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August 27, 1986

TO: S. Weinreb

FROM: M. A. Gordon

SUBJECT: A Case for a Direct Detection SIS Receiver

John Payne asked me to share my enthusiasm for the development of this device for millimeter wavelengths.

Enclosed are some data which I'm preparing for publication. The NRAO contributions are the observations at 230 GHz, made with the mixer and the 12-m telescope. These data are unique because of the narrow-band capability of the receiver.

For several years, the far-IR and submillimeter people have examined the emission from dust clouds associated with HII regions. A major objective is to determine the frequency dependence of the optical depth, which might lead to an identification of the material making up the dust grains.

An observational difficulty at millimeter wavelengths is the separation of the free-free emission from the nearby HII regions from the thermal emission from the dust. As you can see, the importance of the millimeter point is that it determines the slope of the long-wave side of the dust emission and, thereby, the frequency dependence of the opacity. An error in this correction could lead to a sizable error in the slope and thus in the frequency exponent.

Until the advent of the NRAO 1-mm mixer, most observations at 1 mm have been made with bolometers with resolving powers (F/B) ranging from 1.5 in the late 1970s to the present value of 10. Presently the most common value is about 3. With these enormous bandwidths, the observations integrate over a lot of free-free and dust emission -- so much that it is nearly impossible to separate them accurately to determine the true emission from the dust. The NRAO mixer has a resolving power of about 60, making it easy to perform this separation.

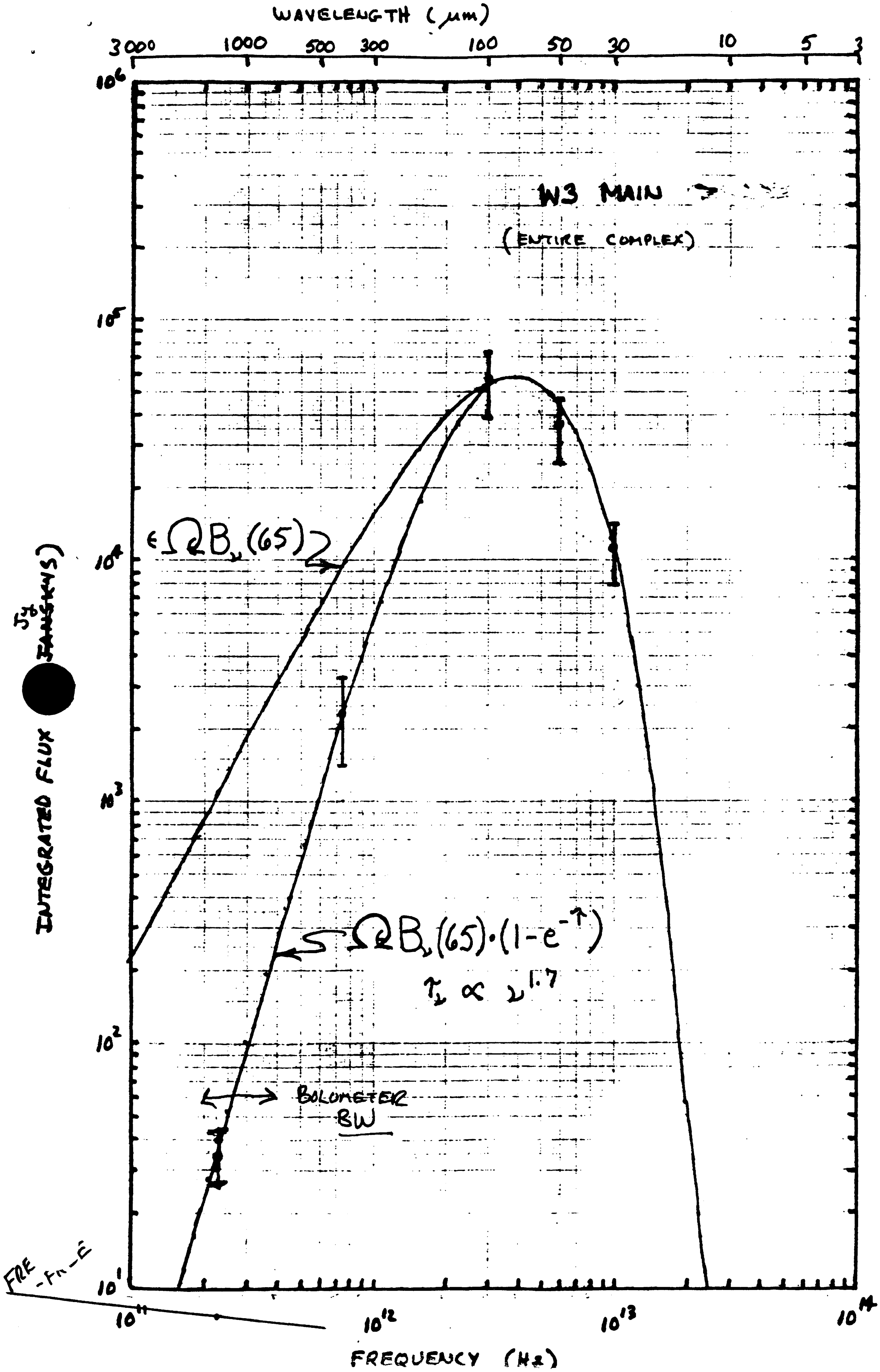
If the direct detection SIS device also has a high resolving power, I think the NRAO should build it. Bolometers may be capable of <u>detecting</u> weak sources, but the data is not worth much if there's no way of knowing the composition of the flux. I believe that, at 1 mm ,bolometers are desparation devices, that is, receivers to be used when you don't have anything else available. If you can't do decent astrophysics with the measurements, what good are they?

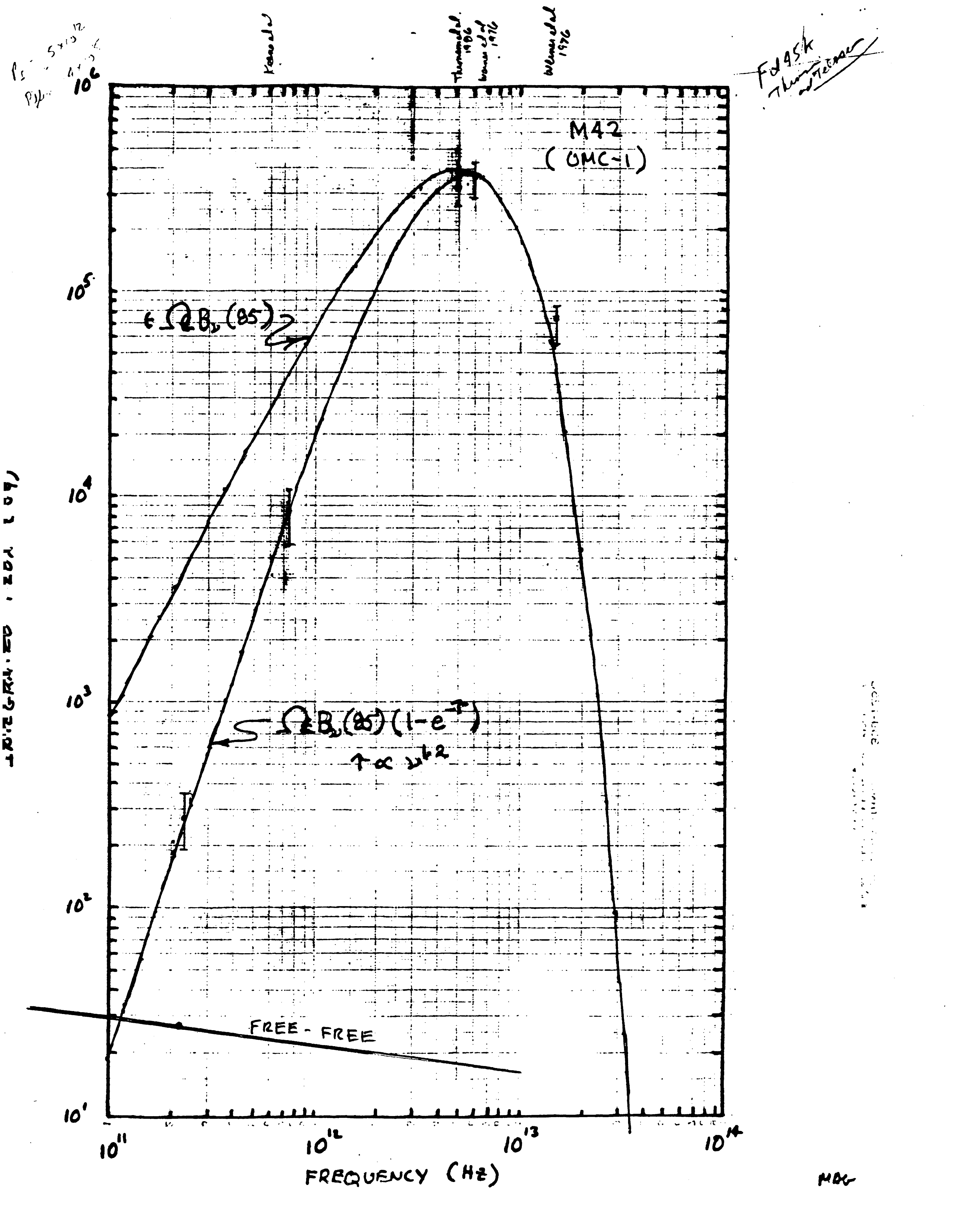
One last comment. The Caltech people have shown that there are a lot of strong spectral lines radiated from the Orion Nebula in the 1-mm window. They claim that these lines contaminate the continuum observations made there. While it is too early to know whether the Orion situation occurs generally, this is another argument for avoiding bolometers in this spectral region.

Dump the bolometer. It's taken too many man hours already, and it's apt to be astrophysically useless in many situations in the 1-mm wavelength range. Build narrow band receivers.

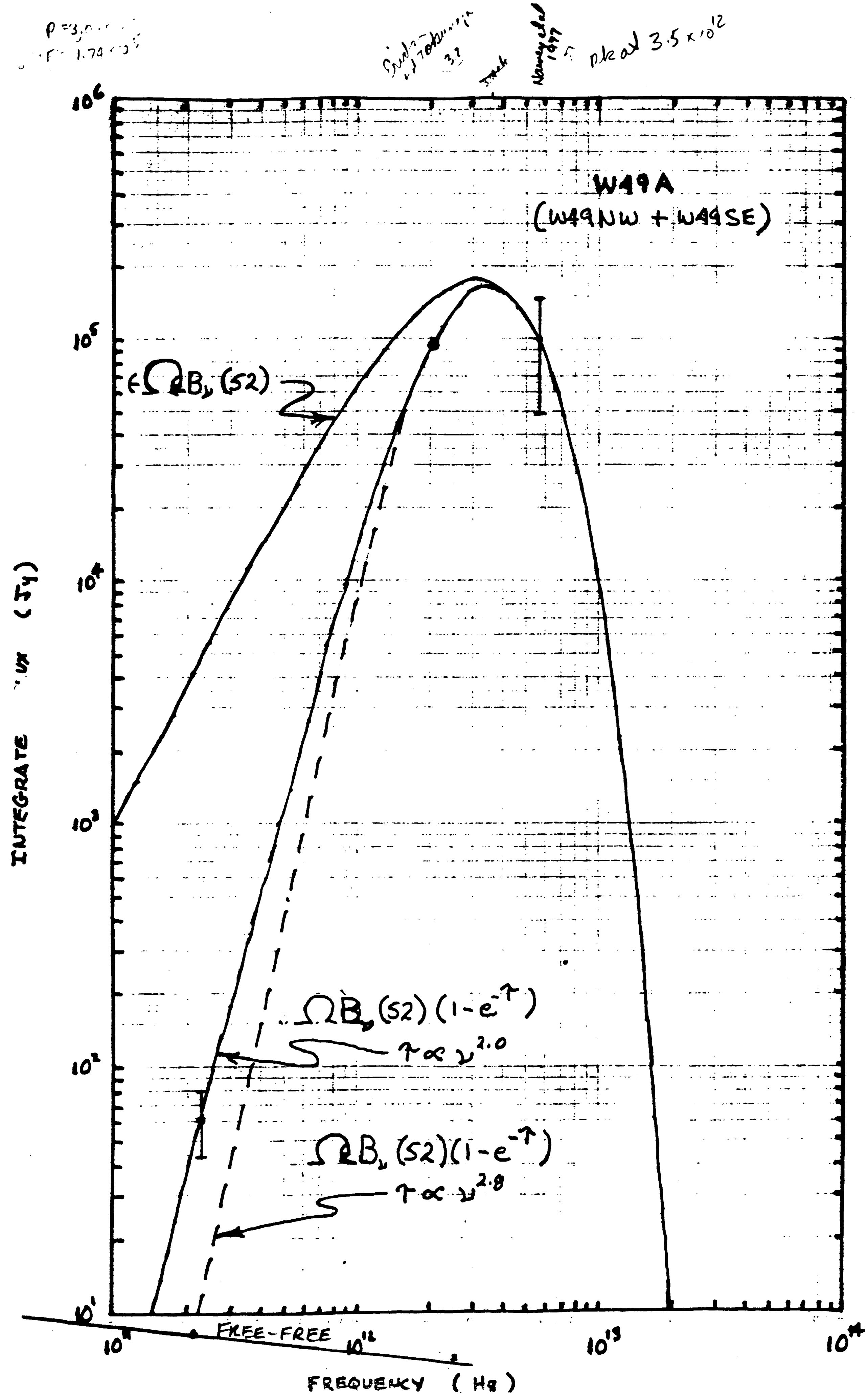
enclosures

c:
R. L. Brown
D. E. Hogg
J. M. Payne
P. A. Vanden Bout
✓ Phil Jewell

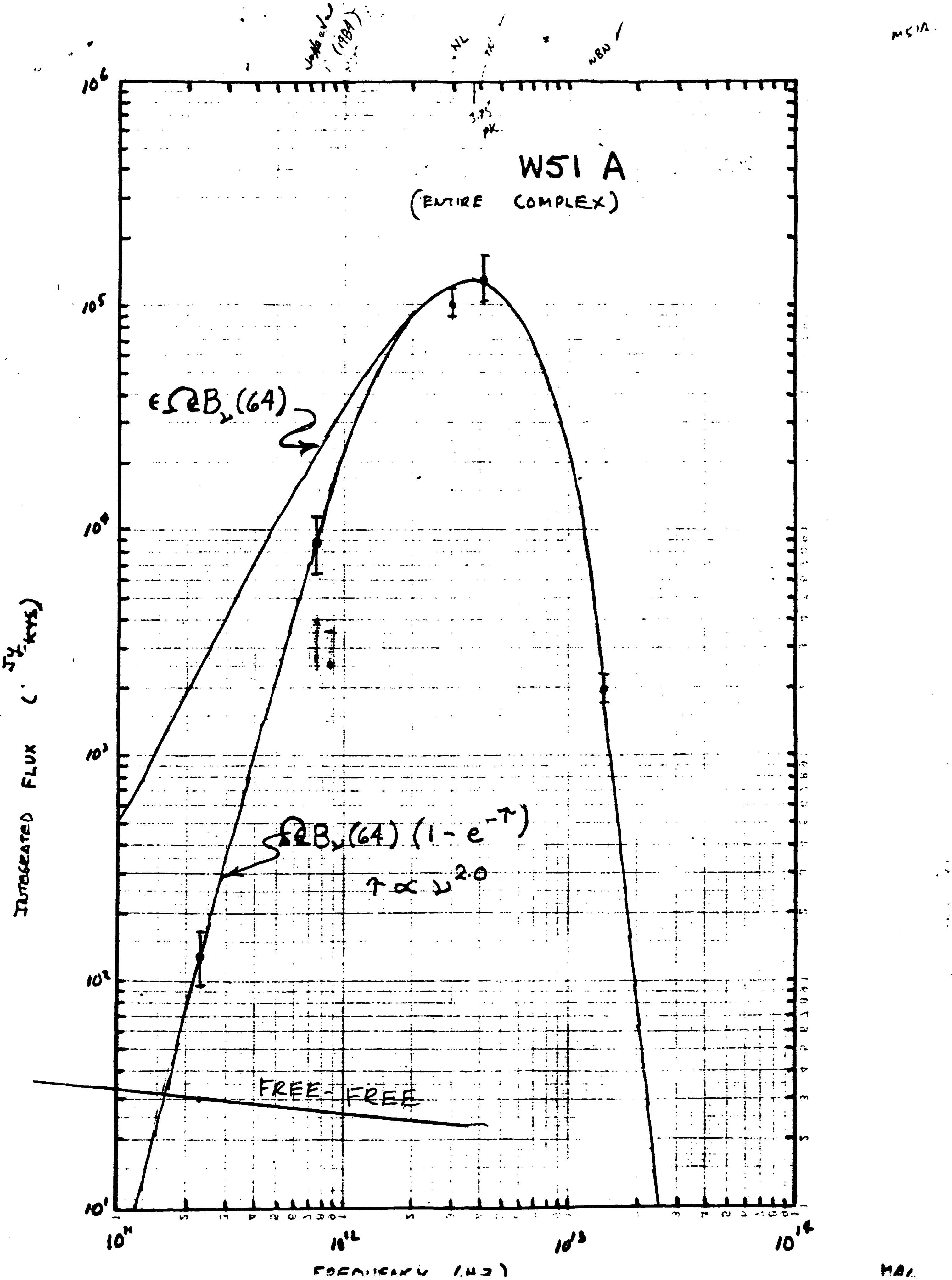

WAVELENGTH (μm)
3000 1000 500 300 100 50 30 10 5 3
W3 MAIN
(ENTIRE COMPLEX)
εΩB_ν(65)
ΩB_ν(65)·(1-e^-τ)
τ_ν ∝ ν^1.7
BOLOMETER BW
INTEGRATED FLUX Jy JANSKYS
10^6 10^5 10^4 10^3 10^2 10^1
10^11 10^12 10^13 10^14
FREQUENCY (Hz)



M42
(OMC-1)
FREE - FREE
FREQUENCY (Hz)



pk at 3.5 x 10^12
W49A
(W49NW + W49SE)
εΩB_ν(52)
ΩB_ν(52)(1-e^-τ)
τ ∝ ν^2.0
ΩB_ν(52)(1-e^-τ)
τ ∝ ν^2.8
FREE-FREE
10^6
10^5
10^4
10^3
10^2
10^1
10^11
10^12
10^13
10^14
FREQUENCY (Hz)
INTEGRATE
(Jy)


W51 A
(ENTIRE COMPLEX)
ϵΩB_ν(64)
ΩB_ν(64) (1 - e^-τ)
τ ∝ ν^2.0
FREE-FREE
INTEGRATED FLUX
10^6
10^5
10^4
10^3
10^2
10^1
10^11
10^12
10^13
10^14
3.75' PK
NL
WBN