

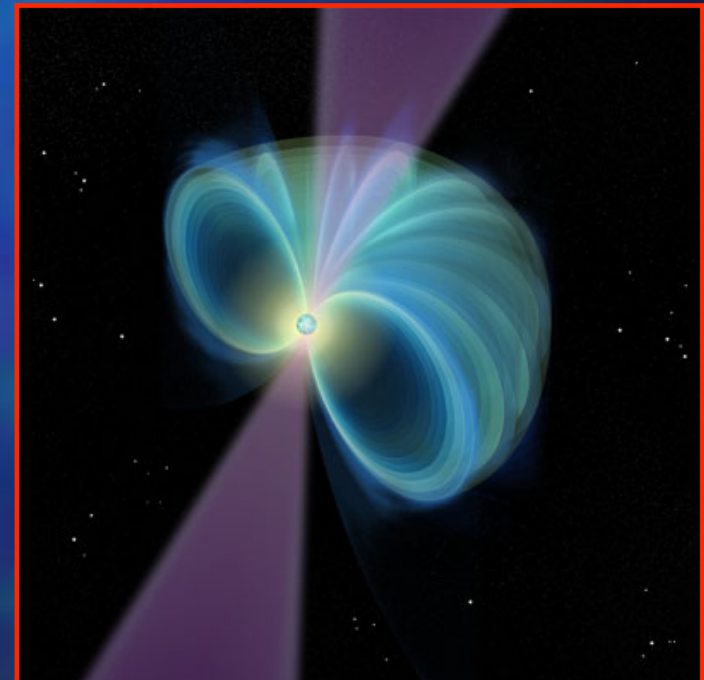
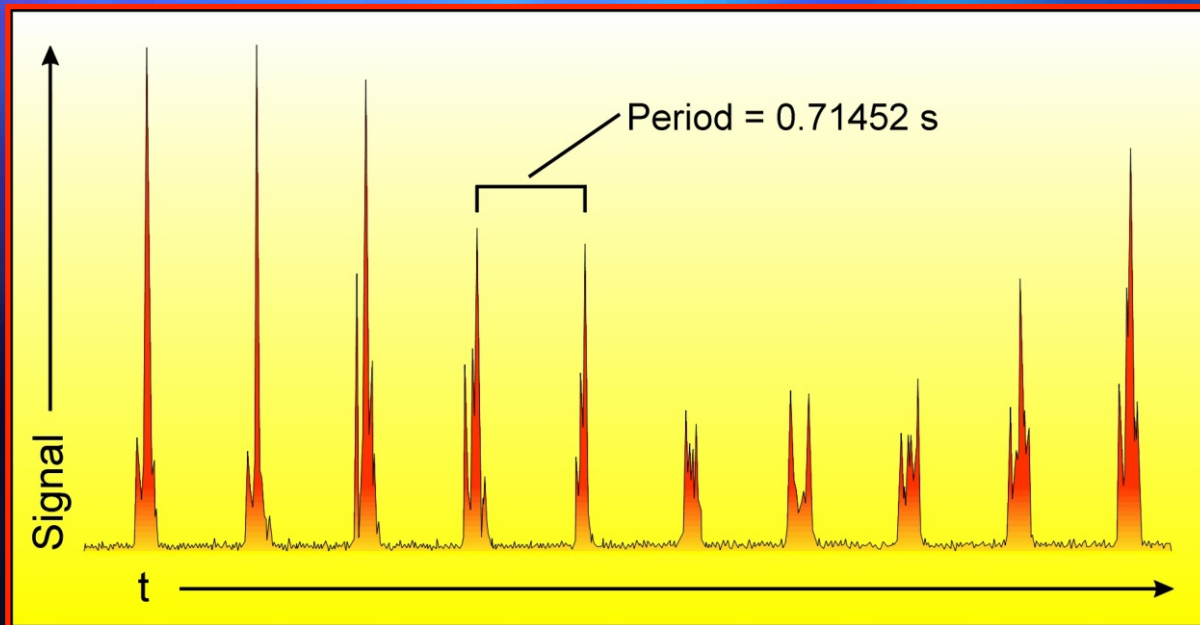
The Tzioumis Conferences at Kerastari.

The Labyrinth of the Unexpected: Unforeseen treasures in impossible regions of phase space

Early Pulsar searches



John H. Seiradakis
Laboratory of Astronomy, Department of Physics
Aristotle University of Thessaloniki

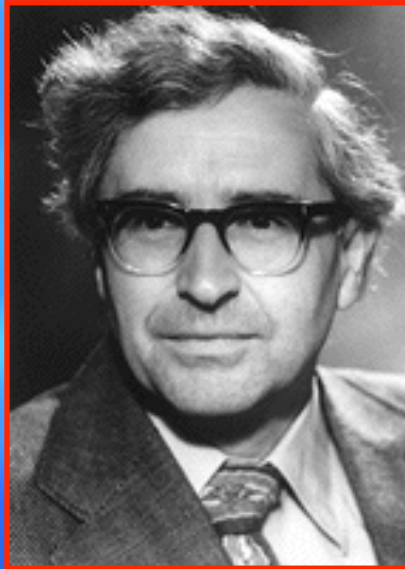


The detection of Pulsars in 1977

Jocelyn Bell-Burnell – Antony Hewish

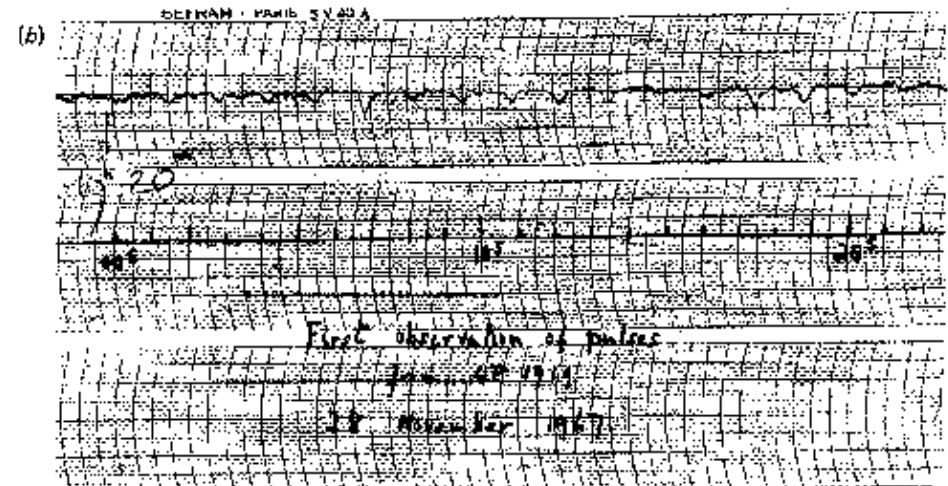
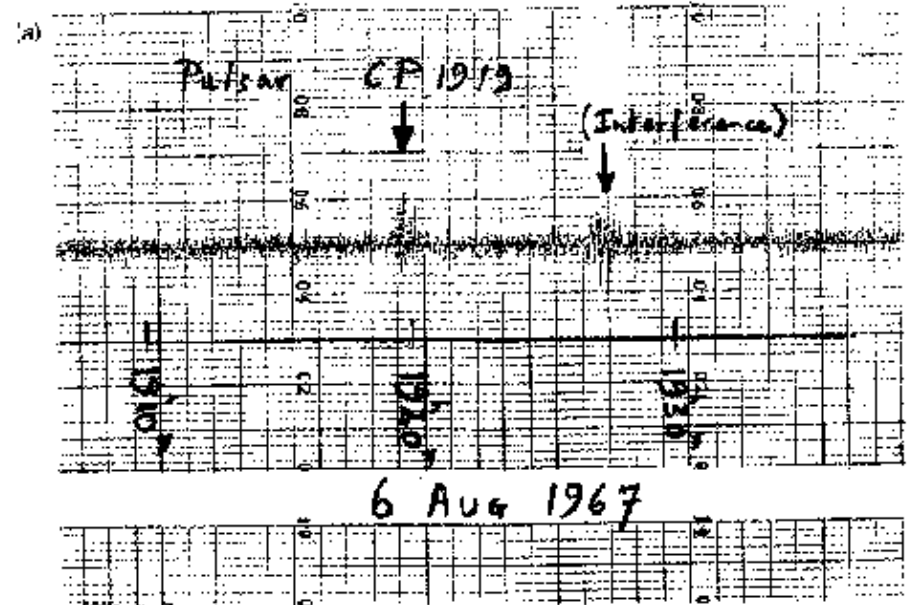


Jocelyn Bell



Antony Hewish

More than 2500 pulsars have been detected since 1967, when Jocelyn Bell discovered PSR 1919+21 (CP 1919)



Pulsar Search Techniques

Periodicity Searches:

- Fourier transforms
- Fast Folding Algorithms

De-dispersion Searches:

Single Pulse Searches:

1968 – 1973: Pulsar Searches in Australia

Molonglo Cross searches (32 new pulsars)

(1968) Large, Vaughan and Wielebinski: 7 new pulsars

(1969) Large, Vaughan and Wielebinski: 4 new pulsars

(1968) Large, Vaughan and Mills: Discovery of **PSR 0833-45** (SNR)

(1969) Wielebinski, Vaughan and Large: Further new pulsars

(1969) Vaughan, Large and Wielebinski: 3 new pulsars

(1969) Large, Vaughan and Wielebinski: **High DM pulsars**

(1970) Vaughan and Large: 5 new pulsars

(1971) Large and Vaughan: 2 new pulsars

1968 – 1973: Pulsars discovered

Observatory	Pulsars	Technique
Jodrell Bank (U.K.)	40	Dispersion and periodicity technique
Molonglo (Australia)	32	Paper charts, de-dispersion
Arecibo (Puerto Rico)	16	Periodicity searches, dedispersion
Parkes (Australia)	8	Periodicity searches
Cambridge (U.K.)	6	Paper charts
NRAO (U.S.A.)	6	Dispersion and periodicity technique
Bologna (Italy)	5	Paper charts
Ootacamund (India)	3	Paper charts?
Puschino (U.S.S.R.)	1	Paper charts

117 pulsars

Jodrell Bank – The Pulsar Search System

Telescope:	MK1A (Lovell telescope)
Frequency:	408 MHz
Bandwidth:	4 MHz
Beam width:	0.75°
Sensitivity:	$> 1.2 \text{ K/Jy}$
Technique:	Periodicity search
Integration time:	$10^{\text{m}} 55^{\text{s}}$
Sampling interval:	40 ms
Method of analysis:	Fast-folding algorithm (FFA)
Period range:	0.16 to 4 s
Other characteristics:	On-line analysis, gave about two pages of output per integration



Jodrell Bank – The Pulsar Search discovery records

 0 OBJECT: PSR 2020+28 SCAN NO.= 4568 CHANNEL: 2 *
 RA= 20 20 33.293 DEC= 28 44 42.8 VHEL=-18.5553 *
 4.0 MILLISECOND SAMPLES MEAN=-.4 SIGMA= 24.0 *
 DISTRIBUTION OF INTENSITY OF INPUT SAMPLES *
 3966 4477 4585 2242 791 233 73 44 *
 19 17 7 3 2 0 3 2 *

 0 PERIOD(S) BARYCENTRIC

1112	.034329	24	13						.034331
1114	.034333	55							.034338
1115	.034336	55							.034340
1116	.034338	40							.034342
1117	.034340	32			14				.034345
1118	.034342	8			28	54	23		

 2 PERIOD(S) BARYCENTRIC

592	.038146	6	51	66	16				.038148
593	.038148	45	54	35	18				.038151
594	.038151	11	74	54	24				.038153
595	.038154	57	49						.038156
596	.038157	68	54	14					.038159
597	.038159	59	27						.038162
599	.038165	7	4				52	41	.038167

 3 PERIOD(S) BARYCENTRIC

323	.040362	38	3						.040364
79	.042908								.042910
71	.042911								.042914
72	.042915								.042918
73	.042918								.042921
74	.042922								.042925
75	.042925								.042928
76	.042929								.042932
77	.042932								.042935

 4 PERIOD(S) BARYCENTRIC

572	.049638	11							.049641
574	.049643								.049646
575	.049647								.049650
576	.049652								.049655
577	.049656								.049659
578	.049661								.049664
579	.049666								.049669

 5 PERIOD(S) BARYCENTRIC

317	.052832	2	28						.052835
45	.057162	50	7						.057166
52	.057204	73	19						.057209
53	.057212	42	18						.057216
54	.057218	24							.057222
55	.057225								.057228
56	.057231								.057234
57	.057237								.057241
58	.057243								.057247
59	.057250								.057253

 6 PERIOD(S) BARYCENTRIC

555	.068647	38	34	52					.068651
556	.068654	41	94	14					.068658
557	.068658	182	44						.068661
558	.068674	126							.068678
559	.068683	58							.068687
560	.068692	19							.068696
561	.068701								.068705

 7 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 8 PERIOD(S) BARYCENTRIC

555	.088647	38	34	52					.088651
556	.088654	41	94	14					.088658
557	.088658	182	44						.088661
558	.088674	126							.088678
559	.088683	58							.088687
560	.088692	19							.088696
561	.088701								.088705

 9 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 10 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 11 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 12 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 13 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 14 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 15 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 16 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 17 PERIOD(S) BARYCENTRIC

24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085843
38	.085851								.085857
39	.085865								.085871
40	.085880								.085885
41	.085894								.085899

 18 PERIOD(S) BARYCENTRIC

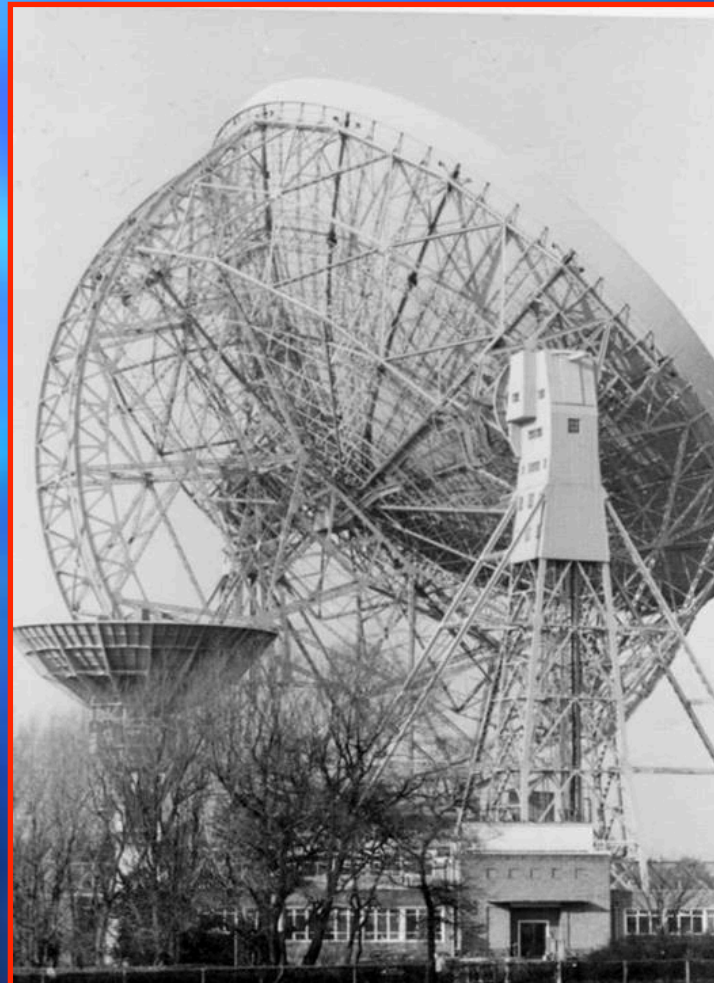
24	.073399	5	9	1					.073404
41	.079246	7	5	37					.079251
32	.085767								.085772
33	.085781								.085786
34	.085795								.085799
35	.085809								.085814
36	.085823								.085827
37	.085837								.085

Jodrell Bank pulsar searches

Project leaders



**Professor
J.G. Davies**



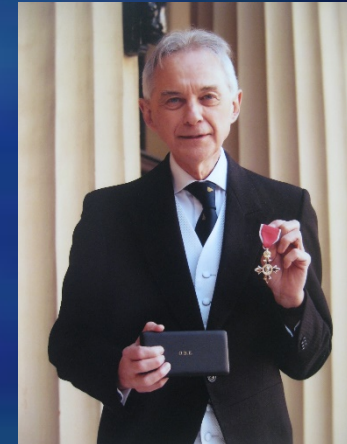
**Professor
Andrew Lyne**

Jodrell Bank – The discovery of the 100th pulsar

The piglet and the champagne!



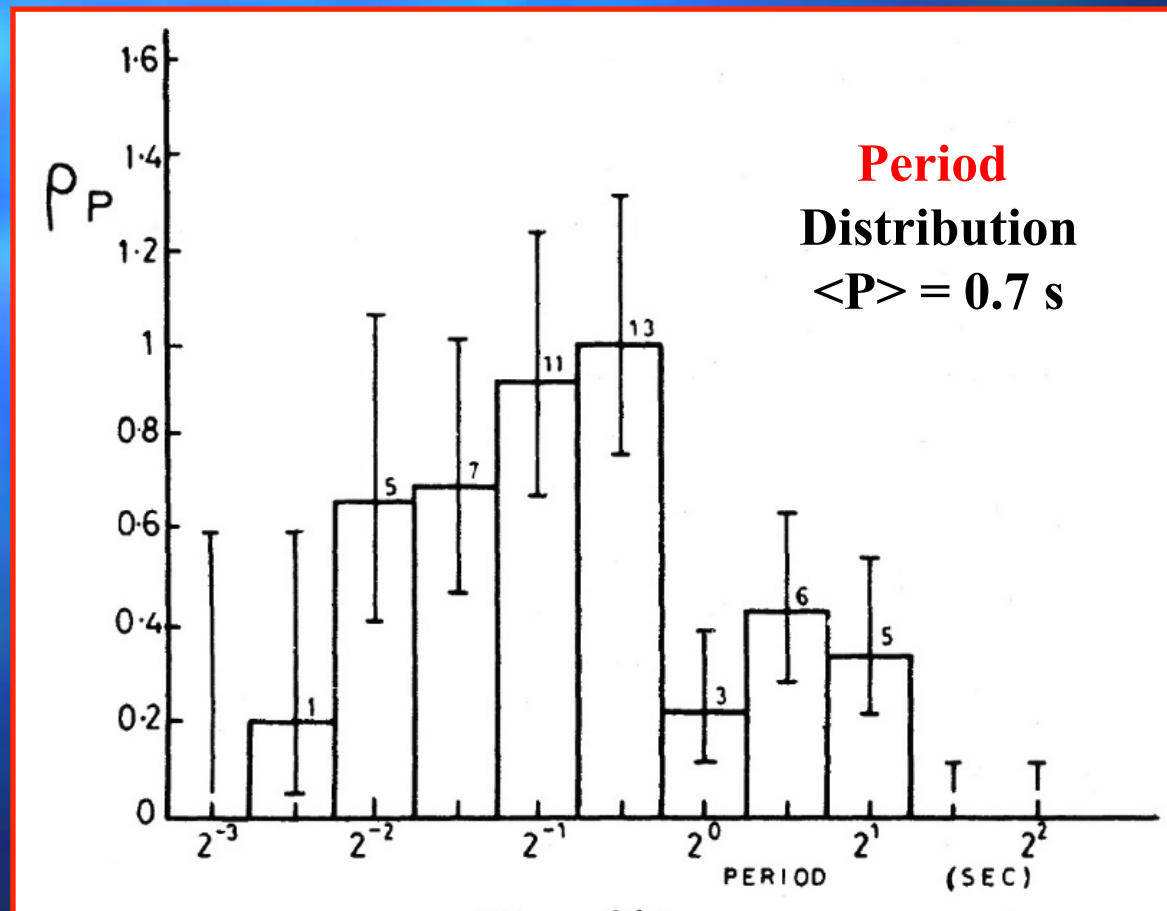
**Sir Francis
Graham-Smith**



**Professor
R.J. Davis**

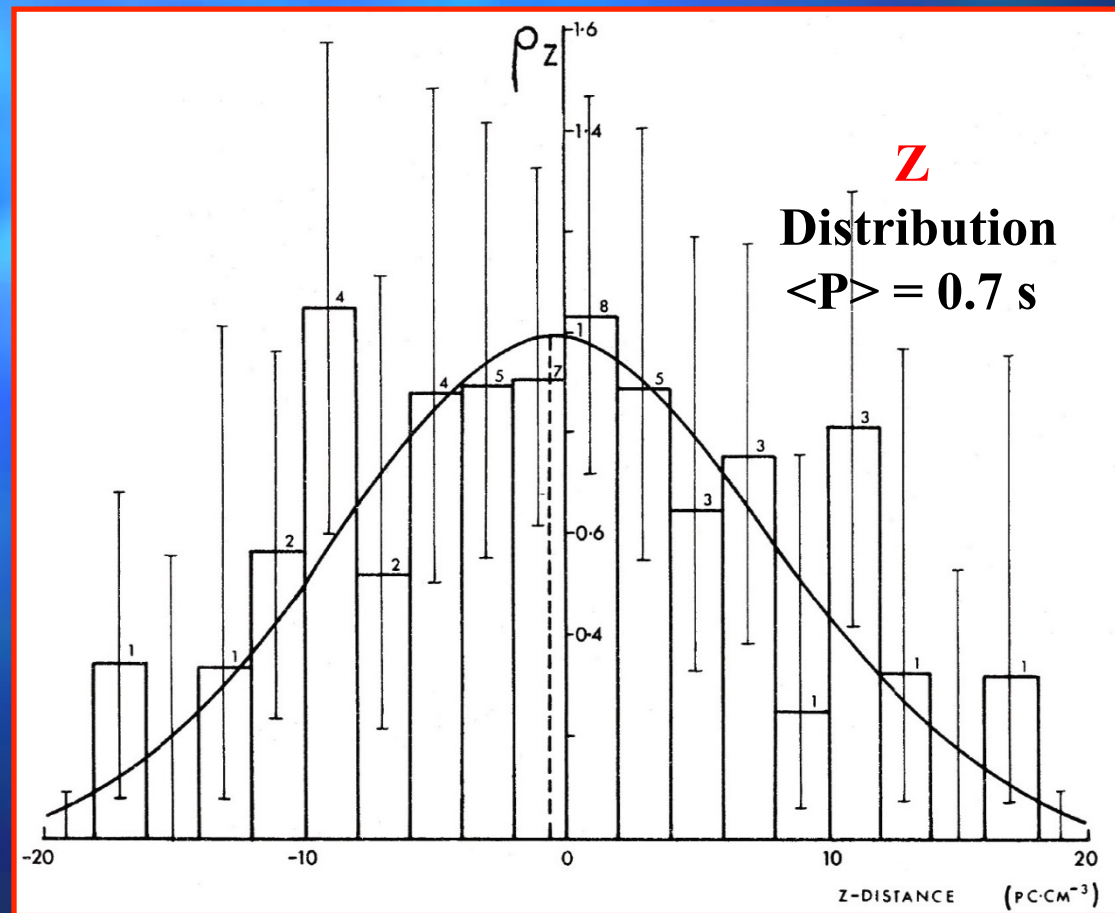
Basic Statistics

By the end of 1973 more than a hundred pulsars had been discovered.
Time for some basic statistics.



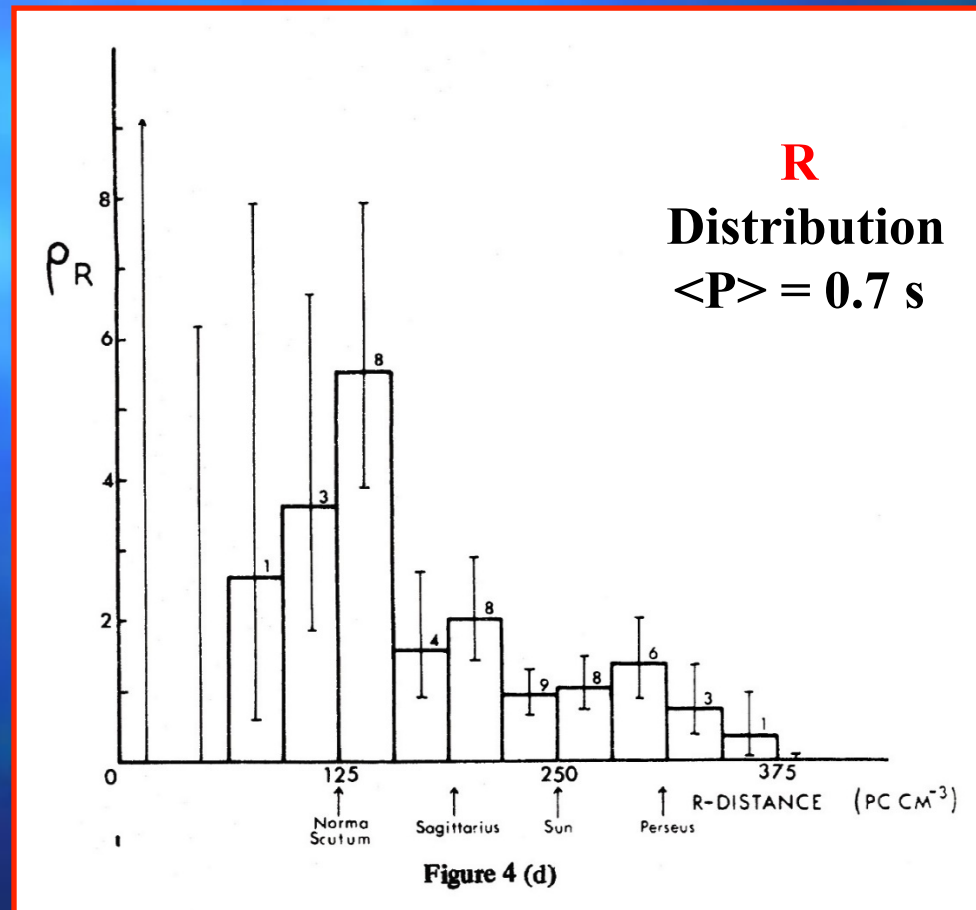
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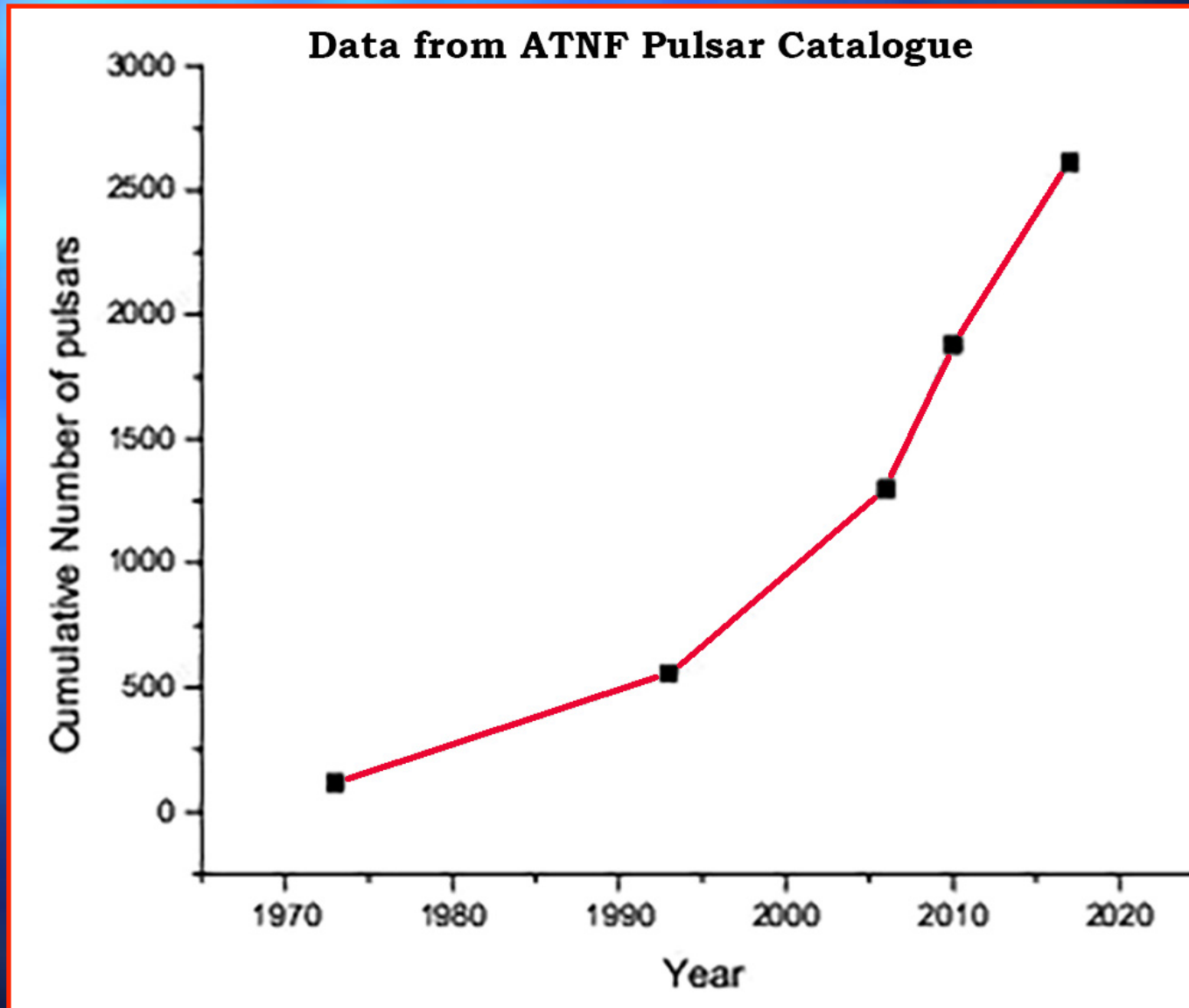


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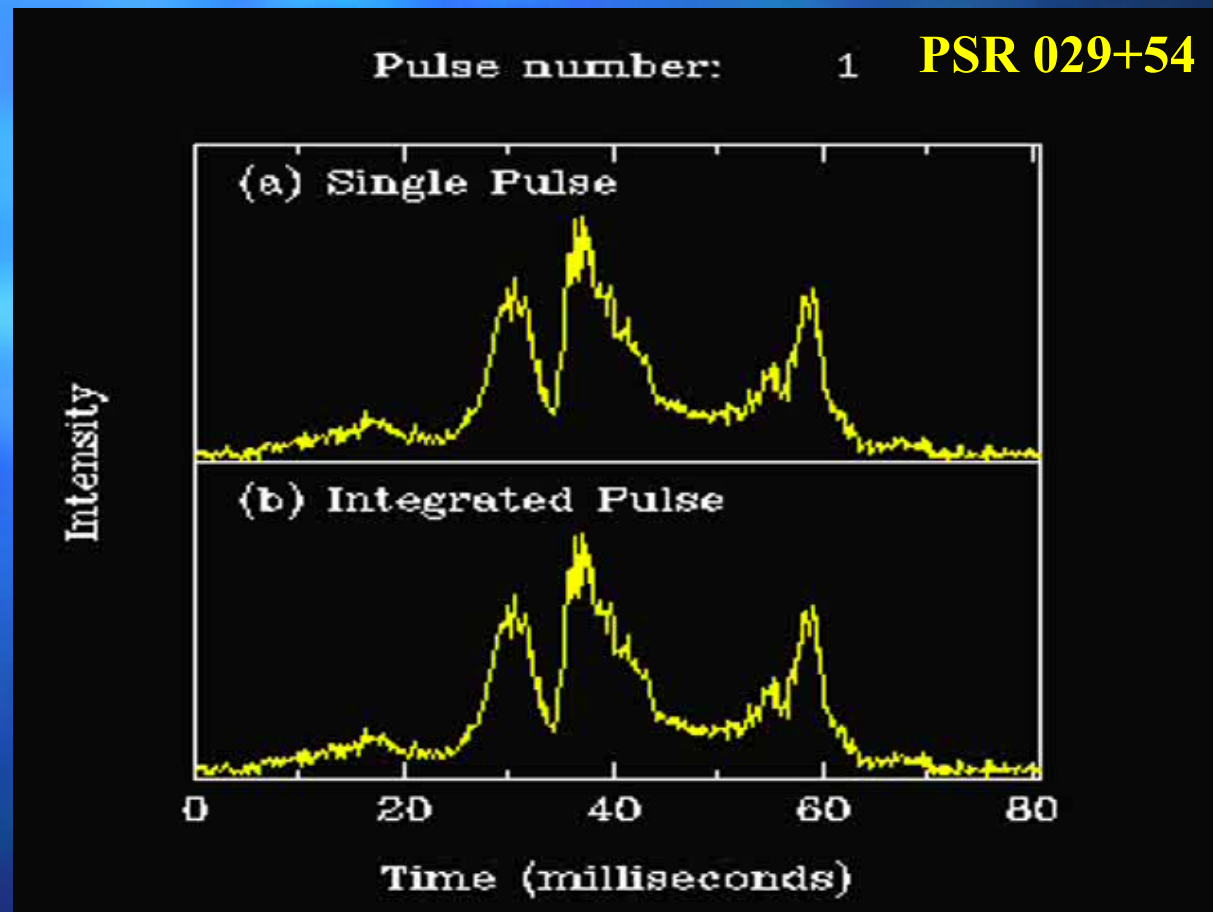


The explosive rate of pulsar discovery



Single pulses

The thrill of listening to pulsar sounds



Video: Dunc Lorimer Audio: Michael Kramer



**Thank you all
and thank you Tasso for organizing this conference.**