Citation: K. Hagiwara *et al.* (Particle Data Group), Phys. Rev. D **66**, 010001 (2002) (URL: http://pdg.lbl.gov)

NON-$q\overline{q}$ CANDIDATES

We include here mini-reviews and reference lists on gluonium and other non-$q\overline{q}$ candidates. See also the section on Futher States for possible bound states.

NON-$q\overline{q}$ MESONS

Revised March 2002 by C. Amsler (University of Zürich).

The constituent quark model describes the observed meson spectrum as bound $q\overline{q}$ states grouped into SU(3) flavor nonets. The self-coupling of gluons in QCD suggests that additional mesons made of bound gluons (glueballs), or $q\overline{q}$-pairs with an excited gluon (hybrids), may exist. Multiquark color singlet states like $qq\overline{q}\overline{q}$ or $qqq\overline{q}\overline{q}\overline{q}$ have also been predicted (`JAFFE 77`). Among the signatures naively expected for glueballs are (i) no place in $q\overline{q}$ nonets, (ii) enhanced production in gluon rich channels such as central production and radiative $J/\psi(1S)$ decay, (iii) decay branching fractions incompatible with SU(3) predictions for $q\overline{q}$ states, and (iv) reduced $\gamma\gamma$ couplings. However, mixing effects with isoscalar $q\overline{q}$ mesons (`AMSLER 96`, `ANISOVICH 97`, `WEINGARTEN 97`, `CLOSE 97B`) and decay form factors (`BARNES 97`) may obscure these simple signatures.

Lattice calculations (`BALI 93`, `SEXTON 95`, `MORNINGSTAR 99`), QCD sum rules, flux tube, and constituent glue models agree that the lightest glueballs have quantum numbers $J^{PC} = 0^{++}$ and 2^{++} (for a review see `SWANSON 97`). On the lattice, the scale parameter (estimated from the string tension in heavy quark mesons) gives by extrapolation to zero lattice spacing a mass of 1611 ± 163 MeV for the ground state (0^{++}) glueball, while the first excited state (2^{++}) has a mass of 2232 ± 310 MeV (`MICHAEL 97`). Hence, the low-mass glueballs lie in the same mass region as ordinary isoscalar $q\overline{q}$ states, that is, in the mass range of the $1^3P_0(0^{++})$, $2^3P_2, 3^3P_2$, and $1^3F_2(2^{++})$ $q\overline{q}$ states. The 0^{-+} state and exotic glueballs (with non-$q\overline{q}$ quantum numbers like 0^{--}, 0^{+-}, 1^{-+}, 2^{+-}, *etc.*) are expected above 2 GeV (BALI 93).

The lattice calculations assume that the quark masses are infinite, and therefore neglect $q\overline{q}$ loops. However, one expects that glueballs will mix with nearby $q\overline{q}$ states of the same quantum numbers. The presence of a glueball mixed with $q\overline{q}$ would still lead to a supernumerary isoscalar in the SU(3) classification of $q\overline{q}$ mesons.

For earlier experimental searches, we refer to the Notes in the 1996 and 1998 issues of this *Review.* See also the review on exotic mesons by LANDSBERG 99.

We first deal with non-$q\overline{q}$ candidates in the scalar sector. Five isoscalar resonances are well established: the very broad $f_0(400-1200)$ (or σ), the $f_0(980)$, the broad $f_0(1370)$, and the comparatively narrow $f_0(1500)$ and $f_0(1710)$ (see the Note on "Scalar Mesons," and also AMSLER 98). The $f_0(1500)$ was observed in many experiments, *e.g.*, in pion-induced reactions $\pi^- p$ (BINON 83, AMELIN 96B), in $\overline{p}p$ annihilations (AMSLER 95B,95C, BERTIN 97C), in central collisions (REYES 98, BARBERIS 99, BELLAZZINI 99), in $J/\psi(1S)$ radiative decays (BUGG 95), and in D_s decays (AITALA 01A). The $f_0(1710)$ has now been shown to have spin 0 (BARBERIS 99,00E, FRENCH 99), and to decay mainly into $K\overline{K}$ (BARBERIS 99,99B,99D). This points to a mostly $s\overline{s}$ structure, although no signal was reported earlier in $K^- p \to K_S K_S \Lambda$ interactions (ASTON 88D). However, the assumption was that the spin would be 2. In $\gamma\gamma$ collisions leading to $K_S K_S$ (ACCIARRI 01H), a signal is observed at the $f_0(1710)$ mass. Spin 2 is preferred, but the isospin cannot be determined, hence the signal is perhaps coming from $a_2(1700)$.

A spin 0 component, *e.g.*, from $f_0(1710)$, is not excluded. However, $f_0(1500)$ is absent, while in $\gamma\gamma$ collisions leading to $\pi^+\pi^-$, neither $f_0(1710)$ nor $f_0(1500)$ are observed (`BARATE 00E`). The production rate for $f_0(1710)$, and the absence of $f_0(1500)$ in both $K\overline{K}$ and $\pi\pi$, favor the former to be mainly $s\overline{s}$, and the latter to have a small coupling to $\gamma\gamma$ at most compatible with an $s\overline{s}$ state (`AMSLER 99`). Also, $f_0(1710)$ is not observed in $p\bar{p}$ annihilation (`AMSLER 02`), as expected from the OZI rule for an $s\overline{s}$ state.

On the other hand, the $K\overline{K}$ decay branching ratio of $f_0(1500)$ is small compared to $\pi\pi$ (`ABELE 96B,98`, `BARBERIS 99D`), indicating that this state has a small $s\overline{s}$ component. Since $f_0(1370)$ does not couple strongly to $s\overline{s}$ either (`BARBERIS 99D`), $f_0(1370)$ or $f_0(1500)$ appear to be supernumerary. Note that $f_0(1370)$ and $f_0(1500)$ have rather different 4π decay patterns. The former decays dominantly to two S-wave dipions, and the latter mostly to $\pi(1300)\pi$ (`ABELE 01,01B`). The narrow width of $f_0(1500)$, and its enhanced production at low transverse momentum transfer in central collisions (`CLOSE 97,98B`, `KIRK 00`) favor $f_0(1500)$ to be non-$q\overline{q}$. In `AMSLER 96`, the ground state scalar nonet is made of $a_0(1450)$, $f_0(1370)$, $K_0^*(1430)$, and the at-the-time-missing $s\overline{s}$ state, which can now be identified as $f_0(1710)$. The isoscalars $f_0(1370)$ and $f_0(1710)$ contain a small fraction of glue, while $f_0(1500)$ is mostly gluonic. In the mixing scheme of `CLOSE 01B`, which uses all recent data in central production and $p\bar{p}$ annihilation, glue is shared between $f_0(1370)$ and $f_0(1500)$, while $f_0(1710)$ remains mainly $s\overline{s}$. Alternative mixing schemes have been proposed (`TORNQVIST 96`, `ANISOVICH 97`, `BOGLIONE 97`, `WEINGARTEN 97`, `MINKOWSKI 99`).

The $a_0(980)$ and $f_0(980)$ could be four-quark states (`JAFFE 77`, `ALFORD 00`) or $K\overline{K}$ molecular states (`WEINSTEIN 90`, `LOCHER

98) due to their strong affinity for $K\overline{K}$, in spite of their masses being very close to threshold. For $q\overline{q}$ states, the expected $\gamma\gamma$ widths (`OLLER 97B`, `DELBOURGO 99`) are not significantly larger than for molecular states (`BARNES 85`). A better filter might be radiative $\phi(1020)$ decay to $a_0(980)$ and $f_0(980)$. Recent data (`ACHASOV 98B,98I,00E`, `AKHMETSHIN 99C`) favor these mesons to be four-quark states (`ACHASOV 00F`), although not everybody agrees (`MALTMAN 99B`, `DELBOURGO 99`). Also, the $f_0(980)$ is strongly produced in D_s^+ decay (`FRABETTI 97`, `AITALA 01A`), suggesting a large $s\overline{s}$ component (`BEVEREN 00`), while in contrast, hadronic Z^0 decay favors a large $u\overline{u} + d\overline{d}$ component (`ACKERSTAFF 98Q`).

We now turn to the 2^{++} sector. The isoscalar $1^3P_2(2^{++})$ $q\overline{q}$ mesons, $f_2(1270)$, and $f_2'(1525)$, are well known. Above the $f_2'(1525)$, none of the reported isoscalars can be definitely assigned to the 2^3P_2, 3^3P_2, or 1^3F_2 nonets, and therefore, the identification of the 2^{++} glueball is premature. Three states appear to be solid. The $f_2(1565)$ observed in $\overline{p}p$ annihilation at rest (`MAY 90`, `BERTIN 98`) is perhaps the same state as $f_2(1640)$, reported to decay into $\omega\omega$ (`ALDE 90`, `BAKER 99`) and 4π (`ADAMO 92`). This could be one of the 2^3P_2 isoscalars or a nucleon-antinucleon resonance. The rather broad $f_2(1950)$ is observed by several experiments, *e.g.*, in central production (`BARBERIS 00C`) and in $\overline{p}p$ annihilation in flight (`AMSLER 02`). Finally, a broad structure (of perhaps several states) decaying to $\phi\phi$ was reported around 2300 MeV in $\pi^- N$ reactions (`BOOTH 86`, `ETKIN 88`), in $\overline{p}p$ annihilation in flight (`EVANGELISTA 98`), and in central collisions (`BARBERIS 98`).

The evidence for a narrow meson, $f_J(2220)$ (possibly a tensor), is fading with new formation data in $\overline{p}p$ annihilation (see the Note under the $f_J(2220)$ section). The measured partial width to $\overline{p}p$ in radiative $J/\psi(1S)$ decay (`BAI 96B`) is too large and inconsistent with the upper limit from $\overline{p}p$ annihilation into $\pi\pi$ (`AMSLER 99,01`). However, the surprisingly large $\phi\phi$ cross section in $\overline{p}p$ just above threshold (`EVANGELISTA 98`) could be due to the production of the 2^{++} glueball. In fact, the broad enhancement was reanalyzed by `PALANO 99`. The dominating contribution was found to be 2^{++}, resonating at a mass of 2231 MeV with a width of 70 MeV, in accord with earlier observations in $\pi^- N$ reactions (`BOOTH 86`, `ETKIN 88`).

Let us now deal with hybrid states. Hybrids may be viewed as $q\overline{q}$ mesons with a vibrating gluon flux tube. In contrast to glueballs, they can have isospin 0 and 1. The mass spectrum of hybrids with exotic (non-$q\overline{q}$) quantum numbers was predicted by `ISGUR 85`, while `CLOSE 95` also deals with non-exotic quantum numbers. The ground state hybrids with quantum numbers (0^{-+}, 1^{-+}, 1^{--}, and 2^{-+}) are expected around 1.7 to 1.9 GeV. Lattice calculations predict that the hybrid with exotic quantum numbers 1^{-+} lies at a mass of 1.9 ± 0.2 GeV (`LACOCK 97`, `BERNARD 97`). Most hybrids are rather broad, but some can be as narrow as 100 MeV (`PAGE 99`). They prefer to decay into a pair of S- and P-wave mesons.

A $J^{PC} = 1^{-+}$ exotic meson, $\pi_1(1400)$ (called $\hat{\rho}(1405)$ previously), with a mass of 1370 MeV and a width of 385 MeV, was reported in $\pi^- p \rightarrow \eta\pi^- p$ (`THOMPSON 97`, `CHUNG 99`). It was observed as an interference between the angular momentum $L = 1$ and $L = 2$ $\eta\pi$ amplitudes, leading to a forward/backward asymmetry in the $\eta\pi$ angular distribution. This state was reported earlier in $\pi^- p$ reactions (`ALDE 88B`), but ambiguous solutions in the partial-wave analysis were pointed out by `PROKOSHKIN 95B,95C`. A resonating 1^{-+} contribution to the $\eta\pi$ P wave is also required in the Dalitz plot analysis of

$\overline{p}n$ annihilation into $\pi^-\pi^0\eta$ (ABELE 98B), and in $\overline{p}p$ annihilation into $\pi^0\pi^0\eta$ (ABELE 99). Mass and width are consistent with THOMPSON 97.

Another 1^{-+} state, $\pi_1(1600)$, decaying into $\rho\pi$ (ADAMS 98B) and $\eta'\pi$ (IVANOV 01), was reported in the reaction $\pi^-p \rightarrow \pi^-\rho^0(\pi^-\eta')n$. It was already observed earlier in the decay modes $\rho\pi$, $\eta'\pi$, and $b_1(1235)\pi$, but not $\eta\pi$ (GOUZ 92). A strong enhancement in the 1^{-+} $\eta'\pi$ wave, compared to $\eta\pi$, was reported at this mass by BELADIDZE 93. DONNACHIE 98 suggests that a Deck-generated $\eta\pi$ background from final state rescattering in $\pi_1(1600)$ decay could mimic $\pi_1(1400)$. However, this mechanism is absent in $\overline{p}p$ annihilation. The $\eta\pi\pi$ data require $\pi_1(1400)$ and cannot accommodate a state at 1600 MeV (DUENNWEBER 99).

Thus, we now have evidence for two 1^{-+} exotics, $\pi_1(1400)$ and $\pi_1(1600)$, while the flux tube model and the lattice concur to predict a mass of about 1.9 GeV, where a signal had been reported earlier (LEE 94). As isovectors, $\pi_1(1400)$ and $\pi_1(1600)$ cannot be glueballs. The coupling to $\eta\pi$ of the former points to a four-quark state, while the strong $\eta'\pi$ coupling of the latter is favored for hybrid states (CLOSE 87B, IDDIR 01). Its mass is not far below the lattice prediction.

Finally, 0^{-+}, 1^{--}, and 2^{-+} hybrids were also reported. The $\pi(1800)$ decays mostly to a pair of S- and P-wave mesons (AMELIN 95B), in line with expectations for a 0^{-+} hybrid meson, although recent data contradict this, indicating a strong $\rho\omega$ decay mode (ZAITSEV 97). This meson is also rather narrow if interpreted as the second radial excitation of the the pion. The evidence for 1^{--} hybrids required in e^+e^- annihilation and in τ decays has been discussed by DONNACHIE 99. A candidate for the 2^{-+} hybrid, the $\eta_2(1870)$, was reported in $\gamma\gamma$ interactions

(KARCH 92), in $\overline{p}p$ annihilation (ADOMEIT 96), and in central production (BARBERIS 97B). The near degeneracy of $\eta_2(1645)$ and $\pi_2(1670)$ suggests ideal mixing in the 2^{-+} $q\overline{q}$ nonet, and hence, the second isoscalar should be mainly $s\overline{s}$. However, $\eta_2(1870)$ decays mainly to $a_2(1320)\pi$ and $f_2(1270)\pi$ (ADOMEIT 96), with a relative rate compatible with a hybrid state (CLOSE 95).

References

References may be found at the end of the Non-$q\overline{q}$ Candidates Listing.

Non-$q\overline{q}$ Candidates

OMITTED FROM SUMMARY TABLE

NON-$q\overline{q}$ CANDIDATES REFERENCES

AMSLER	02	EPJ C23 29	C. Amsler *et al.*	
BASS	02	PR D65 057503	S.D. Bass, E. Marco	
LIU	02	PL B529 65	L.C. Liu	
ABELE	01	EPJ C19 667	A. Abele *et al.*	(Crystal Barrel Collab.)
ABELE	01B	EPJ C21 261	A. Abele *et al.*	(Crystal Barrel Collab.)
ACCIARRI	01H	PL B501 173	M. Acciarri *et al.*	(L3 Collab.)
AITALA	01A	PRL 86 765	E.M. Aitala *et al.*	(FNAL E791 Collab.)
AMSLER	01	PL B520 175	C. Amsler *et al.*	(Crystal Barrel Collab.)
ANISOVICH	01H	EPJ A12 103	A.V. Anisovich, V.V. Anisovich, V.A. Nikonov	
CLOSE	01B	EPJ C21 531	F.E. Close, A. Kirk	
IDDIR	01	PL B507 183	F. Iddir, A.S. Safir	
IVANOV	01	PRL 86 3977	E.I. Ivanov *et al.*	
ACHASOV	00E	NP B569 158	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	00F	PL B479 53	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ALFORD	00	NP B578 367	M. Alford, R.L. Jaffe	
BARATE	00E	PL B472 189	R. Barate *et al.*	(ALEPH Collab.)
BARBERIS	00C	PL B471 440	D. Barberis *et al.*	(WA 102 Collab.)
BARBERIS	00E	PL B479 59	D. Barberis *et al.*	(WA 102 Collab.)
BEVEREN	00	PL B495 300	E. van Beveren, G. Rupp, M.D. Scadron	
Also	01	PL B509 365 (erratum)	E. van Beveren, G. Rupp, M.D. Scadron	
FILIPPI	00	PL B495 284	A. Filippi *et al.*	(OBELIX Experiment)
KIRK	00	PL B489 29	A. Kirk	
NOYA	00A	PL B479 163	H. Noya, T. Sanaki	
VLADIMIRSKII	00	JETPL 26 486 Translated from ZETFP 72 698.	V.V. Vladimirskii *et al.*	
ABELE	99	PL B446 349	A. Abele *et al.*	(Crystal Barrel Collab.)
ABELE	99B	EPJ C8 67	A. Abele *et al.*	(Crystal Barrel Collab.)
AKHMETSHIN	99C	PL B462 380	R.R. Akhmetshin *et al.*	(Novosibirsk CMD-2 Collab.)
AMSLER	99	NP A663 and 664 93C	C. Amsler	
Proceedings XV Particle and Nucle Int. Conf., Uppsala				
BAKER	99	PL B449 114	C.A. Baker *et al.*	
BARBERIS	99	PL B453 305	D. Barberis *et al.*	(Omega expt.)
BARBERIS	99B	PL B453 316	D. Barberis *et al.*	(Omega expt.)
BARBERIS	99D	PL B462 462	D. Barberis *et al.*	(Omega expt.)
BELLAZZINI	99	PL B467 296	R. Bellazzini *et al.*	
BRACCINI	99	Hadron Spectroscopy 53	S. Braccini	
Frascati Physics Series XV (1999) 53, Proceedings Workshop on Hadron Spectroscopy				
BUGG	99	PL B458 511	D.V. Bugg *et al.*	

CHUNG	99	PR D60 092001	S.U. Chung *et al.*	(BNL E852 Collab.)
DELBOURGO	99	PL B446 332	R. Delbourgo, D. Liu, M. Scadron	
DONNACHIE	99	PR D60 114011	A. Donnachie, Yu.S. Kalashnikova	
DUENNWEBER	99	NP A 663 + 664, 592C Proc. XV Particles and Nuclei Int. Conf., Uppsala	W. Duennweber	
FRENCH	99	PL B460 213	B. French *et al.*	(WA76 Collab.)
GODFREY	99	RMP 71 1411	S. Godfrey, J. Napolitano	
KISIEL	99	Hadron Spectroscopy Frascati Physics Series XV 357, Proceedings Workshop	J. Kisiel	
LANDSBERG	99	SPU 42 871 Translated from UFN 42 961.	L.G. Landsberg	
MALTMAN	99B	PL B462 14	K. Maltman	
MINKOWSKI	99	EPJ C9 283	P. Minkowski, W. Ochs	
MORNINGSTAR	99	PR D60 034509	C.J. Morningstar, M. Peardon	
PAGE	99	PR D59 034016	P.R. Page, E.S. Swanson, A.P. Szczepaniak	
PALANO	99	Hadron Spectroscopy 363 Frascati Physics Series XV 363, Proceedings Workshop on Hadron Spectroscopy	A. Palano	
THOMA	99	Hadron Spectroscopy 45 Fracati Physics Series XV 45, Proceedings Workshop on Hadron Spectroscopy	U. Thoma	
TORNQVIST	99	EPJ C11 359	N. Tornqvist	
ABELE	98	PR D57 3860	A. Abele *et al.*	(Crystal Barrel Collab.)
ABELE	98B	PL B423 175	A. Abele *et al.*	(Crystal Barrel Collab.)
ACHASOV	98B	PL B438 441	M.N. Achasov *et al.*	(Novosibirsk SND Collab.)
ACHASOV	98I	PL B440 442	M.N. Achasov *et al.*	
ACKERSTAFF	98Q	EPJ C4 19	K. Ackerstaff *et al.*	(OPAL Collab.)
ADAMS	98B	PRL 81 5760	G.S. Adams *et al.*	(MPS Collab.)
AMSLER	98	RMP 70 1293	C. Amsler	
BARBERIS	98	PL B432 436	D. Barberis *et al.*	(Omega expt.)
BERTIN	98	PR D57 55	A. Bertin *et al.*	(OBELIX Collab.)
CLOSE	98B	PL B419 387	F.E. Close	
DONNACHIE	98	PR D58 114012	A. Donnachie *et al.*	
EVANGELISTA	98	PR D57 5370	C. Evangelista *et al.*	(JETSET Collab.)
LOCHER	98	EPJ C4 317	M.P. Locher *et al.*	(PSI)
REYES	98	PRL 81 4079	M.A. Reyes *et al.*	
ACHASOV	97C	PR D56 4084	N.N. Achasov *et al.*	
ACHASOV	97D	PR D56 203	N.N. Achasov *et al.*	
ACHASOV	97E	IJMP A12 5019	N.N. Achasov *et al.*	
ANISOVICH	97	PL B395 123	A.V. Anisovich, A.V. Sarantsev	(PNPI)
ANISOVICH	97B	ZPHY A357 123	A.V. Anisovich *et al.*	(PNPI)
ANISOVICH	97C	PL B413 137	A.V. Anisovich, A.V. Sarantsev	
ANISOVICH	97E	PAN 60 1892 Translated from YAF 60 2065.	A.V. Anisovich *et al.*	(PNPI)
BARBERIS	97	PL B397 339	D. Barberis *et al.*	(WA 102 Collab.)
BARBERIS	97B	PL B413 217	D. Barberis *et al.*	(WA 102 Collab.)
BARBERIS	97C	PL B413 225	D. Barberis *et al.*	(WA 102 Collab.)
BARNES	97	PR D55 4157	T. Barnes *et al.*	(ORNL, RAL, MCHS)
BERNARD	97	PR D56 7039	C. Bernard *et al.*	(MILC Collab.)
BERTIN	97	PL B400 226	A. Bertin *et al.*	(OBELIX Collab.)
BERTIN	97C	PL B408 476	A. Bertin *et al.*	(OBELIX Collab.)
BOGLIONE	97	PRL 79 1998	M. Boglione *et al.*	
BUGG	97	PL B396 295	D.V. Bugg *et al.*	
CLOSE	97	PL B397 333	F. Close *et al.*	(RAL, BIRM)
CLOSE	97B	PR D55 5749	F. Close *et al.*	(RAL, RUTG, BEIJT)
DUNWOODIE	97	Hadron 97 Conf.	W. Dunwoodie	(SLAC)
FRABETTI	97D	PL B407 79	P.L. Frabetti *et al.*	(FNAL E687 Collab.)
GERASYUTA	97	ZPHY C74 325	S.M. Gerasyuta *et al.*	
HOU	97	PR D55 6952	W.-S. Hou	
KISSLINGER	97	PL B410 1	L.S. Kisslinger *et al.*	
LACOCK	97	PL B401 308	P. Lacock *et al.*	(EDIN, LIVP)
MICHAEL	97	Hadron 97 Conf. AIP Conf. Proc. 432 657	C. Michael	
OLLER	97	NP A620 438	J.A. Oller *et al.*	(VALE)
OLLER	97B	Hadron 97 Conf. AIP Conf. Proc. 432 413	J.A. Oller, E. Oset	
PAGE	97	PL B402 183	P.R. Page	
PAGE	97B	NP B495 268	P.R. Page	
PAGE	97C	PL B415 205	P.R. Page	(CEBAF)
SWANSON	97	Hadron 97 Conf. AIP Conf. Proc. 432 471	E.S. Swanson	
THOMPSON	97	PRL 79 1630	D.R. Thompson *et al.*	(E852 Collab.)
WEINGARTEN	97	NPPS 53 232	D. Weingarten	
YAN	97	JP G23 L33	Y. Yan *et al.*	

ZAITSEV 97 Hadron 97 Conf. A. Zaitsev
AIP Conf. Proc. 432 461
ABELE 96 PL B380 453 A. Abele *et al.* (Crystal Barrel Collab.)
ABELE 96B PL B385 425 A. Abele *et al.* (Crystal Barrel Collab.)
ADOMEIT 96 ZPHY C71 227 J. Adomeit *et al.* (Crystal Barrel Collab.)
AMELIN 96B PAN 59 976 D.V. Amelin *et al.* (SERP, TBIL)
Translated from YAF 59 1021.
AMSLER 96 PR D53 295 C. Amsler, F.E. Close (ZURI, RAL)
AMSLER 96B ZPHY C70 219 C. Amsler *et al.* (Crystal Barrel Collab.)
AMSLER 96C Third Paper C. Amsler *et al.* (Crystal Barrel Collab.)
BAI 96B PRL 76 3502 J.Z. Bai *et al.* (BES Collab.)
BAI 96C PRL 77 3959 J.Z. Bai *et al.* (BES Collab.)
BAJC 96 ZPHY A356 187 B. Bajc *et al.*
CLOSE 96 PL B366 323 F.E. Close, P.R. Page (RAL)
SZCZEPANIAK 96 PRL 76 2011 A. Szczepaniak *et al.* (NCARO)
TORNQVIST 96 PRL 76 1575 N.A. Tornqvist, M. Roos (HELS)
AMELIN 95B PL B356 595 D.V. Amelin *et al.* (SERP, TBIL)
AMSLER 95B PL B342 433 C. Amsler *et al.* (Crystal Barrel Collab.)
AMSLER 95C PL B353 571 C. Amsler *et al.* (Crystal Barrel Collab.)
AMSLER 95D PL B355 425 C. Amsler *et al.* (Crystal Barrel Collab.)
AMSLER 95E PL B353 385 C. Amsler, F.E. Close (ZURI, RAL)
AMSLER 95F PL B358 389 C. Amsler *et al.* (Crystal Barrel Collab.)
BERTIN 95 PL B361 187 A. Bertin *et al.* (OBELIX Collab.)
BUGG 95 PL B353 378 D.V. Bugg *et al.* (LOQM, PNPI, WASH)
CLOSE 95 NP B443 233 F.E. Close, P.R. Page (RAL)
PROKOSHKIN 95B PAN 58 606 Y.D. Prokoshkin, S.A. Sadovsky (SERP)
Translated from YAF 58 662.
PROKOSHKIN 95C PAN 58 853 Y.D. Prokoshkin, S.A. Sadovsky (SERP)
Translated from YAF 58 921.
SEXTON 95 PRL 75 4563 J. Sexton *et al.* (IBM)
ALBRECHT 94Z PL B332 451 H. Albrecht *et al.* (ARGUS Collab.)
AMSLER 94D PL B333 277 C. Amsler *et al.* (Crystal Barrel Collab.)
ANISOVICH 94 PL B323 233 V.V. Anisovich *et al.* (Crystal Barrel Collab.)
BERDNIKOV 94 PL B337 219 E.B. Berdnikov *et al.* (SERP, TBIL)
LEE 94 PL B323 227 J.H. Lee *et al.* (BNL, IND, KYUN, MASD+)
TORNQVIST 94 ZPHY C61 525 N.A. Tornqvist (HELS)
ALEEV 93 PAN 56 1358 A.N. Aleev *et al.* (BIS-2 Collab.)
Translated from YAF 56 100.
AOYAGI 93 PL B314 246 H. Aoyagi *et al.* (BKEI Collab.)
BALI 93 PL B309 378 G.S. Bali *et al.* (LIVP)
BARNES 93 PL B309 469 P.D. Barnes, P. Birien, W.H. Breunlich
BELADIDZE 93 PL B313 276 G.M. Beladidze *et al.* (VES Collab.)
DONNACHIE 93 ZP C60 187 A. Donnachie, Yu.S. Kalashnikova, A.B. Clegg (BNL)
ERICSON 93 PL B309 426 T.E.O. Ericson, G. Karl (CERN)
MANOHAR 93 NP B399 17 A.V. Manohar, M.B. Wise (MIT)
ADAMO 92 PL B287 368 A. Adamo *et al.* (OBELIX Collab.)
AMSLER 92 PL B291 347 C. Amsler *et al.* (Crystal Barrel Collab.)
BARNES 92 PR D46 131 T. Barnes, E.S. Swanson (ORNL)
DOOLEY 92 PL B275 478 K. Dooley, E.S. Swanson, T. Barnes (ORNL)
GOUZ 92 Dallas HEP 92, p. 572 Yu.P. Gouz *et al.* (VES Collab.)
Proceedings XXVI Int. Conf. on High Energy Physics
KARCH 92 ZPHY C54 33 K. Karch *et al.* (Crystal Ball Collab.)
ALBRECHT 91F ZPHY C50 1 H. Albrecht *et al.* (ARGUS Collab.)
DOVER 91 PR C43 379 C.B. Dover, T. Gutsche, A. Faessler (BNL)
FUKUI 91 PL B257 241 S. Fukui *et al.* (SUGI, NAGO, KEK, KYOT+)
TORNQVIST 91 PRL 67 556 N.A. Tornqvist (HELS)
ACHASOV 90 TF 20 (178) N.N. Achasov, G.N. Shestakov (NOVM)
ALDE 90 PL B241 600 D.M. Alde *et al.* (SERP, BELG, LANL, LAPP+)
BREAKSTONE 90 ZPHY C48 569 A.M. Breakstone *et al.* (ISU, BGNA, CERN+)
BURNETT 90 ARNPS 46 332 T.H. Burnett, S.R. Sharpe (RAL)
LONGACRE 90 PR D42 874 R.S. Longacre (BNL)
MAY 90 ZPHY C46 203 B. May *et al.* (ASTERIX Collab.)
WEINSTEIN 90 PR D41 2236 J. Weinstein, N. Isgur (TNTO)
ALDE 89 PL B216 447 D.M. Alde *et al.* (SERP, BELG, LANL, LAPP)
ARMSTRONG 89B PL B221 221 T.A. Armstrong *et al.* (CERN, CDEF, BIRM+)
ARMSTRONG 89D PL B227 186 T.A. Armstrong, M. Benayoun (ATHU, BARI, BIRM+)
MAY 89 PL B225 450 B. May *et al.* (ASTERIX Collab.)
ACHASOV 88 PL B207 199 N.N. Achasov, A.A. Kozhevnikov (NOVM)
AIHARA 88 PR D37 28 H. Aihara *et al.* (TPC-2γ Collab.)
ALDE 88 PL B201 160 D.M. Alde *et al.* (SERP, BELG, LANL, LAPP+)
ALDE 88B PL B205 397 D.M. Alde *et al.* (SERP, BELG, LANL, LAPP)

ASTON	88D	NP B301 525	D. Aston *et al.*	(SLAC, NAGO, CINC, INUS)
BERGER	88B	ZPHY C38 521	C. Berger *et al.*	(PLUTO Collab.)
BIRMAN	88	PRL 61 1557	A. Birman *et al.*	(BNL, FSU, IND, MASD)
CLEGG	88	ZPHY C40 313	A.B. Clegg, A. Donnachie	(MCHS, LANC)
ETKIN	88	PL B201 568	A. Etkin *et al.*	(BNL, CUNY)
IDDIR	88	PL B205 564	F. Iddir *et al.*	(ORSAY, TOKY)
ACHASOV	87	ZPHY C36 661	N.N. Achasov, V.A. Karnakov, G.N. Shestakov	(NOVM)
ASTON	87	NP B292 693	D. Aston *et al.*	(SLAC, NAGO, CINC, INUS)
BITYUKOV	87	PL B188 383	S.I. Bityukov *et al.*	(SERP)
CLOSE	87	RPP 51 833	F.E. Close	(RHEL)
ANDO	86	PRL 57 1296	A. Ando *et al.*	(KEK, KYOT, NIRS, SAGA+)
BOOTH	86	NP B273 677	P.S.L. Booth *et al.*	(LIVP, GLAS, CERN)
BOURQUIN	86	PL B172 113	M.H. Bourquin *et al.*	(GEVA, RAL, HEIDP+)
LONGACRE	86	PL B177 223	R.S. Longacre *et al.*	(BNL, BRAN, CUNY+)
BARNES	85	PL B165 434	T. Barnes	
CHUNG	85	PRL 55 779	S.U. Chung *et al.*	(BNL, FLOR, IND+)
ISGUR	85	PRL 54 869	N. Isgur, R. Kokoski, J. Paton	(TNTO)
LEYAOUANC	85	ZPHY C28 309	A. Le Yaouanc *et al.*	(ORSAY)
BEHREND	84E	ZPHY C21 205	H.J. Behrend *et al.*	(CELLO Collab.)
BARNES	83	NP B224 241	T. Barnes *et al.*	(RAL, LOUV)
BINON	83	NC 78A 313	F.G. Binon *et al.*	(BELG, LAPP, SERP+)
WEINSTEIN	83B	PR D27 588	J. Weinstein, N. Isgur	(TNTO)
AIHARA	82	PR D37 28	H. Aihara *et al.*	(TPC Collab.)
ALTHOFF	82	ZPHY C16 13	M. Althoff *et al.*	(TASSO Collab.)
BARNES	82	PL B116 365	T. Barnes, F.E. Close	(RHEL)
BURKE	81	PL B103 153	D.L. Burke *et al.*	(Mark II Collab.)
BRANDELIK	80B	PL B97 448	R. Brandelik *et al.*	(TASSO Collab.)
GUTBROD	79	ZP C1 391	F. Gutbrod, G. Kramer, C. Rumpf	(DESY)
JAFFE	77	PR D15 267,281	R. Jaffe	(MIT)
VOLOSHIN	76	JETPL 23 333	M.B. Voloshin, L.B. Okun	(ITEP)
		Translated from ZETFP 23 369.		
BAILLON	67	NC 50A 393	P.H. Baillon *et al.*	(CERN, CDEF, IRAD)