The Experimental Basis for Dark Matter

Peter Fisher

May 27, 2008

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A NUMERICAL STUDY OF THE STABILITY OF FLATTENED GALAXIES: OR, CAN COLD GALAXIES SURVIVE?*

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Received 1973 May 29

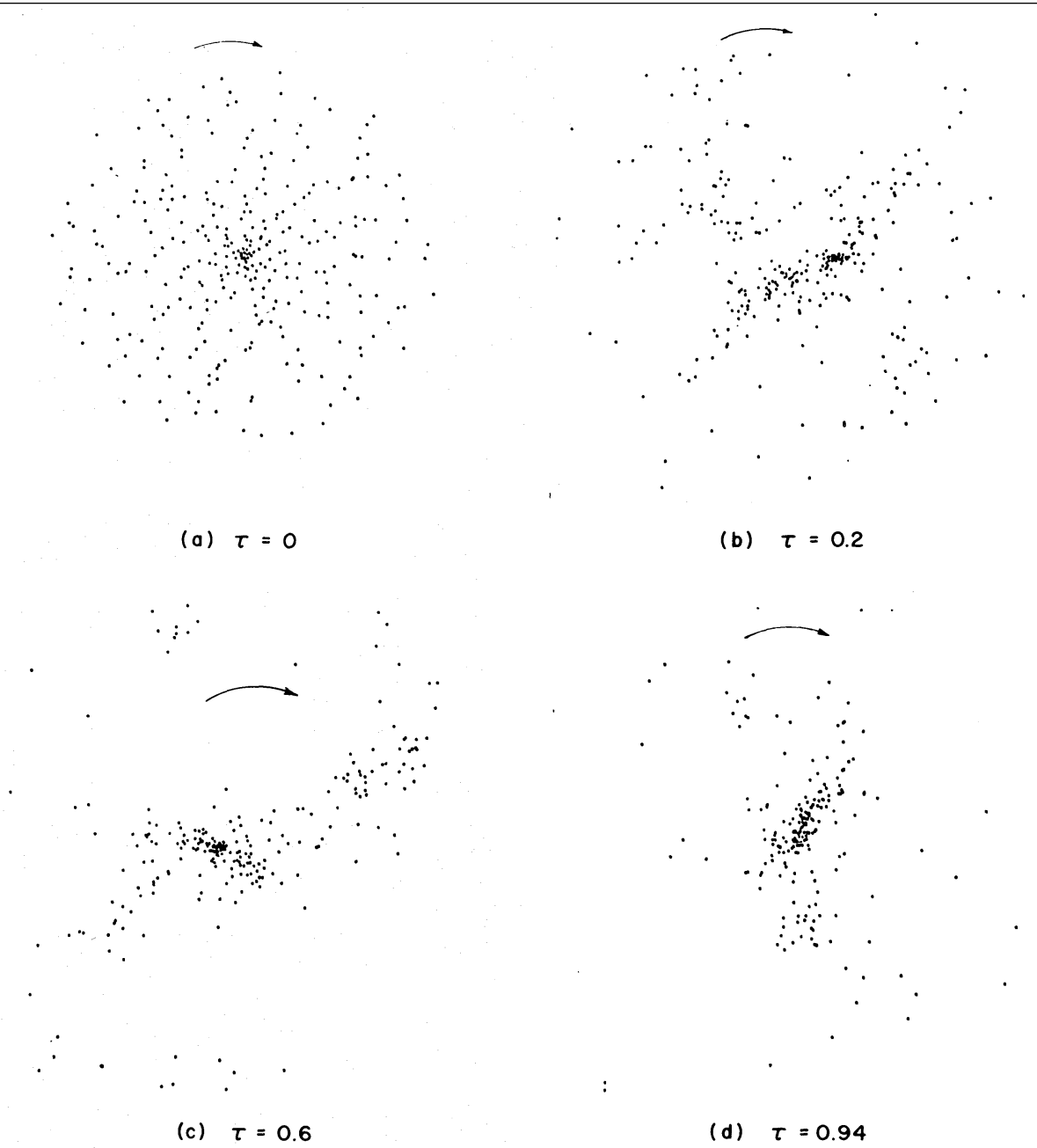

FIG. 4.—Evolution of model 1. The graphs show the positions of the mass points projected onto the plane, at four instants.

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TION OF THE ANDROMEDA NEBULA FROM A SPECTROSCOPIC SURVEY OF EMISSION REGIONS*

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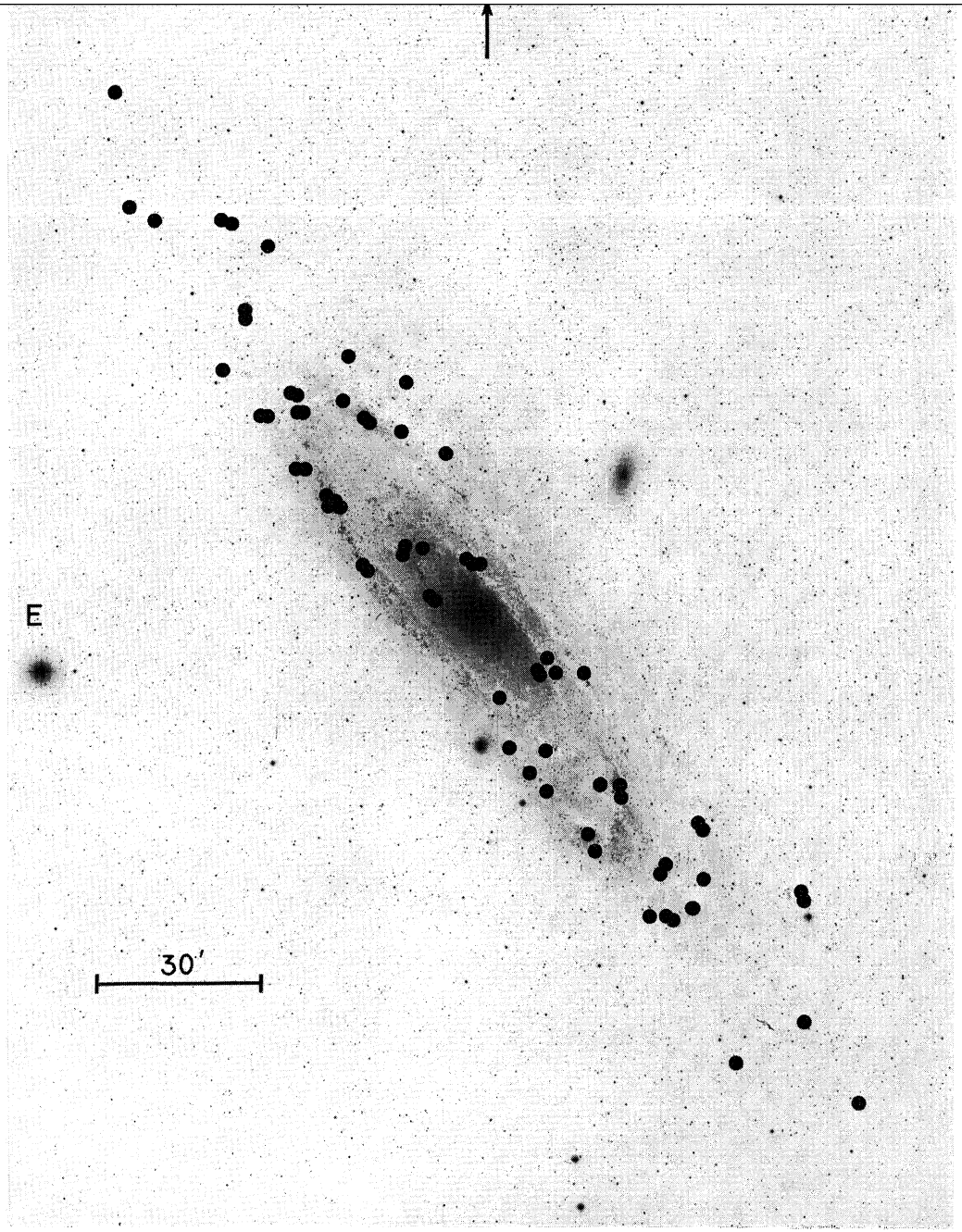

FIG. 1.—Identification chart for emission regions in M31 for which velocities have been obtained. Palomar 48-inch Schmidt ultraviolet photograph, 103aO plate + UG 1 filter, courtesy of Dr. S. van den Bergh.

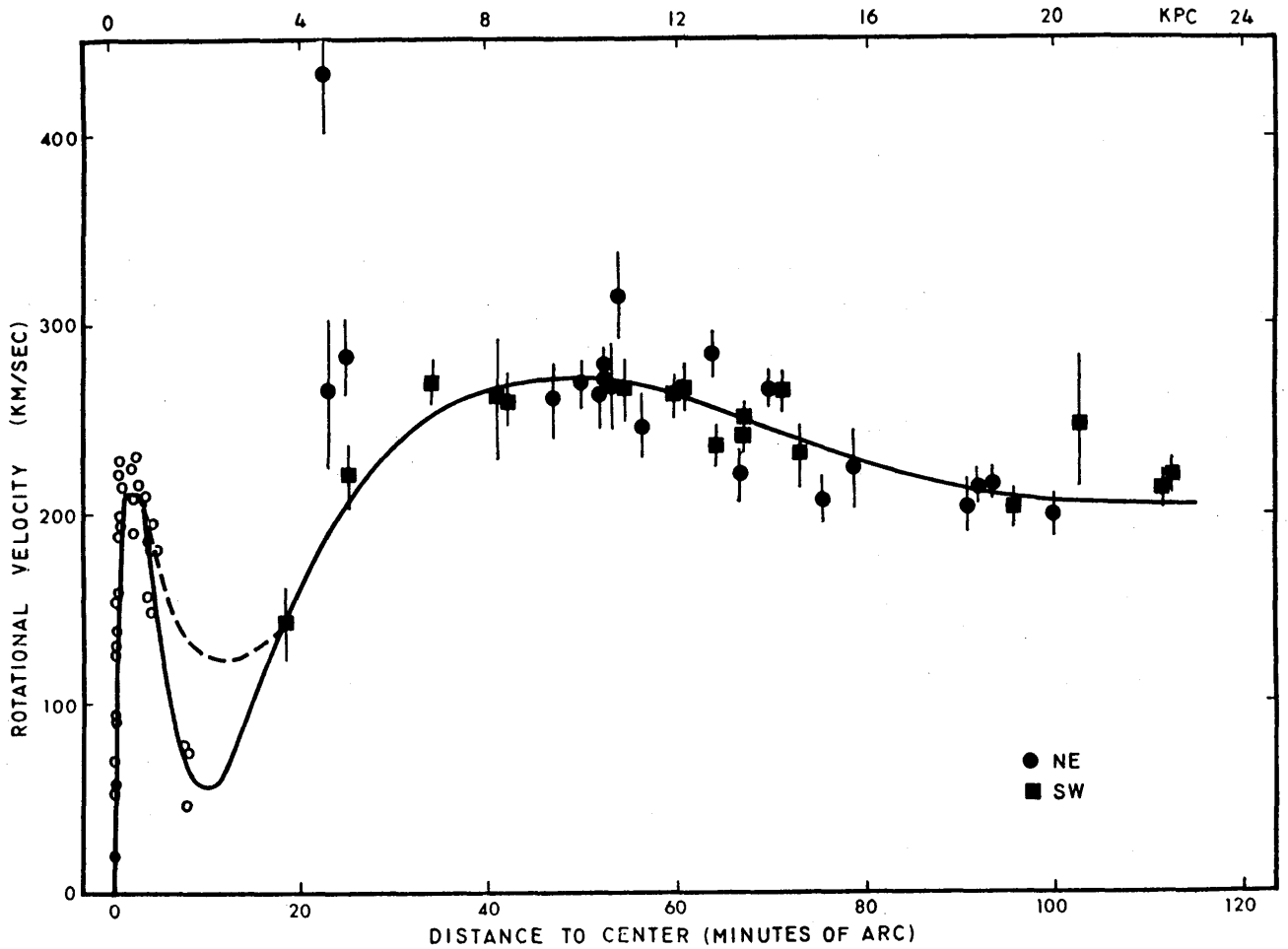

FIG. 9.—Rotational velocities for OB associations in M31, as a function of distance from the center. *Solid curve*, adopted rotation curve based on the velocities shown in Fig. 4. For $R \leq 12'$, curve is fifth-order polynomial; for $R > 12'$, curve is fourth-order polynomial required to remain approximately flat near $R = 120'$. Dashed curve near $R = 10'$ is a second rotation curve with higher inner minimum.

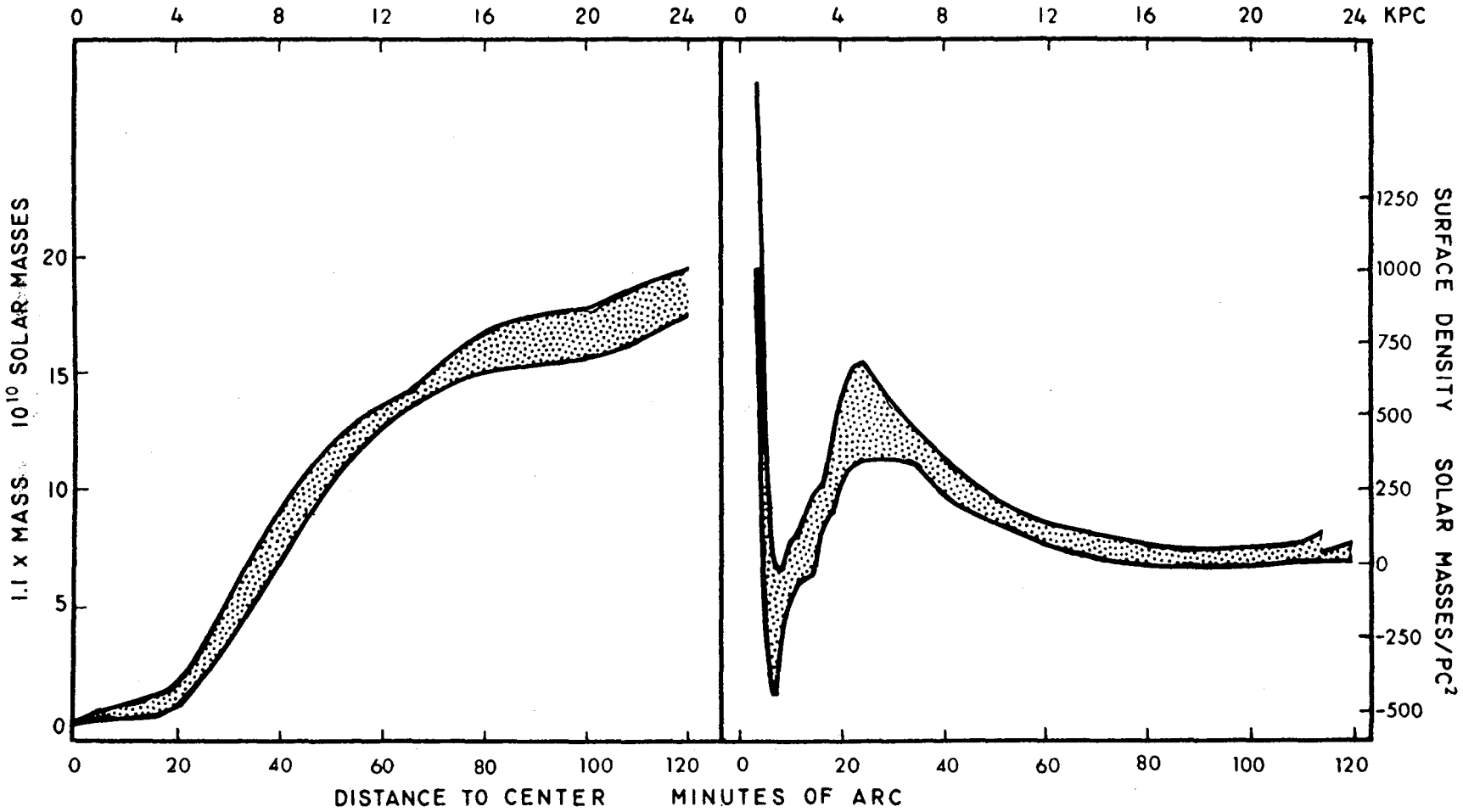

FIG. 12.—*Left:* range of calculated values of total mass for M31, as a function of distance to center or fourteen rotation curves (Fig. 11). Dotted region indicates range of fourteen multiply intersecting curves. *Right:* range of calculated values of surface density of M31, as a function of distance to center Dotted region indicates range of multiply intersecting curves.

ON THE MEASUREMENTS OF D/H IN QSO ABSORPTION SYSTEMS

Closing in on the primordial abundance of deuterium

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Space Science Reviews
1998 vol. 84 pp. 65

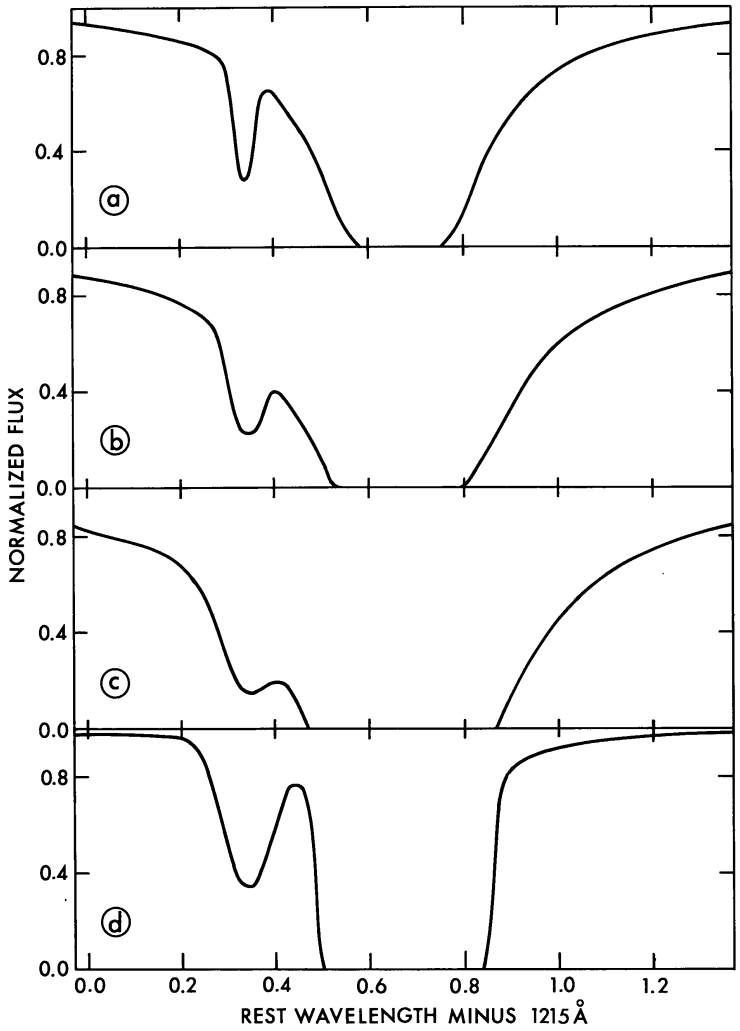
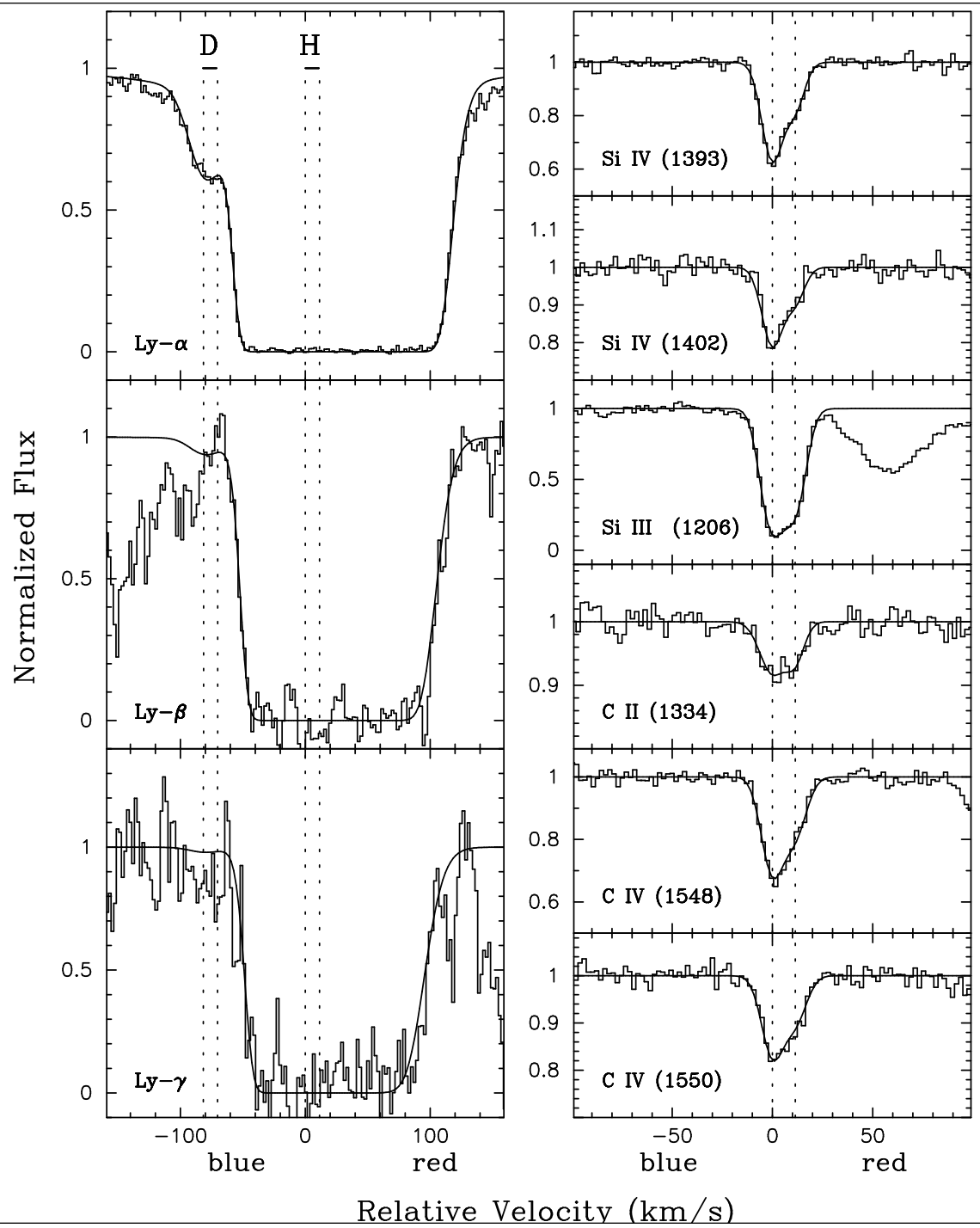
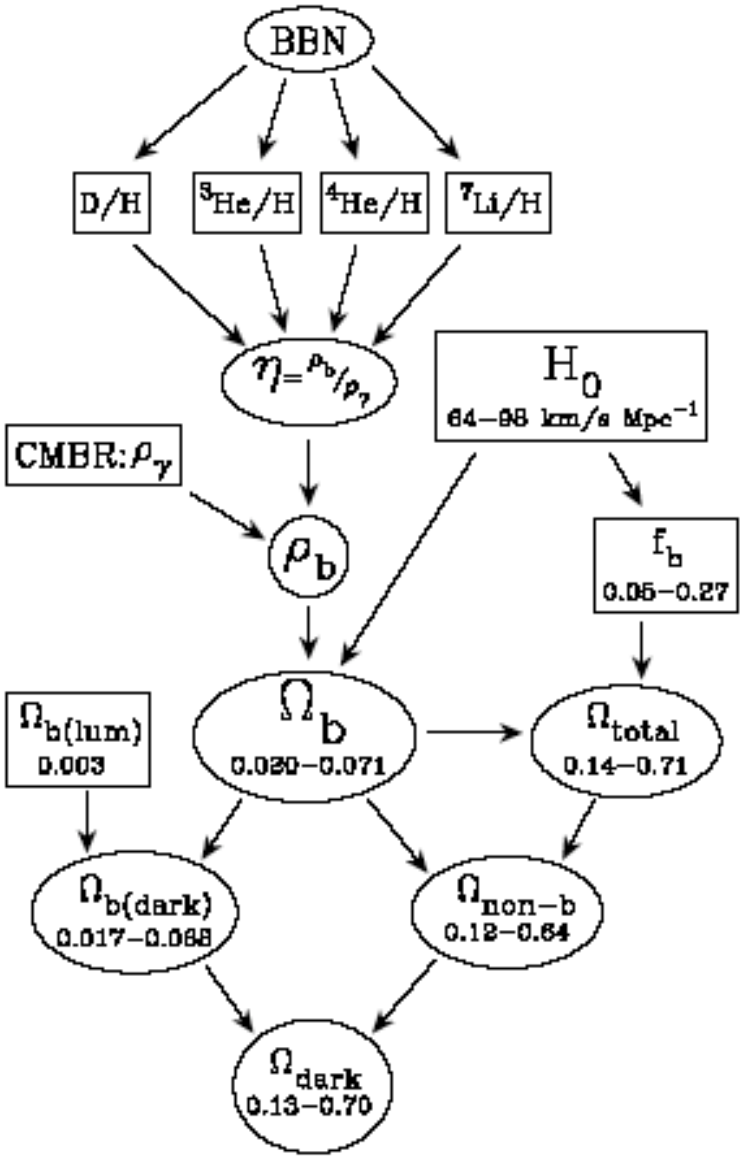


Fig. 1a—d. Theoretical D Lα − H Lα blended line profiles. The assumed abundance ratio, n(D)/n(H), and the H Lα line center optical depth are taken to be 10^{-5} and 10^{5} for blends **(a)**, **(b)** and **(c)**, and 10^{-4} and 10^{4} for blend **(d)**, respectively. The Doppler velocity, v_0, and implied neutral hydrogen column densities, N_H are: **(a)**, 6 km s^{-1} (0.79 10^{18} atom cm^{2}); **(b)**, 10 km s^{-1} (1.3 10^{18} atom cm^{-2}); **(c)**, 15 km s^{-1} (2.0 10^{18} atom cm^{-2}); **(d)**, 15 km s^{-1} (2.0 10^{17} atom cm^{-2}). The profiles were calculated using Harris' approximation to the Voigt function as tabulated by Aller (1963)


D
H
Ly−α
Ly−β
Ly−γ
Si IV (1393)
Si IV (1402)
Si III (1206)
C II (1334)
C IV (1548)
C IV (1550)
Normalized Flux
blue
red
blue
red
Relative Velocity (km/s)


BBN
D/H
^{3}He/H
^{4}He/H
^{7}Li/H
$\eta = \rho_b/\rho_\gamma$
H_0
64–98 km/s Mpc^{-1}
CMBR: ρ_γ
ρ_b
f_b
0.05–0.27
$\Omega_{b(lum)}$
0.003
Ω_b
0.020–0.071
Ω_{total}
0.14–0.71
$\Omega_{b(dark)}$
0.017–0.068
Ω_{non-b}
0.12–0.64
Ω_{dark}
0.13–0.70

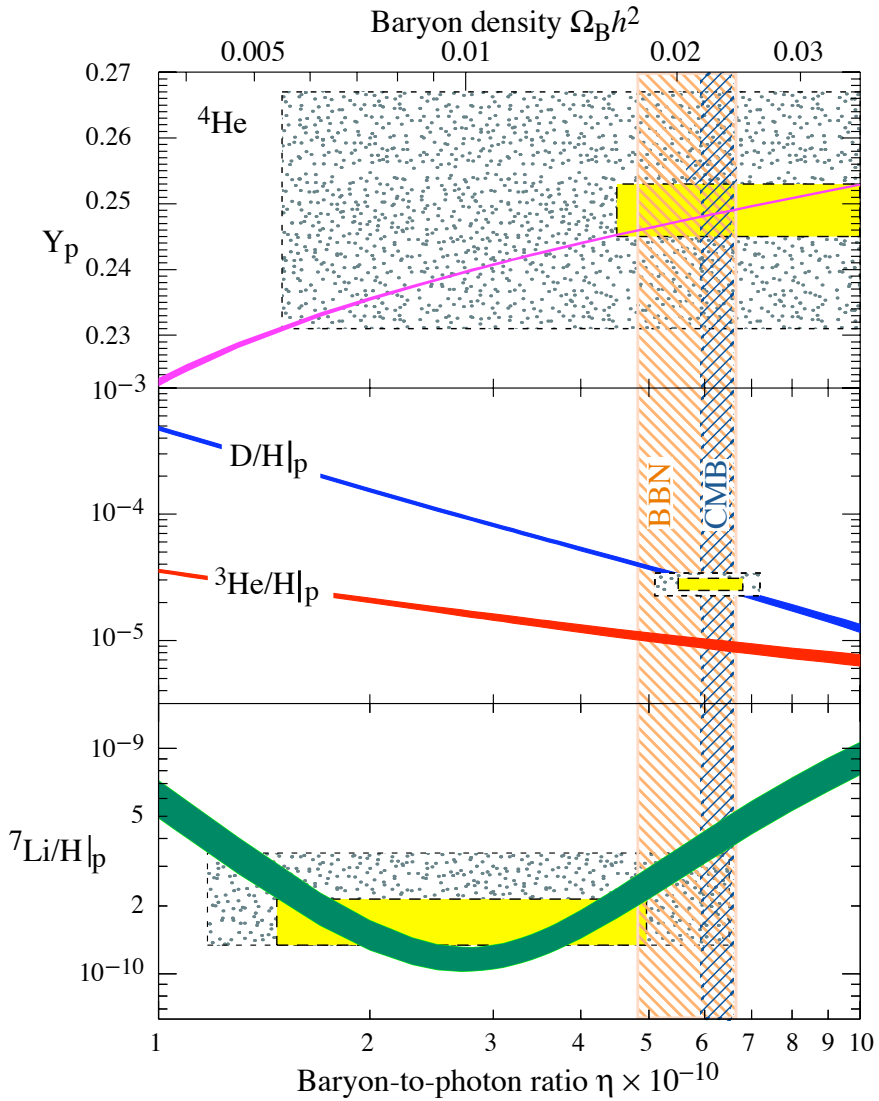


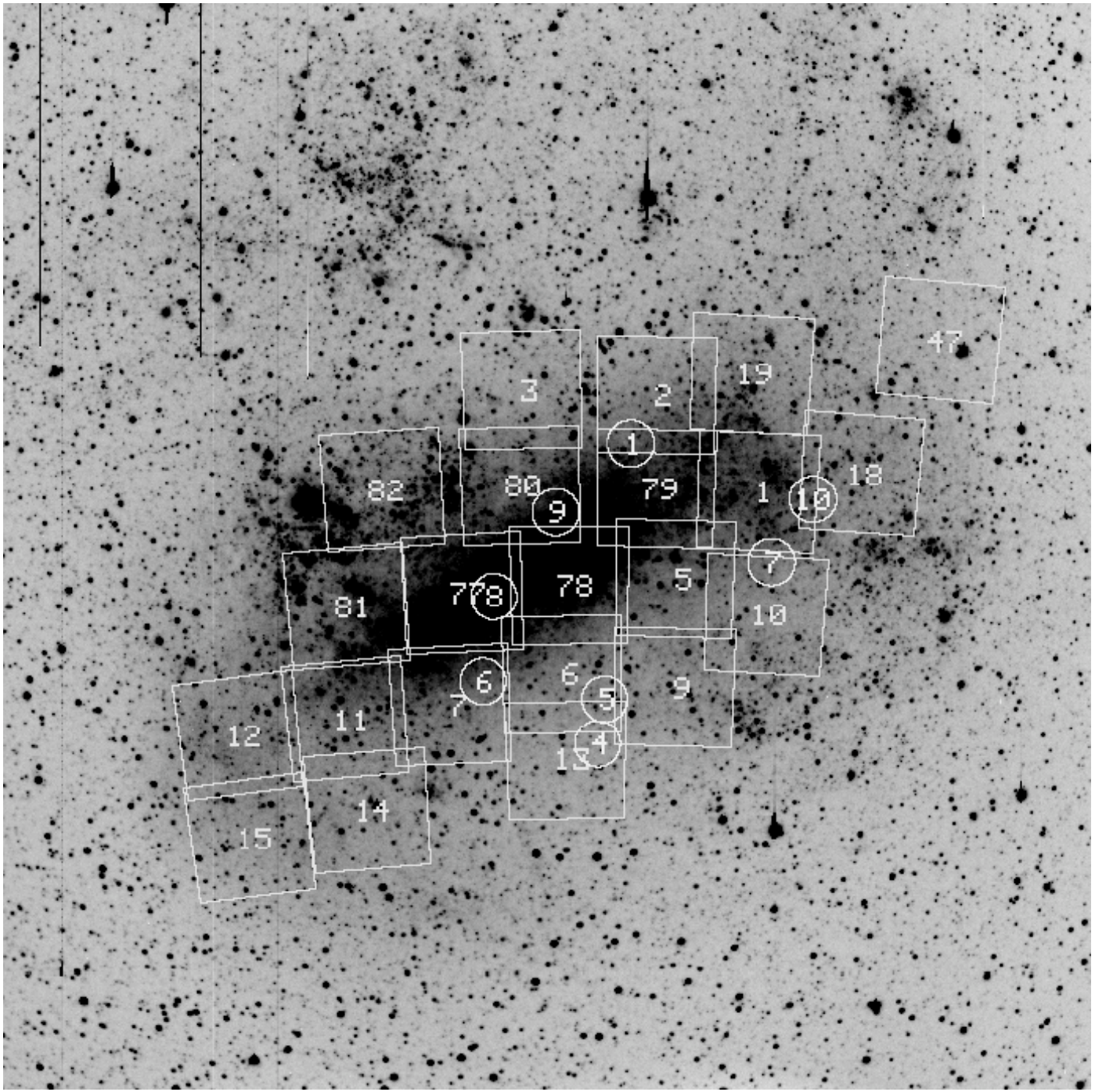
Figure 20.1: The abundances of ^{4}He, D, ^{3}He and ^{7}Li as predicted by the standard model of big-bang nucleosynthesis — the bands the 95% CL range. Boxes indicate the observed light element abundances (smaller boxes: $\pm 2\sigma$ statistical errors; larger boxes: $\pm 2\sigma$ statistical *and* systematic errors). The narrow vertical band indicates the CMB measure of the cosmic baryon density, while the wider band indicates the BBN concordance range (both at 95% CL). Color version at end of book.

The MACHO Project LMC Microlensing Results from the First Two Years and the Nature of the Galactic Dark Halo

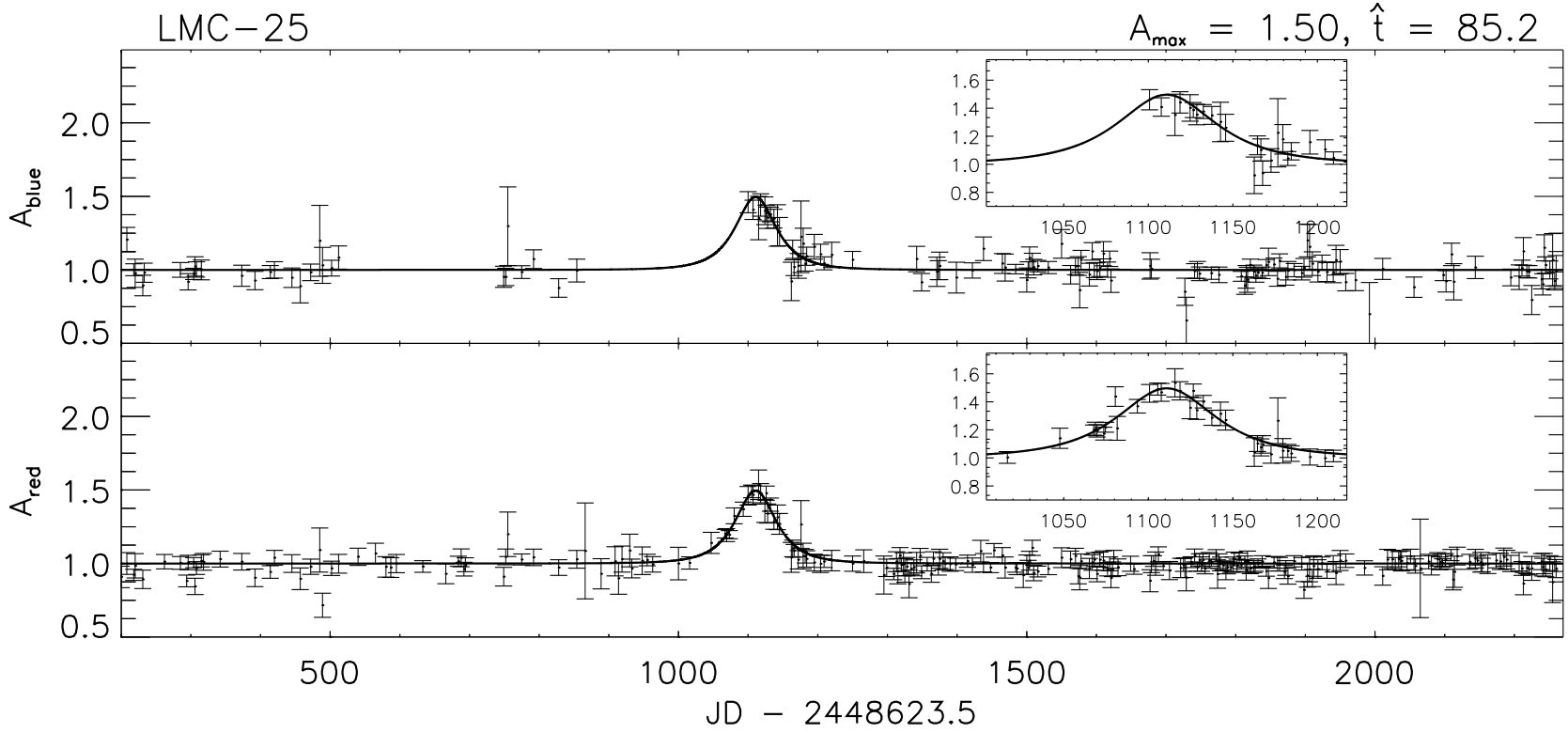
C. Alcock[1,2], R.A. Allsman[3], D. Alves[1,4], T.S. Axelrod[5], A.C. Becker[2,6], D.P. Bennett[1,2,4,7], K.H. Cook[1,2], K.C. Freeman[5], K. Griest[2,8], J. Guern[2,8], M.J. Lehner[2,8], S.L. Marshall[1,2], B.A. Peterson[5], M.R. Pratt[2,6,9], P.J. Quinn[10], A.W. Rodgers[5], C.W. Stubbs[2,6], W. Sutherland[11], D.L. Welch[12]

(The MACHO Collaboration)

Submitted to ApJ, 24 June 1996



47
19
3
2
1
18
82
80
9
79
1
10
7
81
77
8
78
5
10
6
6
9
7
5
12
11
4
13
14
15


LMC−25
A_{max} = 1.50, $\hat{t}$ = 85.2
A_{blue}
A_{red}
2.0
1.5
1.0
0.5
1.6
1.4
1.2
1.0
0.8
1050
1100
1150
1200
500
1000
1500
2000
JD − 2448623.5

arXiv:astro-ph/9801286v1 28 Jan 1998

Results from a High-Sensitivity Search for Cosmic Axions

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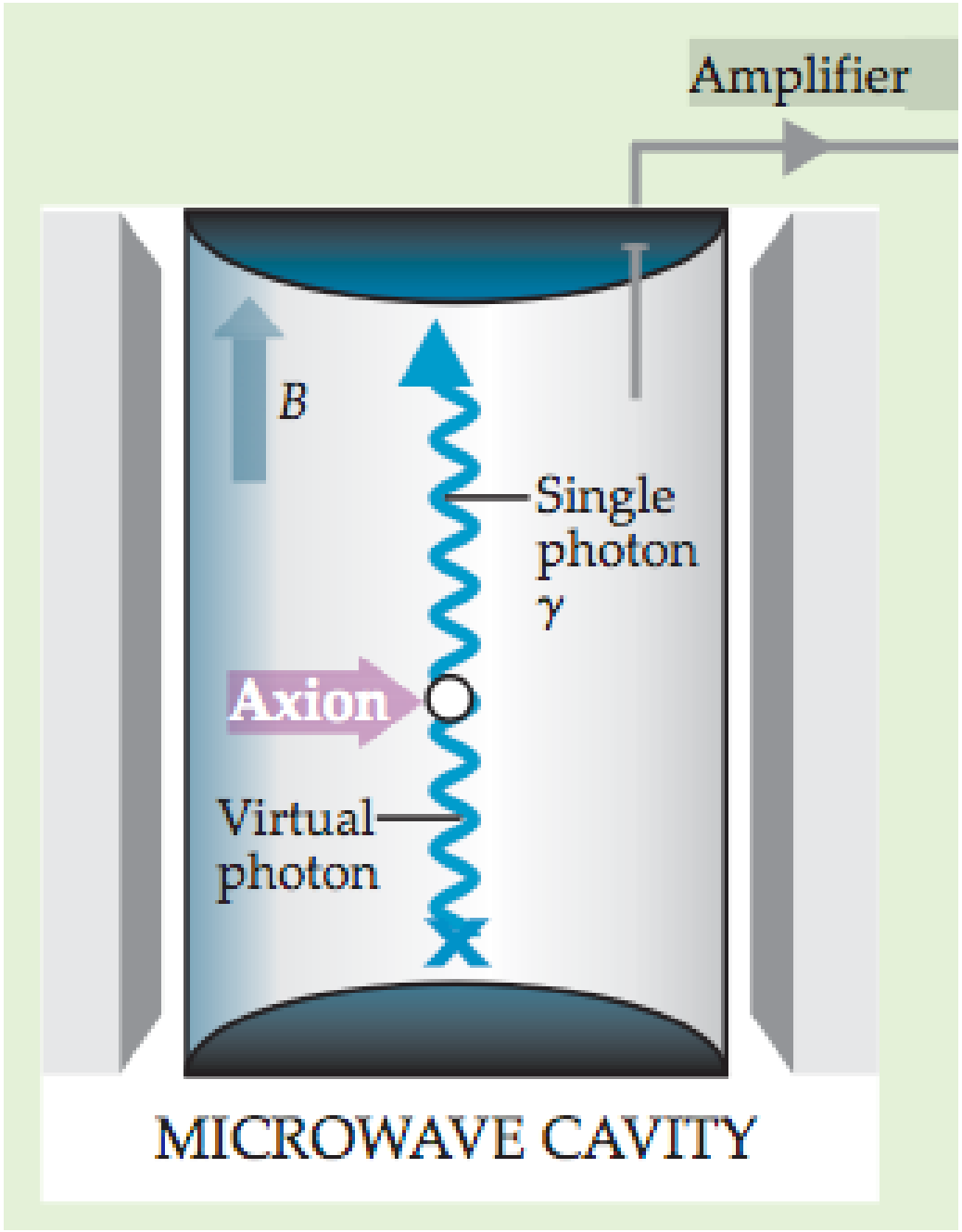

Amplifier
B
Single
photon
γ
Axion
Virtual
photon
MICROWAVE CAVITY

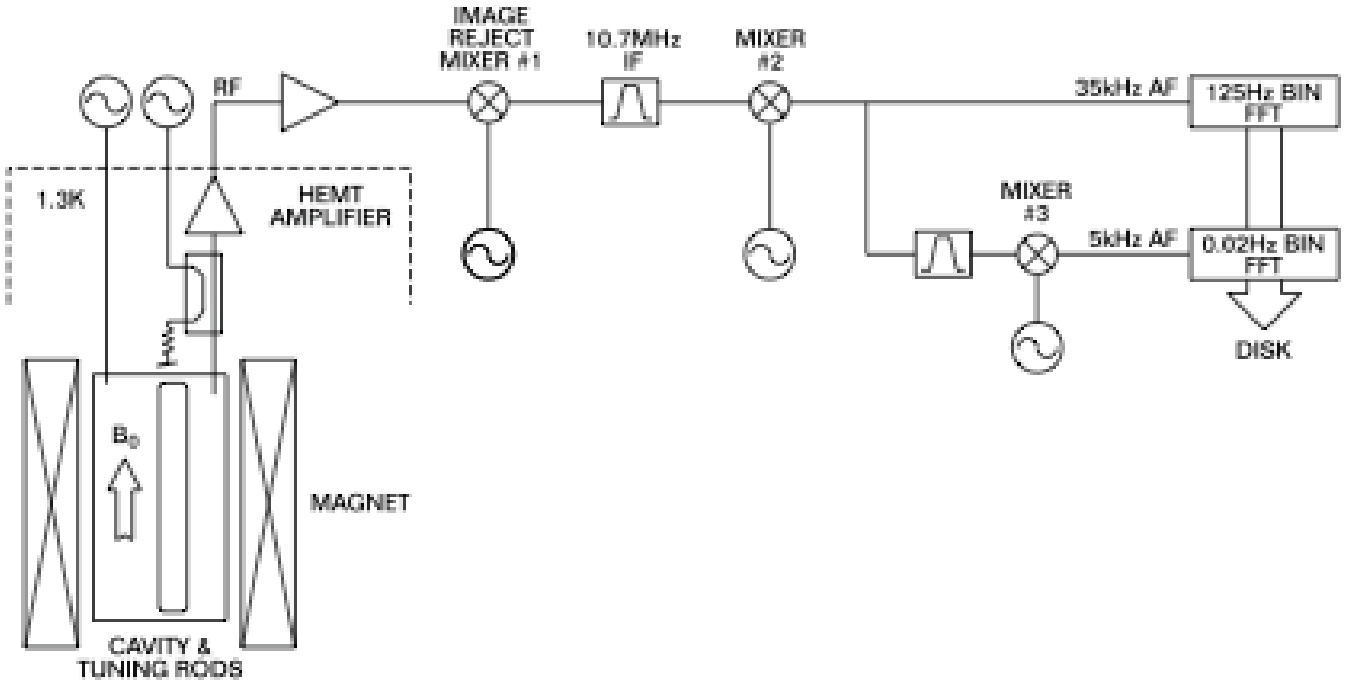
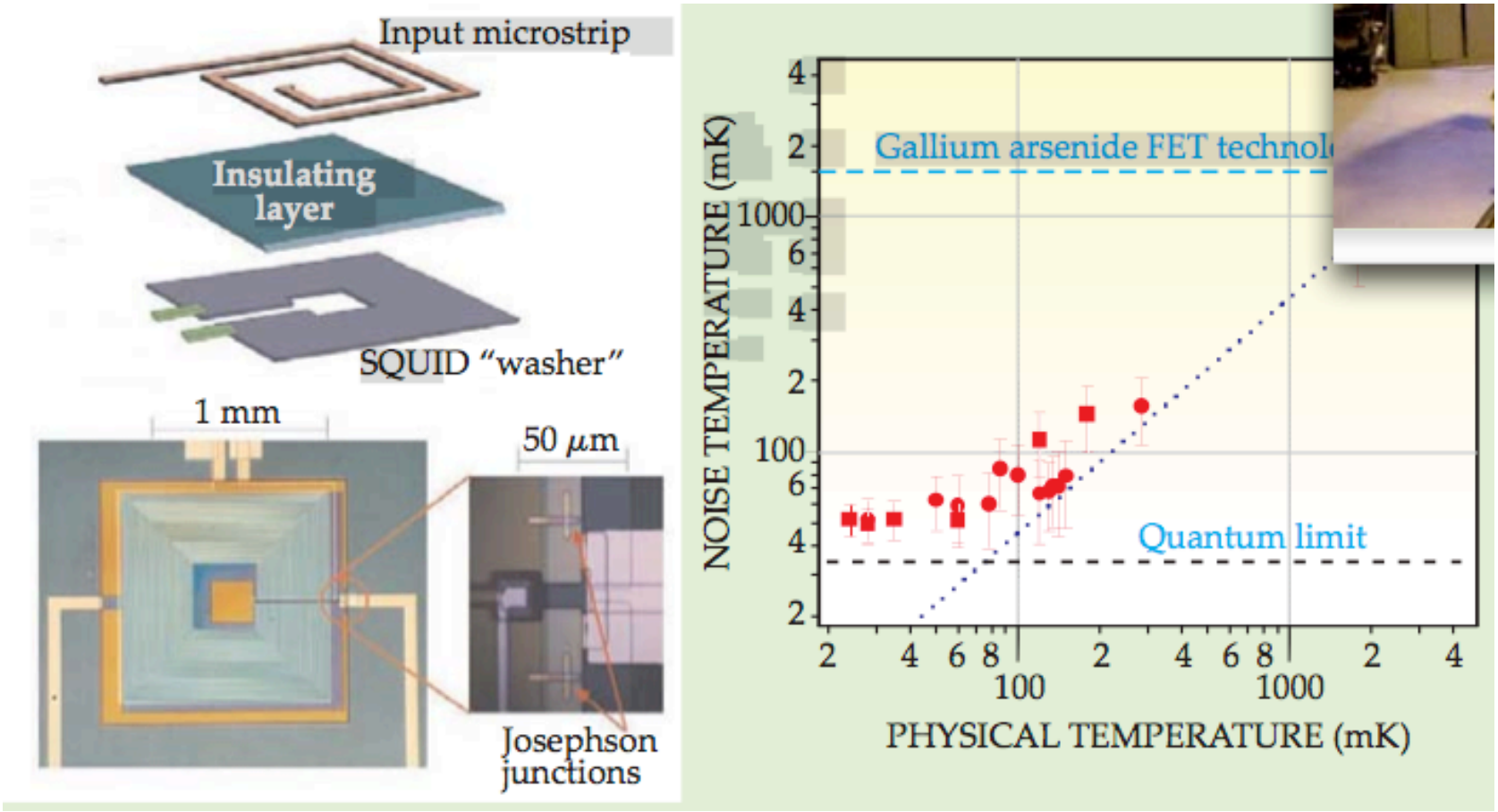
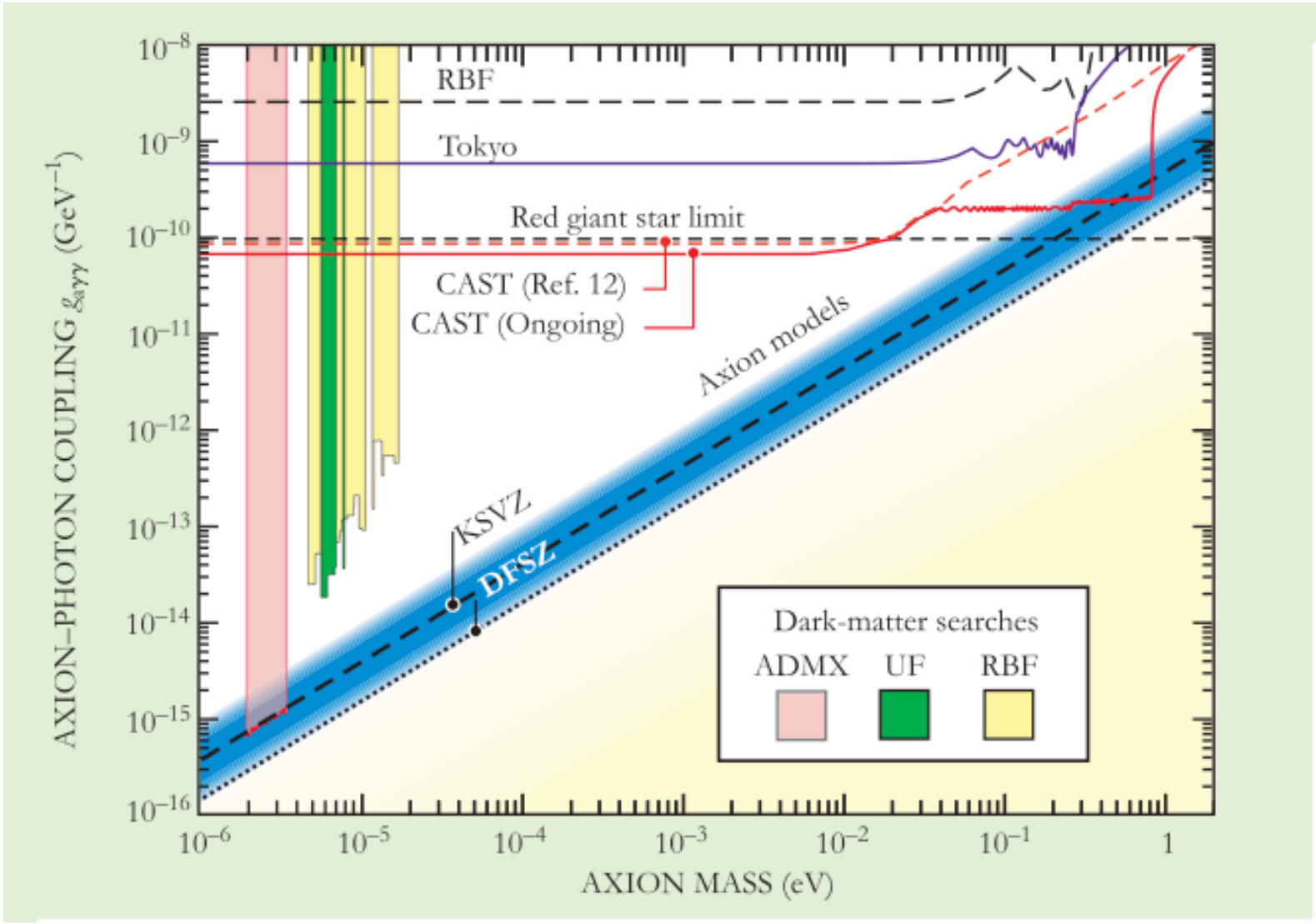
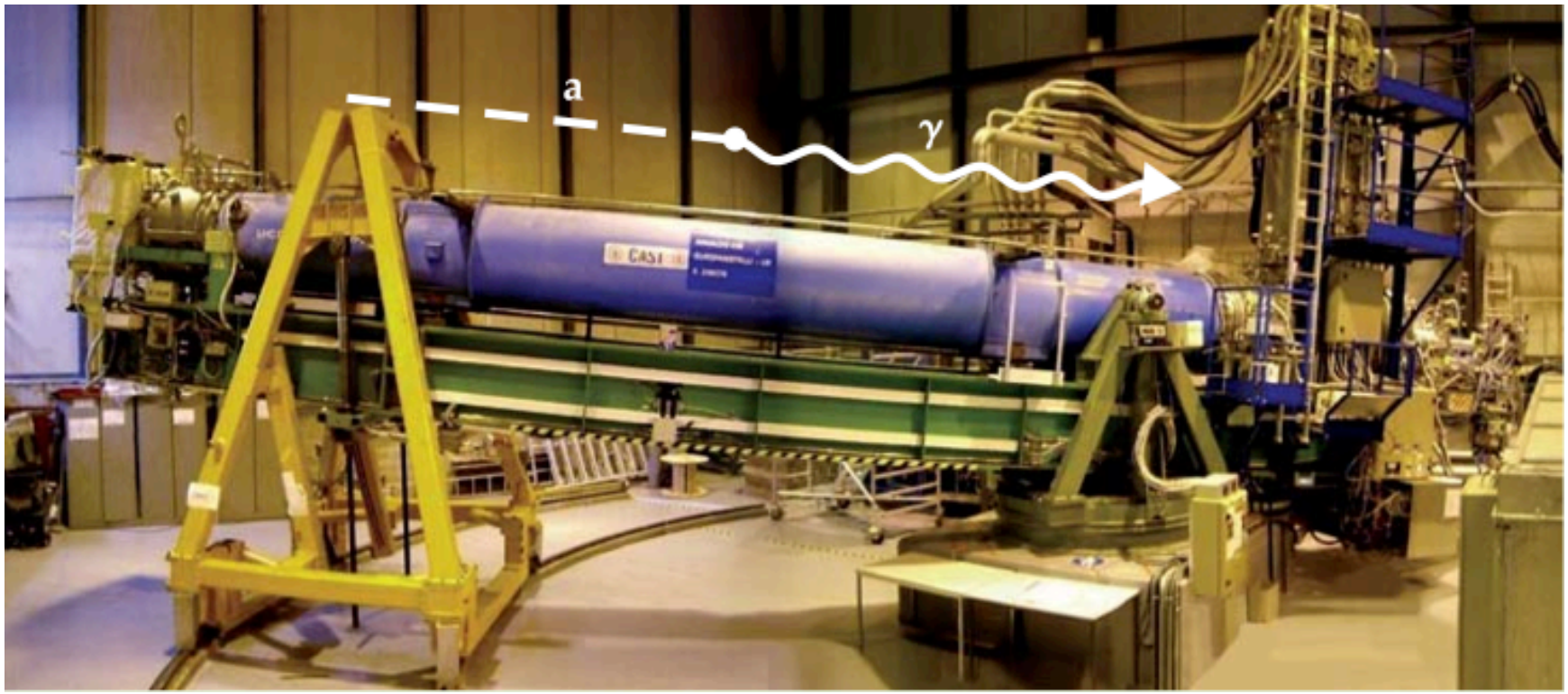


IMAGE
REJECT
MIXER #1
10.7MHz
IF
MIXER
#2
RF
35kHz AF
125Hz BIN
FFT
1.3K
HEMT
AMPLIFIER
MIXER
#3
5kHz AF
0.02Hz BIN
FFT
DISK
B_0
MAGNET
CAVITY &
TUNING RODS


Input microstrip
Insulating layer
SQUID "washer"
1 mm
50 μm
Josephson junctions
NOISE TEMPERATURE (mK)
PHYSICAL TEMPERATURE (mK)
Gallium arsenide FET technol
Quantum limit
4
2
1000
6
4
2
100
6
4
2
2
4
6
8
100
2
4
6
8
1000
2
4


RBF
Tokyo
Red giant star limit
CAST (Ref. 12)
CAST (Ongoing)
Axion models
KSVZ
DFSZ
Dark-matter searches
ADMX
UF
RBF
AXION–PHOTON COUPLING $g_{a\gamma\gamma}$ (GeV^{-1})
AXION MASS (eV)
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
10^{-15}
10^{-16}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1


a
γ
CAST

Limits on cold dark matter from the Gotthard Ge experiment

D. Reusser [a], M. Treichel [a], F. Boehm [b], C. Broggini [a], P. Fisher [b,1], L. Fluri [a], K. Gabathuler [c], H. Henrikson [b], V. Jörgens [a], L.W. Mitchell [a,2], C. Nussbaum [a] and J.-L. Vuilleumier [a]

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Received 22 October 1990

LIMITS ON COLD DARK MATTER CANDIDATES FROM AN ULTRALOW BACKGROUND GERMANIUM SPECTROMETER

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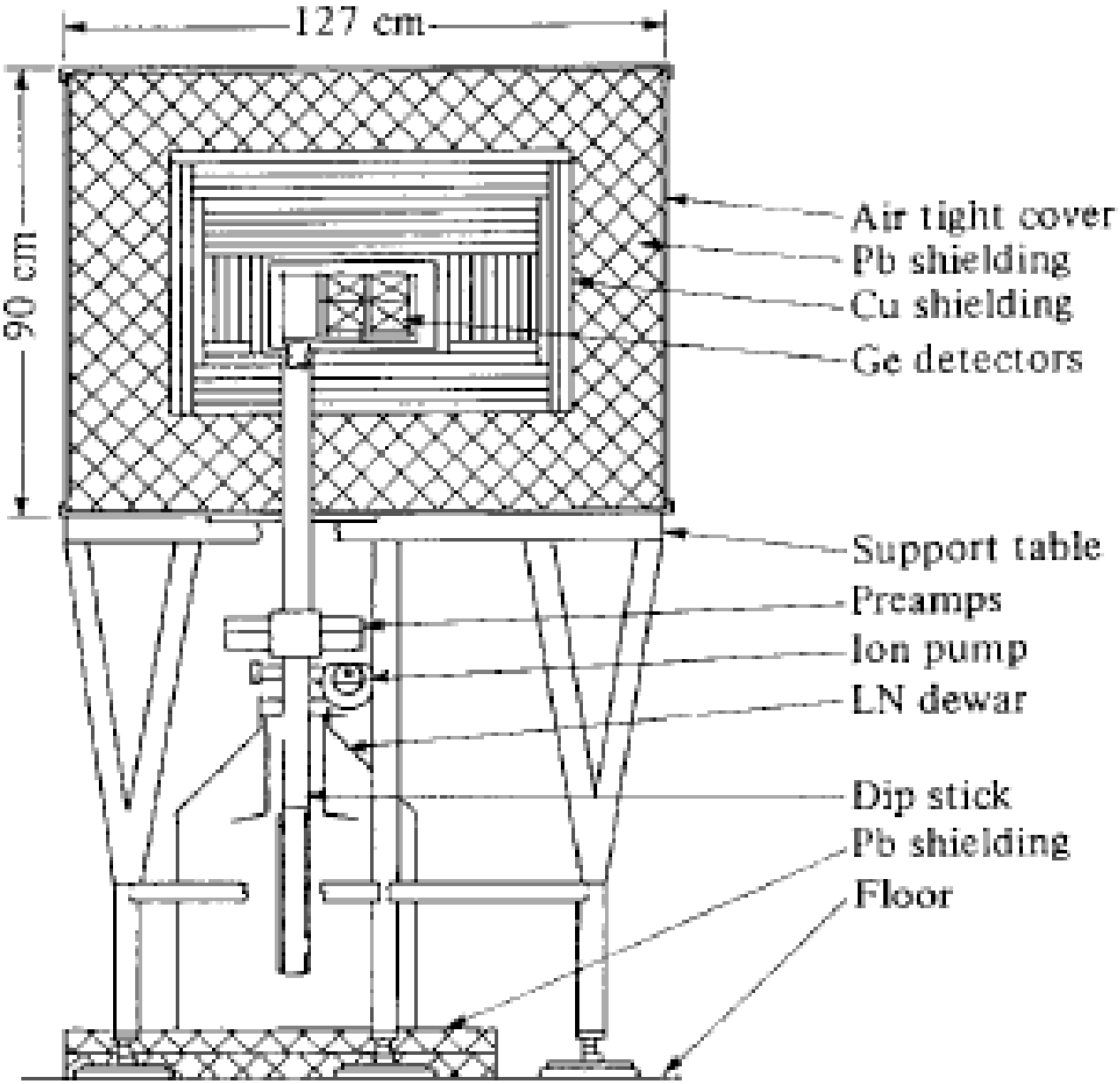
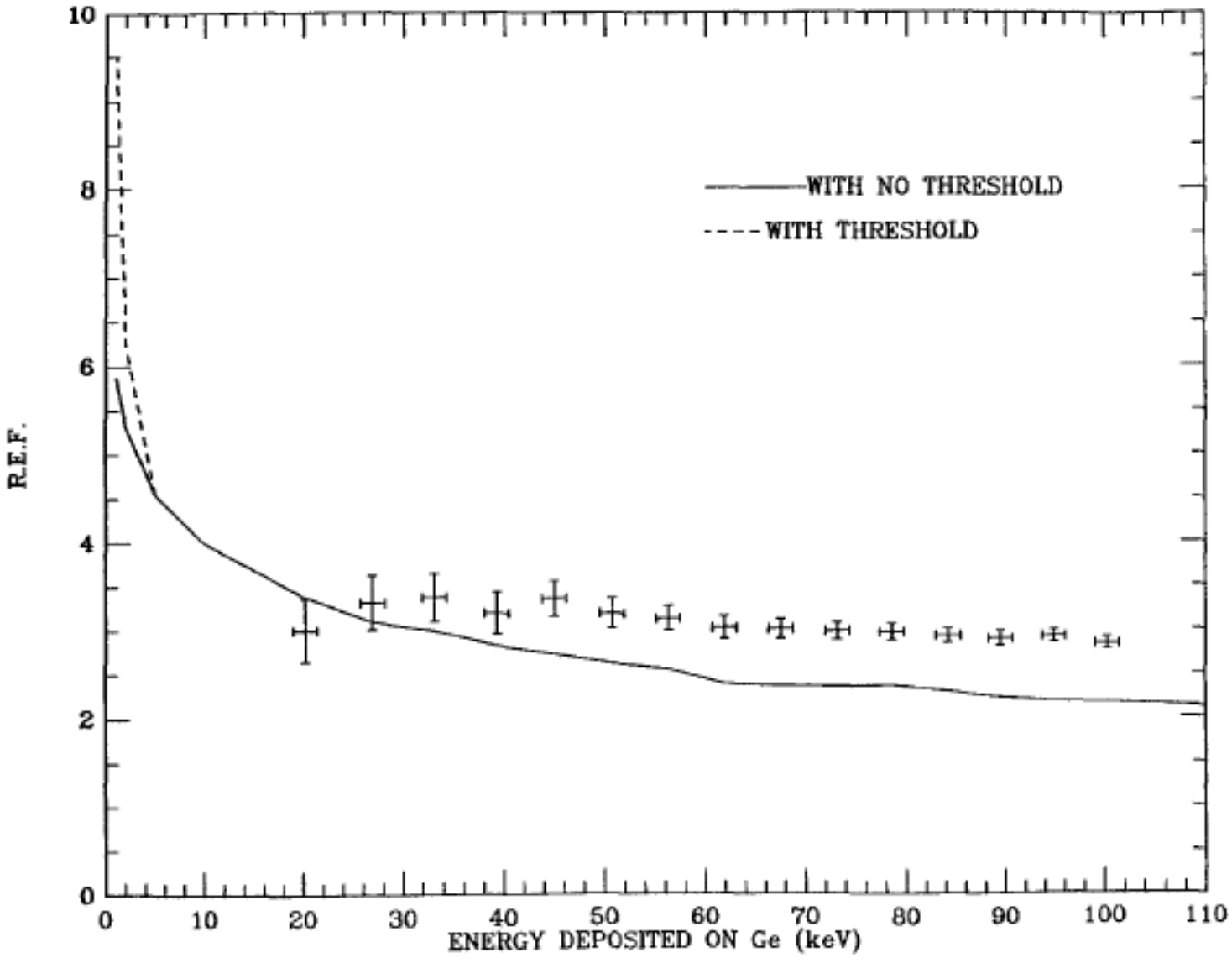
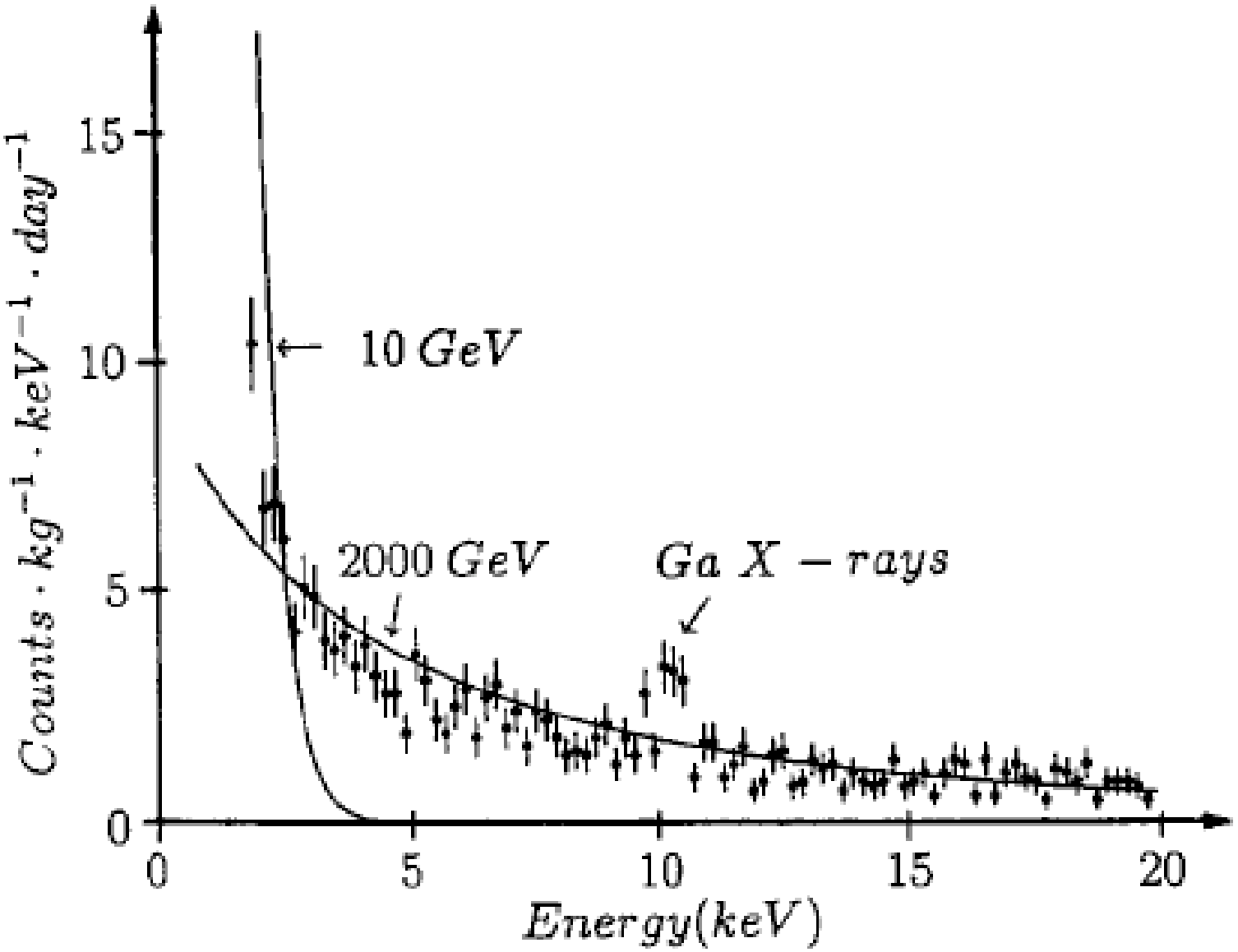
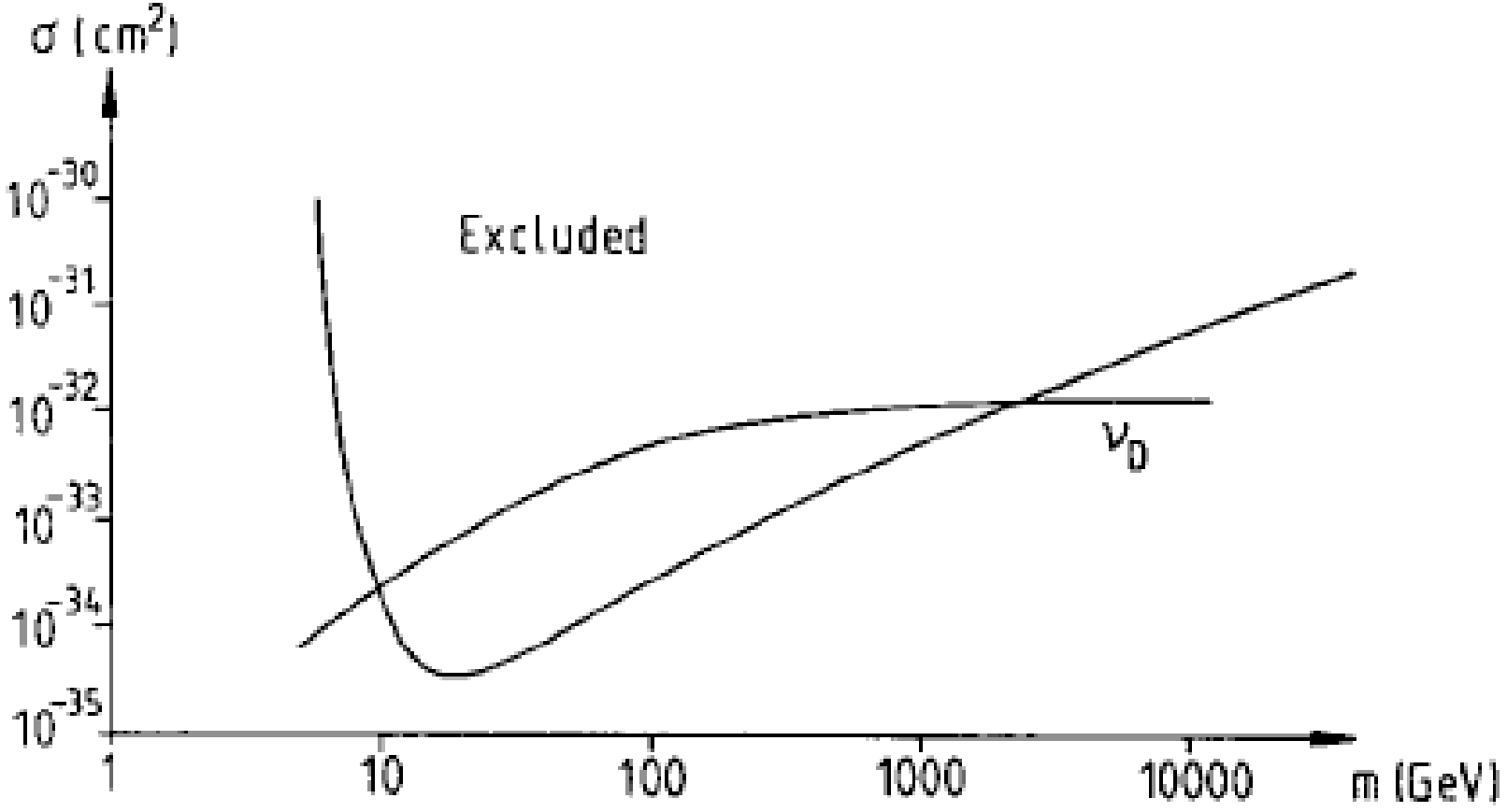
Received 5 May 1987


127 cm
90 cm
Air tight cover
Pb shielding
Cu shielding
Ge detectors
Support table
Preamps
Ion pump
LN dewar
Dip stick
Pb shielding
Floor


WITH NO THRESHOLD
WITH THRESHOLD
R.E.F.
ENERGY DEPOSITED ON Ge (keV)
0
2
4
6
8
10
0
10
20
30
40
50
60
70
80
90
100
110


$Counts \cdot kg^{-1} \cdot keV^{-1} \cdot day^{-1}$
15
10
5
0
0
5
10
15
20
$Energy(keV)$
$\leftarrow 10\,GeV$
$2000\,GeV$
$Ga\ X-rays$


σ (cm²)
10⁻³⁰
10⁻³¹
10⁻³²
10⁻³³
10⁻³⁴
10⁻³⁵
Excluded
ν_D
1
10
100
1000
10000
m (GeV)