT ION BEAM BIBLIOGRAPHY

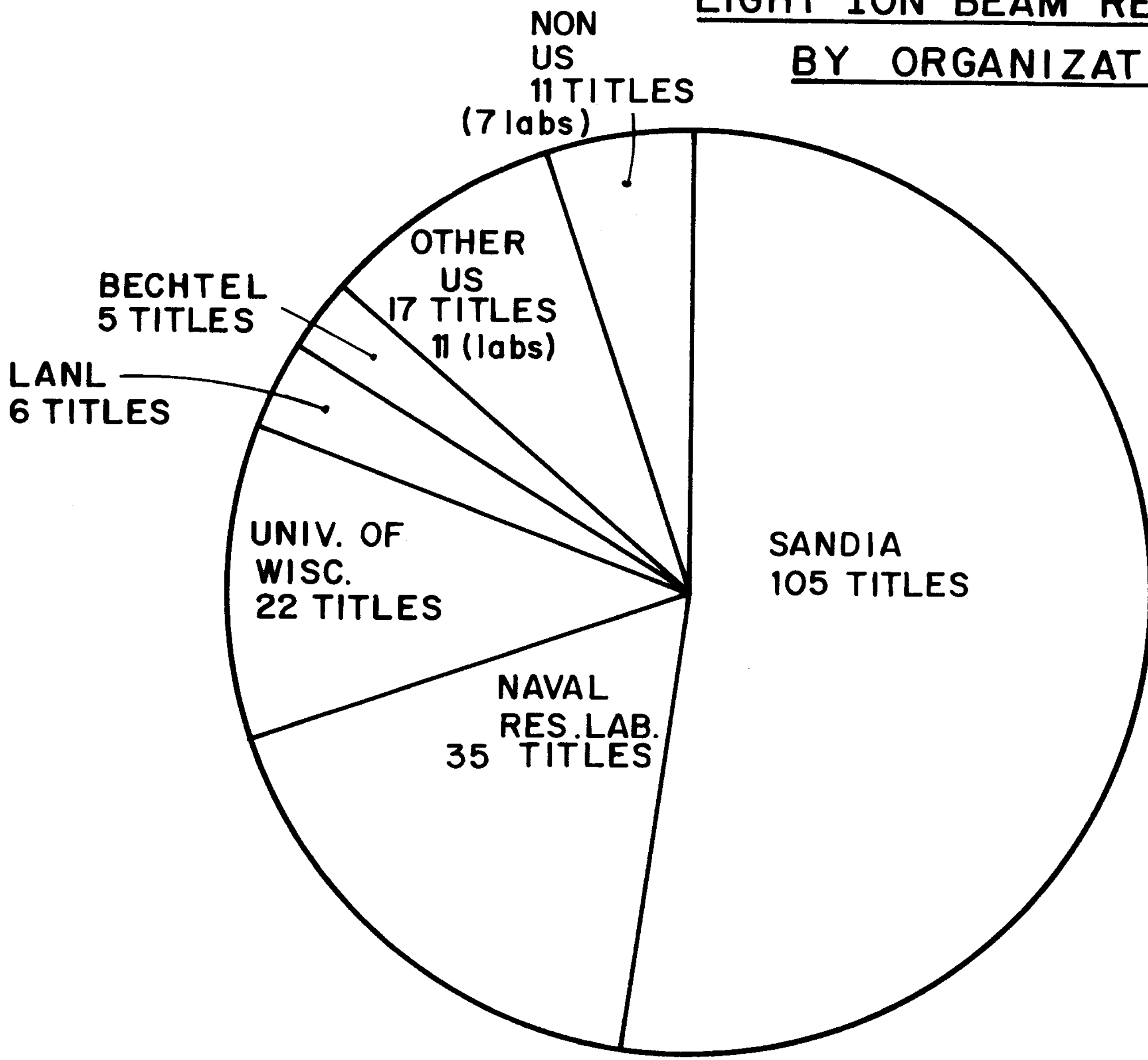
- DEFENSE NON–FUSION APPLICATIONS EXCLUDED
- ELECTRON BEAM WORK EXCLUDED
- DRIVER WORK INCLUDED IF SPECIFIC TO LIGHT ION BEAM FUSION (DRIVER SUPPORT TECHNOLOGY MAY BE OMITTED)
- ALL TITLES INCLUDED REGARDLESS OF MERIT

SEARCH IS NOT COMPLETE
SHOULD BE UP TO DATE BY FALL 1982



LIGHT ION RELATED TITLES BY DATE OF PUBLICATION

LIGHT ION BEAM RELATED TITLES BY ORGANIZATION



ORGANIZATIONS WITH PUBLICATIONS IN LIGHT ION BEAM RELATED RESEARCH

UNITED STATES OF AMERICA

SANDIA NATIONAL LABORATORY
NAVAL RESEARCH LABORATORY
LOS ALAMOS NATIONAL LABORATORY
LAWRENCE BERKELEY LABORATORY
LAWRENCE LIVERMORE NATIONAL LABORATORY
ARGONNE NATIONAL LABORATORY

CORNELL UNIVERSITY
UNIVERSITY OF ILLINOIS
UNIVERSITY OF NEW MEXICO
UNIVERSITY OF MARYLAND
UNIVERSITY OF WISCONSIN

BECHTEL
JAYCOR
MAXWELL
OCCIDENTAL RESEARCH
PHYSICS INTERNATIONAL
POWER CONVERSION TECHNOLOGY
SCIENCE APPLICATIONS INC.
TRW

ORGANIZATIONS WITH PUBLICATIONS IN LIGHT ION BEAM RELATED RESEARCH

OTHER THAN U.S.

- ATOMIC WEAPONS RESEARCH ESTABL. (GREAT BRITAIN)
- NAGOYA UNIVERSITY (JAPAN)
- OSAKA UNIVERSITY (JAPAN)
- KURCHATOV (USSR)
- INSTITUTE OF NUCLEAR PHYSICS – TOMSK (USSR)
- UNIVERSITY OF TORONTO (CANADA)
- KERNFORSCHUNGSZENTRUM KARLSRUHE (FRG)

SOME DATES IN ION BEAM FUSION

1968 WINTERBERG

considered ions from field emission
could be used to induce fusion in D–T

1974 BLAUGRUND and COOPERSTEIN – NRL

experiments on electron diodes suggested
presence of ions from anode

1975 HUMPHRIES, LEE, SUDAN – CORNELL

demonstrated proton beam 130 keV @ 6000 A

1975 GOLDSTEIN and LEE – NRL

calculation of electron flow in diodes
suggest using as a source of ions

1975 CLAUSER, SHEARER – SANDIA, LIVERMORE

noted excessive power requirements for
electron beam fusion – presented ion
beam target considerations

1979 SANDIA LABORATORY

changes emphasis from electron beam
to light ion beam fusion

SUMMARY OF U.S. FUNDING FOR ICF PARTICLE BEAM RESEARCH

YEAR	FUNDS PER YEAR (million $)	TOTAL FUNDS TO DATE (million $)
73	3	3
74	4	7
75	7	14
76	9	23
77	18	41
78	12	53
79	~13	66
80	~15	81
81	16	97
82	~17.5	115

LIGHT ION BEAM STUDIES

	UW – SNL	TRW	BECHTEL–EPRI
DATES	'78 – '82	'79 – '80	'81 – '82
DESIGN	Single Shot Test Facility	Experimental Accelerator	Test Reactor (Phase III)
SCOPE	Nuclear Island	Accelerator, Beam Transport	Critical Issues (Phase II) Complete Reactor (Phase I)
ION	8 MeV He^{++}	10 MeV He^{+}	150 MeV Ne^{+}
DRIVER	Pulse Power Diode	Multi-Stage Electrostatic	Induction Linac
PROPAGATION	Pre-formed Plasma Channel	Neutralized Ballistic	Self–Pinched

LIGHT ION BEAM STUDIES

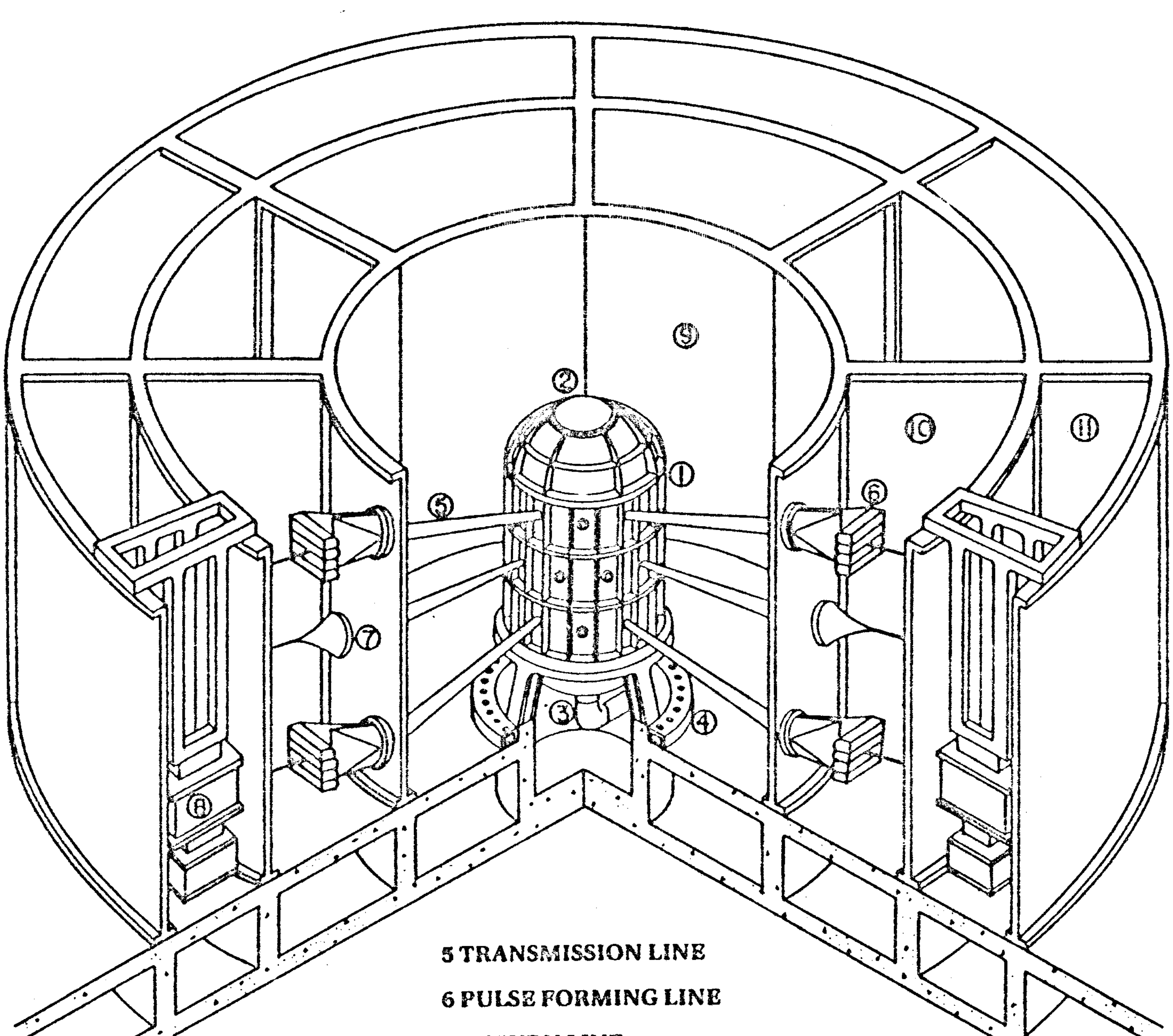
	UW – SNL	TRW	BECHTEL–EPRI
# OF BEAMS	40	40	2
CAVITY GAS	20 torr Ar + 0.2% Na	10^{-3} torr Li	5.6 torr Xe
REP. RATE	10/day	—	3 Hz
DRIVER STANDOFF	4 m	10 m	5 m
DRIVER ENERGY (ON TARGET)	>4 MJ	2 MJ	5.8 MJ
DRIVER POWER (ON TARGET)	>100 TW	150 TW	200 TW
TARGET YIELD	>200 MJ	—	300 MJ
FIRST WALL PROTECTION	Buffer Gas	—	Li Fog

LIGHT ION BEAM FUSION TARGET DEVELOPMENT FACILITY (UW – SNL)

- FIRST ICF "NUCLEAR FACILITY" TO STUDY HIGH YIELD (200 MJ) TARGETS
- TO BE BUILT AFTER PBFA–II
- SHOT RATE OF 10/DAY FOR LIFETIME OF 5 YEARS (1.5×10^4 SHOTS)
- MULTIPLE ION DIODES AND TRANSPORT IN PLASMA CHANNELS
- APPROXIMATELY 4 MJ OF ION ENERGY ON TARGET

LIST OF TOPICS

- CONCEPTUAL DESIGN OF TDF TARGET CHAMBER
- CODE DEVELOPMENT
- CANDIDATE FIRST WALL MATERIALS
- RESPONSE OF TARGET CHAMBER GAS
- THERMAL RESPONSE OF FIRST WALL AND FRAME
- RADIOACTIVITY
- RADIATION SHIELD AND MAINTENANCE


1
2
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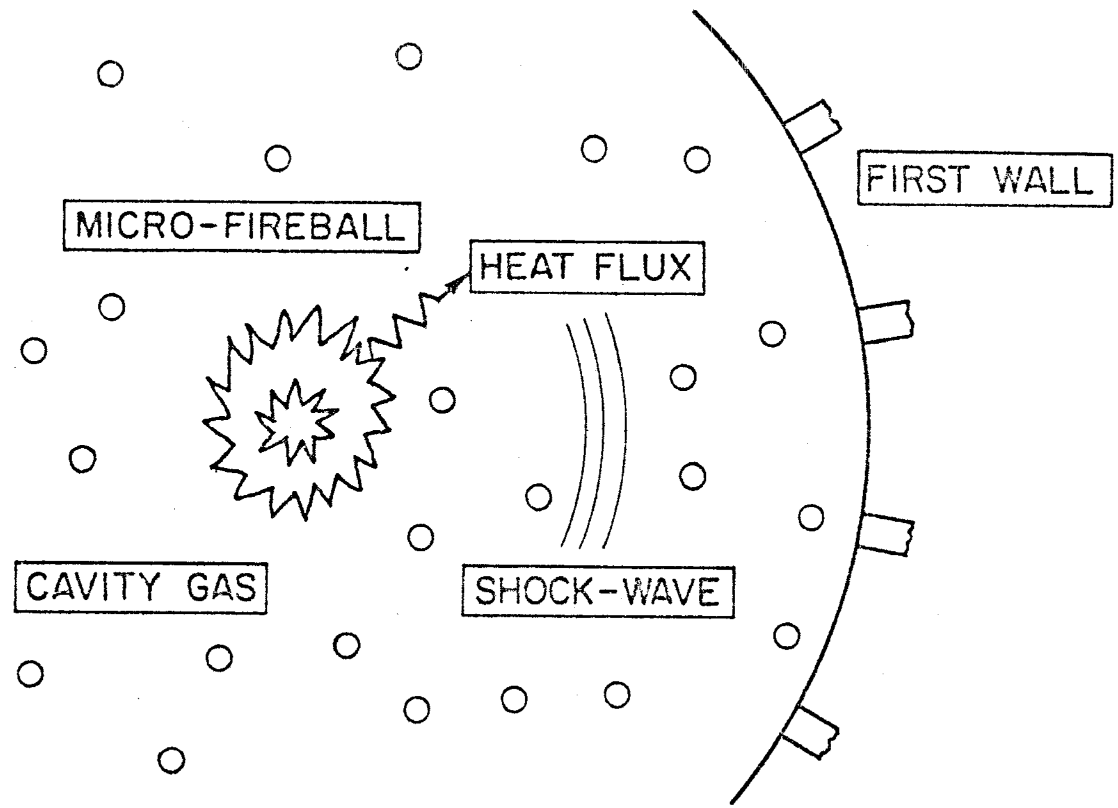
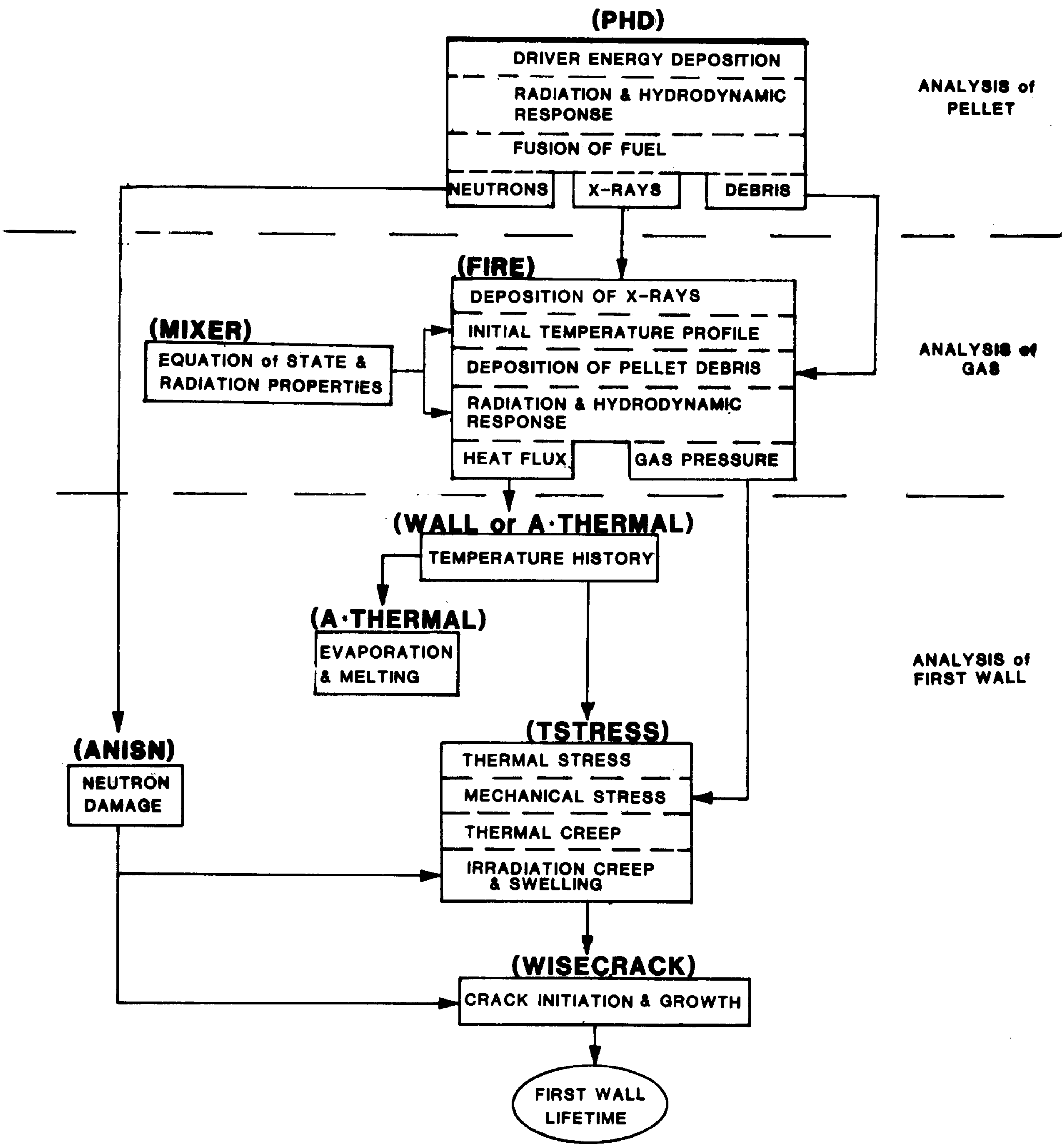
11
6
1 TARGET CHAMBER
2 DIAGNOSTIC PORT
3 PURGE LINE
4 AIR BUBBLE PLENUM
5 TRANSMISSION LINE
6 PULSE FORMING LINE
7 RETURN LINE
8 BEAM MARX GENERATOR
9 SHIELDING POOL - WATER
10 PULSE FORMING SECTION - WATER
11 ENERGY STORAGE SECTION - OIL

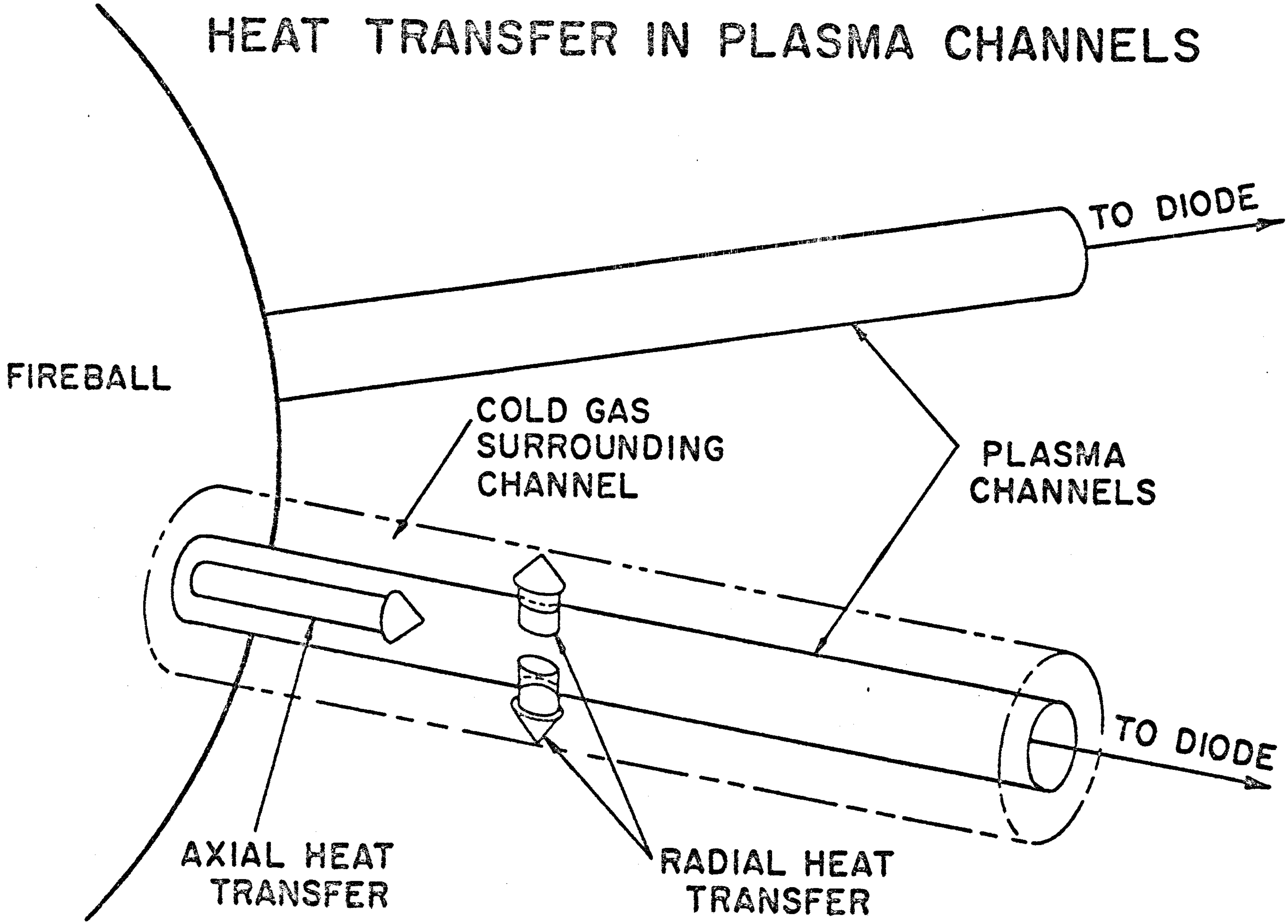
PARTICLE BEAM FUSION CAVITY PHENOMENA



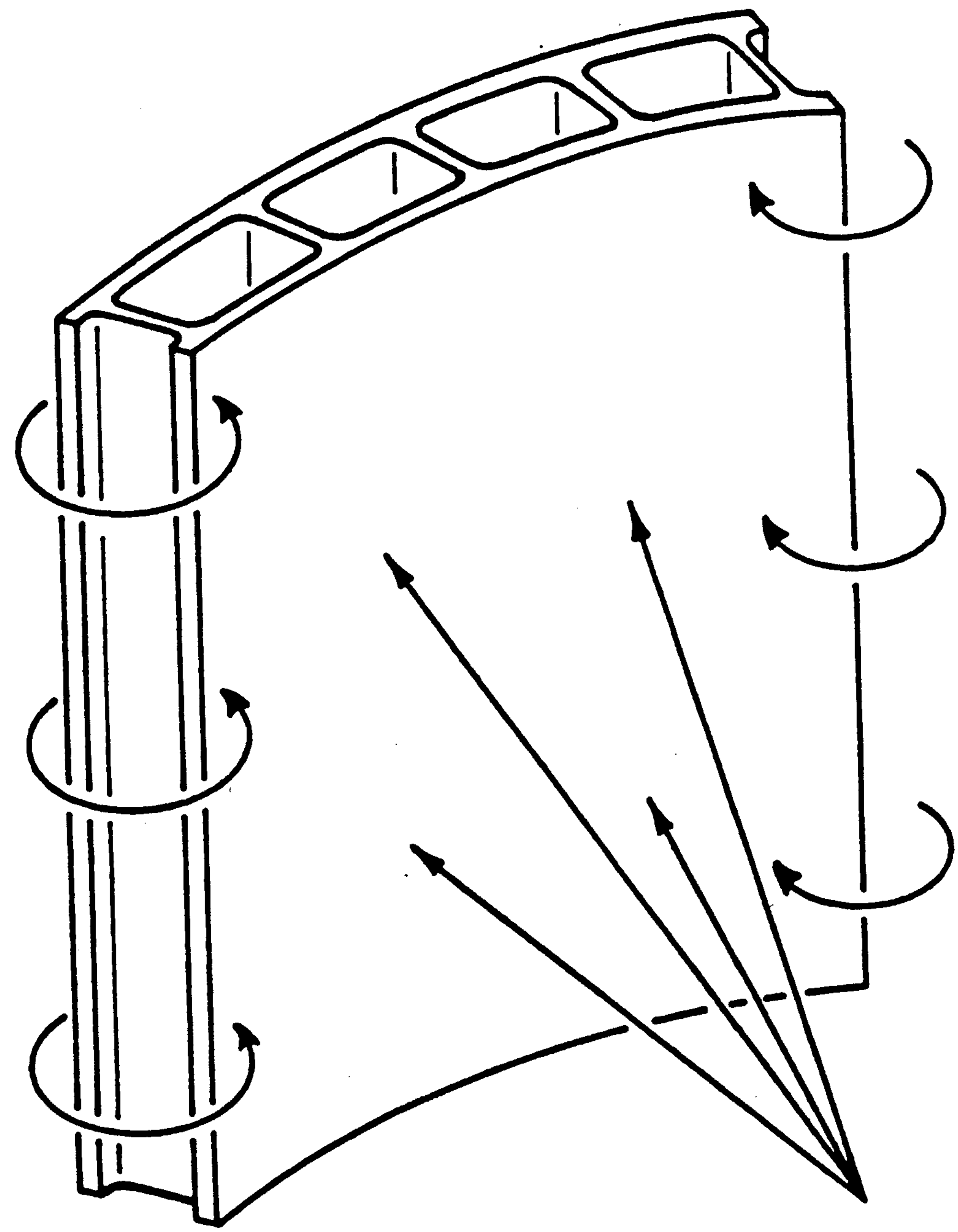
COMPUTER CODES DEVELOPED AT UW FOR THE ANALYSIS OF ICF CAVITIES PROTECTED BY A BUFFER GAS



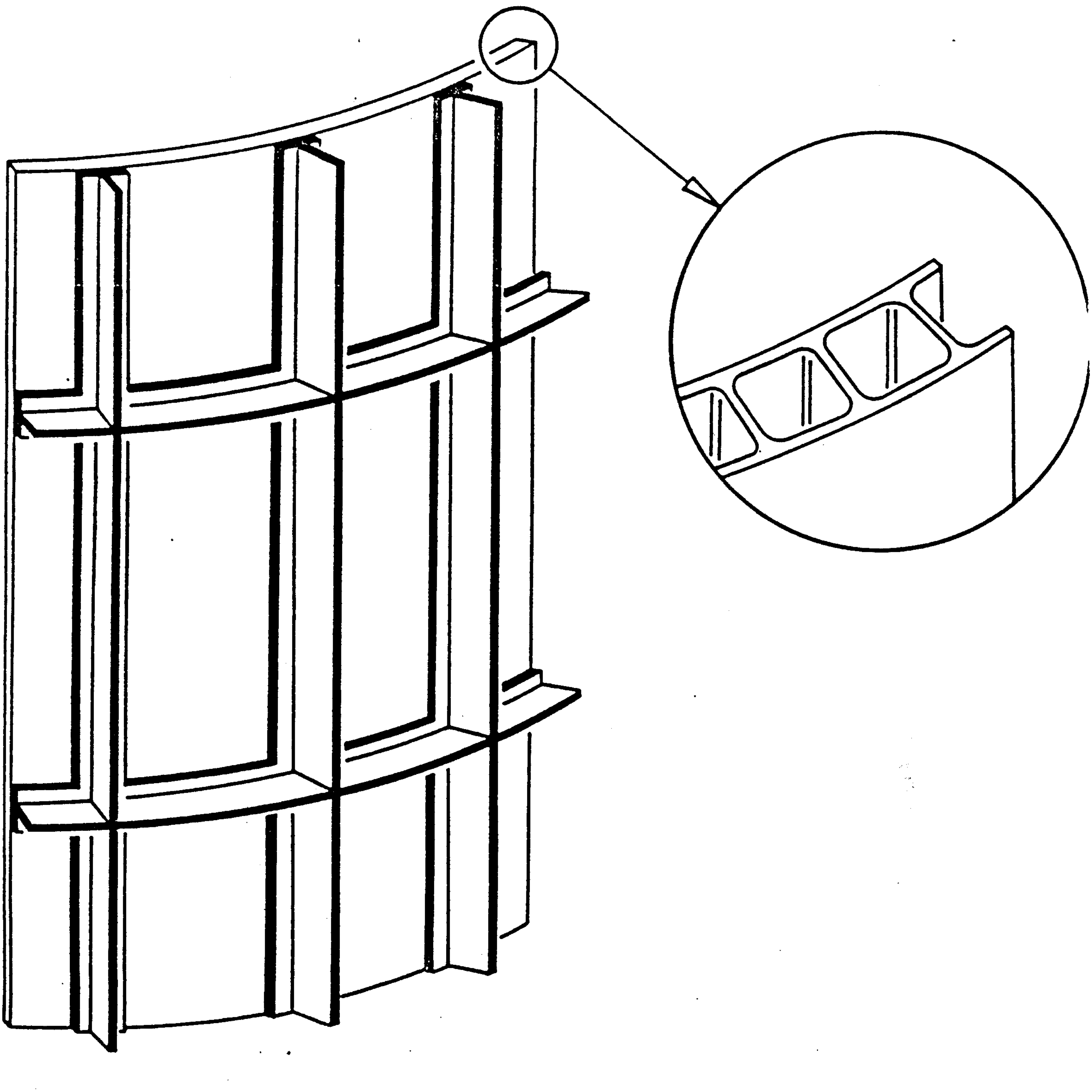
HEAT TRANSFER IN PLASMA CHANNELS

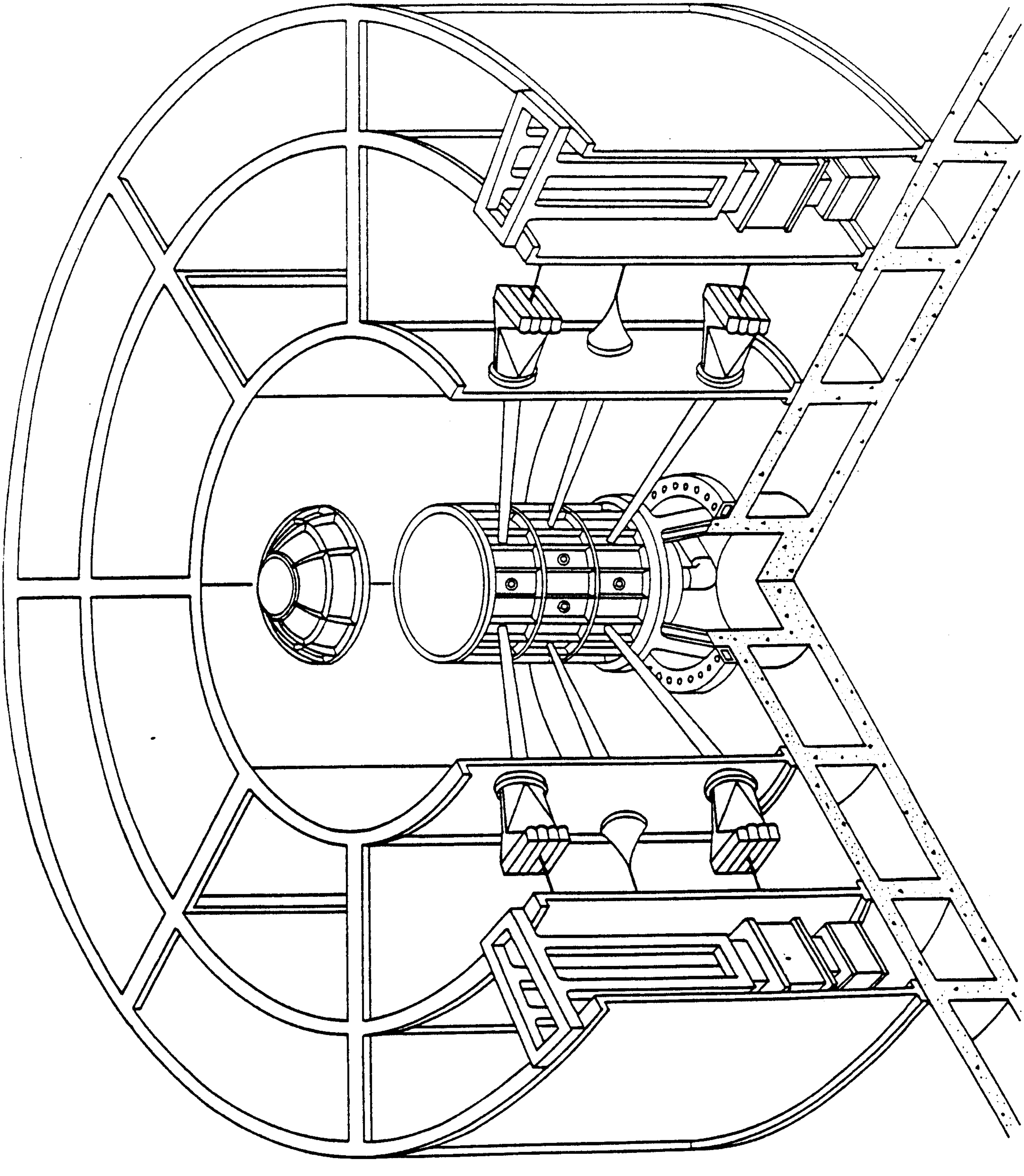


CELLULAR WALL IN DYNAMIC FLEXURE



CONCEPTUAL FIRST WALL STRUCTURAL SYSTEM





L.I.F.E. SINGLE BEAM PARAMETERS FOR A 2 MJ, 150 TW, 95 TW/cm^2, 40 BEAM-LINE ICF DRIVER SYSTEM

SOURCE → ACCELERATOR → NEUTRALIZER → BALLISTIC TRANSPORT →

SOURCE (INTENSE PULSED COLD PLASMA)

- He^+
- $n_i = 10^{13}$ cm^{-3}
- $T_i \sim 0.1$ eV
- 10^{-3} torr
- 1 A/cm^2

ACCELERATOR (CHANNEL FOCUSING MULTI-GRID MULTI-APERTURE)

- 23 kA/BEAM LINE
- 400 ns
- 3 → 10 MeV
- 20:1 AXIAL COMPRESSION
- 45:1 RADIAL COMPRESSION
- 200:1 GEOMETRIC RADIAL FOCUSING

NEUTRALIZER

- He PLASMA
- PULSED FILAMENTS
- $n_e = 3 \times 10^{12}$ cm^{-3}
- CO-MOVING e
- CO-LOCATED e
- $T_{eo} \approx 40$ eV

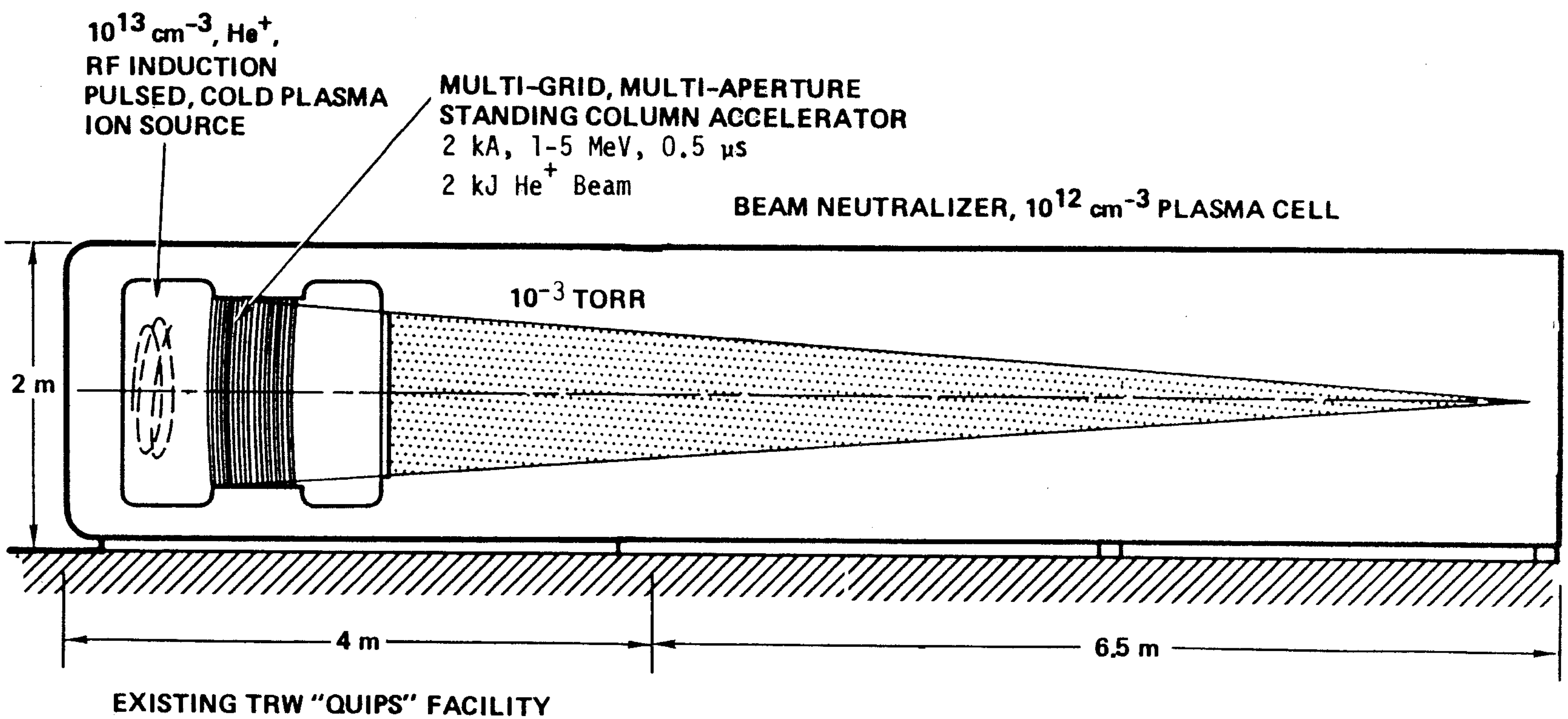
BALLISTIC TRANSPORT

- 10^{-3} torr, Li
- 10 m
- $R_T = 0.6$ cm
- 50 kJ/BEAM LINE

TRW
DEFENSE AND SPACE SYSTEMS GROUP

BALLISTIC PROPAGATION WITH CO-MOVING ELECTRONS

EXPERIMENTAL LAYOUT



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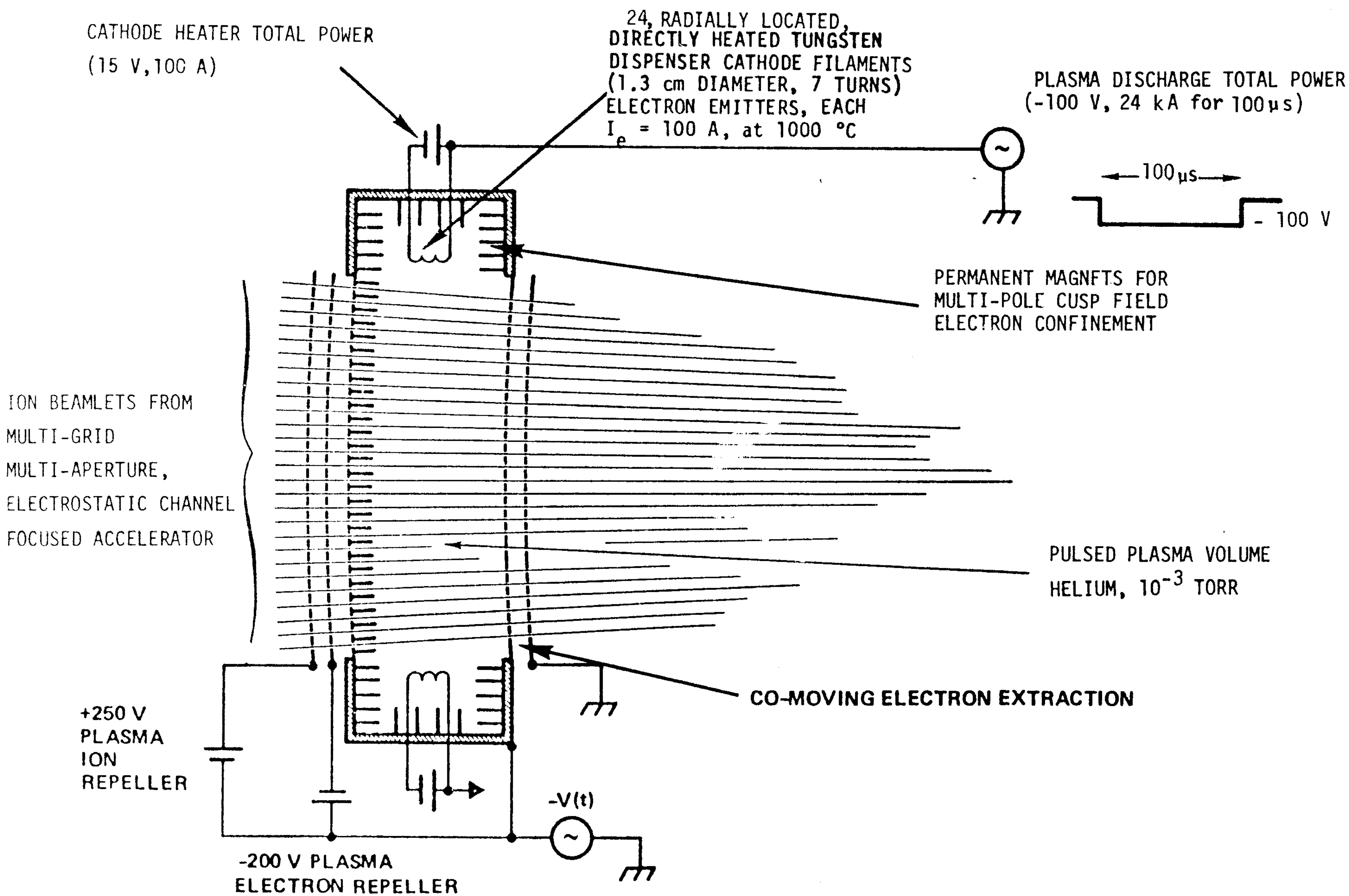
BEAM NEUTRALIZER PLASMA CELL TO PRODUCE CO-MOVING & CO-LOCATED ELECTRONS

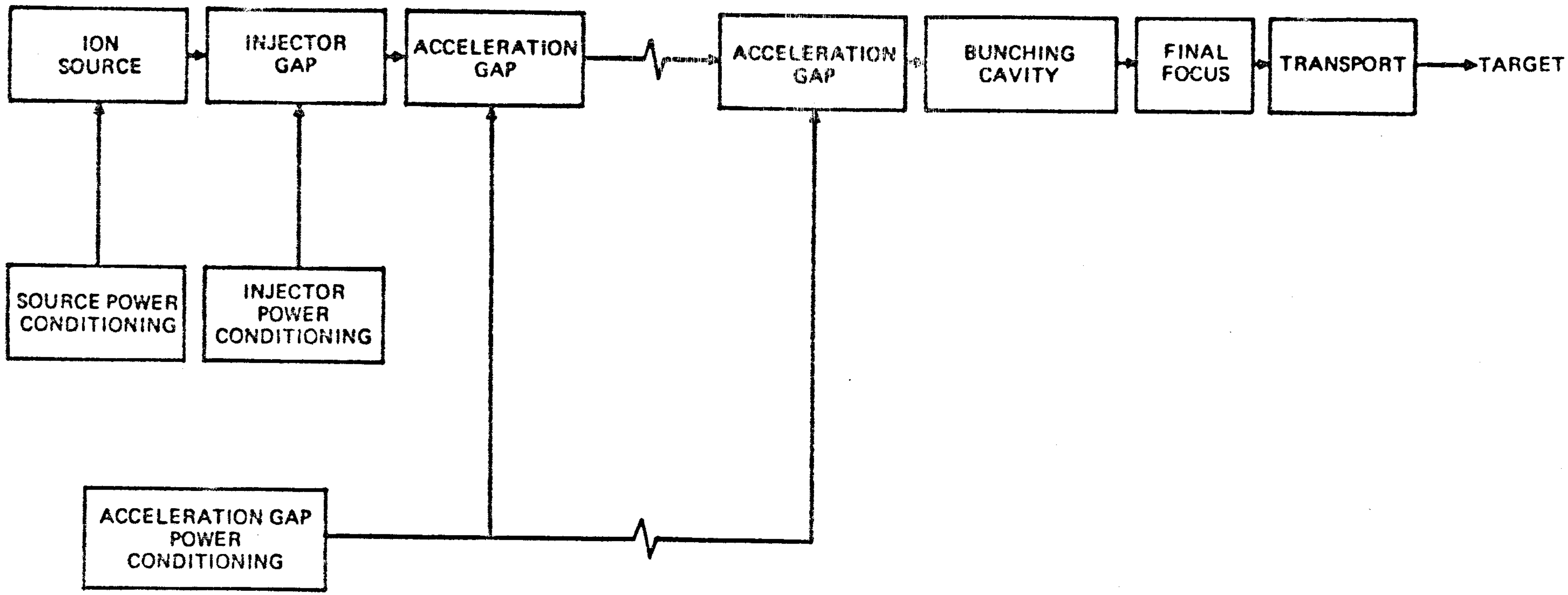


"EAGLE" DEMONSTRATION REACTOR PARAMETERS

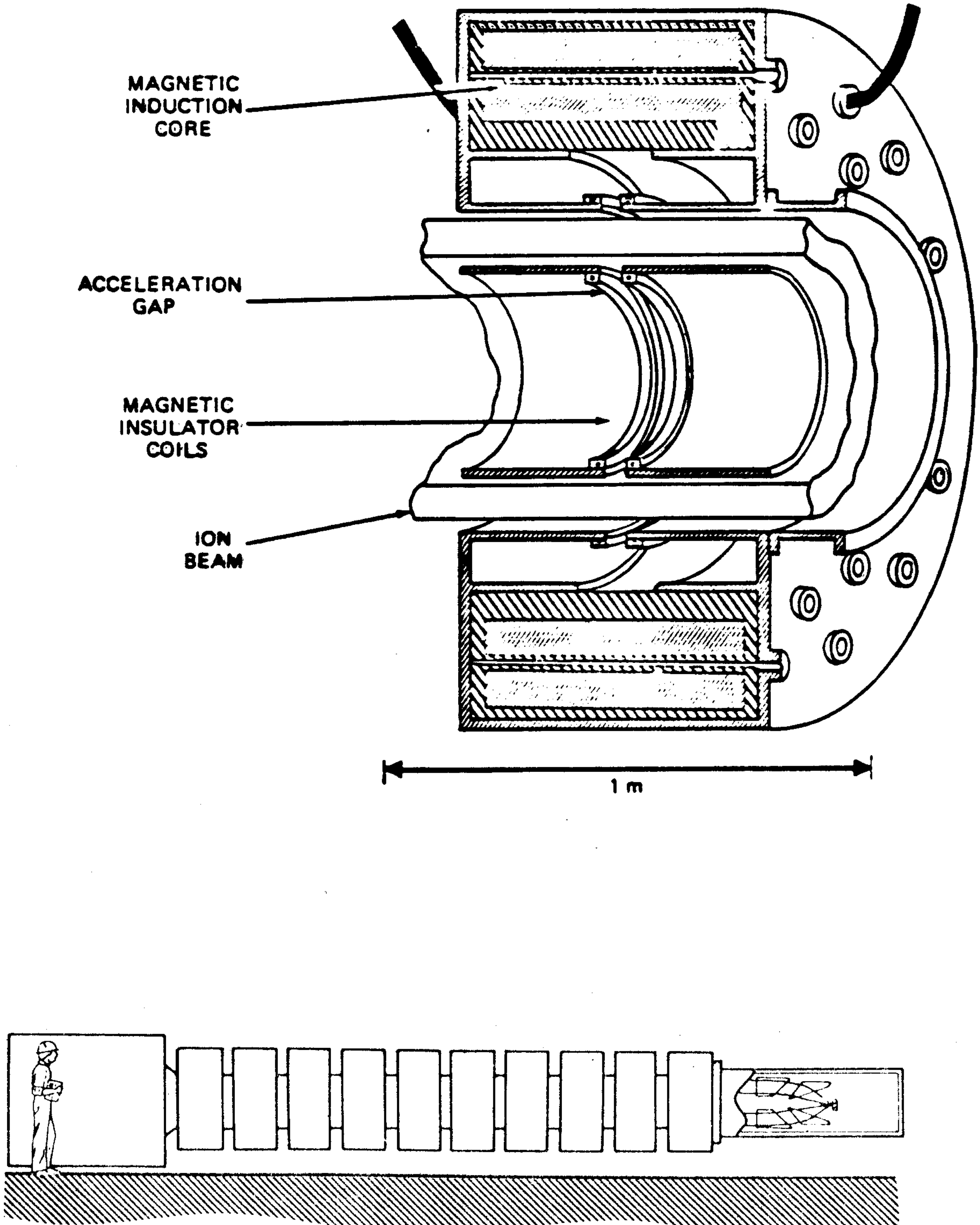
DT POWER	990 MW
GROSS THERMAL POWER	1040 MW
GROSS ELECTRICAL POWER	380 MW_e
NET ELECTRICAL POWER	290 MW_e
TARGET YIELD	300 MJ
TARGET GAIN	60
TARGET REP. RATE	3 Hz
REACTOR COOLANT AND BREEDER	LITHIUM
REACTOR STRUCTURAL MATERIAL	HT-9
FIRST WALL PROTECTION	LITHIUM FOG
CAVITY GEOMETRY	4 m RADIUS CYLINDER

LINEAR ACCELERATOR PARAMETERS

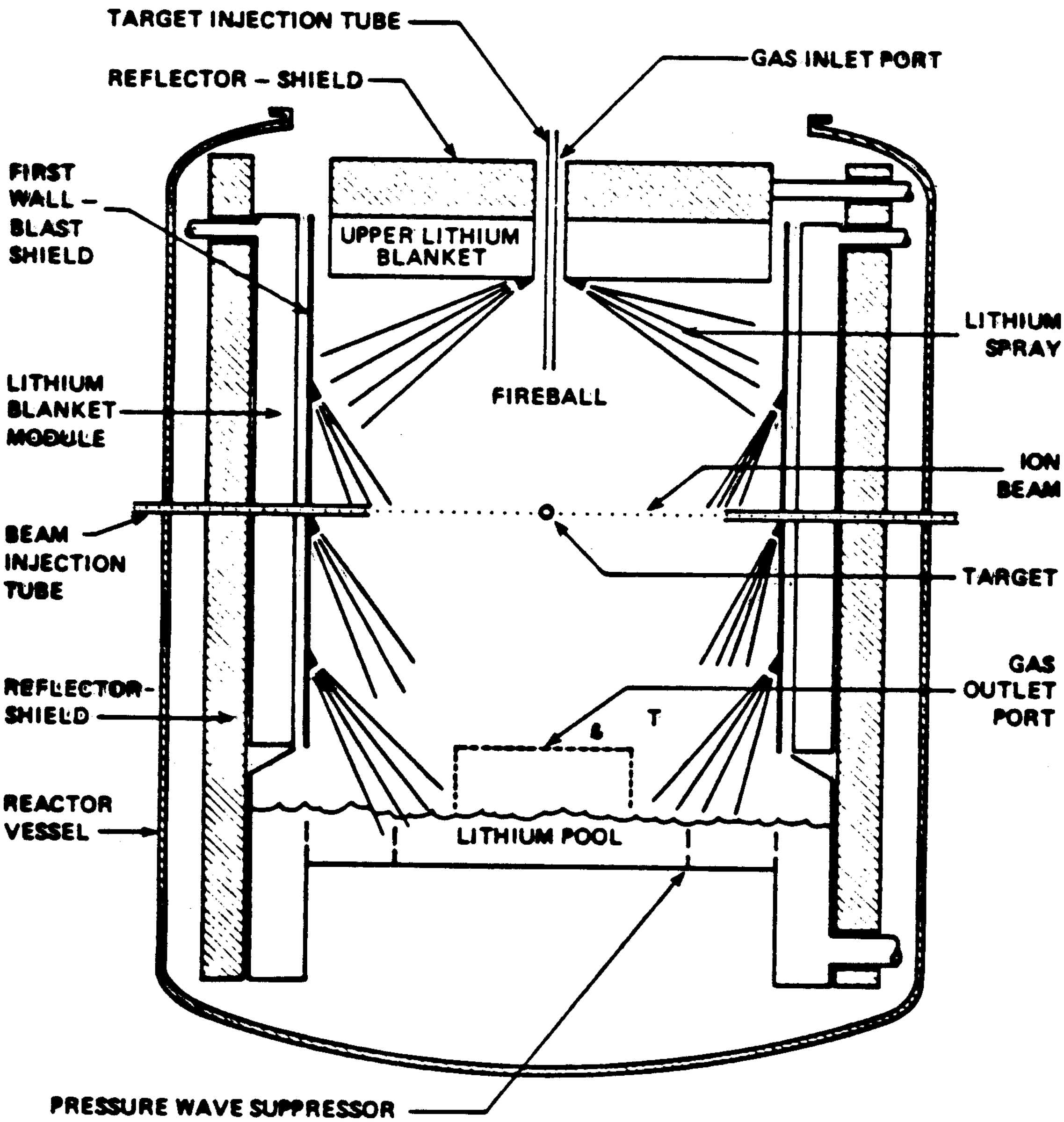
EFFICIENCY	32%
BEAM TRANSPORT EFFICIENCY	80%
OVERALL DRIVER EFFICIENCY	25%
ION	Ne^+
ION ENERGY	150 MeV
VOLTAGE PER STAGE	3 MV
BEAM CURRENT	300 kA
#OF BEAMS	2
TOTAL ENERGY ON TARGET	5.8 MJ
ACCELERATOR PULSE LENGTH	80 ms
PULSE LENGTH ON TARGET	30 ms
TOTAL POWER ON TARGET	200 TW
REACTOR CHAMBER GAS	Xe
GAS DENSITY	2×10^{17} cm^{-3} (5.7 torr)



Accelerator Power Flow Diagram

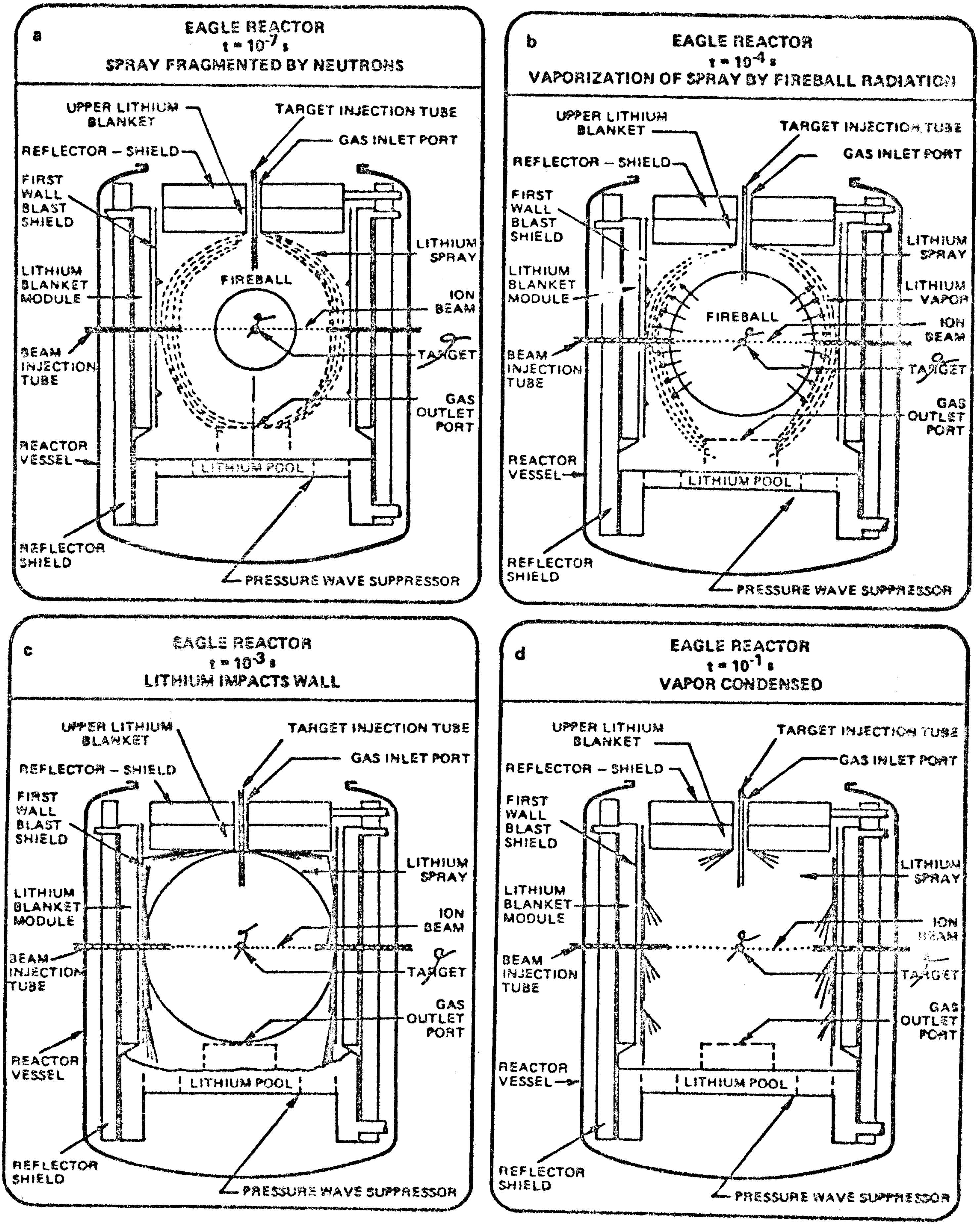


Pulselac-D Fusion Test System. Scale drawings of accelerator and detail of one cavity.



EAGLE

ENERGY ABSORBING GAS LITHIUM EJECTOR



Interaction of Shock and Spray

LIBRA DESIGN PHILOSOPHY

DECISIONS	IMPLICATIONS	OPTIONS
Objective of Study	Depth and Timing of Study	• Full Scale "HIBALL" Type • Nuclear Island Only "TASKA" • Critical Issues
Type of Reactor	Level of Technology and Physics Assumptions	• Commercial Reactor • Demonstration Reactor • Test Reactor
Level of Physics and Technology Assumed	The Limit of Extrapolation Allowed	• 1990 • 2000 • 2010

LIBRA DESIGN PHILOSOPHY

DECISIONS	IMPLICATIONS	OPTIONS
Power Level of Reactor	Special Market or Competition with Large Scale PWR's & Coal Plants	• ~ 100 MW_{th} • 500-1000 MW_{th} • > 3000 MW_{th}
Ultimate Fusion Product	Inclusion of Fission Technology	• Electricity Producer Only • Process Heat • Synthetic Fuels • Fissile Fuel Producer
Driver Approach	"Conventional" or Innovative	• Pulsed Power–Diode • Multi-stage

LIBRA DESIGN PHILOSOPHY

DECISIONS	IMPLICATIONS	OPTIONS
Type of Ion	Target Design, Source Credibility, and Focussing	• Electrons • Protons – 1-3 MeV • Light Ions, Z = 2-6, 3-16 MeV • Welterweight Ions, 3 MeV/amu, $6 < Z < 30$
Target Type	Fabrication, Injection, Required Ion Intensity, Gain	• Single Shell • Double Shell • Cryogenic vs. Room Temp.
Illumination Uniformity	Target Design, Reactor Design	• Axisymmetric • Uniform • 2–Sided

LIBRA DESIGN PHILOSOPHY

DECISIONS	IMPLICATIONS	OPTIONS	
Target Gain and Energy on Target	Level of Target Sophistication Level of Conservatism	•G = 20 •G = 80 •G = 120	E = 4 MJ E = 8 MJ E = 12 MJ
Rep. Rate	Cavity Gas Recycle, Beam Transmission, Number of of Cavities	•1 – 2 Hz •2 – 5 Hz •5 – 10 Hz	
No. of Cavities	Power Level, Cavity Gas Recycle	•1 •2 – 4	

LIBRA DESIGN PHILOSOPHY

DECISIONS	IMPLICATIONS	OPTIONS
Beam Transmission Scheme	Cavity Gas Pressure, Need for Pre–Ionizing Laser Pulse	• Ballistic • Preformed Plasma Channels • Self–Pinch Transport
Cavity Gas and Pressure	Protection of First Surface	• N_2, • Ar, • Ne] 10^{-4}, 1, 10, 50, or 100 torr] Alkali doping: Na, Li, Cs
First Wall	Lifetime and Cavity Size	• Dry Wall [C (ceramic), Steel (Metallic)] • Wetted • INPORT Units ("HIBALL Type") • Free Jets ("HYLIFE Type") • Mist ("EAGLE Type")

LIBRA DESIGN PHILOSOPHY

DECISIONS	IMPLICATIONS	OPTIONS
Blanket	Compatible with Pulsed Loads	• Solid Breeder (Li_2O, Li_4SiO_4) • Liquid Metals (PbLi, Li)
Shield	Maintenance Schemes	• "Traditional" • Swimming Pool
Power Cycle	Need for Secondary Loop	• Dbl. Wall HX (Liq. Metal to Steam) • Intermediate Loop H_2O • Intermediate Loop Liquid Metal

LIBRA DESIGN PHILOSOPHY

DECISIONS	IMPLICATIONS	OPTIONS
BOP	Need for A & E	• Reactor Bldg. Only • Complete Power Plant
Cost Goal	Competition with Fission, Fossil or other Fusion Plants	• < 1500 \$/kW$_e$ (1982) • 2500 \$/kW$_e$ (1982) • < 50 mills/kWh (1982) • Capital Cost Limit (0.5, 1.0, 1.5 B\$)

MULTISTAGE ACCELERATOR – PULSELAC

ADVANTAGES

- POTENTIALLY REP. RATEABLE TECHNOLOGY
- POTENTIAL LOW COST

DISADVANTAGES

- EXTREMELY LITTLE EXPERIMENTAL DATA
- NO PLANS TO BUILD SUCH A DEVICE

PULSED POWER – DIODE

ADVANTAGES

- Based upon mature technology
- Confident cost scaling

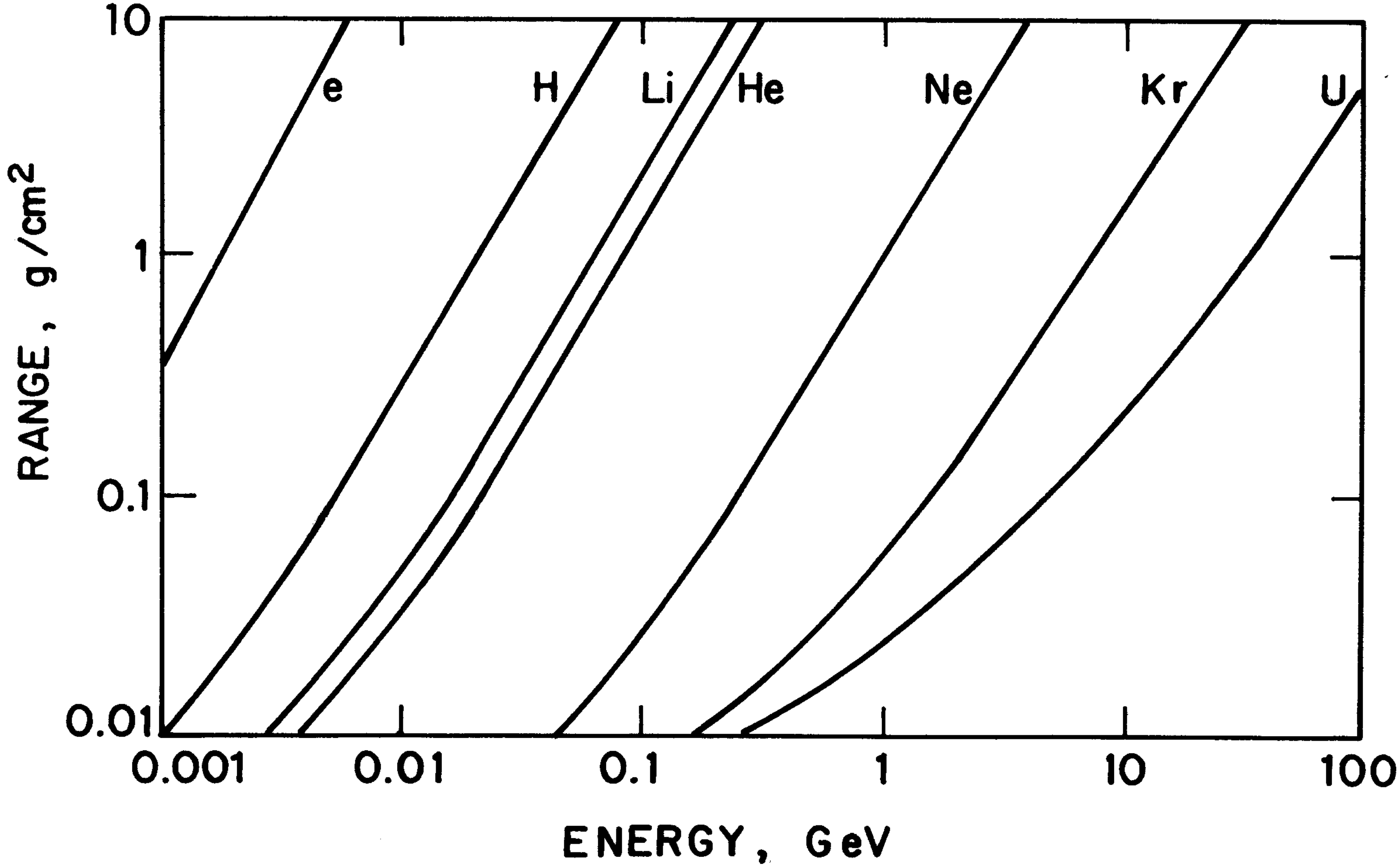
DISADVANTAGES

- Component lifetime
- Rep. rateable diode not yet developed

TYPE OF ION

- ELECTRONS ARE NO GOOD – RANGE IS TOO LONG
- PROTONS ARE CONVENIENT FOR PRESENT EXPERIMENTS BUT THEY MAY BE TOO LIGHT FOR GOOD FOCUSSING
- LITHIUM AND CARBON ARE BEING ACTIVELY STUDIED AS CANDIDATES IN THE 3 – 15 MeV ENERGY RANGE.

RANGES OF IONS IN COLD MATERIAL



TYPE OF TARGET

- CRYOGENIC FOR GAIN ≥ 20
- SINGLE SHELL

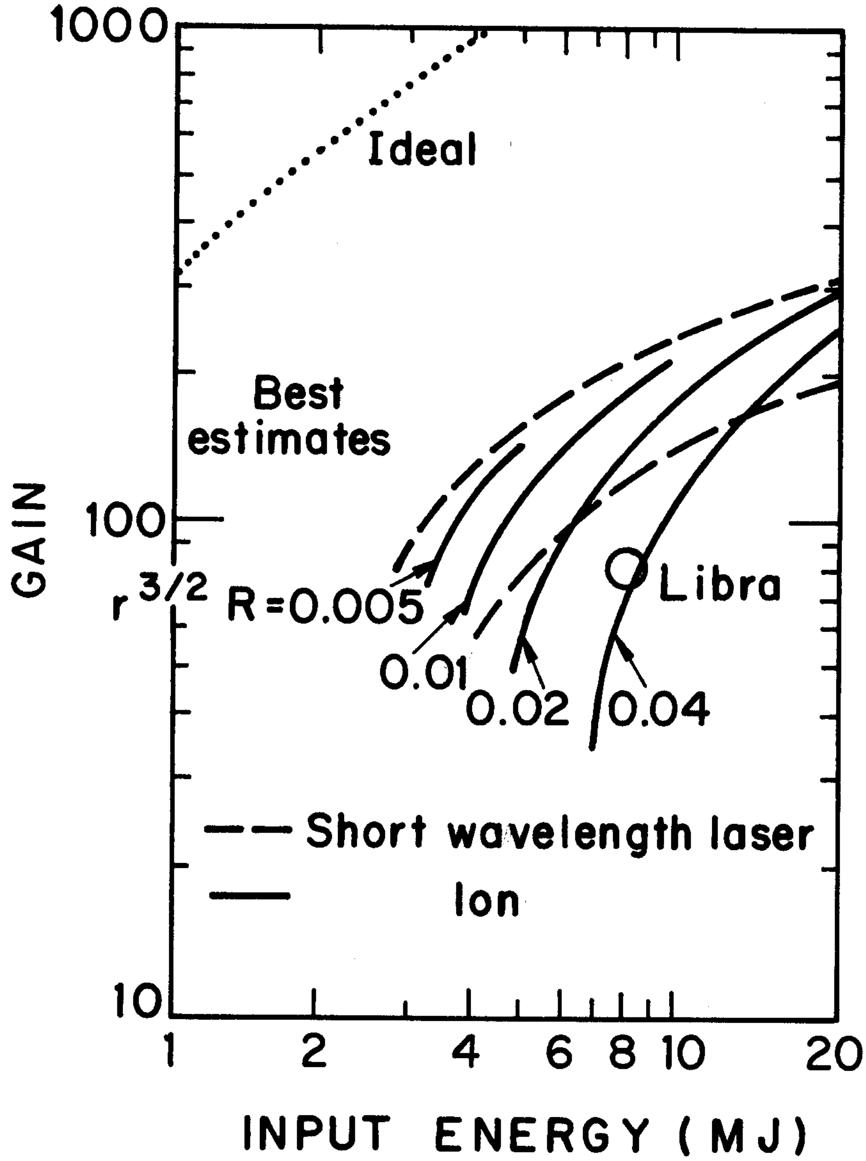
  INTENSITY $\geq$ 200 TW/cm^2

  PULSE SHAPING REQUIRED FOR G > 20
- DOUBLE SHELL

  INTENSITY $\geq$ 50 TW/cm^2

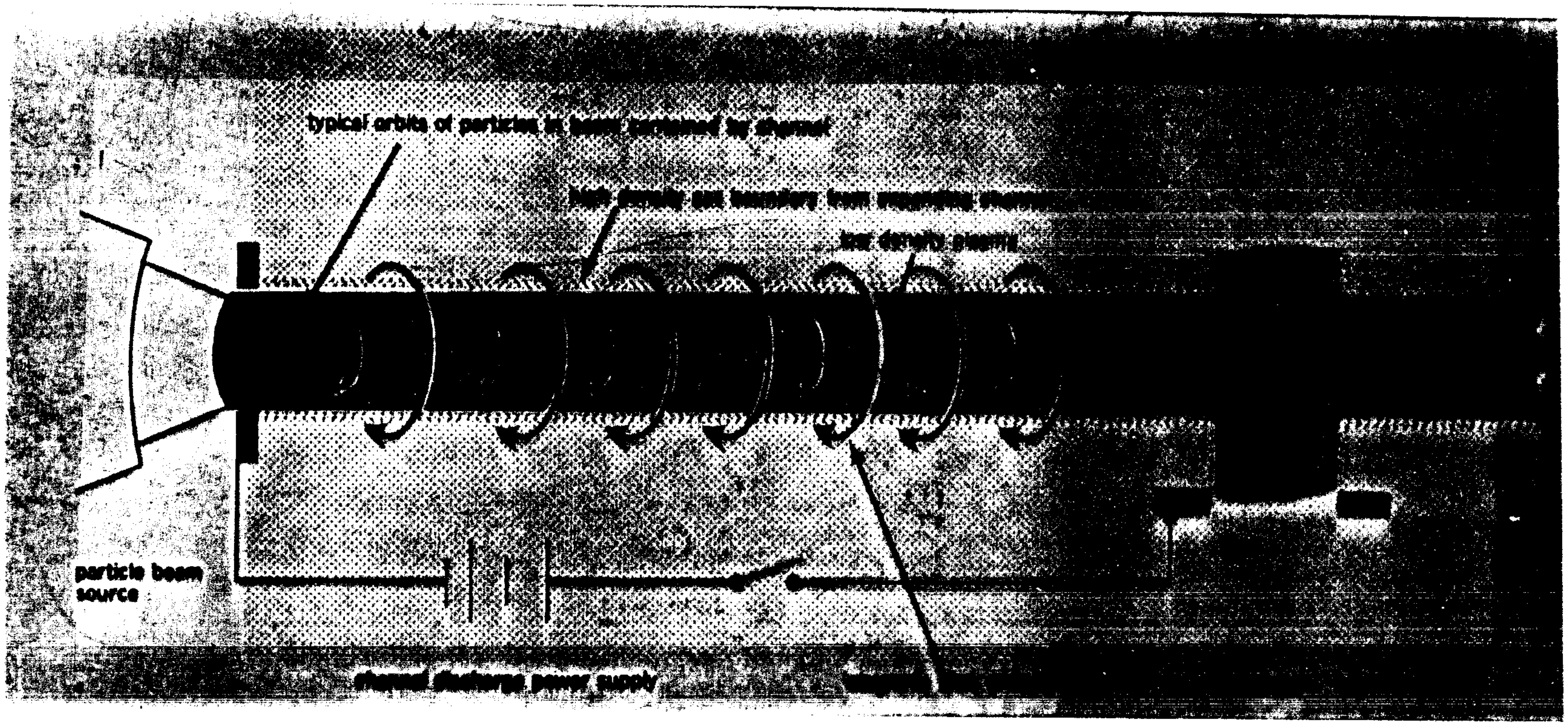
  LESS PULSE SHAPING REQUIRED

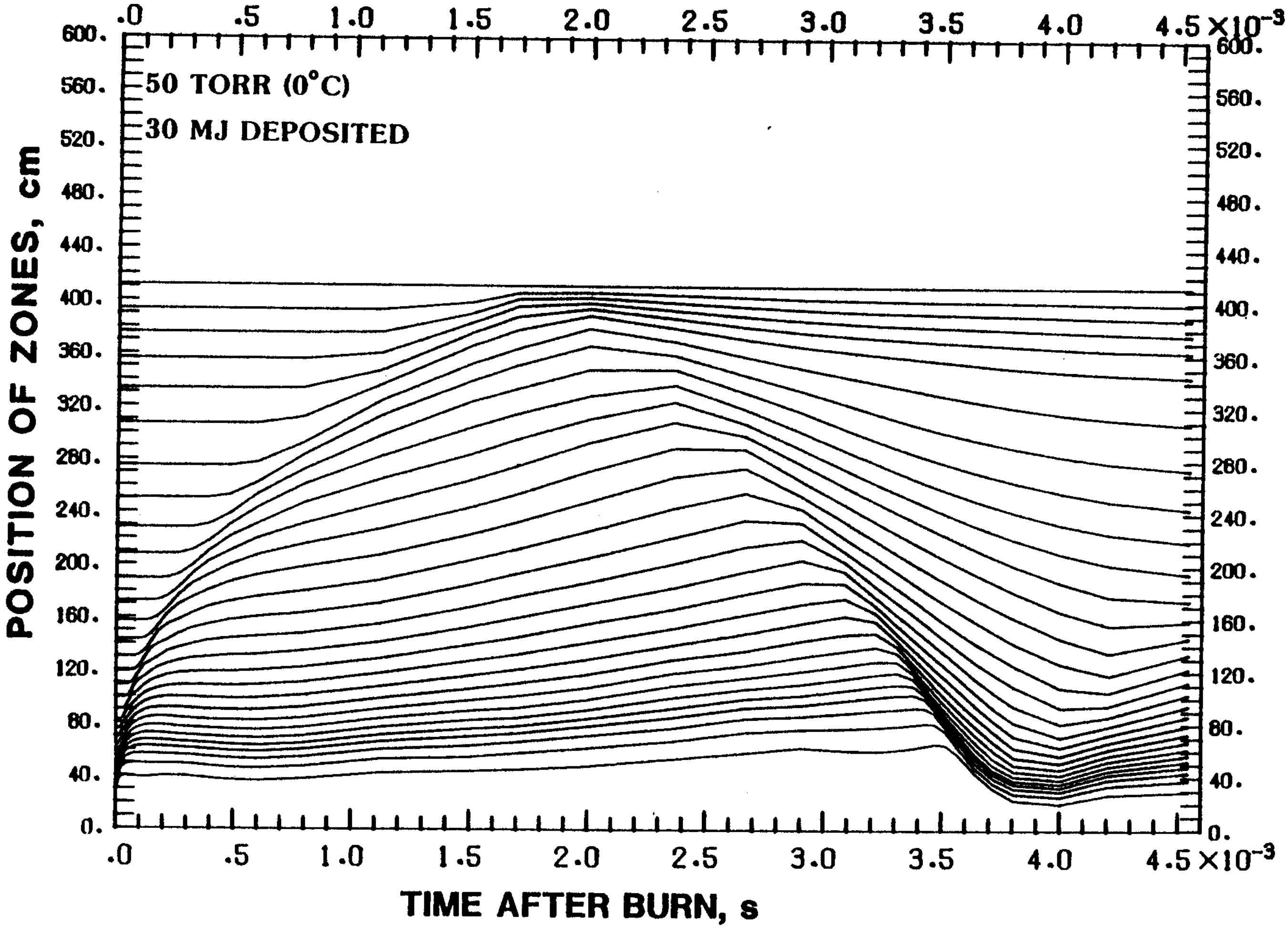
TARGET GAIN AS A FUNCTION OF INPUT ENERGY FOR DOUBLE-SHELL TARGETS



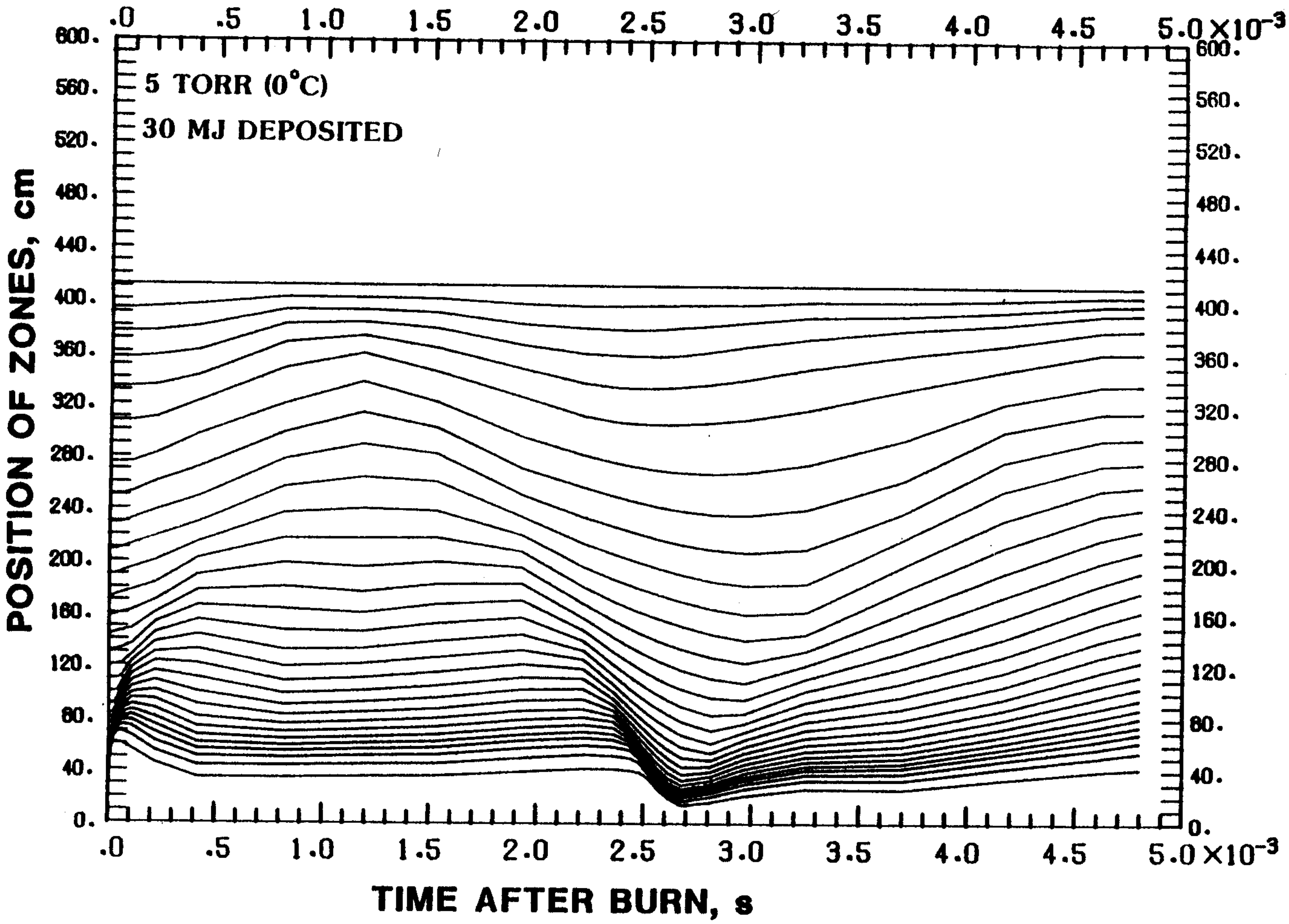
REPETITION RATE

- CAVITY GAS MUST BE COOLED BEFORE NEXT SHOT
- CAVITY GAS MUST HAVE LOW RESIDUAL IONIZATION LEVEL TO FORM PLASMA CHANNELS
- TURBULENCE MUST BE LOW TO FORM PLASMA CHANNELS

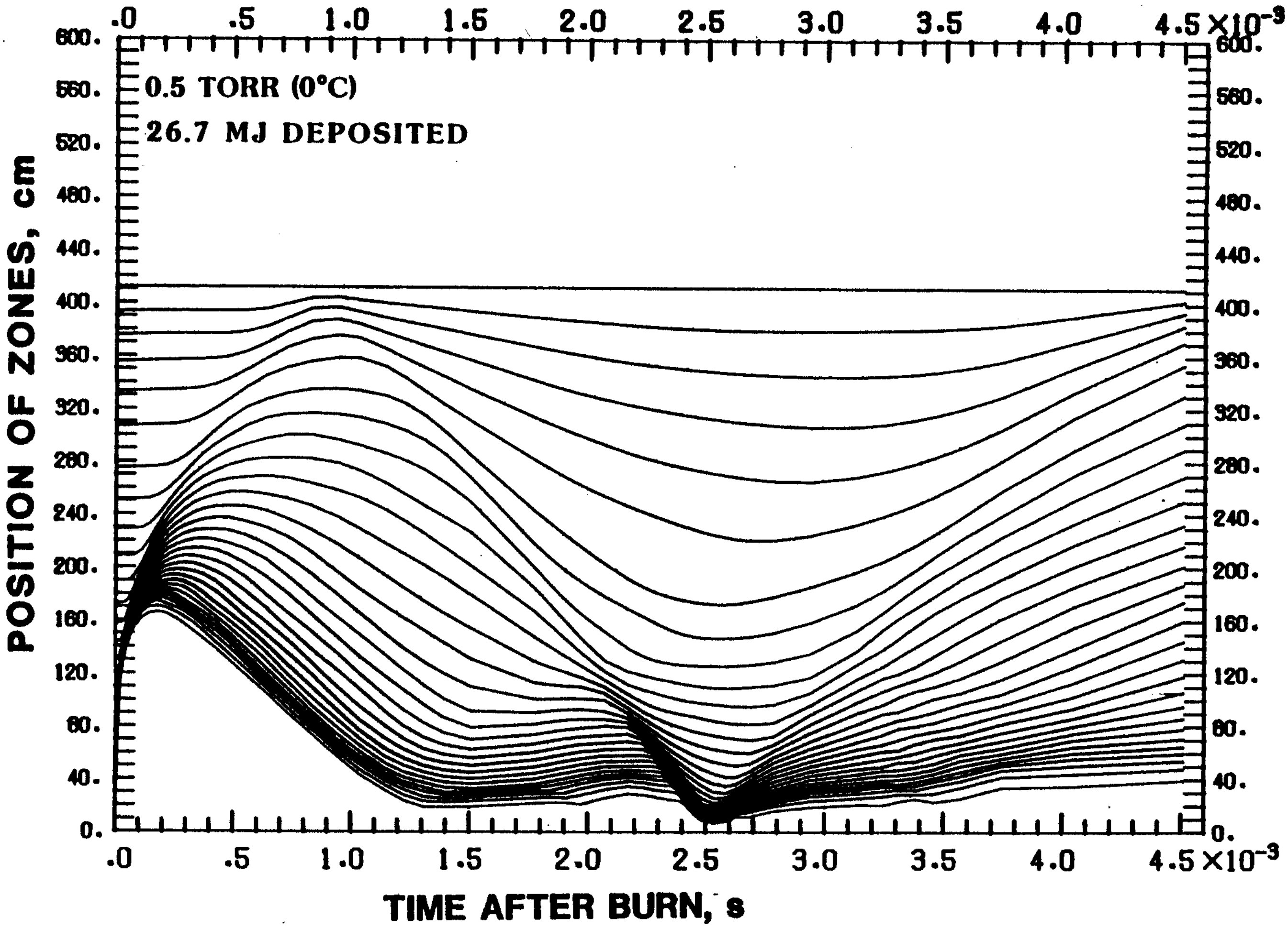

particle beam
source



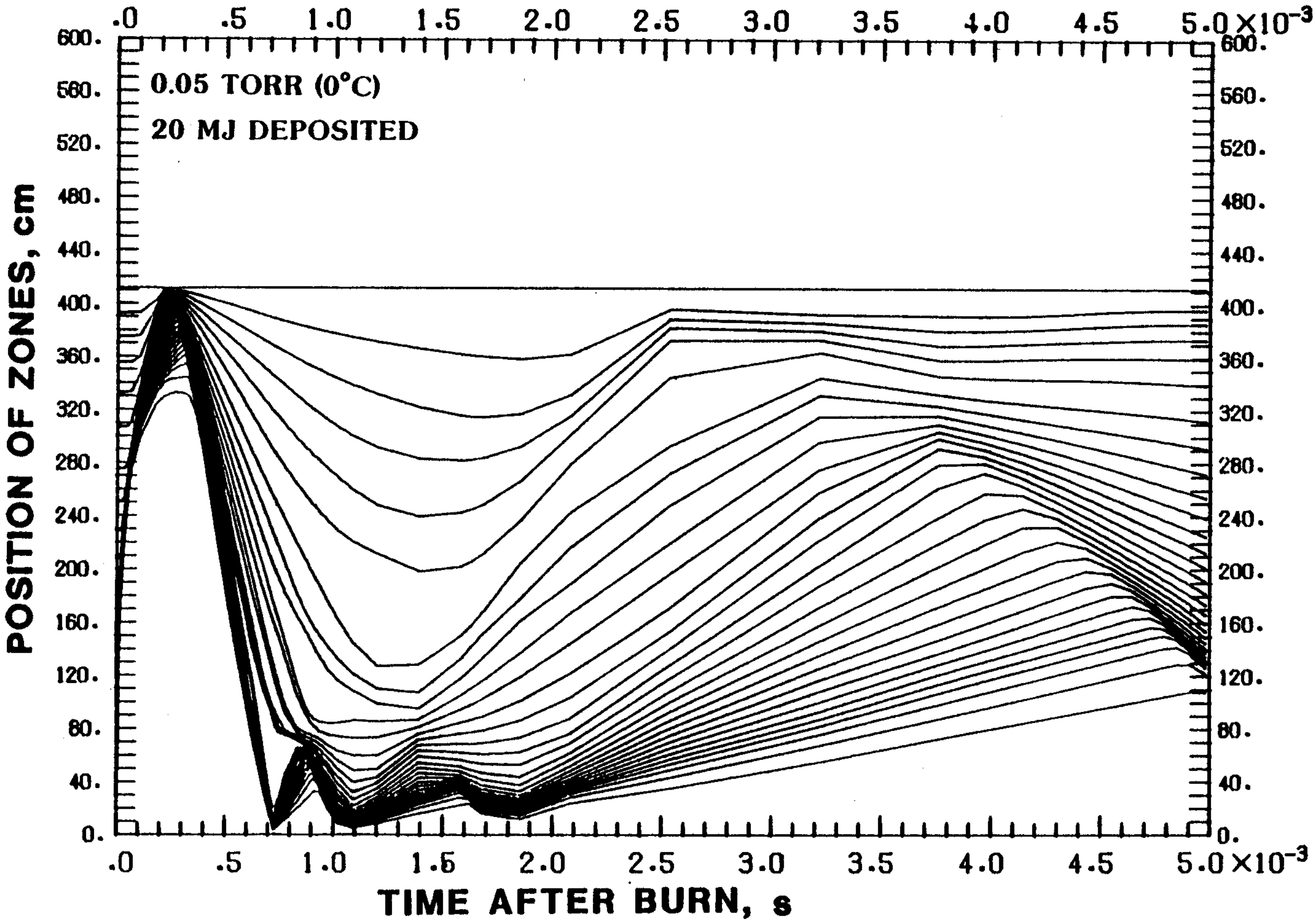
The position of the Lagrangian zones as a function of time for a density corresponding to 50 torr (0°C).



The position of the Lagrangian zones as a function of time for a density corresponding to 5 torr (0°C).



The position of the Lagrangian zones as a function of time for a density corresponding to 0.5 torr (0°C).



The position of the Lagrangian zones as a function of time for a density corresponding to 0.05 torr (0°C).

PRELIMINARY LIBRA PARAMETERS

P_{FUSION}	960 MW
$P_{ELECTRIC}$ (GROSS)	384 MW_e
$P_{ELECTRIC}$ (NET)	300 MW_e

TARGET YIELD	640 MJ
TARGET GAIN	80
ENERGY ON TARGET	8 MJ
REPETITION RATE	1.5 Hz

PRELIMINARY LIBRA PARAMETERS

ION TYPE	Li^+
ION ENERGY	8 MeV
PULSE LENGTH	20 ns
ION POWER	400 TW
NO. OF DIODES	25
ION CURRENT/CHANNEL	2 MA
AVE. CHANNEL DIAMETER	1.2 cm
AVE. CHANNEL CURRENT DENSITY	0.44 MA/cm^2
OVERLAP RADIUS AT TARGET	3 cm
BEAM DIVERGENCE HALF–ANGLE	0.1 rad

PRELIMINARY LIBRA PARAMETERS

ACCELERATOR TYPE	PULSED POWER–DIODE
ACCELERATOR EFFICIENCY	40%
ION GENERATION EFFICIENCY	70%
ION PROPAGATION EFFICIENCY	70%
TOTAL DRIVER EFFICIENCY	20%

TARGET TYPE	DOUBLE SHELL–CRYOGENIC
TARGET DIAMETER	1.2 cm
TARGET INJECTION TIME	25 ms

PRELIMINARY LIBRA PARAMETERS

CAVITY GAS PRESSURE	5 – 20 torr
CAVITY GAS DENSITY	1.8 – 7×10^{17} cm^{-3}
CAVITY GAS TYPE	Ne or Ar + 0.2% Li
CAVITY GAS TEMP. BEFORE SHOT	< $800^{o}C$

CAVITY RADIUS	5 m
CAVITY SHAPE	CYLINDRICAL

PRELIMINARY LIBRA PARAMETERS

FIRST WALL DESIGN	PANELS & FRAME
FIRST WALL MATERIAL	HT-9
FIRST WALL PROTECTION	INPORT CONCEPT
COOLANT AND BREEDER	$Li_{17}Pb_{83}$
NEUTRON WALL LOADING	1.5 MW/m^2
BLAST OVERPRESSURE	?
BLAST HEAT FLUX	?
COOLANT OUTLET TEMPERATURE	$\leq 600^{o}C$
BLANKET TRITIUM INVENTORY	1 mg/tonne

AREAS TO BE ADDRESSED IN LIBRA STUDY FROM JUNE – DECEMBER 1982

- **Develop First Order List of Reactor Parameters**
- **Initiate Cavity Gas Recycle Analysis**
- **Examine Ion Source Options**
  Diode vs. Multistage

LIGHT ION BEAM

BIBLIOGRAPHY

Argonne National Laboratory

Magelssen, G.R. — no date
X-Ray and Pressure Conditions on the First Wall of a Particle Beam Inertial Confinement Reactor

Bechtel Corp.

no author — 4/1982
Light Ion System Analysis and Design Phase I: Engineering Test Reactor Goal Specification Final Report (DRAFT)

Thomson, S. — 12/1978
Electron Beam Fusion-Fission Reactor Systems Study

no author — no date
Viewgraphs relating to EAGLE Reactor

Allen, W.O. — no date
Light Ion System Analysis and Design

Caird, J.A. Allen, W.O. — 1980
Technical Research and Development Project 90307

no author — 10/1978
1075 MWe Electron Beam Fusion-Fission Power Plant Captial Cost Estimate

Cornell University

Nation, J.N. Sudan, R.N. editors — 10/1977
Proc. of the 2nd Intl. Topical Conference on High Power Electron and Ion Beam Research and Technology, 3-5 Oct. 1977 (2 Vols.)

Electric Power Research Insitute

EPRI AP-1371 Brueckner, K.A. et al. — 2/1980
Assessment of Drivers and Reactors for Inertial Confinement Fusion Final Report

Euratom – C.E.A.

Chevallier, J. et al. — no date
Pulsed Electron Beam Generators Operating in C.E.A.

International Atomic Energy Agency

Kuswa, G.W. — 7/1980
Progress Toward Fusion with Light Ions (SAN)

Cooperstein, G. et al. — 7/1980
Progress at NRL and Cornell in Light Ion Beam Research for ICF (NAV)(COR)

JAYCOR, Inc.

Sandel, F.L. et al. — 7/1981
Experimental Studies of Intense Light-Ion Beam Transport

AD-A–081958 Mako, F. — 2/1980
Investigation of Collection Ion Acceleration Using Intense Relativistic Electron Beams Final Report, 11 Dec. 1978 - 13 December 1979

Kurchatov Institute of Atomic Energy

Bogolyubskij, S. et al. — no date
Demonstration of the Possibility of Using Electron Beams for Heating Thermonuclear Targets

Baranchikov, E.I et al. — no date
Transfer and Focusing of High-Current Relativistic Electron Beams onto a Target

Lawrence Berkeley Laboratory

LBL-10301 Guiragossian, Z. Hermannsfeldt, W (editor) — 9/1980
Light Ion Fusion Experiment (LIFE) Accelerator System for ICF

Lawrence Livermore National Laboratory

Bangerter, R.O. et al. — no date
Stability and Symmetry Requirements of Electron and Ion Beam Fusion Targets

Los Alamos National Laboratory

LA-7014-MS Bohachevsky, I.O — 11/1977
Scaling of Reactor Cavity Wall Loads and Stresses

LA-8327-MS Slaughter, M.D. — 4/1980
A Numerical and Theoretical Analysis of Some Spherically Symmetric Containment Vessel Problems

LA-UR-81-1408 Guiragossian, Z.G. et al. — 1981
Method of Active Charge and Current Neutralization of Intense Ion Beams for ICF

LA-UR-81-1873 Lemons, D.S. — 1981
Electron-Temperature Requirements for Neutralized Inertial-Confinement-Fusion Light-Ion Beams

LA-UR-81-2989 Bangerter, R.O. Mark, J.W-K. Meeker, D.J. — 1981
Target Gain for Ion Driven Inertial Targets

Riepe, K.B. Stapleton, R.E. no date
Electron-Beam-Controlled Gas Lasers: Discussion from the Engr. Viewpoint Part II. Problems in the Electrical Design of Very High Energy Systems

MOD (PE) Atomic Weapons Research Laboratory

Martin, J.C. no date
Short Pulse High Voltage Systems

Maxwell Laboratories

Harrison, J. et al. no date
Compact Electron Beam Generators for Laser and Fusion Research

Harrison, J. et al. no date
Design of Very Fast Rise and Fall Time, Low Impedance Megavolt Pulse Generators for Laser Excitation

Nagoya University

Kubota, Y. Miyahara, A. Kawasaki, S. no date
2 MV Coaxial Marx Generator for Producing Intense Relativistic Electron Beams

Naval Research Laboratory

AD-1–076154 Ottinger, P.F. Mosher, D. Goldstein, S.A. 10/1979
Electromagnetic Instabilities in a Focused Ion Beam Propagating through a Z-Discharge Plasma Interim Report

NRL 4380 Raleigh, M. et al. 2/1981
Laser-Initiated, Reduced Density Channels for Transporting Charged Particle Beams

NRL MR-3784 Ottinger, P.F. Mosher, D. Goldstein, S.A. 6/1978
Microstability of a Focussed Ion Beam Propagating Through a Z-Pinch Plasma

NRL MR-4088 Ottinger, P.F. Mosher, D. Goldstein, S.A. 10/1979
Electromagnetic Instabilities in a Focused Ion Beam Propagating through a Z-Discharge Plasma

NRL MR-4387 Cooperstein, G. et al. 11/1980
NRL Light Ion Beam Research for Inertial Confinement Fusion

NRL MR-4397 Mosher, D. Colombant, D.G. Goldstein, S.A. 11/1980
Beam Requirements for Light-Ion-Driven Inertial-Confinement Fusion

NRL MR-4462 Bleach, R.D. et al. 1981
X-Ray Diagnostic for Light-Ion Current Measurements

NRL MR-4726 Young, F.C. et al. 1/1982
Production of Intense Light Ion Beams from a Superpower Generator

Ottinger, P.F. Mosher, D. Goldstein, S.A. 3/1981
Stability Considerations for Light-Ion Beam Transport in Z-Discharge Channels

Blaugrund, A.E. Stephanakis, S.J Goldstein, S.A. no date
A Time Resolved Beam Profile Monitor for Intense Ion Beams

Mosher, D. 4/1981
Light-Ion-Beam Transport for Inertial Confinement Fusion

Goldstein, S.A. et al. — 7/1981
Ion Beam Handling in Magnetized Plasmas

Mosher, D. et al. — 7/1981
System Requirements for Light-Ion ICF

Mosher, D. — 7/1981
Recent Progress in the NRL Light-Ion Program

Mosher, D. — 7/1981
ICF Research Outside the United States Some Background Information & Highlihgts of the Int. Top. Conf. on High-Power E & Ion Beam Res.

Cooperstein, G. et al. — 7/1981
Light Ion Production and Focusing with Pinch-Reflex Diodes

Burton, J.K. — no date
The TRITON Electron Beam Accelerator

Osaka University

ILE-8119P Ozaki, T. et al. — 9/1981
no title

Nakai, S. Imasaki, K. Yamanaka, C. — no date
Relativistic-Electron-Beam-Induced Fusion

Physics International, Inc.

Aslin, H. — no date
Fast Marx Generator

Smith, I. — no date
Liquid Dielectric Pulse Line Technology

Sandia National Laboratories

SAND76-0615 Mogford, J.A. Garner, W.L. editors — 10/1976
Sandia Technology: Particle Beam Fusion (various articles)

SAND76-5122 Vol. I&II Yonas, G. editor — 2/1976
Proc. of the Int. Topical Conf. on Electron Beam Research and Technology Albuquerque, NM, 3-5 November 1975

SAND78-0110C Cook, D.L. Sweeney, M.A. — 6/1978
Deisgn of Compact Particle-Beam-Driven Inertial-Confinement Fusion Reactors

SAND78-0753 Prestwich, K.R. Cook, D.L. Yonas, G. — 1978
Pulsed Power Technology for Inertial Confinement

SAND79-0222C Cook, D.L. Sweeney, M.A. — 1/1979
Critical Environmental Considerations for Particle-Beam-Driven ICF Reactor Materials

SAND79-0600C Sweeney, M.A. — 1979
Sandia Particle Beam Fusion Program

SAND79-0734C Freeman, J.R. et al. 1979
Electron and Ion Beam Transport to Fusion Targets

SAND79-0819C Kuswa, G.W. Bieg, K.W. Burns, E.J.T. 1979
Progress Toward Fusion with Particle Beams

SAND79-0949C Van Devender, J. 1979
Pulsed Power Systems for Inertial Confinement Systems

SAND79-1011 Sweeney, M.A. Cook, D.L. 12/1979
Particle Beam Fusion Progress Report 4/78 – 12/78

SAND79-1411C Clauser, M.J. Burns, E.J. Chang, J. 1979
Particle Beam Interactions with Plasmas and their Application to Inertial Fusion

SAND79-1611 Cook, D.L. Sweeney, M.A. 11/1979
The Pellet Injection Problem in a Gas-Filled Particle Beam Reactor

SAND79-1673 Humphries, S.Jr. et al. 8/1979
Production and Post-Acceleration of Intense Ion Beams in Magnetically Insulated Gaps

SAND79-1927C Mehlhorn, T.A. 1980
Ion Beam Energy Deposition Physics for ICF Targets

SAND79-1942C Bieg, K.W. Chang, J. 1980
Target Fabrication for Particle Beam Fusion

SAND79-1944 Cook, D.L. 1979
Pellet Injection, Protection and Targeting

SAND79-2133C Yonas, G. 1979
Pulsed Power Particle Beam Fusion Research

SAND79-7044 no author 5/1979
Technical Review of the Sandia Laboratories Particle Beam Fusion Program

SAND80-0038 Mehlhorn, T.A. 1980
Finite Material Temperature Model for Ion Energy Deposition in Ion-Driven ICF Targets

SAND80-0154 Olsen, J.N. Baker, L. 2/;980
Laser Heating of a Molecular Gas Channel

SAND80-0367C Kuswa, G.W. 1980
Pulse-Power Driven Light Ion Accelerators for Fusion: The Sandia Approach

SAND80-0387C Wright, T.P. et al. 1980
Light-Ion Transport in Plasma Channels for ICF

SAND80-0466C Cook, D.L. 3/1980
Technological Aspects of Particle Beam Fusion

SAND80-0974 Sweeney, M.A. Cook, D.L. 1/1981
Particle Beam Fusion Progress Report 6/79 – 12/79

SAND80-1355C no author 1980
Progress Toward Fusion with Light Ions

SAND80-2425C Cook, D.L. et al. 10/1980
Light Ion Driven Inertial Fusion Reactor Concepts

SAND80-2436C Yonas, G. 1980
Light Ion Beams as a Potential ICF Ignition Source and Requirements for Reactor Application

SAND80-2788C Cook, D.L. Sweeney, M.A. 1981
Heating of Cryogenic Targets in a Light-Ion Fusion Cavity

SAND80-7001 Moses, G.A. Abdel-Khalik, S. Drake, D. 8/1980
First Wall and Cavity Design Studies for a Light Ion Beam Driven Fusion Reactor

SAND81-0445C Quintenz, J.P. Kuswa, G.W. 1981
Light Ion Ignitors for Inertial Confinement Fusion: Progress Toward Proof-of-Principle

SAND81-0672C Kuswa, G.W. Quintenz, J.P. Seidel, D.B. 1981
Scalability of Light Ion Beams to Reach Fusion Conditions

SAND81-0842C Mix, L.P. et al. 1981
Low-Energy X-Ray Emission from Light Ion Targets

SAND81-2009 Humphries, S.Jr. Lockner, T.R. November 1981
High Power Pulsed Ion Beam Acceleration and Transport

Humphries, S.Jr. 4/1980
Magnetic Field Effects in Light Ion Fusion Transport (Internal Memo)

Olsen, J.N. Leeper, R.J. 1981
Ion Beam Transport in Laser Initiated Discharge Channels

Yonas, G. 4/1980
Testimony on Particle Beam Fusion Research House Armed Services Committee

Cook, D.L. Sweeney, M.A. no date
Design of Compact Particle-Beam-Driven Inertial-Confinement Fusion Reactors

Sweeney, M.A. Cook, D.L. 11/1979
Blast-Wave Kinetics and Thermal Transport in a Particle-Beam Reactor Chamber

Cook, D.L. 10/1979
Impulse and Overpressure on PBFA-I (Memo to J.P. VanDevender)

no author no date
Viewgraphs relating to LIB Reactors

VanDevender, J.P 10/1981
Drivers for Light Ion Fusion (In "Particle Beam Fusion Articles", SNL)

Cook, D.L. et al. 10/1981
Light Ion Driven Inertial Fusion Reactor Concepts (In "Particle Beam Fusion Articles", SNL)

Yonas, G. 10/1980
Light Ion Beams as a Potential ICF Ignition Source and Requirements for Reactor Application (In "Particle Beam Fusion Articles", SNL)

Yonas, G. 9/1981
Inertial Fusion Research Using Pulsed Power Drivers

Olsen, J. no date
Ion Beam Transport Experiments in Laser- or Wire-Triggered Discharges

Johnson, D.L. no date
Parallel Plate Transmission Line (Lecture Notes)

Clauser, M.J. Sweeney, M.A.
Charged-Particle Beam Implosion of Fusion Targets — no date

no author
Particle Beam Fusion — 1/1980

Kuswa, G.W.
Pulse-Power Driven Light Ion Accelerators for Fusion – The Sandia Approach — no date

Kuswa, G.W. et al.
Scalability of Light Ion Beams to Reach Fusion Conditions — 7/1981

Freeman, J.R. et al.
Particle Beam Fusion Research — no date

Prestwich, K.R. Cook, D.L. Yonas, G.
Pulsed Power Technology for Inertial Confinement — no date

Kuswa, G.W. et al.
High Power Magnetically Insulated Radial Diode — no date

Prestwich, K.R.
Pulse Power Technology Application to Lasers — no date

Kuswa, G.W.
Inertial Confinement Fusion Energy with Particle Beams — no date

Martin, T.H.
High Power Laser Accelerators — no date

Miller, P.A. et al.
REB Propagation and Combination in Plasma Channels — no date

Ramirez, J.J. Prestwich, K.R.
REBLE, A Radially Converging Electron Beam Accelerator — no date

Humphries, S.Jr.
Intense Pulsed Linear Ion Accelerators for Inertial Fusion — no date

Mendel, C.W.Jr. Goldstein, S.A.
Electron Beam Pinching from Discrete Large Diameter Cathodes — no date

Miller, P.A. et al.
REB Pinching, Transport, and Combination in Plasma Channels for ICF — no date

Science Applications, Inc.

Drobot, A.T. et al.
Electromagnetic and Quasi-Static Simulations of Ion Diodes — 7/1981

University of Illinois

Johnson, G.B.
Ion Bunching at High Energies — 1980

University of New Mexico

NE-74 Cooper, G.W. 10/1979
A Feasibility Study of Laser Guided Discharges

Measures, R.M. Cardinal, P.G. no date
Laser Ionization Based on Resonance Saturation – A Simple Model Description

University of Toronto

Measures, R.M. Cardinal, P.G. Schinn, G. no date
A Theoretical Model of Laser Ionization of Alkali Vapours Based on Resonance Saturation

University of Wisconsin

UWFDM-307 Peterson, R.R. Moses, G.A. 6/1979
MFP – A Calculation of Radiation Mean Free Paths, Ionization and Internal Energies in Noble Gases

UWFDM-315 Peterson, R.R. Moses, G.A. 10/1979
Blast Wave Calcualtions in Argon Cavity Gas for Light Ion Beam Fusion Reactors

UWFDM-320 Moses, G.A. et al. 10/1979
First Wall and Cavity Design Studies for a Light Ion Beam Driven Fusion Reactor

UWFDM-322 Engelstad, R.L. Lovell, E.G. 12/1979
First Wall Mechanical Design for Light Ion Beam Fusion Reactors

UWFDM-323 Moses, G.A. Peterson, R.R. 10/1979
First Wall Protection in ICF Reactors by Inert Cavity Gases

UWFDM-336 Moses, G.A. Peterson, R.R. 1/1980
FIRE - A Computer Code to Simulate Cavity Gas Response to Inertial Confinement Target Explosions

UWFDM-371 Peterson, R.R. Cooper, G.W. Moses, G.A. 8/1980
Cavity Gas Analysis for Light Ion Beam Fusion Reactors

UWFDM-372 Peterson, R.R. Moses, G.A. 9/1980
MIXER - A Multi-Species Optical Data and Equation of State Computer Code

UWFDM-382 Peterson, R.R. et al. 12/1980
TSTRESS - A Transient Stress Computer Code

UWFDM-405 McCarville, T.J. Kulcinski, G.L. Moses, G.A. 1/1981
An Analytical Model for the Motion and Radiative Response of a Low Density Inertial Confinement Fusion Buffer Gas

UWFDM-406 McCarville, T.J. Kulcinski, G.L. Moses, G.A. 1/1981
A Model for the Deposition of X-Rays and Pellet Debris from Inertial Confinement Fusion Targets into a Cavity Gas

UWFDM-407 McCarville, T.J. Peterson, R.R. Moses, G.A. 2/1982
Improvements in the FIRE Code for Simulating the Response of a Cavity Gas to ICF Target Explosions

UWFDM-414 Badger, B. et al. 1/1982
Progress Report to Sandia for Light Ion Beam Activities During 1980-1981

UWFDM-421 Lovell, E.G. et al. 8/1981
Transient Elastic Stresses in ICF Reactor First Wall Structural Systems

UWFDM-423 Hassanein, A.M. McCarville, T.J. Kulcinski, G.L. 8/1981
FIrst Wall Evaporation in Inertial Confinement Fusion Reactos Utilizing Gas Protection

UWFDM-442 Peterson, R.R. Lee, K.J. Moses, G.A. 10/1981
Low Density Cavity Gas FIreball Dynamics in the Light Ion Beam Target Development Facility

UWFDM-455 Peterson, R.R. Lee, K.J. Moses, G.A. 1/1982
Fireball Propagation in Preformed Plasma Channels in the Light Ion Beam Driven Target Development Facility

UWFDM-456 Peterson, R.R. et al. 2/1982
Choice of First Wall Material in the Light Ion Beam Target Development Facility

UWFDM-457 Badger, B. et al. 2/1982
Report to Sandia Laboratory on University Wisconsin Fusion Engr. Program Design Activities for the LIB TDF from Aug. 1981 – Feb. 1982

UWFDM-458 Moses, G.A. McCarville, T.J. Peterson, R.R. 1982
Documentaiton for MF-FIRE, A Multifrequency Radiative Transfer Version of FIRE

Other Reports

Bergeron, K.D.
Theory of the Secondary Electron Avalanche at Electrically Stressed Insulator-Vacuum Interfac(SAN) [Reprint: J. Appl. Phys. 48, pp. 3073-3080 7/1977]

Bergeron, K.D. Poukey, J.W.
Relativistic Space-Charge Flow in a Magnetic Field (SAN) [Reprint: Appl. Phys. Lett. 27, pp. 58-60 7/1975]

Bergeron, K.D.
One- and Two-Species Equilibria for Magnetic Insulation in Coaxial Geometry (SAN) [Reprint: Phys. Fluids 20, pp. 688-697 4/1977]

Bergeron, K.D.
Equivalent Circuit Approach to Long Magnetically Insulated Transmission Lines (SAN) [Reprint: J. Appl. Phys. 48, pp. 3065-3069 1977]

Blaugrund, A.E. Cooperstein, G. Goldstein, S.
Relativisitic (sic) Electron Beam Pinch Formation Processes in Low Impedance Diodes (NAV)(UMD) [Reprint: Phys. Fluids 20, pp. 1185-1194 7/1977]

Blaugrund, A.E. Cooperstein, G.
Intense Focusing of Relativistic Electrons by Collapsing Hollow Beams (NAV) [Reprint: Phys. Rev. Lett. 34, pp. 461-464 2/1975]

Booth, L.A.
Considerations for Inertial Confinement Fusion Reactor Design [Atomkernerergie/Kerntechnik 36, pp. 211-212 1980]

Briggs, R.J. et al.
Transport and Self-Focused Relativistic Electron Beams [From: 2nd Int. Top. Conf. High Power Electron and Ion Beam Research, 1977]

Buchanan, H.L. et al.
Transport of Intense Particle Beams with Application to Heavy Ion Fusion [From: Proc. 3rd Int. Top. Conf. on High Power E. 1979]

Colombant, D.G. Goldstein, S.A. Mosher, D.
Hydrodynamic Response of Plasma Channels to Propagating Ion Beams (NAV) [Reprint: Phys. Rev. Lett. 45, pp. 1253-1256 10/1980]

Cook, D.L. Sweeney, M.A.
Critical Environmental Considerations for Particle-Beam-Driven ICF Reactor Materials (SAN) [Reprint: J. Nucl. Matls. 85&86, pp. 127-131 1979]

Cook, D.L.
Technological Aspects of Particle Beam Fusion [20th Annual ASME Symp., pp. 37-46 1980]

Destler, W.W. et al.
Collective Acceleration of Light and Heavy Ions (UMD) [Reprint: IEEE Trans. Nucl. Sci. NS-28 1981]

Didenko, A.N. et al.
Generation of High Power Ion Beams in Ballistic Focusing Diodes (TOM) [Reprint: IEEE Trans. Nucl. Sci. NS-28, p. 3436 1981]

Frazier, G. et al.
no title [From 3rd IEEE Int. Pulsed Power Conf. 6/1981]

Freeman, J.R. Baker, L. Cook, D.L.
no title [From: 4th Conf. on High Power E. & Ion Beam Res. 6/1981]

Freiwald, D.A. Axford, R.A.
Approximate Spherical Blast Theory Including Source Mass (LOS) [Reprint: J. Appl. Phys. 46, pp. 1171-1174 3/1975]

Goldstein, S.A. Lee, R.
Ion-Induced Pinch and the Enhancement of Ion Current by Pinched Electron Flow in Relativistic Diodes (UMD)(NAV) [Reprint: Phys. Rev. Lett. 35, pp. 1079-1082 10/1975]

Goldstein, S.A. et al.
Focusing of Intense Ion Beams from Pinched-Beam Diodes (NAV) [Reprint: Phys. Rev. Lett. 40, pp. 1504-1507 6/1978]

Grieg, J.R. et al.
Electrical Discharges Guided by Pulsed CO2-Laser Radiation (NAV) [Reprint: Phys. Rev. Lett. 41, pp. 174-177 7/1978]

Guragossian, Z.G et al.
Method of Active Charge and Current Neutralization of Intense Ion Beamsfor ICF (TRW) [Reprint: IEEE Trans. Nucl. Sci. NS-28, p. 3398 1981]

Halbleib, J.A. et al.
Overlap of Intense Charged Particle Beams for Inertial Confinement Fusion [Nature (London) 286, pp. 366-368 1980]

Hovingh, J. et al.
Fluid Mechanics Considerations for Liquid Wall Inertially Confined Fusion Reactors (LAL) [From: 8th Symp. on Engr. Prob. Fus. Res. 11/1979]

Humphries, S. Jr
Intense Pulsed Ion Beams for Fusion Applications (SAN) [Reprint: Nucl. Fus. 20, pp. 1549-1612 1980]

Humphries, S. Jr
Options for Light-Ion Fusion [Comm. Plasma Phys. Contrl. Fusion 6, pp. 45-52 1980]

Humphries, S.Jr.
Options for Light-Ion Fusion (SAN) [Reprint: Comm. Plasma Phys. Cont. Fusion 6, pp. 45-52 1980]

Humphries, S.Jr. et al.
One-Dimensional Ion-Beam Neutralization by Cold Electrons (SAN) [Reprint: Phys. Rev. Lett.

46, pp. 995-998 4/1981]

Humphries, S.Jr.
Intense Ion-Beam Neutralization in Free Space (SAN) [Reprint: Appl. Phys. Lett. 32, pp. 792-794 6/1978]

Humphries, S.Jr. et al.
Pulselac Program: Space Charge Neutralized Ion Beams for Inertial Fusion Applications (SAN) [Reprint: Nucl. Inst. Meth. 187, pp. 289-294 1981]

Humphries, S.Jr.
no title [Reprint: J. Appl. Phys. 51, p. 1876 1980]

Humphries, S.Jr.
Intense Pulsed Ion Beams for Fusion Applications [Nucl. Fusion 20, pp. 1549-1612 1980]

Humphries, S.Jr. Poukey, J.W.
Proposed Method for the Transport of Ions in Linear Accelerators Utilizing Electron Neutralization (SAN) [Reprint: Particle Accelerators 10, pp. 71-87 1979]

Humphries, S.Jr.
Longitudinal Instabilities of Pulseline Driven Neutralized Linear Ion Accelerators(SAN) [Reprint: J. Appl. Phys. 51, pp. 2338-2347 5/1980]

Humphries, S.Jr.
Velocity Lens Model for Longitudinal Beam Dynamics in Inductive Linear Ion Accelrators (SAN) [Reprint: J. Appl. Phys. 53, pp. 1334-1341 3/1982]

Humphries, S.Jr. Lockner, T.R. Freeman, J.R.
High Intensity Ion Accelerators for Inertial Fusion (SAN) [Reprint: IEEE Trans. on Nucl. Sci., NS-28, pp. 2410-3416/1981]

Humphries, S.Jr. et al.
Production and Postacceleration of Intense Ion Beams in Magnetically Insulated Gaps [J. Appl. Phys. 51, pp. 1876-1895 1980]

Imasaki, K. et al.
Implosion Efficiency of Light Ion Beam Driven Target (OSA) [Reprint: J. Phys. Soc. Japan 50, pp. 1819-1820 6/1981]

Imasaki, K. et al.
no title [From: 4th Conf. on High Power Electron adn Ion Beam Research, 6/1981]

Iners, J.D. Nation, J.A. Roth, I.
Proton Induction in an Induction Linac (COR) [Reprint: IEEE Trans. Nucl. Sci. NS-28, 3380 1981]

Johnson, D.J. et al.
Time-Dependent Impedance Behavior of Low-Impedance REB Diodes During Self-Pinching (NAV) [Reprint: J. Appl. Phys. 49, pp. 4634-4643 9/1978]

Johnson, D.J. et al.
Production of 0.5-TW Proton Pulses with a Spherical Focusing, Magnetically Insulated Diode(SAN) [Reprint: Phys. Rev. Lett. 42, pp. 610-613 2/1979]

Johnson, D.J. et al.
Dual-Current Feed Magnetically Insulated Light-Ion Diode [J. Appl. Phys. 50, pp. 4524-4531 1979]

Jorna, S. Metzler, N. Hammerling, P.
Dependence of Target Yield on Input Energy Profile [Phys. Lett. A 80, pp. 380-382 1980]

Kramer, J.M. Meek, C.C. Predebon, W.W.
A Generalized Analysis of Thermal and Mechanical Loads in Inertial Confinement Reactors (ARG)(MIC) [Reprint: J. Thermal Stresses 3, pp. 537-549 1980]

Lee, E.P. Cooper, R.K.
General Envelope Equation for Cylindrically Symmetric Charged-Particle Beams [Reprint: Particle Accelerators 7, p. 83 1976]

Lerner, E.J.
Electromagnetic Pulses: Potential Crippler [Reprint: IEEE Spectrum, pp. 41-49 5/1981]

Lockner, T.R. Humphries, S.Jr. Ramirez, J.J.
Experiments on the Acceleration and Transport of Multi-Kiloampere Ion Beams (SAN) [Reprint: IEEE Tras. Nucl. Sci. 28, pp. 3407-3409 6/1981]

Lockner, T.R. Humphries, S. Ramires, J.J.
no title [Reprint: IEEE Trans. Nucl. Sci. NS-28, p. 3407 1981]

Maenchen, J. et al.
Magnetic Focusing of Intense Ion Beams (COR) [Reprint: Phys. Fluids 22, p. 555-565 1979]

Martin, T.H. et al.
Particle Beam Fusion Accelerator–I (PBFA-I) (SAN) [Reprint: IEEE Trans. Nucl. Sci. NS-28, p. 3365 1981]

Measures, R.M. Drewell, N. Cardinal, P.
Superelastic Laser Energy Conversion [From: Radiation Energy Conv. in Space Conf. 1978]

Measures, R.M. Drewell, N. Cardinal, P.
Electron- and Ion-Beam Transportation Channel Formation by Laser Ionization Based on Resonance Saturation-Libors [Reprint: J. Appl. Phys. 50 1979]

Mendel, C.W.
no title (paper 4C3-4) [From: IEEE Int. Conf. Plasma Science 1980]

Mendel, C.W. Jr. Goldstein, S.A.
A Fast-Opening Switch for Use in REB Diode Experiments (SAN) [Reprint: J. Appl. Phys. 48, pp. 1004-1006 3/1977]

Miller, P.A. et al.
Propagation of Pinched Electron Beams for Pellet Fusion (SAN) [Reprint: Phys. Rev. Lett. 39, pp. 92-95 7/1977]

Miller, P.A. Gerardo, J.B.
Relativistic Electron Beam Propagation in High-Pressure Gases (SAN) [Reprint: J. Appl. Phys. 43, pp. 3008-3013 7/1972]

Miller, P.A. et al.
Light Ion and Electron Beams for Inertial Fusion (SAN) [Reprint: Comments Plasma Phys. 5, pp. 95-104 1979]

Moses, G.A. Spencer, R.
Compact-Electron-Beam or Light-Ion-Beam Fusion Reactor Cavity Design Using Non-Spherical Blast Waves [Nucl. Fusion 19, pp. 1386-1388 1979]

Moses, G.A. Peterson, R.R.
First-Wall Protection in Particle-Beam Fusion Reactors by Inert Cavity Gases [Nucl. Fusion 20, pp. 849-857 1980]

Mosher, D. Bernstein, I.B.
Magnetic-Field–Induced Enhancement of Relativistic-Electron-Beam Energy Deposition (NAV) [Reprint: Phys. Rev. Lett. 38, pp. 1483-1486 6/1977]

Mosher, D.
Interactions of Relativistic Electron Beams with High Atomic-Number Plasmas (NAV) [Reprint: Phys. Fluids 18, pp. 846-857 7/1975]

Mosher, D. et al.
no title [From: Conf. on High-Power E. and Ion-Beam Res. 6/1981]

Olsen, J.N. Baker, L.
Laser-Initiated Channels for Ion Transport: Breakdown and Channel Evolution (SAN) [Reprint: J. Appl. Phys. 52, pp. 3286-3292 6/1981]

Olsen, J.N.
Laser-Initiated Channels for Ion Transport: CO2-Laser Absorption and Heating of NH3 and C2H4 Gases (SAN) [Reprint: J. Appl. Phys. 52, pp. 3279-3285 5/1981]

Olsen, J.N. Johnson, D.J. Leeper, R.J.
Propagation of Light Ions in a Plasma Channel [Appl. Phys. Lett. 36, pp. 808-810 1980]

Olsen, J.N.
Laser-Initiated Channels for Ion Transport: CO2-Laser Absorption and Heating of NH3 and C2H4 Gases [J. Appl. Phys. 52, pp. 3279-3285 1981]

Olson, C.L.
Pulsed Power Ion Accelerators for Inertially Confined Fusion [Fiz. Plazmy 3, pp. 465-486 1977]

Ottinger, P.F. Mosher, D. Goldstein, S.A.
Electromagnetic Instabilities in a Focused Ion Beam Propagating Through a Z-Discharge Plasma (NAV)(JAY) [Reprint: Phys. Fluids 24, pp. 164-170 1/1981]

Ottinger, P.F. Mosher, D. Goldstein, S.A.
Microstability of a Focused Ion Beam Propagating Through a Z-Pinch Plasma (NAV)(SCI) [Reprint: Phys. Fluids 22, pp. 332-337 2/1979]

Ottinger, P.F. Mosher, D. Goldstein, S.A.
Propagation of Intense Ion Beams in Straight and Tapered Z-Discharge Plasma Channels (NAV) [Reprint: Phys. Fluids 23, pp. 909-920 5/1980]

Ottinger, P.F. Mosher, D. Goldstein, S.A.
Electromagnetic Instabilities in a Focused Ion Beam Propagating Through a Z-Discharge Plasma [Phys. Fluids 24, pp. 164-170 1981]

Pasour, J.A. et al.
Reflex Tetrode with Unidirectional Ion Flow (NAV) [Reprint: Phys. Rev. Lett. 40, pp. 448-451 2/1978]

Phelps, D.A. Salisbury, W.W. Jorna, S.
Injector Based on Electric Insulation for the Controlled Ballistic Focusing of Light Ion Beams [J. Appl. Phys. 52, pp. 3761-3768 1981]

Phelps, D.A. Chang, D.B.
Stability of Bounded Electron Beams Neutralized by Co-Moving Electrons (OCC) [Reprint: IEEE Trans. Nucl. Sci. NS-28, p. 3427 1981]

Phelps, D.A. Somerstein, S.
Precision Intense Particle Beam Accelerators Using In-Situ Tuning Techniques (OCC) [Reprint: IEEE Trans. Nucl. Sci. NS-28, p. 3424 1981]

Poukey, J.W.
Two-Dimensional Ion Effects in Relativistic Diodes (SAN) [Reprint: J. Vac. Sci. Technol. 12, pp. 1214-1217 12/1975]

Poukey, J.W.
Ion Effects in Relativistic Diodes (SAN) [Reprint: Appl. Phys. Lett. 26, pp.145-146 1975]

Poukey, J.W. et al.
Focused Intense Ion Beams Using Self-Pinched Relativistic Electron Beams (SAN) [Reprint: Phys. Rev. Lett. 35, pp.1806-1808 1975]

Prestwich, K.R.
HARP, A Short Pulse, High Current Electron Beam Acclerator (SAN) [Reprint: IEEE Trans. on Nucl. Sci. NS-22, 975-978, 1975]

Quintenz, J.P. Poukey, J.W.
Ion Current Reduction in Pinched Electron Beam Diodes (SAN) [Reprint: J. Appl. Phys. 48, pp. 2287-2293 1977]

Ranger, A.A.
Shock Wave Propagation Through a Two-Phase Medium [Reprint: Astonautica Acta 17, pp. 675-83 1972]

Ryutov, D.D.
High-Current Electron and Ion Beam Research and Technology. Report on the 3rd Int. Top. Conf.,Novosibirsk, USSR, 3-6 July 1979 [Nucl. Fusion 19, pp. 1685-1688 1979]

Sandel, F.L. et al.
no title [From: 4th Conf. on High Power Electron and Ion Beam Research, 6/1981]

Slutz, S.A. Mehlhorn, T.A.
no title [Reprint: Appl. Phys. Lett. 39 12/1981]

Stephanakis, S.J et al.
no title [Reprint: Bull. Am. Phys. Soc. 26, p. 921 9/1981]

Stephanakis, S.J et al.
Production of Intense Proton Beams in Pinched-Electron-Beam Diodes (NAV) [Reprint: Phys. Rev. Lett. 37, pp. 1543-1546 12/1976]

Stringfield, R. et al.
no title [J. of Vac. Tech. 18, p. 146 1980]

Swain, D.W. et al.
Measurements of Large Ion Currents in a Pinched Relativistic Electron Diode (SAN) [Reprint: J. Appl. Phys. 48, pp. 118-124 1977]

Swain, D.W. et al.
The Characteristics of a Medium Current Relativistic Electron-Beam Diode (SAN) [Reprint: J. Appl. Phys. 48, pp. 1085-1093 3/1977]

Sweeney, M.A. Farnsworth, A.V.
High-Gain, Low-Intensity ICF Targets for a Charged-Particle Beam Fusion Driver [Nucl. Fusion 21, pp. 41-54 1981]

Sweeney, M.A. Widner, M.M.
Thick-Shell Shock-Focusing Electron Beam Targets (SAN) [Reprint: Nucl. Fus. 13, pp. 429-433 1978]

Thayer, W.J. et al.
Pressure Wave Suppression for a Pulsed Chemical Laser [Reprint: AIAA Journal 18, pp. 657-64 6/1980]

Thomson, S.L.
Hydrodynamic Effects in Inertial Fusion Reactors (BEC) [Reprint: 5th SMIRT Conf., Berlin 8/1979]

VanDevender, J.P
Long Self-Magnetically Insulated Power Transport Experiment(SAN) [J. Appl. Phys. 50, p. 3928 1979]

Varnado, S.G. Carlson, G.A.
Considerations in the Design of Electron-Beam-Induced Fusion Reactor Systems (SAN) [Reprint: Nucl. Tech. 29, pp. 415-427 6/1976]

Wright, T.P. Green, T.A. Mehlhorn, T.A.
Charge Exhange and Energy Loss of Carbon Ions in Air-Plasma Channels [J. Appl. Phys. 52, pp. 147-150 1981]

Wright, T.P.
Multi-Channel Ion Beam Overlap (SAN) [Reprint: Phys. Fluids 24, p. 370-372 2/1981]

Wright, T.P. Halbleib, J.A.Sr
Theoretical Multiple Beam Overlap from Channel Transport of Intense Particle Beams (SAN) [Reprint: Phys. Fluids 23, p. 1603-1619 8/1980]

Yonas, G.
Developments in Sandia Laboratories Particle Beam Fusion Programme [Plasma Phys. Control. Nucl. Fus. Res., IAEA 1979]

Yonas, G.
Intense Particle Beams [IEEE Trans. Nucl. Sci. NS-26, pp. 4160-4165 1979]

Yonas, G. et al.
Electron Beam Focusing and Application to Pulsed Fusion [Reprint: Nuclear Fusion 14, pp. 731-740 1974]

Yonas, G. et al.
Electron Beam Focusing Using Current-Carrying Plasmas in High – gamma over nu -Diodes (SAN) [Reprint: Phys. Rev. Lett. 30, pp.164-167 1973]

Yonas, G.
Fusion Power with Particle Beams (SAN) [Reprint: Scientific American 239 pp. 50-61 1978]

Yu, S. Lee, E.P. Buchanan, H.L.
Focal Spot Size Predictions for Beam Transport through a Gas-Filled Reactor [From: Proc. of the Heavy Ion Workshop, p. 504 1979]

Yu, S. et al.
Beam Propagation through a Gaseous Reactor - Classical Transport [From: Proc. of Heavy Ion Fusion Workshop 1978]

Yu, S. et al.
Propagation of a Heavy Ion Beam in a Gas-Filled Reactor [From: Proc. of Heavy Ion Fusion Workshop 1977]

et al.
Production and Postacceleration of Intense Ions Beams in Magnetically Insulated Gaps (SAN) [Reprint: J. Appl. Phys. 51, pp. 1876-1895 4/1980]

no author
Proc. of the 4th Int. Topical Conf. on High-Power Electron and Ion-Beam Research and Technology, Palaiseau, France [Conference Proceedings 6/1981]