

Pulsar Timing

June 2014: If you are looking for LAT-derived ephemerides, [this is the place to go](#). Also take a look at [this page](#).

October 2013: Time to update. See [Year 6 Pulsar Timing](#)

September 23, 2009: Time to update the MoU's for Year 2, and beyond, which certainly rates a [new child page called Year 2 Pulsar Timing](#).

December 19, 2008: Here is the 'Pulsar search consortium' [MoU](#).

May 6, 2008: [Here is Nancay's current request](#) for telescope time for the GLAST LAT pulsar timing campaign.

March 9, 2008: [Update of the "pulsar timing MoU", now called LAT-0947-01](#). Late April -- we got all of the signatures!

March 4, 2008: [Here is version 3](#) of the "GLAST LAT Memo of Understanding of a Pulsar Timing Consortium" which was circulated to the people listed on page 6 of the document on February 23rd. [Here is Changes3to4.txt](#) which is some modifications that were suggested by LAT leadership in a telecon a few days after that. Since then there has been considerable discussion resulting in a finite list of changes likely to be made in the next week or so: to cite two -- Mallory Roberts lead a series of e-mail exchanges ; and Scott Ransom lead a discussion of the topic at the [Glast User's Group meeting](#) yesterday. Several pulsar PI's have agreed to sign the document in more or less its present form.

A little background -- without going back to 2001 or 2002 when the LAT team and pulsar scientists laid the groundwork for all this, and without going back to a splinter session on the topic held at the IAU general assembly in Prague in the summer of 2006, I'll just say that on February 6th I (= David Smith) circulated a draft of an A&A article called "Pulsar Timing for the GLAST LAT". It describes the science motivation for gamma ray pulsars and the need for a sustained timing campaign to achieve that science. It lists 231 gamma pulsar candidates ($\text{Edot} > 1\text{E}34 \text{ erg/s}$) that Simon Johnston has argued should be 225. About half of the article is tests of the LAT pulsar "Science Tools" software applied to various data sets. We (= a few senior LAT and pulsar people) built an author list of pulsar timers and LAT people. We suggested that agreeing to sign the A&A would amount to committing to the "timing consortium" the rules of which were only roughly described. By wide acclaim, we quickly separated that particular paper from the consortium constitution, and the MoU was born. Achieving consensus on its contents took the rest of February and has bled into March.

I'm uneasy about posting a multi-author draft of an A&A on a public web site while corrections are still in progress. Contact me if you want to see it (me = smith@cenbg.in2p3.fr).

January 2008: VERITAS held a collaboration meeting in Tuscon last month. They asked John Millis of Purdue University to be the point-of-contact to the LAT collaboration for timing ephemerides. John is a graduate student working with John Finley. The e-mail address is john.millis@gmail.com . Millis and Bordeaux have begun exchanging file formats and a few selected timing solutions.

May 25, 2007: Marcos Moya Lopez visited Bordeaux these last few weeks. With Damien, he wrote a note discussing which known pulsars are really the best candidates, which [you can find here](#).

February 6, 2007: While at Stanford for the 1st GLAST Symposium, a meeting was held. Romani recapitulated needs and tactics. [Lyne showed slides summarizing Jodrell observations for GLAST](#). Johnston spoke of Parkes observations ([his rough notes here](#)). Smith spoke of Nancay observations (see slides, Feb 2, below). Ransom and others intend to request GBT and/or Arecibo time for the radio-faint but gamma-likely targets. McLaughlin will use the 140' telescope to time noisier, louder gamma candidates. The consensus was that the timing needs for GLAST are on track for being met, even if much work remains to be done. (Attendees: Andrew Lyne, Simon Johnston, Scott Ransom, Maura McLaughlin, Mallory Roberts, Jim Cordes, Alberto Carramiñana, Roger Romani, Dave Thompson, Steve Thorsett, Peter Michelson, Steve Ritz, Denis Dumora, David Smith.)

February 21, 2007: [Abstract for Kes 75 pulsar timing proposal with RXTE](#)

February 21, 2007: [Abstract for LMC pulsar timing proposal with RXTE](#)

February 3, 2007: Here are [two abstracts of RXTE proposals](#) submitted by Livingstone & Kaspi of McGill University.

February 2, 2007: (Lucas Guillemot) [GLAST pulsars.pdf](#) These slides summarize the current status of radio timing for GLAST in the northern and southern skies. It also deals with the problem of the distribution of pulsar observations.

Pulsars of Greatest Interest to the LAT Collaboration

[Spreadsheet with this list](#)

fvel - Ranked by "expected gamma-ray flux" normalized to Vela
srad - radio flux
time req - estimated radio time for timing detection
visits per y - estimated number of observations per year to maintain timing
time per y - total radio telescope hours estimated per year
G - time with gamma rays
X - time with X-rays
M - ms pulsar of special interest. (0.001) in time per y - ms pulsar
Must-do PSR - $\text{Edot} > 3\text{E}34$
Worthwhile PSR - $3\text{E}34 > \text{Edot} > 1\text{E}34$

#	i	name	fvel	srad	log(edot)	time req	visits per y	time per y
#		Must-Do PSR						
#								
	1	B0833-45	1	1100	36.84	1.26E-07	27.23	2.269
G	2	J0633+1746	0.2237	0.0187	34.51	7499	3.269	0.000

	3	B0531+21	0.1717	14	*	0.007653	47.77	3.980
	4	B0656+14	0.07422	3.7	34.58	0.006941	3.119	0.260
X	5	J0205+6449	0.01625	0.04	37.43	5.109	10.1	51.620
	6	J1747-2958	0.01253	0.25	36.4	0.8353	4.458	3.724
	7	B1706-44	0.01116	7.3	36.53	0.0004929	4.943	0.412
	8	B1055-52	0.0107	6.504	34.48	0.001062	1.042	0.087
	9	J1833-1034	0.0101	0.07	37.53	1.594	9.121	14.540
	10	J1740+1000	0.009987	9.2	35.37	0.001383	2.022	0.169
	11	B1951+32	0.009855	1	36.57	0.1941	2.959	0.574
	12	J1357-6429	0.009241	0.44	36.49	0.4119	5.779	2.380
	13	J1524-5625	0.007306	0.83	36.51	0.4488	3.631	1.629
	14	B1509-58	0.007017	0.94	37.25	0.1115	10.06	1.121
	15	J1531-5610	0.006993	0.6	35.96	0.0744	2.243	0.187
	16	B1046-58	0.006076	6.5	36.3	0.0001565	3.612	0.301
	17	B0355+54	0.005614	23	34.66	1.93E-06	0.8767	0.083
	18	J0940-5428	0.005072	0.35	36.29	0.08507	2.787	0.237
	19	J0538+2817	0.004762	1.9	34.69	0.0001037	0.8187	0.083
X	20	J1930+1852	0.004437	0.06	37.06	19.02	6.908	131.400
X	21	J1124-5916	0.003804	0.08	37.08	6.965	6.599	45.960
	22	B1259-63	0.003725	1.7	35.92	1.687	1.296	2.185
	23	J0834-4159	0.003656	0.19	34.99	0.1303	0.9043	0.130
	24	B0906-49	0.003502	10	35.69	7.40E-06	1.585	0.132
	25	J1509-5850	0.003489	0.15	35.71	0.2683	1.461	0.392
	26	B1823-13	0.003469	2.1	36.45	0.001722	3.095	0.258
	27	J1809-1917	0.003409	2.5	36.25	0.06579	2.289	0.191
	28	J1420-6048	0.003195	0.9	37.02	0.1173	4.089	0.480
	29	B1800-21	0.003155	7.6	36.35	0.0007363	3.147	0.262
	30	B0114+58	0.00302	0.3	35.34	0.02597	1.066	0.089
	31	J2229+6114	0.002857	0.25	37.35	0.2492	4.628	1.153
	32	J1718-3825	0.002817	1.3	36.1	0.002783	1.768	0.147
	33	B1727-33	0.002799	3.2	36.09	0.0007512	2.448	0.204
	34	B0740-28	0.002796	15	35.16	4.95E-06	1.138	0.095
X	/R? 35	J1617-5055	0.002754	0.0187	37.2	53.97	4.668	0.000
	36	J1843-1113	0.002746	0.1	34.78	7.993	0.07262	(0.001)
M	37	B1937+21	0.002591	10	36.04	2.01E-05	0.2075	(0.001)
	38	J1913+1011	0.002407	0.5	36.46	0.02344	1.604	0.134
	39	J2043+2740	0.002339	0.0187	34.75	83.79	0.5636	0.000
	40	J1740-5340	0.002265	0.0187	35.13	83.79	0.1403	(0.001)
	41	J0855-4644	0.002231	0.2	36.03	1.142	1.473	1.681
	42	J0218+4232	0.0022	0.9	35.39	0.03617	0.1391	(0.001)
	43	J1739-3023	0.002071	1	35.48	0.004445	1.207	0.101
	44	B1957+20	0.002066	0.4	35.2	0.001892	0.09681	(0.001)
	45	J1105-6107	0.002041	0.75	36.39	0.02283	2.041	0.170
M	46	B1821-24	0.001978	0.18	36.35	0.1071	0.3909	(0.001)
	47	B1853+01	0.001928	0.19	35.63	0.002328	2.187	0.182
	48	B1757-24	0.001895	0.85	36.41	0.0184	2.99	0.249
	49	B0611+22	0.001843	2.2	34.8	5.29E-05	1.141	0.095
	50	B1719-37	0.0017	3.2	34.51	1.39E-05	0.7312	0.083
	51	J1835-1106	0.001696	2.2	35.25	0.0001376	1.193	0.099
	52	B0540+23	0.001528	9	34.61	5.79E-06	0.8171	0.083
	53	J0729-1448	0.001367	0.7	35.45	0.007327	1.785	0.149
	54	B1737-30	0.00123	6.4	34.92	4.50E-07	1.749	0.146
	55	J1928+1746	0.001188	0.25	36.21	0.05675	1.796	0.150
	56	J1015-5719	0.001139	0.9	35.92	1.286	2.013	2.589
	57	B1830-08	0.001123	3.6	35.77	0.0004287	1.345	0.112

	58	J1837-0604	0.001102	0.7	36.3	0.1471	2.346	0.345
	59	J1637-4642	0.0009926	0.78	35.81	0.06474	1.911	0.159
	60	J0631+1036	0.0009802	0.8	35.24	0.04578	1.585	0.132
	61	J1702-4310	0.000962	0.72	35.8	0.01664	2.417	0.201
	62	J1301-6305	0.0009441	0.46	36.23	0.4837	3.094	1.497
	63	J1828-1101	0.0009214	2.9	36.19	0.009036	1.822	0.152
	64	B1634-45	0.0008782	1.1	34.88	0.000732	0.7073	0.083
	65	J1702-4128	0.0008275	1.1	35.53	0.01352	1.627	0.136
	66	J1705-3950	0.0008196	1.5	34.87	0.0002213	1.188	0.099
	67	J1016-5857	0.0008067	0.46	36.41	0.05306	2.752	0.229
	68	J0901-4624	0.0008053	0.46	34.6	0.0002127	1.107	0.092
	69	B2334+61	0.0008035	1.4	34.79	0.000375	1.405	0.117
X	70	J1811-1925	0.0008005	0.0187	36.81	83.79	3.026	0.000
	71	J1841-0345	0.0007374	1.4	35.43	0.001508	1.571	0.131
	72	J1857+0143	0.0006497	0.74	35.65	0.07584	1.579	0.132
	73	B1001-47	0.000646	0.4878	34.48	0.00566	0.8143	0.083
	74	B1610-50	0.0006425	2.4	36.2	0.0005443	3.402	0.284
	75	B1828-11	0.0006008	1.4	34.55	7.37E-06	1.009	0.084
	76	J1648-4611	0.0005965	0.58	35.32	0.03353	1.267	0.106
	77	B1643-43	0.0005731	0.98	35.55	0.005395	1.886	0.157
	78	J1906+0746	0.0005706	0.55	35.43	7.00E-06	1.303	0.109
	79	B0021-72F	0.00052	0.0187	35.15	579.7	0.1193	(0.001)
	80	J1738-2955	0.0005086	0.29	34.57	0.0512	1.076	0.090
	81	J1723-3659	0.0004981	1.5	34.58	0.0007417	0.7157	0.083
	82	J1715-3903	0.0004979	0.46	34.84	0.003937	1.076	0.090
	83	J1601-5335	0.0004891	0.22	35.01	0.01022	1.285	0.107
	84	J1514-5925	0.0004862	0.27	34.54	0.01349	0.5844	0.083
M	85	B1820-30A	0.0004674	0.72	35.92	0.05651	0.357	(0.001)
	86	J1828-1057	0.0004601	0.23	34.74	0.1251	0.9187	0.125
	87	J1910-5959D	0.0004564	0.07	34.71	5.979	0.1542	(0.001)
	88	J1112-6103	0.0004534	1.4	36.66	0.07257	2.64	0.220
	89	B1356-60	0.0004166	7.6	35.08	1.45E-05	0.8878	0.083
	90	B0021-72E	0.0004123	0.0187	34.94	1382	0.1158	(0.001)
	91	B1915+13	0.0003972	1.9	34.59	7.05E-05	0.7047	0.083
	92	J1838-0549	0.0003955	0.29	35	0.009171	1.147	0.096
	93	J1548-5607	0.0003952	1	34.93	0.002475	0.9002	0.083
	94	J2021+3651	0.0003846	0.1	36.53	2.548	3.012	7.673
	95	J1638-4608	0.0003659	0.33	34.98	0.005708	1.22	0.102
	96	J1841-0524	0.0003591	0.2	35.02	0.01817	1.631	0.136
	97	J0024-7204O	0.0003543	0.0187	34.81	83.79	0.08788	(0.001)
	98	B1754-24	0.0003308	3.9	34.6	0.0005067	0.7867	0.083
	99	J1452-5851	0.000324	0.24	34.54	0.01171	0.9733	0.083
	100	J1541-5535	0.0003223	0.22	35.06	0.06415	1.36	0.113
	101	B1607-52	0.000312	1.2	34.53	3.56E-05	0.6444	0.083
	102	B1338-62	0.0003064	1.9	36.14	0.00194	2.935	0.245
	103	J1907+0918	0.0002985	0.29	35.51	0.002567	1.783	0.149
	104	J0024-7204U	0.0002981	0.0187	34.66	83.79	0.09962	(0.001)
	105	J1016-5819	0.000291	0.31	34.61	0.03333	0.4712	0.083
X	106	J0537-6910	0.0002905	0.0187	*	83.79	8.146	0.000
	107	B1930+22	0.0002887	1.2	35.88	0.00125	1.973	0.164
	108	J1853-0004	0.000287	0.87	35.32	0.0004113	0.9817	0.083
	109	J1019-5749	0.0002821	0.8	35.27	0.9088	1.198	1.089
	110	J1543-5459	0.0002665	0.62	34.58	0.004796	0.9996	0.083
	111	J1737-3137	0.0002602	0.8	34.78	0.002209	1.315	0.110
	112	J1815-1738	0.0002571	0.25	35.59	1.463	1.802	2.636

X	113	J1846-0258	0.0002552	0.0187	36.92	83.79	7.895	0.000
	114	B1822-14	0.0002532	2.6	34.61	0.0003441	0.8769	0.083
	115	B1821-19	0.0002468	4.9	34.48	4.39E-06	0.6317	0.083
	116	J1853+0056	0.0002424	0.21	34.61	0.004998	0.8639	0.083
	117	J1413-6141	0.000233	0.61	35.75	0.1712	2.526	0.432
	118	J1756-2225	0.0002301	0.25	34.5	0.04841	0.9584	0.083
	119	J1406-6121	0.0002261	0.36	35.35	0.09571	1.492	0.143
	120	B1718-35	0.0002151	11	34.65	0.000193	0.9116	0.083
	121	B1508-57	0.0002137	6	35.1	0.0001812	0.91	0.083
	122	B1832-06	0.0001965	1.3	34.75	0.01986	1.04	0.087
	123	B1838-04	0.000196	2.6	34.59	0.0001	0.6922	0.083
	124	J1538-5551	0.0001913	0.25	35.04	0.544	0.7713	0.544
	125	J1138-6207	0.0001883	0.49	35.48	0.1298	1.229	0.160
	126	J1156-5707	0.000186	0.19	34.64	0.003741	0.9129	0.083
	127	J1734-3333	0.0001816	0.5	34.75	0.3242	2.132	0.691
	128	J1412-6145	0.0001814	0.47	35.09	0.007317	1.455	0.121
	129	J1743-3153	0.0001776	0.5	34.76	0.02348	0.8269	0.083
	130	J1632-4757	0.0001759	0.3	34.7	0.2525	0.8513	0.253
	131	J1909+0912	0.0001721	0.35	35.11	0.02158	1.222	0.102
	132	J1638-4417	0.0001661	0.21	34.59	0.07137	0.5411	0.083
	133	J1119-6127	0.0001653	0.8	36.37	0.009335	5.392	0.449
X	134	B0540-69	0.0001607	0.02	38.17	3346	9.28	0.000
	135	J1052-5954	0.000159	0.15	35.13	0.2943	1.114	0.328
	136	J1551-5310	0.0001524	0.54	34.92	0.2569	1.499	0.385
	137	J1913+0832	0.0001406	0.6	34.87	15.3	0.752	15.300
	138	J1838-0453	0.0001399	0.33	34.92	0.009977	1.368	0.114
	139	J1248-6344	0.0001347	0.12	34.93	0.4506	0.9787	0.451
	140	J1845-0316	0.000128	0.35	34.59	0.04617	0.7334	0.083
	141	J1755-2534	0.0001175	0.17	34.54	0.2686	0.7447	0.269
	142	J1839-0321	0.0001169	0.27	34.56	0.004648	0.7667	0.083
	143	J1632-4818	0.0001162	0.39	34.68	0.02845	1.644	0.137
	144	B2127+11E	0.000107	0.01626	34.84	563.9	0.1222	(0.001)
	145	J1726-3530	8.41E-05	0.3	34.55	0.03959	1.718	0.143
	146	J1904+0800	8.25E-05	0.36	34.57	0.009638	0.8179	0.083
	147	J1820-1529	8.09E-05	0.61	34.61	0.0467	0.9566	0.083
	148	J1908+0909	7.53E-05	0.22	34.56	0.005216	0.9195	0.083
	149	J1806-2125	6.84E-05	1.1	34.63	0.003984	1.19	0.099
	150	B1758-23	5.02E-05	2.2	34.79	0.05738	1.277	0.106
	151	J1808-2024	3.73E-05	0.0187	34.6	83.79	4.981	0.000
	152	J1327-6400	3.16E-05	0.36	34.75	0.02246	0.9922	0.083
#	Worthwile PSR							
	1	J0437-4715	0.179	142	34.08	0.000496	0.2795	(0.001)
	2	B0743-53	0.05373	1.87	34.04	0.0399	1.244	0.104
	3	J0034-0534	0.01902	0.61	34.47	46.38	0.1051	(0.001)
	4	B1257+12	0.007444	2	34.27	0.02607	0.1212	(0.001)
	5	J1909-3744	0.003655	0.0187	34.33	122.5	0.06804	(0.001)
	6	J1046+0304	0.00302	0.3	34.15	0.1378	0.6611	0.138
	7	J1911-1114	0.002357	0.5	34.07	0.1054	0.05252	(0.001)
	8	J2129-5721	0.00219	1.4	34.2	0.008608	0.05996	(0.001)
	9	J0857-4424	0.001372	0.88	34.42	0.001052	0.7979	0.083
	10	J0613-0200	0.001249	1.4	34.12	0.09642	0.05021	(0.001)
	11	B1449-64	0.00102	14	34.27	2.20E-06	0.5063	0.083

12	B1620-26	0.0009119	1.6	34.29	0.00156	0.1165	(0.001)
13	B1317-53	0.0007625	1.463	34.22	0.00032	0.6118	0.083
14	J1549-4848	0.0006812	0.47	34.37	0.001256	0.7095	0.083
15	B0136+57	0.0005594	4.6	34.32	9.63E-06	0.6599	0.083
16	B1730-37	0.0005002	3.4	34.19	1.57E-05	0.6548	0.083
17	J0905-5127	0.0004583	1.1	34.37	0.0004251	0.7883	0.083
18	B1221-63	0.0004477	3.9	34.29	4.31E-05	0.5652	0.083
19	B1727-47	0.0004284	12	34.05	2.85E-06	0.9355	0.083
20	B1535-56	0.0003727	4.6	34.12	6.54E-05	0.5186	0.083
21	J1210-5226	0.000342	0.0187	34.01	83.79	0.631	0.000
22	B1556-57	0.0002757	1.4	34.06	0.002706	0.4334	0.083
23	J0954-5430	0.0002609	0.36	34.21	0.0009021	0.8036	0.083
24	J1115-6052	0.0002375	0.38	34.21	0.001822	0.5824	0.083
25	J0024-7204T	0.0002284	0.0187	34.42	83.79	0.1078	(0.001)
26	J0024-7204Q	0.0001965	0.0187	34.31	83.79	0.06936	(0.001)
27	J1123-6259	0.0001748	0.56	34.02	0.001343	0.4977	0.083
28	J1650-4502	0.0001719	0.35	34.06	0.001684	0.6216	0.083
29	J1834-0731	0.0001599	1	34.23	0.00586	0.8519	0.083
30	B2148+52	0.0001573	2	34.04	0.0002732	0.5651	0.083
31	J1649-4653	0.0001547	0.31	34.06	0.01029	0.7571	0.083
32	J1843-0702	0.0001516	0.17	34.08	0.01496	0.4385	0.083
33	J1349-6130	0.0001414	0.58	34.06	0.00119	0.5083	0.083
34	J1837-0559	0.0001374	0.5	34.21	0.01766	0.5049	0.083
35	J1845-0743	0.000134	2.7	34.1	0.0003636	0.3242	0.083
36	J1839-0905	0.0001294	0.16	34.15	0.07645	0.7065	0.083
37	J1801-2154	0.0001244	0.18	34.08	0.01513	0.6262	0.083
38	J1853+0545	0.0001244	1.6	34.08	0.004859	0.3506	0.083
39	J1907+0731	0.0001199	0.35	34.18	0.006618	0.6761	0.083
40	B1557-50	0.0001183	17	34.45	2.23E-06	0.6164	0.083
41	J1452-6036	0.000117	1.4	34.19	0.0002974	0.4323	0.083
42	B1841-05	0.0001146	2.2	34.36	0.002483	0.6622	0.083
43	B2000+32	0.0001068	1.2	34.09	0.0003223	0.8795	0.083
44	J1907+0919	9.61E-05	0.0187	34.35	83.79	3.246	0.000
45	J1907+0345	9.50E-05	0.17	34.37	0.0183	0.646	0.083
46	J1842-0905	9.17E-05	0.81	34	0.000498	0.5601	0.083
47	J1946+2611	9.00E-05	0.122	34.02	1.97	0.6445	1.970
48	B1636-47	8.35E-05	1.2	34.08	0.001787	0.7435	0.083
49	B2011+38	7.66E-05	6.4	34.46	0.0006859	0.6844	0.083
50	B1855+02	7.46E-05	1.6	34.34	0.0004368	0.8459	0.083
51	J1903+0601	7.37E-05	0.26	34.16	0.0143	0.6749	0.083
52	J1515-5720	7.29E-05	0.2	34.01	0.9264	0.5097	0.926
53	J1853+0011	7.00E-05	0.3	34.32	0.008491	0.8091	0.083
54	J1626-4807	6.66E-05	0.37	34.43	1.561	0.7637	1.561
55	J1305-6203	5.59E-05	0.62	34.21	0.003988	0.758	0.083
56	B2127+11F	5.57E-05	0.00813	34.29	3475	0.06776	(0.001)
57	J1843-0355	5.51E-05	0.8	34.25	0.09204	0.4206	0.092
58	J1735-3258	5.41E-05	0.46	34.38	21.11	0.7962	21.110
59	J1043-6116	4.67E-05	0.91	34.23	0.0005048	0.6279	0.083
60	J1908+0839	4.57E-05	0.49	34.17	0.00254	0.4685	0.083
61	J1812-1910	3.51E-05	0.22	34.27	0.166	0.8043	0.166
62	J1524-5706	2.48E-05	0.41	34	0.001335	1.047	0.087
63	J1216-6223	1.33E-05	0.15	34.1	0.08397	0.6399	0.084