graviton

$J = 2$

graviton MASS

Van Dam and Veltman (VANDAM 70), Iwasaki (IWASAKI 70), and Zakharov (ZAKHAROV 70) almost simultanously showed that "... there is a discrete difference between the theory with zero-mass and a theory with finite mass, no matter how small as compared to all external momenta." The resolution of this "vDVZ discontinuity" has to do with whether the linear approximation is valid. De Rham *etal*. (DE-RHAM 11) have shown that nonlinear effects not captured in their linear treatment can give rise to a screening mechanism, allowing for massive gravity theories. See also GOLDHABER 10 and DE-RHAM 17 and references therein. Experimental limits have been set based on a Yukawa potential or signal dispersion. h_0 is the Hubble constant in units of 100 km s^{-1} Mpc^{-1}.

The following conversions are useful: 1 eV = 1.783×10^{-33} g = 1.957×10^{-6} m_e; $\lambda\!\!\!^{-}_C = (1.973 \times 10^{-7}$ m)$\times$(1 eV/m_g).

VALUE (eV)	*DOCUMENT ID*		*TECN*	*COMMENT*
<6 × 10^{-32}	[1] CHOUDHURY	04	YUKA	Weak gravitational lensing
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$<7 \times 10^{-23}$	[2] ABBOTT	17	DISP	Combined dispersion limit from three BH mergers
$<1.2 \times 10^{-22}$	[2] ABBOTT	16	DISP	Combined dispersion limit from two BH mergers
$<5 \times 10^{-23}$	[3] BRITO	13		Spinning black holes bounds
$<4 \times 10^{-25}$	[4] BASKARAN	08		Graviton phase velocity fluctuations
$<6 \times 10^{-32}$	[5] GRUZINOV	05	YUKA	Solar System observations
$<9.0 \times 10^{-34}$	[6] GERSHTEIN	04		From Ω_{tot} value assuming RTG
$>6 \times 10^{-34}$	[7] DVALI	03		Horizon scales
$<8 \times 10^{-20}$	[8,9] FINN	02	DISP	Binary pulsar orbital period decrease
	[9,10] DAMOUR	91		Binary pulsar PSR 1913+16
$<7 \times 10^{-23}$	TALMADGE	88	YUKA	Solar system planetary astrometric data
$< 2 \times 10^{-29}\ h_0^{-1}$	GOLDHABER	74		Rich clusters
$<7 \times 10^{-28}$	HARE	73		Galaxy
$<8 \times 10^{4}$	HARE	73		2γ decay

[1] CHOUDHURY 04 concludes from a study of weak-lensing data that masses heavier than about the inverse of 100 Mpc seem to be ruled out if the gravitation field has the Yukawa form.

[2] ABBOTT 16 and ABBOTT 17 assumed a dispersion relation for gravitational waves modified relative to GR.

[3] BRITO 13 explore massive graviton (spin-2) fluctuations around rotating black holes.

[4] BASKARAN 08 consider fluctuations in pulsar timing due to photon interactions ("surfing") with background gravitational waves.

[5] GRUZINOV 05 uses the DGP model (DVALI 00) showing that non-perturbative effects restore continuity with Einstein's equations as the gravition mass approaches 0, then bases his limit on Solar System observations.

[6] GERSHTEIN 04 use non-Einstein field relativistic theory of gravity (RTG), with a massive graviton, to obtain the 95% CL mass limit implied by the value of $\Omega_{tot} = 1.02 \pm 0.02$ current at the time of publication.

[7] DVALI 03 suggest scale of horizon distance via DGP model (DVALI 00). For a horizon distance of 3×10^{26} m (about age of Universe/c; GOLDHABER 10) this graviton mass limit is implied.

[8] FINN 02 analyze the orbital decay rates of PSR B1913+16 and PSR B1534+12 with a possible graviton mass as a parameter. The combined frequentist mass limit is at 90%CL.

[9] As of 2014, limits on dP/dt are now about 0.1% (see T. Damour, "Experimental tests of gravitational theory," in this *Review*).

[10] DAMOUR 91 is an analysis of the orbital period change in binary pulsar PSR 1913+16, and confirms the general relativity prediction to 0.8%. "The theoretical importance of the [rate of orbital period decay] measurement has long been recognized as a direct confirmation that the gravitational interaction propagates with velocity c (which is the immediate cause of the appearance of a damping force in the binary pulsar system) and thereby as a test of the existence of gravitational radiation and of its quadrupolar nature." TAYLOR 93 adds that orbital parameter studies now agree with general relativity to 0.5%, and set limits on the level of scalar contribution in the context of a family of tensor [spin 2]-biscalar theories.

graviton REFERENCES

ABBOTT	17	PRL 118 221101	B.P. Abbot *et al.*	(LIGO and Virgo Collabs.)
DE-RHAM	17	RMP 89 025004	C. de Rham *et al.*	
ABBOTT	16	PRL 116 061102	B.P. Abbott *et al.*	(LIGO and Virgo Collabs.)
BRITO	13	PR D88 023514	R. Brito, V. Cardoso, P. Pani	(LISB, MISS, HSCA+)
DE-RHAM	11	PRL 106 231101	C. de Rham, G. Gabadadze, A.J. Tolley	
GOLDHABER	10	RMP 82 939	A.S. Goldhaber, M.M. Nieto	(STON, LANL)
BASKARAN	08	PR D78 044018	D. Baskaran *et al.*	
GRUZINOV	05	NAST 10 311	A. Gruzinov	(NYU)
CHOUDHURY	04	ASP 21 559	S.R. Choudhury *et al.*	(DELPH, MELB)
GERSHTEIN	04	PAN 67 1596	S.S. Gershtein *et al.*	(SERP)
		Translated from YAF 67 1618.		
DVALI	03	PR D68 024012	G.R. Dvali, A. Grizinov, M. Zaldarriaga	(NYU)
FINN	02	PR D65 044022	L.S. Finn, P.J. Sutton	
DVALI	00	PL B485 208	G.R. Dvali, G. Gabadadze, M. Porrati	(NYU)
TAYLOR	93	NAT 355 132	J.N. Taylor *et al.*	(PRIN, ARCBO, BURE+) J
DAMOUR	91	APJ 366 501	T. Damour, J.H. Taylor	(BURE, MEUD, PRIN)
TALMADGE	88	PRL 61 1159	C. Talmadge *et al.*	(JPL)
GOLDHABER	74	PR D9 1119	A.S. Goldhaber, M.M. Nieto	(LANL, STON)
HARE	73	CJP 51 431	M.G. Hare	(SASK)
IWASAKI	70	PR D2 2255	Y. Iwasaki	
VANDAM	70	NP B22 397	H. van Dam, M. Veltman	(UTRE)
ZAKHAROV	70	JETPL 12 312	V.I. Zakharov *et al.*	