Spectra of pulsars

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THE RADIO FREQUENCY SPECTRA OF DISCRETE RADIO SOURCES

R. G. Conway, K. I. Kellermann and R. J. Long

M.N., (1963)

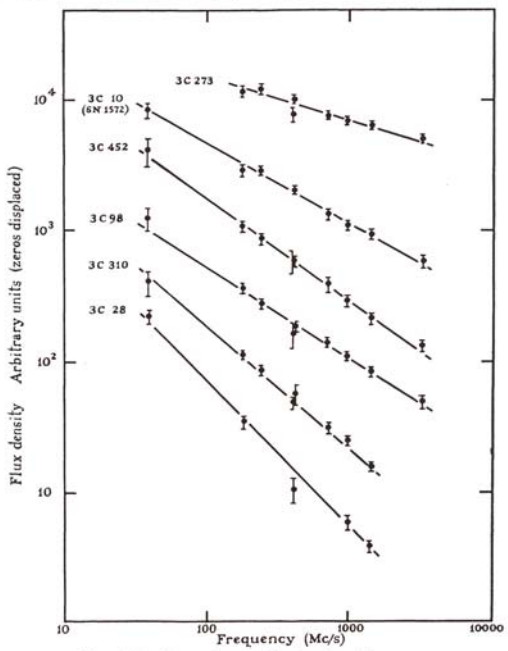

FIG. 3 (*a*).—*Spectra of some of the class* S *and* S_1 *sources.*

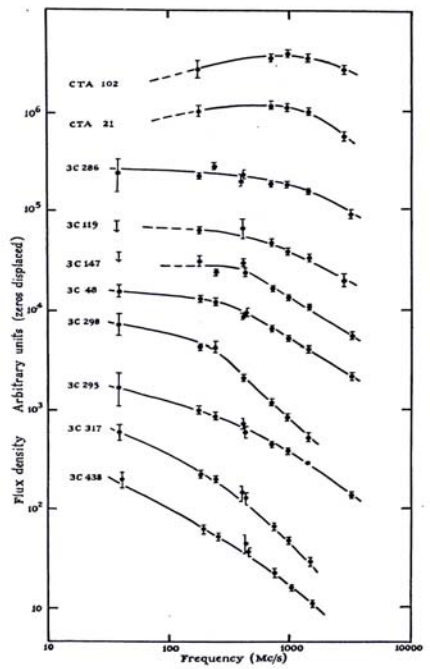

FIG. 3 (*c*).—*Spectra of all sources definitely classed as* C *except Cyg A.*

This work established the non-thermal (synchrotron) nature of emission in radio sources. Similar spectral studies established the same emission process to be responsible for the radio waves from the Galaxy. Hopes to repeat this for pulsars have albeit failed.

First pulsar spectrum
for CP1919

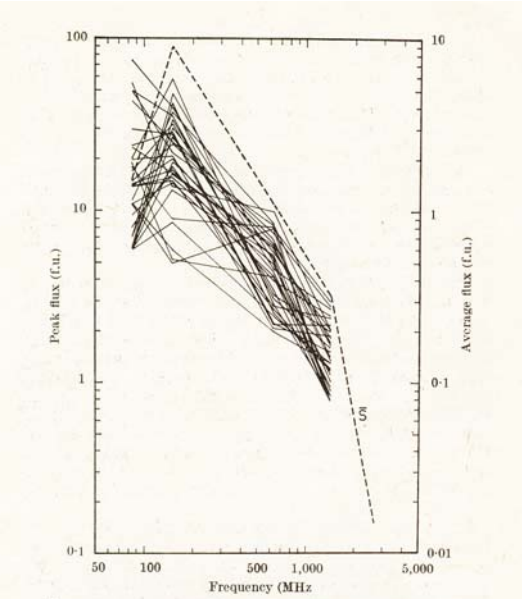

Fig. 4. Spectra of individual pulses between 85 and 1,410 MHz (peak flux scale refers to the continuous lines). The dashed line shows the average pulse height on March 25 integrated over 20 min near 20h sidereal time (average flux scale). The 2,700 MHz measurement was

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B. F. C. Cooper
F. F. Gardiner
CSIRO Division of Radiophysics,
Sydney.
R. Wielebinski
T. L. Landecker
School of Electrical Engineering,
University of Sydney.

Nature, (1968)

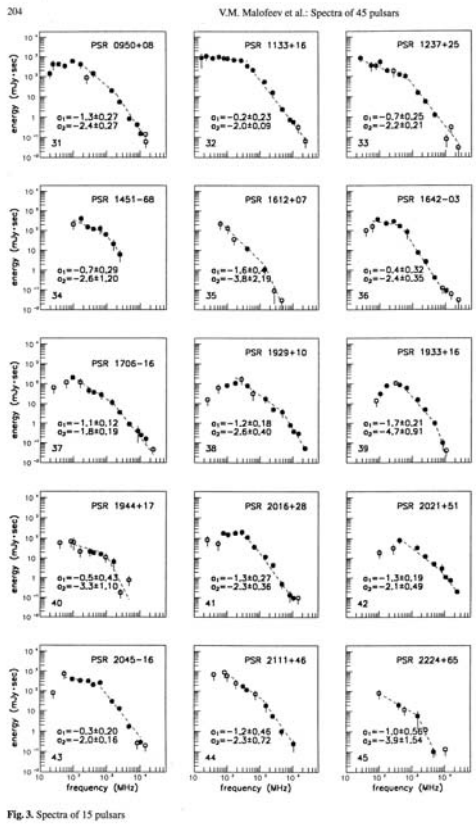


Fig. 3. Spectra of 15 pulsars

Some spectra of 45 pulsars from Malofeev et al. (1994). All points above 1.4 GHz are from Effelsberg

There are many problems in determining pulsar spectra correctly

- Time variability (e.g. Stinebring et al., 2000)
- Polarization (Manchester, 1971; Xilouris et al.,1995)
- Signal/noise at high radio frequencies
- Moding, Fading, New components, etc.

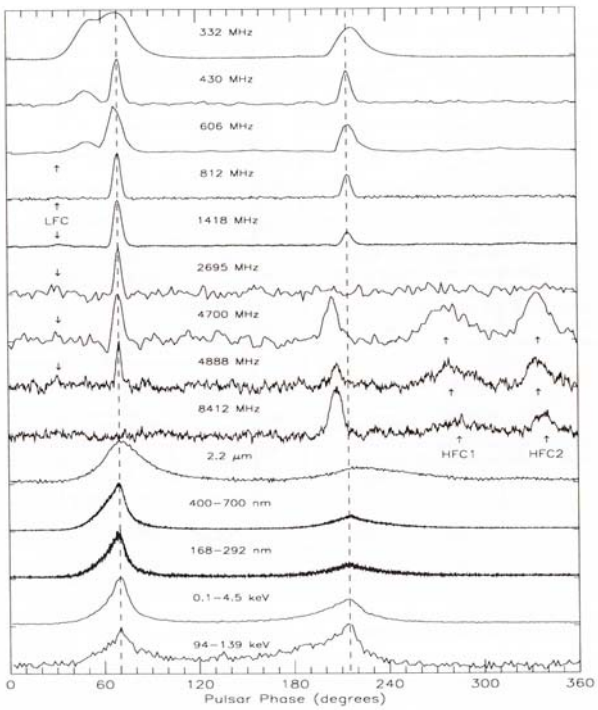
The general opinion is that the spectral index of pulsars is α ~ -1.8 in middle frequency range; (Seiradakis & Wielebinski, A&A Rev, 2004)

some pulsars show a low frequency turn-over;

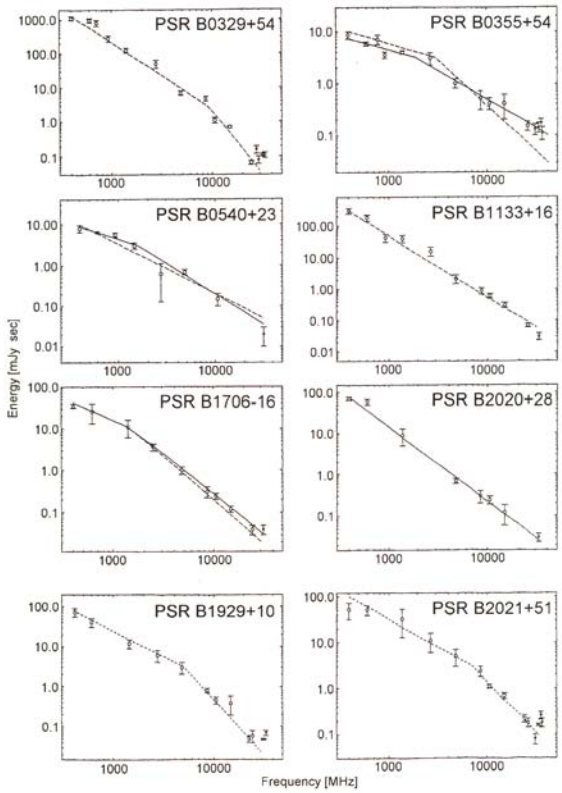
some pulsars show a high frequency break;

some pulsars appear to have a specral turn-up at the highest radio frequencies (short mm-wavelengths)

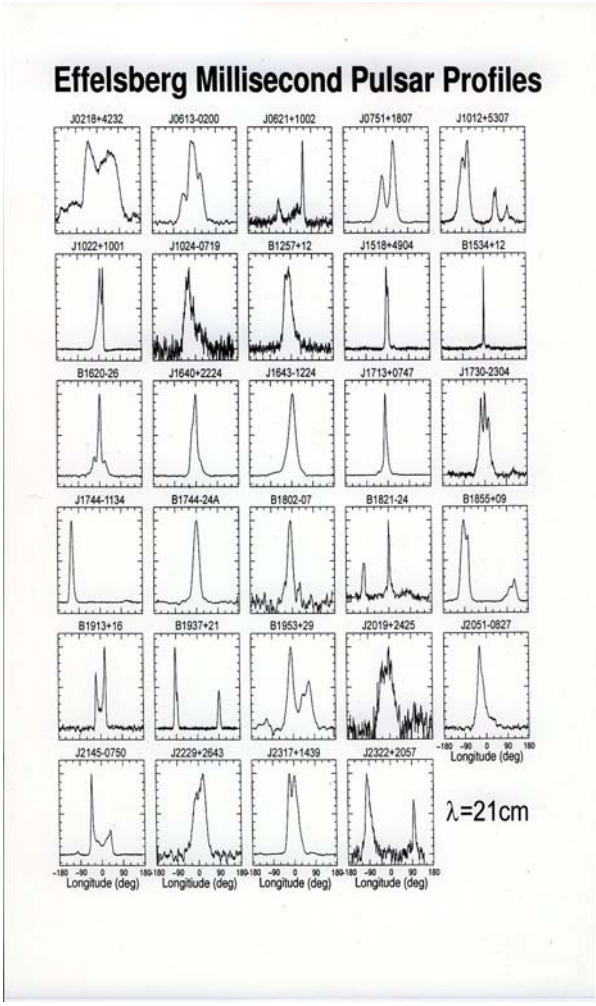
The special case: frequency evolution of the Crab pulsar



(courtesy T.Hankins)



Kramer et al. spectra of pulsars detected at mm waves



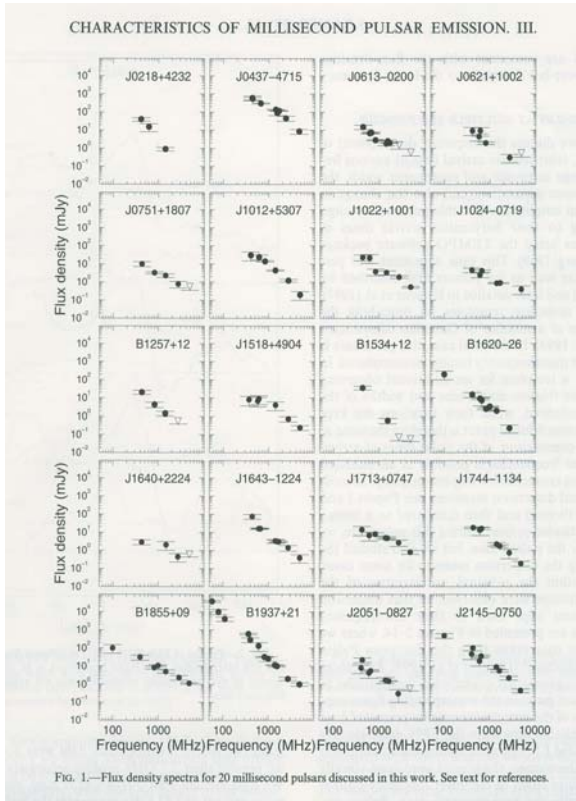


FIG. 1.—Flux density spectra for 20 millisecond pulsars discussed in this work. See text for references.

Spectra of millisecond pulsars From Kramer et al. (1998)

New work by Malofeev, Wielebinski, et al. (in preperation) for 47 millisecond Pulsars suggests that some objects have turn-over, others spectral break, like slow pulsars

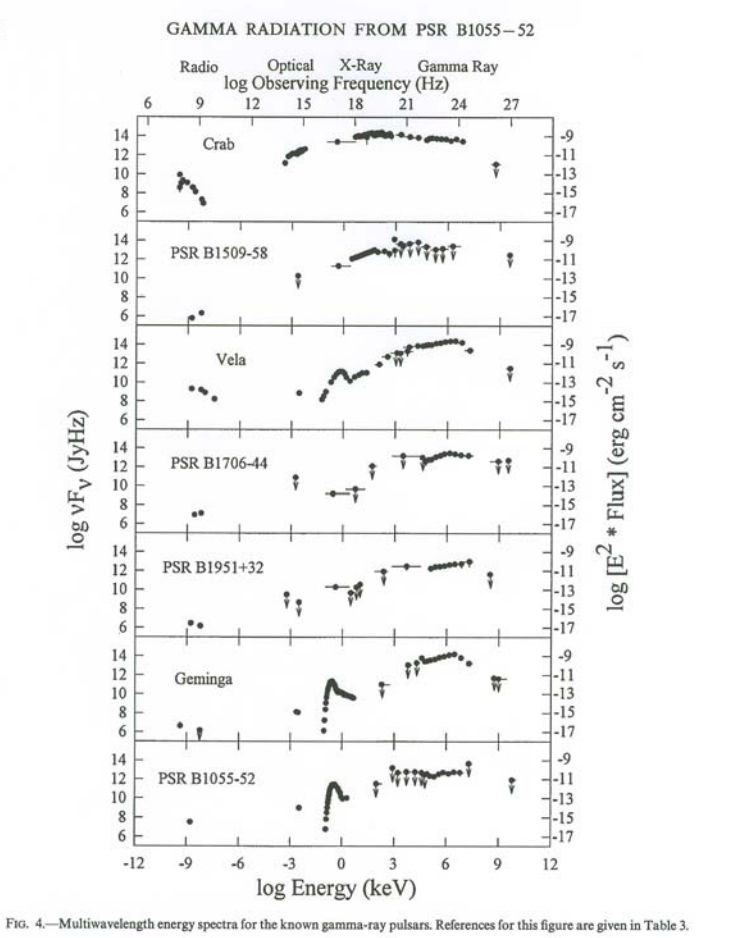


FIG. 4.—Multiwavelength energy spectra for the known gamma-ray pulsars. References for this figure are given in Table 3.

pulsar radio – gamma spectra
D.J.Thompson et al. (1999)

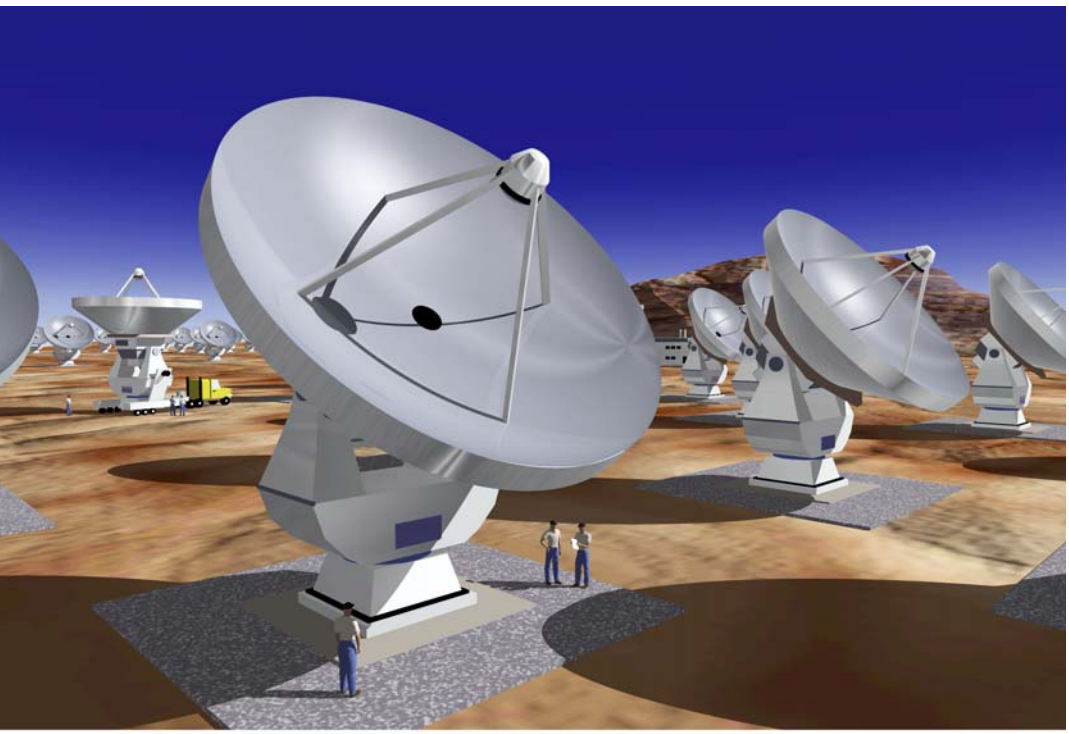
New radio values from Simon Johnston:

	1.4 GHz	3.1 GHz	8.4 GHz
1509-58	1.66 mJy	0.46 mJy	no det.
1706-44	7.3	5.9	5.5

Spectra at radio frequencies are steep in all the new cases
Geminga was claimed as detection by Pushino observers but as yet not confirmed by other telescopes.

Recent observations at 230 GHz by Löhmer et al. A&A 425, 763 (2005) had no detections for the planet pulsar but also not for several 'calibration' objects.

Recent 9mm work in Effelsberg gave 3 new detections and set 12 upper limits (Löhmer, Kramer, et al., in prep.)



Artist's Impression of ALMA
(Atacama Large Millimetre Array)

ESO PR Photo 24a/99 (8 June 1999)

ALMA may hold the key to extend the pulsar spectra from radio to optical range.
Observations at 345 GHz and 810 GHz should be possible.