Dear George and Edwin,

January 17

In corroborating George's flux integrations of various components in A2256 I analyzed the zero-level of the map around the cluster and became more confident of the existence of the diffuse D component.

Figure 1 shows a line printer plot of the cluster at 50cm. One unit equals 0.45 Westerbork unit. I picked four areas to determine the zero level in the NE, NW, SE and SW corners which are shown. For each area at 50cm and 21 cm I made a histogram of the distribution of intensities and these are shown on the following pages. At 610 MHz three offsets agree very well with the SE significantly higher. At 1415 MHz perhaps the SE quadrant is a bit higher. In estimating the center of each distribution I ignored the right-hand tail which is contaminated by emission from the cluster.

From the histograms I have concluded a general offset in the SE quadrant of 0.10±0.02 mJy/beam at 610 MHz and 0.02±0.02 mJy/beam at 1415 MHz. One beam area is very nearly one square arcmin. The main uncertainty of diffuse D is the knowledge of the angular size rather than its general brightness level. Ten arcmin is a reasonable guess from Figure 1 or Paper I which leads to 100 ±20 mJy at 610 MHz and 20 ± 20 mJy at 1415 MHz. The ratio of the flux density between the two frequencies [100±20/20±20] is reasonably well-determined and I believe this shows that diffuse D has a relatively steep spectral index.

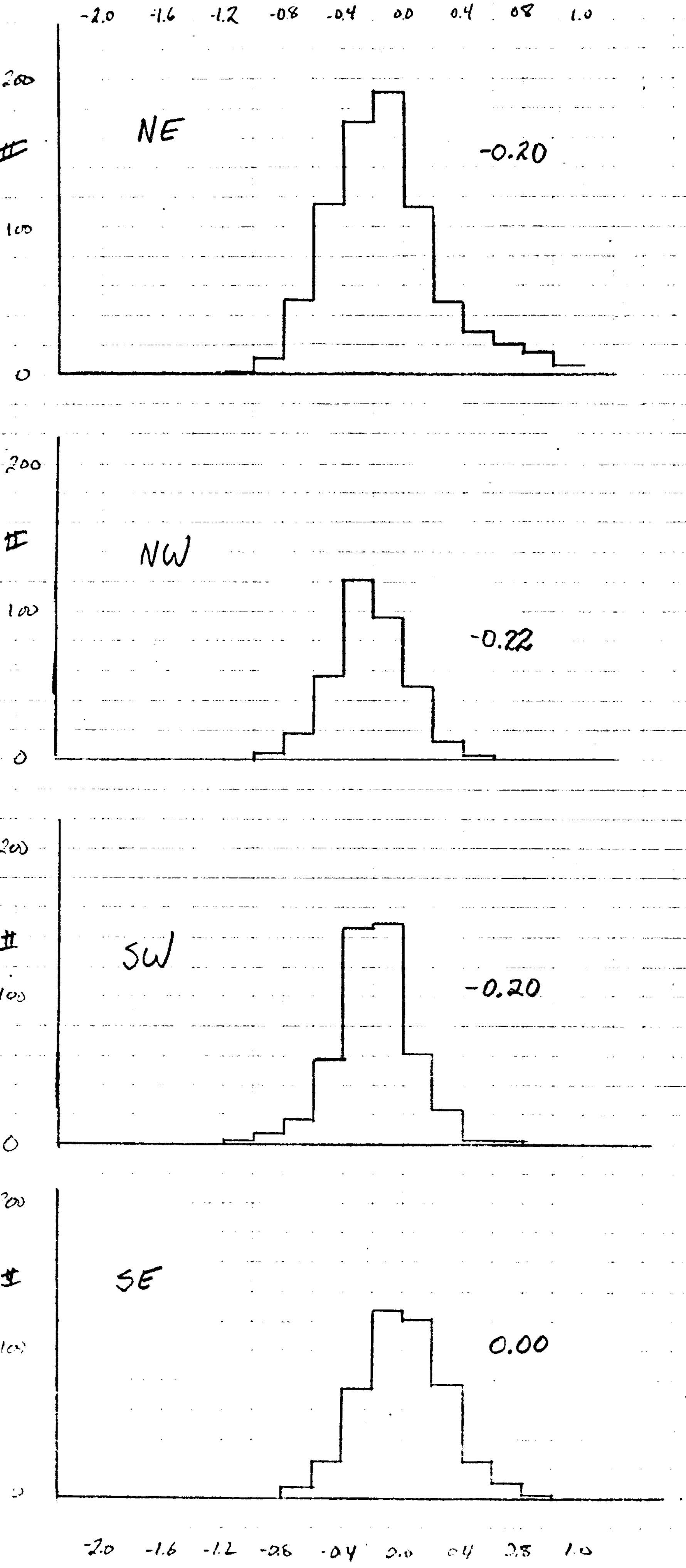
We also have a missing flux problem at both frequencies but I don't think this has any import on the existence of diffuse D.

I propose we strengthen somewhat our discussion of the diffuse D component by describing the above-mentioned analysis. I have send such a draft to Alan for inclusion in the final (?) draft.

I was, in general, happy with the version you sent from Holland with the changes made recently by Alan.

Ed F

610-MHz offset



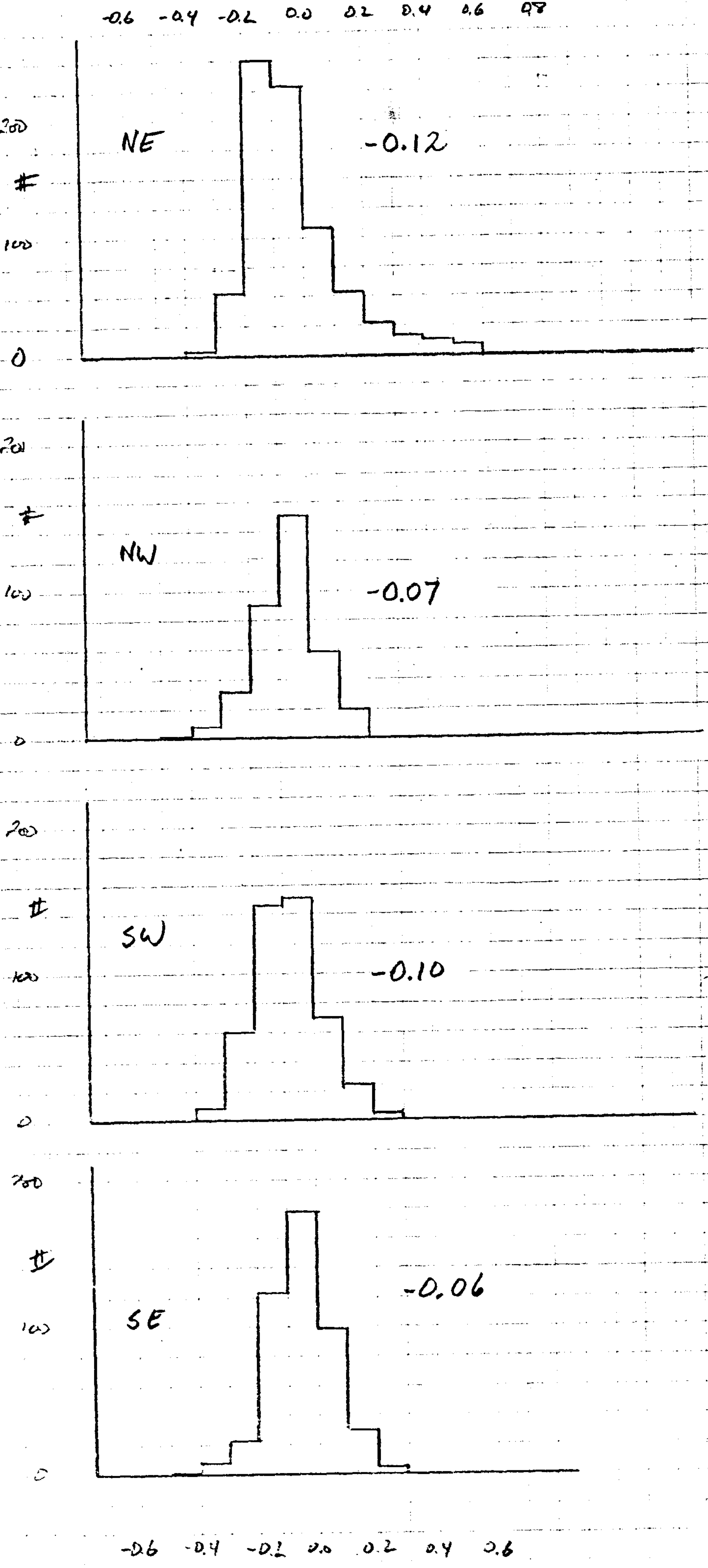
1 unit = $\frac{1}{10}$ West unit

= 0.5 mJy / beam

1415- MHz offset

1 UNIT = $\frac{1}{10}$ WESTERBORK UNIT

= 0.5 mJy / beam



MAP OFFSETS AND DIFFUSE COMPONENT D

	610 MHz	1415 MHz	
OFFSET IN MAP	-0.103±.004	-0.048±.008	mJy / beam
OFFSET NEAR D	0.000±.02	-0.030±.02	mJy / beam
excess near D	0.10±.02	0.018±.02	mJy / beam

1 beam = 7.64 cells = $7.64 \times [21.''2]^2$ = 58.″8 square

sterrewacht leiden
HUYGENS LABORATORIUM - WASSENAARSEWEG 78
Postbus 9513, 2300 RA Leiden

LEIDEN ~~2405~~ NEDERLAND
telex ~~31478~~ astro nl 39058
telefoon 071-148333 tst

December 12, 1978.

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Kingston Canada K7L 3N6

and

Ed Fomalont
National Radio Astronomy Observatory
P.O. Box 2
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Dear Alan and Ed,

Here is a revised and (hopefully!) complete version of the Abell 2256 paper.

As you see Ed and I have radically rewritten the discussion section. I have several reservations about the previous draft.

First, in my view too much emphasis was given to the thermal versus inverse Compton X-ray problem as a motivation for the observations. In fact there was little chance that the 1415 MHz measurements could have discriminated between the two hypotheses. Anyhow a thermal origin for most of the cluster X-rays is now pretty well established from the Fe observations.

Secondly, in my view (Edwin agrees) the old section IV is based on too many shaky assumptions to be very meaningful. Just to list a few

1) F(II) is imbedded in the diffuse component. It is just as likely (to me more likely) that the diffuse component is a westward extension of Source F.
2) The identification of Source F. Probably has a 1 in 3 chance of being correct.
3) The volume of the diffuse component. I do not think there is convincing evidence that it covers the 10' diameter sphere uniformly. In fact it could well be (see assumption 1) a cylinder with dimensions $\sim 7' \times 3'$. This would reduce the volume by a factor of nearly a hundred.
4) The spectral index of the diffuse component. In my view we can only say that $\alpha > 0.8$. {The 610/178 MHz extrapolation has too many uncertainties (mating of the two beams/shortest baselines etc.) to be used as anything other than a very rough guideline. Look at the difference between the two 610 MHz maps! The missing flux is critically dependent on the shortest spacing.}
5) Of course the energy bounds over which the spectrum must be integrated for both the diffuse component and Source F are also uncertain.
6) The filling factor for F(II) is unity.

Maybe one could derive conclusions using one or two of these assumptions but taken as a whole I feel that it is a bit too much.

By the way Edwin or I cannot see how you get $B = 50\mu G$ for the mag field in the diffuse component. Wouldn't pressure balance with an equipartitioned F imply that the magnetic field of the diffuse component was the same as the equipartition field of F i.e. $\sim 4\mu G$.

Regarding the luminosity function we have stuck with Edwin's magnitudes. There is a worrying disagreement between his and your magnitude scales. However, the only important question is whether Abell 2256 has an anomalous RLF or not.

Edwin's magnitudes have been derived in an exactly similar manner to those of the comparison sample of Auriemma et al.

Can you let us have comments changes etc. as soon as possible, because we would like to submit the article before HEAO-B data makes the discussion obsolete.

Wishing you both all the best for 1979.

Cheers,

George

George.

P.S. Tables 2, 3 and 4 will follow in a few days.

K+E LOGARITHMIC
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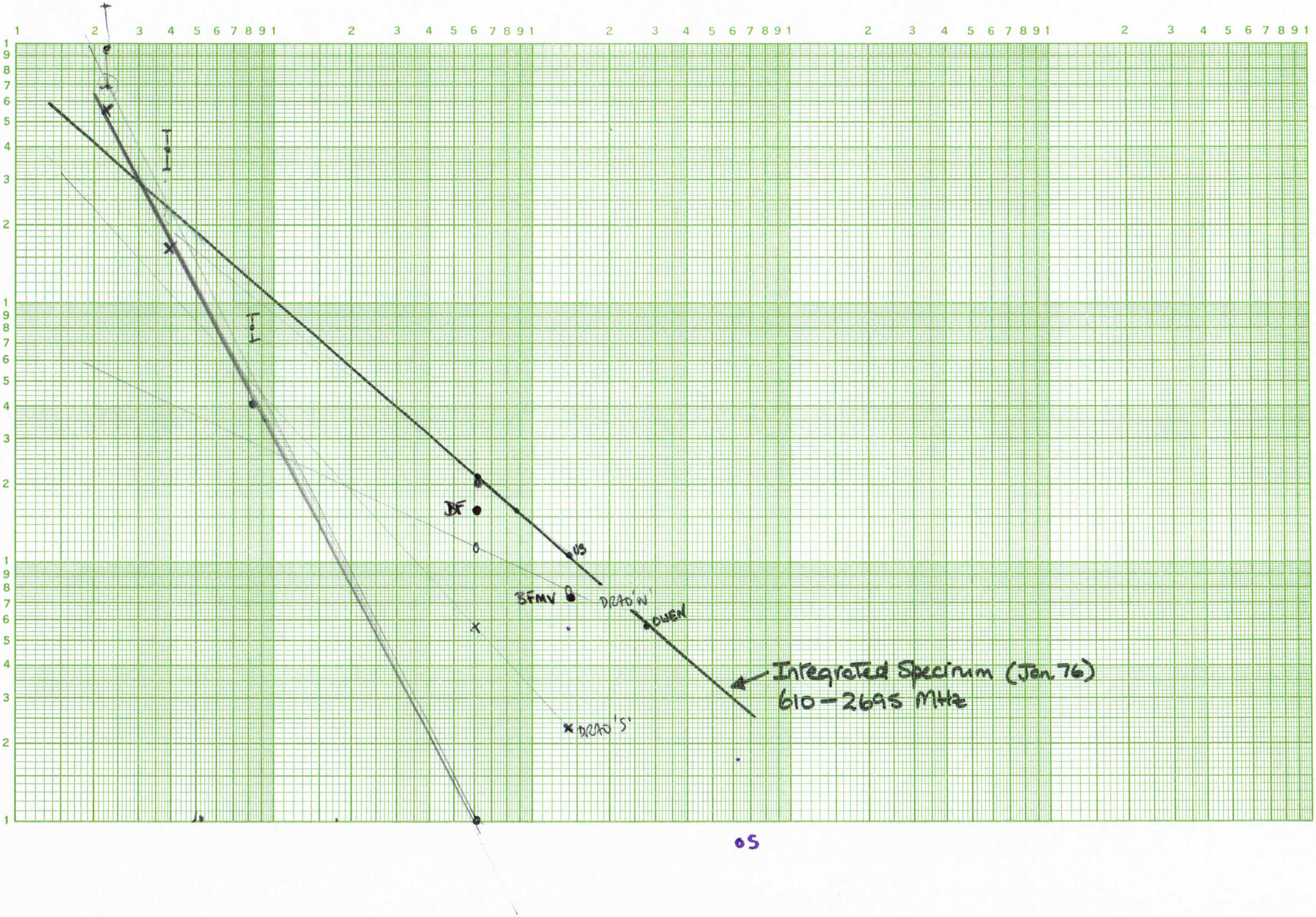
① Branson's pr law on total spectrum



Integrated Spectrum (Jan. 76)
610–2695 MHz

Sam Okoye's ICE sum

$$L_X = \frac{192\pi^3 D^2 h}{c^3 H^2} (0.29\nu_L)^{1-\alpha}\, \Gamma(\alpha+3)\, \zeta(\alpha+3) \left(\frac{kT}{h}\right)^{\alpha+3} S_{\nu_R} \left(\frac{4}{3}\nu_R\right)^{\alpha}$$

$$\times \int_{\nu_{X_1}}^{\nu_{X_2}} \nu_X^{-\alpha}\, d\nu_X$$

D = Distance to source

ν in Hz

H = magnetic field in gauss.

ν_L = cyclotron freq $= eB/m$

$\Gamma(x) = (x-1)!$ GAMMA fn.

$\zeta(x+1) = \sum_1^{\infty} n^{-x}$ Riemann ζ-fn.

$\nu_X = 2.41814 \times 10^{14} \times E_{eV}$

$$L_X = \frac{192\pi^3 D^2 h}{c^3 B^2} \left(0.29\frac{eB}{m}\right)^{1-\alpha} \Gamma(\alpha+3)\, \zeta(\alpha+3) \left(\frac{kT}{h}\right)^{\alpha+3} S_{\nu} \left(\frac{4}{3}\nu\right)^{\alpha} \times \frac{1}{1-\alpha}\left(\nu_{X_2}^{1-\alpha} - \nu_{X_1}^{1-\alpha}\right)$$

$$= 1.4638\times 10^{-54} \frac{D^2}{B^2} \Big(\overset{5.1008\times 10^{6}}{\text{~~[illegible]~~}}\, B \Big)^{1-\alpha} \Big(\qquad \Big) \atop (2.0837\times 10^{10}\, T)^{\alpha+3}$$

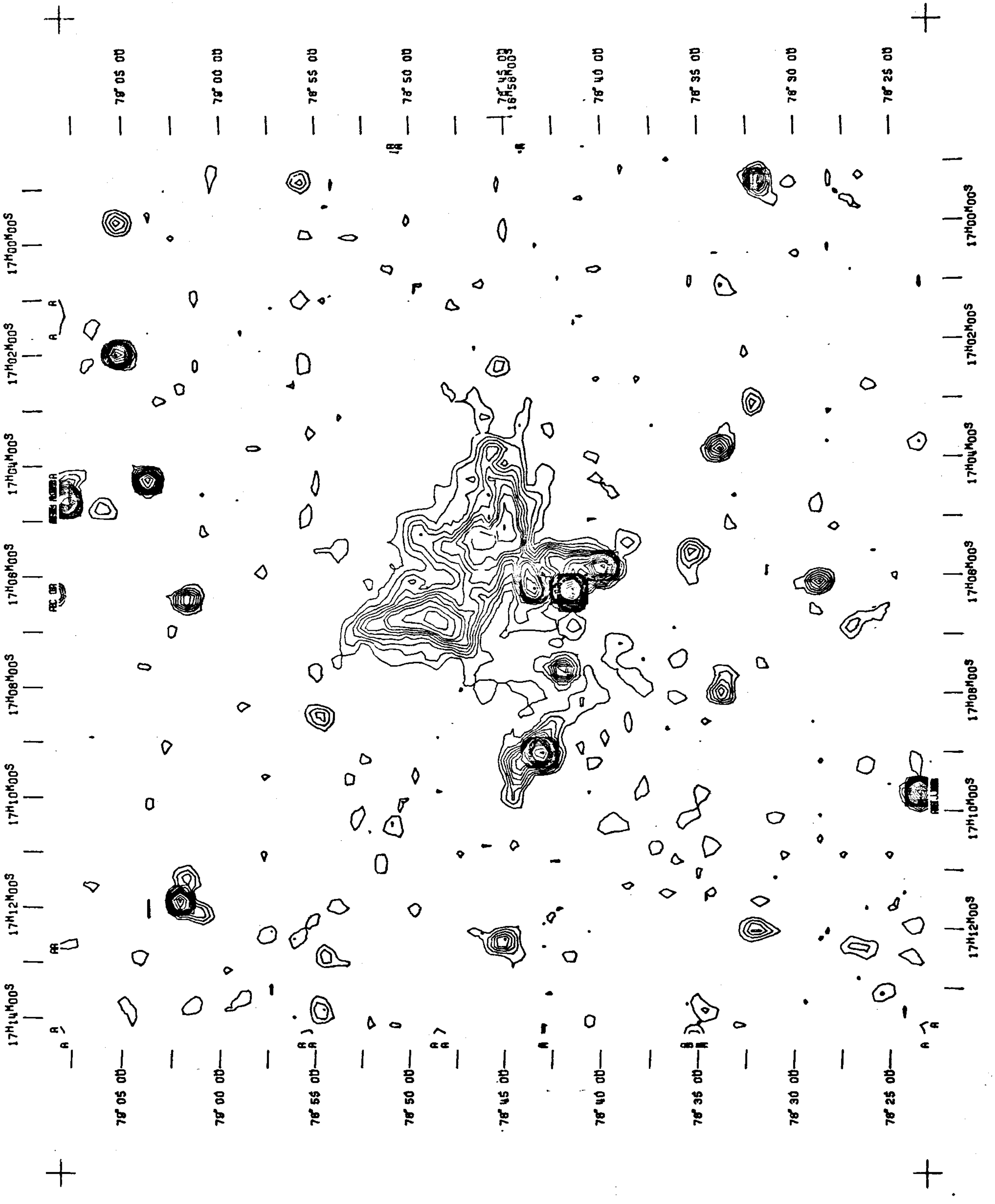
In AHB program FNL(A) calculates

$$L = 1.3938\times 10^{-28} \times \frac{D_{\rm Mpc}^2}{H_{\rm gauss}^2} \times (5.1008\times 10^{6} H)^{1-\alpha} \times \Gamma(\alpha+3) \times \zeta(\alpha+3) \times \overset{\text{in } \mathrm{W\,m^{-2}\,Hz^{-1}}\ 10^{-26}\ \equiv\ 10^{-23}\ \mathrm{erg\,cm^{-2}\,Hz^{-1}\,sec^{-1}}}{S_\nu} \left(\frac{4}{3}\nu\right)^{\alpha} \times (2.0837\times 10^{10}\, T)^{3+\alpha}$$

$$\times \frac{\left(E_{X_2}^{1-\alpha} - E_{X_1}^{1-\alpha}\right)_{(\rm keV)}}{1-\alpha} \times \underset{\text{keV}\to\text{Hz}}{(2.41814\times 10^{17})}^{1-\alpha}$$

Contains conversions Mpc → cm
Jy → erg/cm²/Hz/sec } Okoye units

AHB units ⟶



WT118.A2256 Restored 36^m+72^m map. cleaned To 1.8 w.u. Primary beam corr. done

```
GKM, 610,11, 4,         PLOT:75141(80989),       RED:75141(80381),       VOL:004504(0002)
OBS   75027,   75091,
FIELD(  0.75X  0.75),  SCALE(  0.030X  0.031),  OFFSET=0.000,
PLOT(256.59291, 78.76333),

CTVALUES        0.50,   1.00,   1.50,   2.00,   2.50,   3.00,   3.50,   4.00,   5.00,   6.00,
                7.00,   8.00,   9.00,  10.00,  12.00,  14.00,  16.00,  18.00,  20.00,  25.00,
               30.00,  35.00,  40.00,  50.00,  60.00,  70.00,  80.00,  90.00, 100.00, 110.00,
              120.00,

CTSYMBOLS       &A ,    &B ,    &C ,    &D ,    &E ,    &F ,    &G ,    &H ,    &I ,    &J ,
                &K ,    &L ,    &M ,    &N ,    &O ,    &P ,    &Q ,    &R ,    &S ,    &T ,
                &U ,    &V ,    &W ,    &X ,    &Y ,    &Z ,    &Z ,    &Z ,    &Z ,    &Z ,
```

Abell 2256 Group
Queen's 10 May 1978

Dear Ed and George,

I have now run some simulations of the 6C 151-MHz map based on our components and spectral indices, with some adjustments to get the best fit around sources S and A.

i) took our component positions and sizes, convolved to 4.2 arcmin resolution.

ii) took our predicted fluxes or modified them to improve the fit.

iii) added all components in a matrix at 1 arcmin cell size

iv) hand-contoured the matrix at the 6C contour levels.
(90mJy, then steps of +180mJy)

→ Three of six trials enclosed.

Look at them first to compare with 6C map. Then look on reverse side to see what was put in.

I will generate some text based on my interpretation of this.

Alan

Character Map: Strongest Peak = 100 units, North at bottom

"BEAM"

```
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  1  2  2  2  1  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  1  2  4  7  8  7  4  2  1  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  2  6 13 21 24 21 13  6  2  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  1  4 13 28 46 53 46 29 13  4  1  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  2  7 21 46 73 85 73 46 21  7  2  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  2  8 24 53 86$$$ 86 53 24  8  2  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  2  7 21 46 73 85 73 46 21  7  2  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  1  4 13 29 46 53 46 28 13  4  1  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  2  6 13 21 24 21 13  6  2  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  1  2  4  7  8  7  4  2  1  0  0  0  0  0  0  0  0  0  0  0
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  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
```

Queen's, 4 May 1978

Dear Ed and George

Here are preliminary comments on the 151-MHz (6C) map of A2256.

1) their estimated size for what they call "Source S" is inconsistent with this peak being simply F(i+ii+iii), as they imply. Using our spectra we expect F(i) = 190 mJy at (-104", -28"), F(ii) = 1050 mJy at (0,0) and F(iii) = 405 mJy at (117", +88") — they should see F resolved EW more than NS, whereas they deduce 240" NS by 160" EW. The "agreement" between their "integrated" flux of 1480 mJy for S and the predicted 1650 mJy for F(i+ii+iii) may therefore be illusory, as their "size" is too big and in the wrong direction.

2) what they have documented is a peak of ~ 920 mJy, coincident with F(ii), plus some surrounding emission which is more extensive S and W of their peak than it is N and E. Allowing for the probable contribution of F(iii), their map is consistent with:

a) a peak of ~ 750 mJy associated with F(ii), plus

b) approx. 1 to 1.5 Jy in an extended (~ 10 arcmin) region centred at about $17^h 08^m$, 78° 42'. Some of this (~ 0.4 Jy) is probably F(iii). Very little can be the compact component D.

3) the new 151-MHz map seems consistent with the following scenario. F(i+ii+iii) is a very old, aged, head-tail from which steep-spectrum particles are leaking into A2256. At F(ii) is a region of enhanced magnetic field producing a locally enhanced luminosity. Its spectral index is somewhat lower (~ 1.45) between 151 and 610 MHz than between 610 and 1415 MHz. The "diffuse emission near D", marginally present in the 610-MHz map, has a similar spectrum of particle energies but a lower field strength and is centred S and W of F(ii), perhaps along the F(iii → i) vector. It contains a particle reservoir with a steep spectrum and low surface

brightness, making up the broad component on the 6C map.

4) The uncertainties in the present data are such that neither the bremsstrahlung nor the Compton model is particularly favoured. Some ingredients of both models' predictions can be seen in the radio maps. We may have both a steep-spectrum compact feature (Fii) and a steep-spectrum extended feature in A2256. We obviously have large-scale particle diffusion without extensive losses (G and H) and prolonged confinement (all the head-tails) in the same cluster.

5) The idea that particle diffusion is controlled by large-scale intergalactic fields in the cluster is attractive, but I am worried about energetics of Ed Valentijn's numbers. More on this soon.

6) A high-resolution decametric map is essential to sort this spectral business out properly. We shouldn't state our conclusions too strongly in this paper.

Best wishes

Alan.

P.S. I will make some simulated 151-MHz maps to compare various interpretations with the 6C data. Should we convolve our 610-MHz map to 6C resolution?

"Model Cpts" 151MHz "<u>F goes as all</u>" <u>No</u> diffuse

	Jy	α	δ	θ_1	θ_2	P.A.	B_1	B_2	
A	1.102	17 06 18	78 41 57	15	5"	110°	4.21	4.20	in 110°
B	0.334	17 05 52	78 40 40	120[illegible]"	40"[illegible]"	~~40~~0°	4.65	4.25	in 0°
C(I)	0.341	17 06 10.5	78 43 58	94"	?	122°	4.48	4.21	in 122°
C(II)	0.487	17 04 50.0	78 45	240	20"	122°	5.80	4.21	
D	0.049	17 07 38.46	78 42 22.2	<5"	<5"		4.20	4.20	
E	0.022	17 08 30.6	78 55 06.0	<5"	5"		4.20	4.20	
F(I)	0.187	17 08 31.7	79 42 59.5	<5"	<5"		4.20	4.20	
F(II)	1.043	17 09 06.94	78 43 27	43"	43"	0°	4.26	4.26	
F(III)	0.402	17 09 47.0	78 44 54.8	<5"	<5"		4.20	4.20	
G	1.283	17 06 45	78 50 00	240	50	0°	5.8	4.28	in 0°
H	1.574	17 05 20	78 47 00	240	100	0°	5.8	4.52	in 0°
I	0.118	17 03 40	78 45 20	100	15	45°	4.52	4.20	
J	0.049	17 04 04.2	78 47 34.1	<5	<5		4.20	4.20	
K	0.071	17 05 12.0	78 50 10.0	<5	<5		4.20	4.20	
L	0.040	17 05 37.1	78 35 51.0	<5	<5		4.20	4.20	

INPUTS #

```
          Array Parms: FWHM:  30    arcsec
                       CELLS:  1    arcsec

          #   INTFLUX        RA             DEC          MAJ      MIN      PA
A         1   1102.0    17  6 18.00   78 41 57.00    4.21     4.20   110.00      252   252
B         2    334.0    17  5 52.00   78 40 40.00    4.65     4.25     0.00      279   256
C(I)      3    341.0    17  6 10.50   78 43 58.00    4.48     4.21   122.00      269   252
C(II)     4    487.0    17  4 50.00   78 45  0.00    5.80     4.21   122.00      348   253
D         5     49.0    17  7 38.46   78 42 22.20    4.20     4.20     0.00      252   252
E         6     22.0    17  8 30.60   78 55  6.00    4.20     4.20     0.00      252   252
F(I)      7    187.0    17  8 31.70   78 42 59.50    4.20     4.20     0.00      252   252
F(II)     8   1043.0    17  9  6.94   78 43 27.00    4.26     4.26     0.00      256   256
F(III)    9    402.0    17  9 47.00   78 44 54.80    4.20     4.20     0.00      252   252
G        $$   1283.0    17  6 45.00   78 50  0.00    5.80     4.28     0.00      348   257
H        $$   1574.0    17  5 20.00   78 47  0.00    5.80     4.52     0.00      348   271
I        $$    118.0    17  3 40.00   78 45 20.00    4.52     4.20     0.00      271   252
J        $$     49.0    17  4  4.20   78 47 34.10    4.20     4.20     0.00      252   252
K        $$     71.0    17  5 12.00   78 50 10.00    4.20     4.20     0.00      252   252
L        $$     40.0    17  5 37.10   78 35 51.00    4.20     4.20     0.00      252   252
          Total Flux of   7102      in 15    components
          Phase Centre:  17  6 18.00    78 41 57.00
          Weakest Peak (FU/cell): 1.24716      (FU/arcsec): 1.24716
          Strongest Peak (FU/cell): 62.3232      (FU/arcsec): 62.3232
```

Table 2 <u>0.6 to 1.4 GHz spectral data for components of Abell 2256 field</u>

	Flux Densities (mJy) →		
	610 MHz	1415 MHz	Spectral Index
A	327 ± 17	157 ± 10	-0.87 ± 0.10
B	117 ± 7	62 ± 4	-0.75 ± 0.10
C(i)	83 ± 6	39 ± 3	-0.97 ± 0.12
C(ii)	114 ± 8	48 ± 4	-1.04 ± 0.13
C	203 ± 13	87 → 8~~6~~7 ± 6	-1.01 ± 0.11
D	19.3 ± 1.5	11.0 ± 1.2	-0.67 ± 0.16
E	8 ± 2	4.4 ± 1.0	-0.73 ± 0.40
F(i)	23 ± 3	6.4 ± 1.3	-1.5 ± 0.3
F(ii)	97 ± 6	22 ± 2	-1.7 ± 0.1
F(iii)	43 ± 4	11 ± 2	-1.6 ± 0.4
F	163 ± 12	39 ± 5	-1.70 ± 0.17
G	348 ± 26	185 ± 13	-0.75 ± 0.12
H	323 ± 23	166 ± 11	-0.79 ± 0.11
I	25 ± 2	10.0 ± 1.2	-1.11 ± 0.14
J	14 ± 2	6.5 ± 1.1	-0.89 ± 0.26
K	14 ± 2	5.2 ± 1.0	-1.16 ± 0.28
L	11 ± 2	5.1 ± 1.0	-0.92 ± 0.32
Total	1572 ± 100	737 ± 51	-0.90 ± 0.11
300-ft	2050	1070 ± 110	-0.85

	610MHz		α	22.25(Jy)		
A	327		0.87	5.83 ± 2.29		
B	117		0.75	1.40		
C(I)	88		0.97	2.19	} 5.76	
C(II)	114		1.04	3.57		
D	19.3		0.67	1.78		
E	8		0.73	0.90		
F(I)	23		1.50	3.31	} 38.96	} 1.65 at 151MHz
F(II)	97		1.7	27.04		
F(III)	43		1.6	8.61		
G	348	} 1100	0.77	14.09		
H	323					
I	25					
J	14					
K	14					
L	11					
Diff D	100		1.0	2.74	→ 70.6 total	
			1.5	14.37	82.2 total	
			1.7	27.87	95.7 total	

So if Ddiff ~~has~~ same spectrum as F
→ ½ of 22MHz flux in 4 arcmin
→ ½ ———— in ~ 15 arcmin.
} Diffusion of particles through varying B fields?

10MHz - 100GHz

EQUIPARTITION SUMS IN extended cpts in A2256 $D = 340$ Mpc

	S_{610}	α	$\theta('')$	$V(cm^3)$	L(Watts)	E_{min}(J)	B_{eq}(g)	ρ_E (E/V) J
A	.327	0.87	15 5 5	2.6×10^{67}	2.9×10^{34}	7×10^{49}	1.7×10^{-5}	2.7×10^{-12}
G	.348	0.75	240 50 50	4.1×10^{70}	3.8×10^{34}	1.6×10^{51}	2.0×10^{-6}	3.8×10^{-13}
H	.323	0.79	240 100 100	1.7×10^{71}	5.2×10^{34}	2.8×10^{51}	1.3×10^{-6}	1.7×10^{-14}
I	.025	1.11	100 15 15	1.6×10^{69}	1.9×10^{33}	1.3×10^{50}	2.9×10^{-6}	8.1×10^{-14}
B	.117	0.75	120 40 40	1.3×10^{70}	1.3×10^{34}	5.1×10^{50}	2.0×10^{-6}	3.9×10^{-13}
F(II)	.097	1.7 1.35	43 43 43	5.5×10^{69} (70kpc)	2.1×10^{34}	1.3×10^{51}	5×10^{-6}	2.3×10^{-13}
D(diff)	.100	1.7	600 600 600	1.5×10^{72}	9.5×10^{33}	6.8×10^{50} 3.8×10^{52}	3.7×10^{-6} 5.3×10^{-7}	2.6×10^{-15}
	1.5ar1S1	1.8			3.4×10^{34}	5.2×10^{52}	6.1×10^{-7}	

$\rho kT = 1.38\times10^{-23}\rho T$ i.e $10^{-15} \Rightarrow \rho T = 7.3\times10^{7}$ $2\times10^{-15} \rightarrow 1.46\times10^{7}$ $T=10^{7}$ $\rho = 1.4/m^3$

$2\times10^{-13} \rightarrow$ $\rho = 140/m^3$

$= 1.4\times10^{-4}/cm^3$

	E/L (sec)
A	2.4×10^{15}
G	4.2×10^{16}
H	$8.8\times10^{[illegible]}$
I	6.8×10^{16}
B	3.9×10^{16}
F(II)	1.1×10^{7}
Diff (5.3×10^{-7} gauss)	1.8×10^{18}
(10^{-7} gauss)	1.07×10^{20}

Physical Params on A2256. 2-6 keV luminosity is 8.4×10^{44} erg/sec
8.4×10^{37} watts

Source "Diffuse".

Requires $B\sim10^{-7}$ gauss and spectrum extending down to 0.167 MHz. ($L\sim1.1\times10^{36}$ watts)

Then $E_{min}\sim1.2\times10^{63}$ ergs $\Rightarrow 1.2\times10^{56}$ joules

$\Rightarrow$ very high internal energy density in particles rel to fields.

($\sim7\times10^{-12}$ J/m^3)

If source only went to ~ 10 MHz, $L\sim2.1\times10^{34}$, $E_{min}\sim3.8\times10^{52}$, $\rho_E\sim2.6\times10^{-15}$ J/m^3,
$B_{eq}\sim5.3\times10^{-}$

Energies involved at low limit?

Compare F and "diffuse" at same energy (low end)

B_{eq} in "diffuse" = 1.6×10^{-6} gauss (to 0.167 MHz)
~ 5.3×10^{-7} gauss (to 10 MHz)

Source F [illegible] in 10 MHz limit at $B=5\times10^{-6}$ gauss is 3.53×10^{8} eV.
D diff — 0.167 MHz limit at $B=9.97\times10^{-8}$ gauss is 3.23×10^{8} eV
D diff —— 0.167 MHz limit at $B=1.6\times10^{-6}$ gauss is 8.1×10^{7} eV

ie compare 1.3×10^{51} joules
1.2×10^{56} joules
——> 3.1×10^{54} joules

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Dear Dr. Fomalont,

I have enclosed a photo-copy of the paper by myself and Colin Masson on A2256. which I hope you will find of interest. It is taken from the proof sent by MNRAS so excuse the spelling mistakes etc.

Since writing this paper we have some confirmatory evidence that our estimates of the confusion at 22MHz are about right. I was talking to Peter Dewdney about his new survey at the North Pole and he quoted a preliminary peak flux density of 66Jy It does therefore seem as if the excess low frequency flux can now all be accounted for without invoking a cluster halo.

I ~~hope~~ would be very interested in any new information that you have on this cluster, it is certainly the most interesting of the ~200 in the area of sky I have mapped so far.

Yours sincerely

Chris Mayer.

TABLE II

PARAMETERS OF EXTENDED STEEP-SPECTRUM RADIO SOURCES IN
RICH CLUSTERS OF GALAXIES, ON INVERSE-COMPTON MODEL OF SOFT X-RAY EMISSION

						-----CASE (1)-------		-----CASE (2)-------	
ABELL CLUSTER NO.	DISTANCE (Mpc)	22-MHz POWER (W.Hz^{-1})	SPECTRAL INDEX $(S \propto \nu^{-\alpha})$	RADIO DIAMETER (kpc)	2-10 KeV LUMINOSITY (erg.sec^{-1})	MAGNETIC FIELD (gauss)	TOTAL ENERGY (ergs)	MAGNETIC FIELD (gauss)	TOTAL ENERGY (ergs)
347	129	$4.1\text{x}10^{26}$	1.6	2250	$1.4\text{x}10^{44}$	$1.2\text{x}10^{-7}$	$2.5\text{x}10^{61}$	$6.0\text{x}10^{-8}$	$1.1\text{x}10^{61}$
401	400	$2.4\text{x}10^{27}$	1.7	5800	$1.3\text{x}10^{45}$	$1.2\text{x}10^{-7}$	$2.7\text{x}10^{62}$	$3.9\text{x}10^{-8}$	$8.8\text{x}10^{61}$
1367	124	$3.1\text{x}10^{26}$	2.3	1440	$1.1\text{x}10^{44}$	$2.1\text{x}10^{-7}$	$3.8\text{x}10^{61}$	$7.6\text{x}10^{-8}$	$8.5\text{x}10^{60}$
1656	138	$3.5\text{x}10^{26}$	1.4	1810	$5.7\text{x}10^{44}$	$6.4\text{x}10^{-8}$	$5.6\text{x}10^{61}$	$2.7\text{x}10^{-8}$	$4.4\text{x}10^{61}$
2256	400	$1.1\text{x}10^{27}$	1.2	1750	$1.0\text{x}10^{45}$	$7.4\text{x}10^{-8}$	$5.4\text{x}10^{61}$	$3.5\text{x}10^{-8}$	$7.0\text{x}10^{61}$