

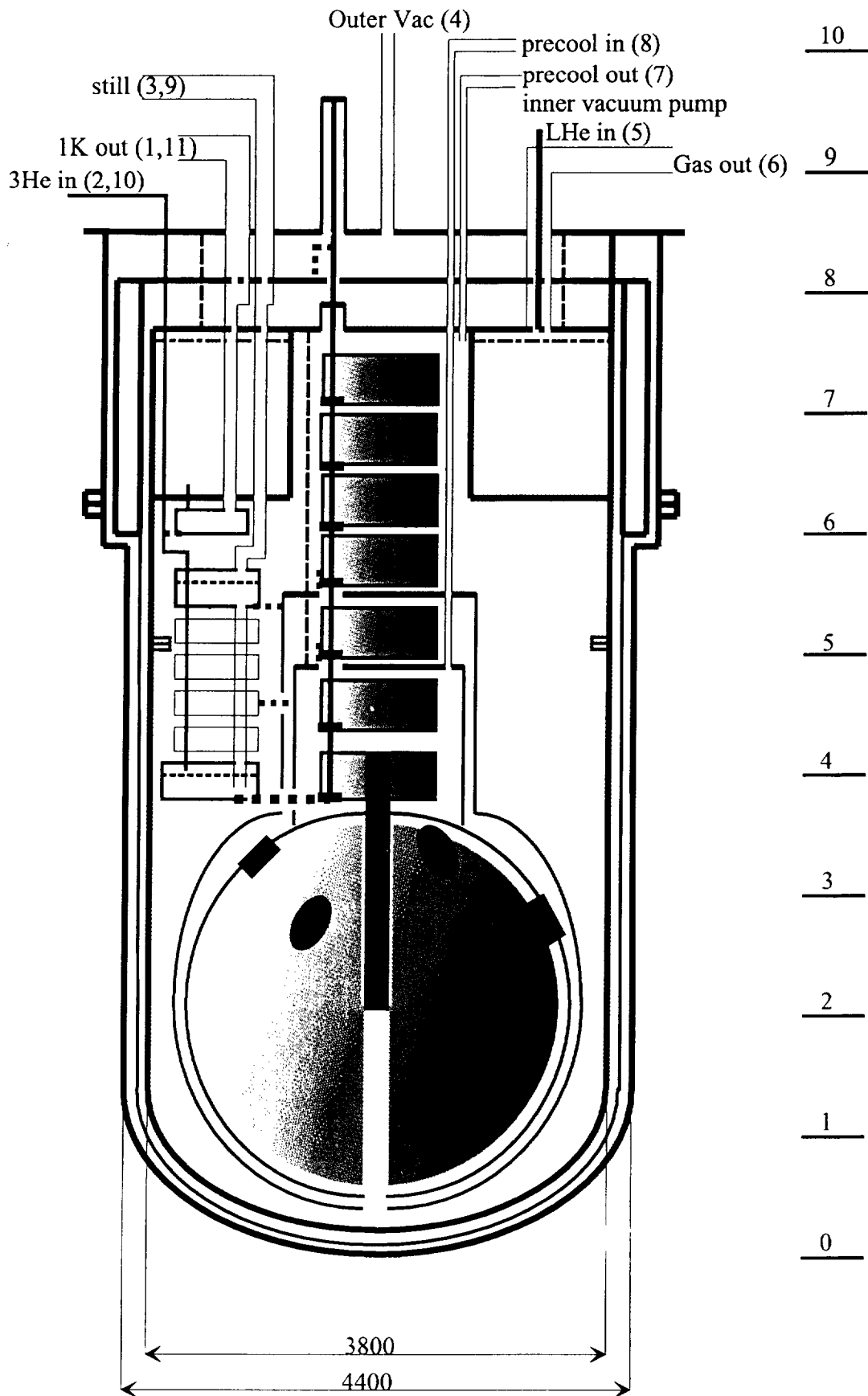
GRAIL OBJECTIVES

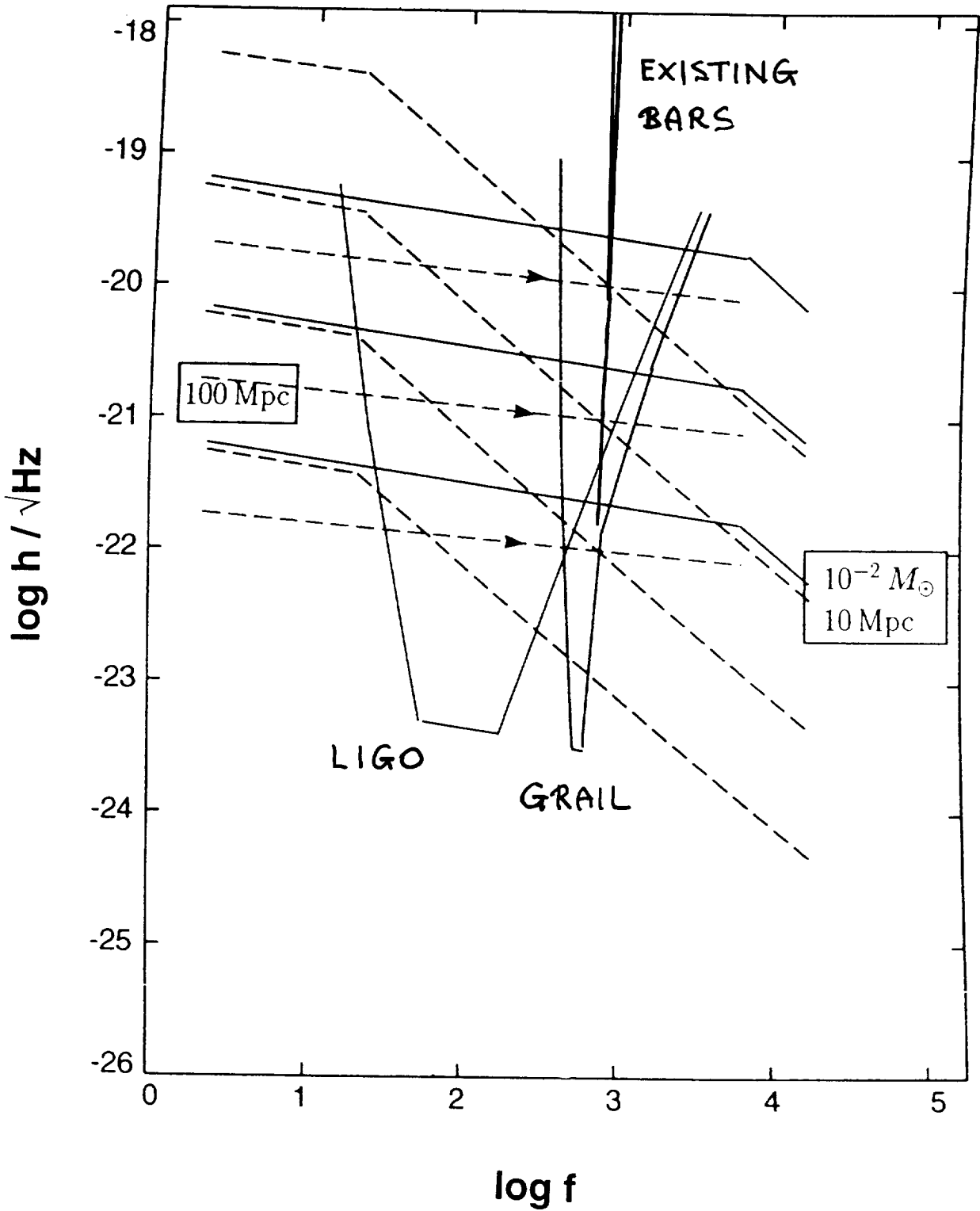
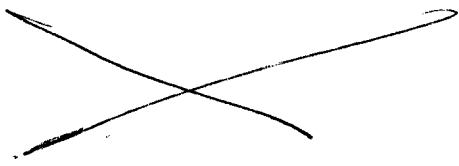
STRAIN SENSITIVITY $< 10^{-21}$

BANDWIDTH > 100 Hz

OMNIDIRECTIONAL

SCHEMATIC DRAWING OF GRAIL





THE GRAIL COLLABORATION

AMSTERDAM UNIVERSITY: CHEAF
E.P.J. van den Heuvel

AMSTERDAM UNIVERSITY: FWI
D. van Albada

EINDHOVEN UNIVERSITY
A.T.A.M. de Waele

LEIDEN UNIVERSITY
G. Frossati

NIKHEF
P.W. van Amersfoort

TWENTE UNIVERSITY
J. Flokstra
H. Rogalla

GRAIL TIME TABLE

1995 - 1997 PILOT STUDY

**1998 - 1999 PHASE A:
R&D ON CRITICAL ISSUES
COST MF 5**

**2000 - 2002 PHASE B:
ANTENNA CONSTRUCTION
COST MF 30**

**2003 - ... PHASE C:
ANTENNA OPERATION
(AND IMPROVEMENT)**

R&D ISSUES I

SPHERE CASTING

- material selection
- homogeneity, purity, etc.

DILUTION REFRIGERATOR

- high power (100 μ W @ 10 mK)
- low vibration level

VIBRATION ISOLATION

- 320 dB @ 700 Hz
- minimise 'upconversion'

MOTION SENSOR

- high quality transducer
- low noise sensor:
 - SQUID & DROS
 - microwave cavity

R&D ISSUES II

RESPONSE MODELLING

- **GRAIL \neq sphere!**
- **prepare design tools**
- **develop test set-up**

COSMICS

- **understand experimental data**

COINCIDENCE

- **need for international collaboration**

SYSTEM INTEGRATION

- **many conflicting requirements!**

WHO DOES WHAT?

UvA: CHEAF
SOURCE MODELLING

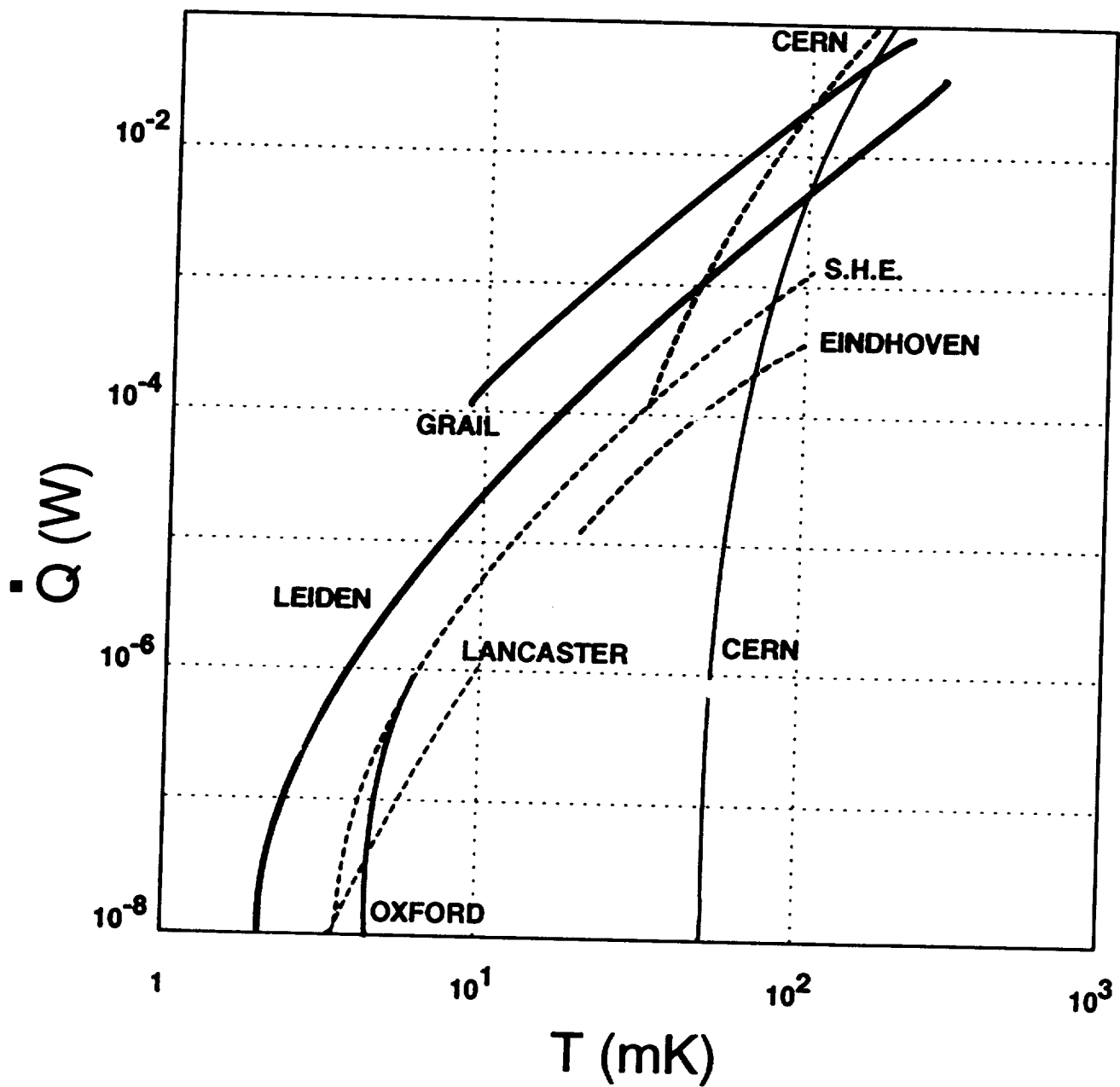
UvA: FWI
RESPONSE MODELLING

TUE
VIBRATION ATTENUATION
MOTION AMPLIFIER

RUL
MATERIAL STUDIES
DILUTION REFRIGERATOR

NIKHEF
MICROWAVE TRANSDUCER
SYSTEM INTEGRATION

UT
QUANTUM LIMITED SQUID
SUPERCONDUCTING TRANSDUCER



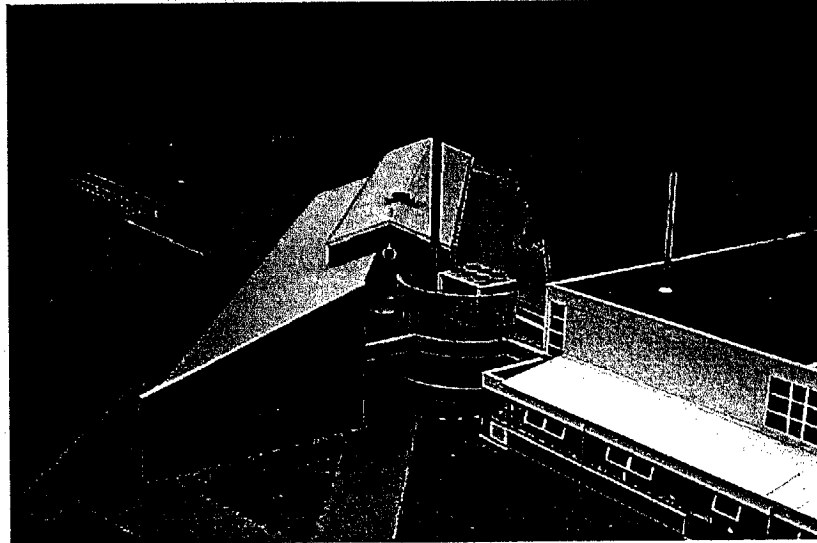


Low Temperature Division

Department of Applied Physics, University of Twente



Laboratorium voor **materialenonderzoek en dunne film technologie**





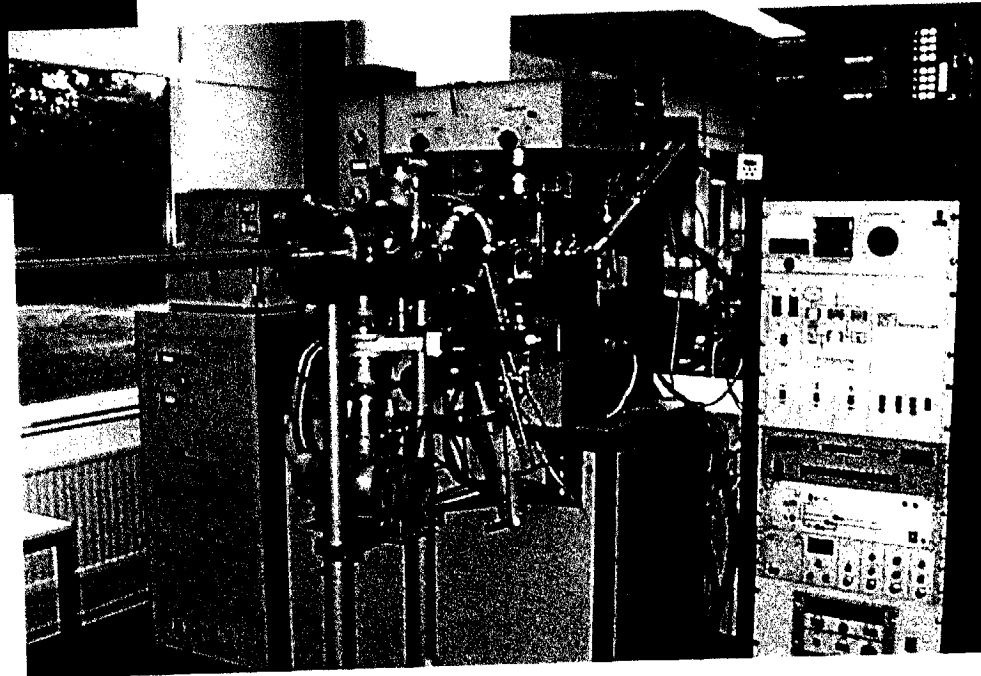
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Cleanroom

- class 10000
- laminar flowboxes class 100
- spinner
- mask aligner
- microscope
- step height meter



Nordiko

RF and DC sputtering
Nb, Al and Pd
 1×10^{-7} mbar



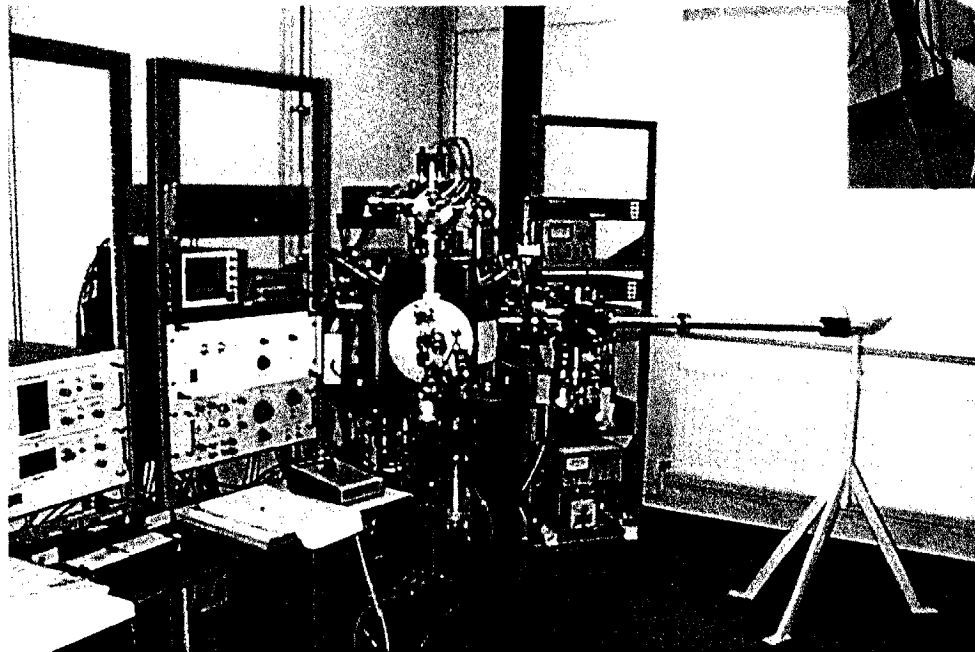
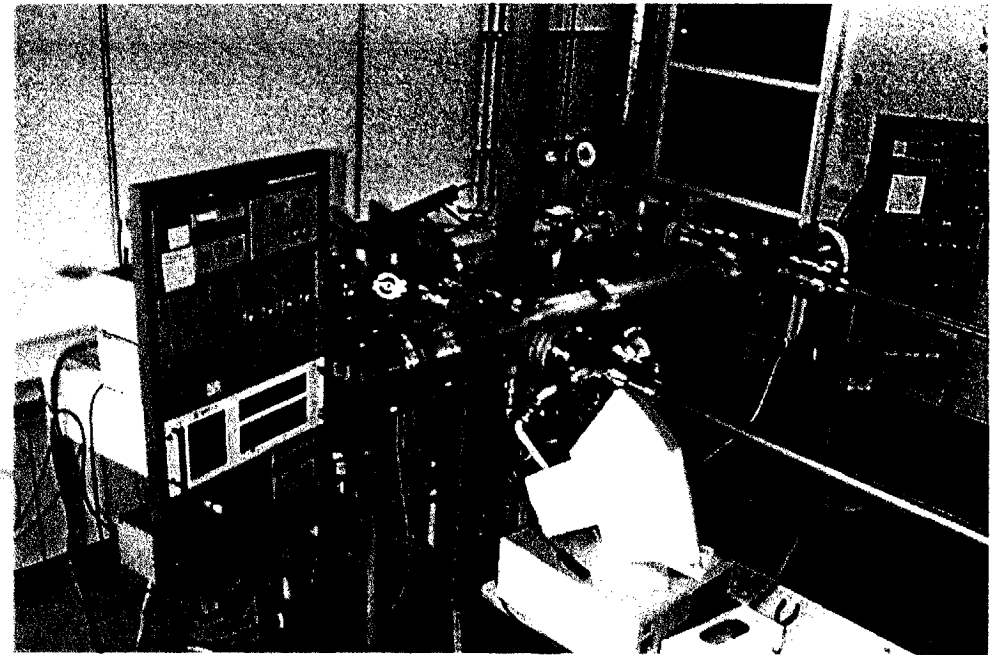
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Reactive Ion Etcher

loadlock system
 SF_6 , Ar, O_2
endpoint control



Focused Ion Beam

gallium ions
energy : 25 keV
spotsize : 50 nm (FWHM)
computer controlled patterning

MANPOWER R&D PHASE

f t e

	Senior physicist	Postdoc	PhD student	Engineer
CHEAF	0.40	2.00	1.00	
NIKHEF	7.00	0.50		4.30
RUL	1.00	1.50	2.00	2.50
TUE	2.60	1.00	2.50	1.90
UvA	0.20	1.00	1.00	
UT	0.60	4.00	1.00	2.70
TOTAL	11.80	10.00	7.50	11.40

Note 1, Linda Turner, 04/30/98 10:57:52 AM
LIGO-G980073-12-M