NODE=B016

$N(1875)\ 3/2^-$

$I(J^P) = \frac{1}{2}(\frac{3}{2}^-)$ Status: ***

was $N(2080)$

Before the 2012 *Review*, all the evidence for a $J^P = 3/2^-$ state with a mass above 1800 MeV was filed under a two-star $N(2080)$. There is now evidence from ANISOVICH 12A for two $3/2^-$ states in this region, so we have split the older data (according to mass) between a three-star $N(1875)$ and a two-star $N(2120)$.

NODE=B016

$N(1875)$ POLE POSITION

NODE=B016215

REAL PART

NODE=B016RE
NODE=B016RE

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1850 to 1950 (≈ 1900) OUR ESTIMATE				→ UNCHECKED ←
1855± 17	SARANTSEV	25	DPWA	Multichannel
1880±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1993	HUNT	19	DPWA	Multichannel
1870± 20	SOKHOYAN	15A	DPWA	Multichannel
1810	SHKLYAR	13	DPWA	Multichannel
1957± 49	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$
1824	VRANA	00	DPWA	Multichannel

−2×IMAGINARY PART

NODE=B016IM
NODE=B016IM

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
100 to 220 (≈ 160) OUR ESTIMATE				→ UNCHECKED ←
260± 20	SARANTSEV	25	DPWA	Multichannel
160± 80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
319	HUNT	19	DPWA	Multichannel
200± 15	SOKHOYAN	15A	DPWA	Multichannel
98	SHKLYAR	13	DPWA	Multichannel
467±106	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$
614	VRANA	00	DPWA	Multichannel

$N(1875)$ ELASTIC POLE RESIDUE

NODE=B016220

MODULUS $|r|$

NODE=B016RER
NODE=B016RER

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
3 to 12 (≈ 10) OUR ESTIMATE				→ UNCHECKED ←
3 ±1.5	SOKHOYAN	15A	DPWA	Multichannel
10 ±5	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
3	SHKLYAR	13	DPWA	Multichannel
2.5±1.0	ANISOVICH	12A	DPWA	Multichannel
53	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$

PHASE θ

NODE=B016IMR
NODE=B016IMR

VALUE (°)	DOCUMENT ID		TECN	COMMENT
50 to 200 (≈ 100) OUR ESTIMATE				→ UNCHECKED ←
160±50	SOKHOYAN	15A	DPWA	Multichannel
100±80	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
− 76	SHKLYAR	13	DPWA	Multichannel
− 65	BATINIC	10	DPWA	$\pi N \to N\pi, N\eta$

$N(1875)$ INELASTIC POLE RESIDUE

NODE=B016250

The "normalized residue" is the residue divided by $\Gamma_{pole}/2$.

NODE=B016250

Normalized residue in $N\pi \to N(1875) \to \Lambda K$

NODE=B016RS1
NODE=B016RS1

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.015±0.005		ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \to N(1875) \to \Sigma K$

NODE=B016RS2
NODE=B016RS2

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.04±0.02		ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \to N(1875) \to N\sigma$

NODE=B016RS3
NODE=B016RS3

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.09±0.03	−175 ± 45	SOKHOYAN	15A	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.08±0.03	−170 ± 65	ANISOVICH	12A	DPWA	Multichannel

Normalized residue in $N\pi \to N(1875) \to \Delta(1232)\pi$, S-wave

NODE=B016RS4
NODE=B016RS4

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.05±0.03	undefined	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to N(1875) \to \Delta(1232)\pi$, D-wave

NODE=B016RS5
NODE=B016RS5

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.04±0.02	undefined	SOKHOYAN	15A	DPWA	Multichannel

Normalized residue in $N\pi \to N(1875) \to N(1440)\pi$

NODE=B016RS6
NODE=B016RS6

MODULUS	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.03±0.02	undefined	SOKHOYAN	15A	DPWA	Multichannel

$N(1875)$ BREIT-WIGNER MASS

NODE=B016M

NODE=B016M

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
1850 to 1920 (≈ 1875) OUR ESTIMATE				→ UNCHECKED ←
1885± 15	SARANTSEV	25	DPWA	Multichannel
2005± 12	[1] HUNT	19	DPWA	Multichannel
1934± 10	[1] SHKLYAR	13	DPWA	Multichannel
1880±100	CUTKOSKY	80	IPWA	$\pi N \to \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1875± 20	SOKHOYAN	15A	DPWA	Multichannel
1951± 27	[1] SHRESTHA	12A	DPWA	Multichannel
2048± 65	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
1946± 1	PENNER	02C	DPWA	Multichannel
1895	MART	00	DPWA	$\gamma p \to \Lambda K^+$
2003± 18	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B016M;LINKAGE=A

$N(1875)$ BREIT-WIGNER WIDTH

NODE=B016W

NODE=B016W

VALUE (MeV)	DOCUMENT ID		TECN	COMMENT
120 to 250 (≈ 200) OUR ESTIMATE				→ UNCHECKED ←
270± 20	SARANTSEV	25	DPWA	Multichannel
321± 21	[1] HUNT	19	DPWA	Multichannel
857±100	[1] SHKLYAR	13	DPWA	Multichannel
180± 60	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
200± 25	SOKHOYAN	15A	DPWA	Multichannel
500± 45	[1] SHRESTHA	12A	DPWA	Multichannel
529±128	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
859± 7	PENNER	02C	DPWA	Multichannel
372	MART	00	DPWA	$\gamma p \to \Lambda K^+$
1070±858	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B016W;LINKAGE=A

$N(1875)$ DECAY MODES

NODE=B016225;NODE=B016

	Mode	Fraction (Γ_i/Γ)	
Γ_1	$N\pi$	3–11 %	DESIG=1;OUR EST
Γ_2	$N\eta$	3–16 %	DESIG=2
Γ_3	$N\omega$	15–25 %	DESIG=12;OUR EST
Γ_4	ΛK	1–2 %	DESIG=3
Γ_5	ΣK	0.3–1.1 %	DESIG=4
Γ_6	$N\pi\pi$	>56 %	DESIG=5;OUR EST

Γ_7	$\Delta(1232)\pi$	4–44 %	DESIG=14;OUR EST
Γ_8	$\Delta(1232)\pi$, S-wave	2–21 %	DESIG=21
Γ_9	$\Delta(1232)\pi$, D-wave	2–23 %	DESIG=22
Γ_{10}	$N\rho$, S=3/2, S-wave	36–56 %	DESIG=23
Γ_{11}	$N\sigma$	16–60 %	DESIG=24
Γ_{12}	$N(1440)\pi$	2–8 %	DESIG=11;OUR EST
Γ_{13}	$N(1520)\pi$	<2 %	DESIG=13;OUR EST
Γ_{14}	$N(1535)\pi$		DESIG=179
Γ_{15}	$\Lambda K^*(892)$	<0.2 %	DESIG=178
Γ_{16}	$p\gamma$	0.001–0.025 %	DESIG=10;OUR EST
Γ_{17}	$p\gamma$, helicity=1/2	0.001–0.021 %	DESIG=6;OUR EST
Γ_{18}	$p\gamma$, helicity=3/2	<0.003 %	DESIG=7;OUR EST
Γ_{19}	$n\gamma$	<0.040 %	DESIG=15;OUR EST
Γ_{20}	$n\gamma$, helicity=1/2	<0.007 %	DESIG=8;OUR EST
Γ_{21}	$n\gamma$, helicity=3/2	<0.033 %	DESIG=9;OUR EST

$N(1875)$ BRANCHING RATIOS

NODE=B016230

$\Gamma(N\pi)/\Gamma_{\text{total}}$ Γ_1/Γ

NODE=B016R1
NODE=B016R1

VALUE (%)	DOCUMENT ID		TECN	COMMENT
3 to 11 (≈ 7) OUR ESTIMATE				
3 ±2	SEIFEN	25	DPWA	Multichannel
7.5±0.1	[1] HUNT	19	DPWA	Multichannel
11 ±1	[1] SHKLYAR	13	DPWA	Multichannel
10 ±4	CUTKOSKY	80	IPWA	$\pi N \to \pi N$ (lower m)
• • • We do not use the following data for averages, fits, limits, etc. • • •				
4 ±2	SOKHOYAN	15A	DPWA	Multichannel
7 ±2	[1] SHRESTHA	12A	DPWA	Multichannel
17 ±7	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
12 ±2	PENNER	02C	DPWA	Multichannel
13 ±3	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B016R1
NODE=B016R1
→ UNCHECKED ←
NODE=B016R1;LINKAGE=A

$\Gamma(N\eta)/\Gamma_{\text{total}}$ Γ_2/Γ

NODE=B016R7
NODE=B016R7

VALUE (%)	DOCUMENT ID		TECN	COMMENT
3–16 % OUR ESTIMATE				
10 ±6	MUELLER	20	DPWA	Multichannel
3.3±0.8	[1] HUNT	19	DPWA	Multichannel
< 1	SHKLYAR	13	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8 ±3	BATINIC	10	DPWA	$\pi N \to N\pi$, $N\eta$
7 ±2	PENNER	02C	DPWA	Multichannel
0 ±2	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

→ UNCHECKED ←
NODE=B016R7;LINKAGE=B

$\Gamma(N\omega)/\Gamma_{\text{total}}$ Γ_3/Γ

NODE=B016R14
NODE=B016R14

VALUE (%)	DOCUMENT ID		TECN	COMMENT
13±7	DENISENKO	16	DPWA	Multichannel
20±5	[1] SHKLYAR	13	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
21±7	PENNER	02C	DPWA	Multichannel

[1] Statistical error only.

NODE=B016R14;LINKAGE=B

$\Gamma(\Lambda K)/\Gamma_{\text{total}}$ Γ_4/Γ

NODE=B016R12
NODE=B016R12

VALUE (%)	DOCUMENT ID		TECN	COMMENT
1–2 % OUR ESTIMATE				
1.1±0.4	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.2±0.2	PENNER	02C	DPWA	Multichannel

[1] Statistical error only.

→ UNCHECKED ←
NODE=B016R12;LINKAGE=A

$\Gamma(\Sigma K)/\Gamma_{total}$ Γ_5/Γ

NODE=B016R13
NODE=B016R13

VALUE (%)	DOCUMENT ID		TECN	COMMENT
0.3–1.1 % OUR ESTIMATE				→ UNCHECKED ←
0.7±0.4	PENNER	02C	DPWA	Multichannel

$\Gamma(\Delta(1232)\pi, S\text{-wave})/\Gamma_{total}$ Γ_8/Γ

NODE=B016R10
NODE=B016R10

VALUE (%)	DOCUMENT ID		TECN	COMMENT
2–21 % OUR ESTIMATE				→ UNCHECKED ←
10^{+15}_{-10}	SARANTSEV	25	DPWA	Multichannel
6± 4	SEIFEN	25	DPWA	Multichannel
< 2	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
14± 7	SOKHOYAN	15A	DPWA	Multichannel
87± 3	[1] SHRESTHA	12A	DPWA	Multichannel
40±10	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B016R10;LINKAGE=A

$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{total}$ Γ_9/Γ

NODE=B016R9
NODE=B016R9

VALUE (%)	DOCUMENT ID		TECN	COMMENT
2–23 % OUR ESTIMATE				→ UNCHECKED ←
4± 2	SARANTSEV	25	DPWA	Multichannel
4± 3	SEIFEN	25	DPWA	Multichannel
17± 6	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
7± 5	SOKHOYAN	15A	DPWA	Multichannel
< 6	[1] SHRESTHA	12A	DPWA	Multichannel
17±10	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B016R9;LINKAGE=A

$\Gamma(N\rho, S{=}3/2, S\text{-wave})/\Gamma_{total}$ Γ_{10}/Γ

NODE=B016R8
NODE=B016R8

VALUE (%)	DOCUMENT ID		TECN	COMMENT
36–56 % OUR ESTIMATE				→ UNCHECKED ←
46±10	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
< 5	[1] SHRESTHA	12A	DPWA	Multichannel
6± 6	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B016R8;LINKAGE=A

$\Gamma(N\sigma)/\Gamma_{total}$ Γ_{11}/Γ

NODE=B016R11
NODE=B016R11

VALUE (%)	DOCUMENT ID		TECN	COMMENT
16–60 % OUR ESTIMATE				→ UNCHECKED ←
33 ±20	SARANTSEV	25	DPWA	Multichannel
50 ±20	SEIFEN	25	DPWA	Multichannel
24.3± 8.6	[1] HUNT	19	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
45 ±15	SOKHOYAN	15A	DPWA	Multichannel
< 4	[1] SHRESTHA	12A	DPWA	Multichannel
24 ±24	VRANA	00	DPWA	Multichannel

[1] Statistical error only.

NODE=B016R11;LINKAGE=A

$\Gamma(N(1440)\pi)/\Gamma_{total}$ Γ_{12}/Γ

NODE=B016R15
NODE=B016R15

VALUE (%)	DOCUMENT ID		TECN	COMMENT
11±5	SEIFEN	25	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
5±3	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N(1520)\pi)/\Gamma_{total}$ Γ_{13}/Γ

NODE=B016R16
NODE=B016R16

VALUE (%)	DOCUMENT ID		TECN	COMMENT
4±4	SEIFEN	25	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<2	SOKHOYAN	15A	DPWA	Multichannel

$\Gamma(N(1535)\pi)/\Gamma_{total}$ Γ_{14}/Γ

NODE=B016R01
NODE=B016R01

VALUE (%)	DOCUMENT ID		TECN	COMMENT
2±2	SEIFEN	25	DPWA	Multichannel

$\Gamma(\Lambda K^*(892))/\Gamma_{total}$ Γ_{15}/Γ

NODE=B016R00
NODE=B016R00

VALUE (%)	DOCUMENT ID		TECN	COMMENT
<0.2 % OUR ESTIMATE				
<0.2	ANISOVICH	17B	DPWA	Multichannel

→ UNCHECKED ←

N(1875) PHOTON DECAY AMPLITUDES AT THE POLE

NODE=B016260

N(1875) → pγ, helicity-1/2 amplitude $A_{1/2}$

NODE=B016PA1
NODE=B016PA1

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.012±0.006	−140 ± 30	SARANTSEV	25	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.017±0.009	−110 ± 40	SOKHOYAN	15A	DPWA	Multichannel

N(1875) → pγ, helicity-3/2 amplitude $A_{3/2}$

NODE=B016PA2
NODE=B016PA2

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.014±0.006	175 ± 30	SARANTSEV	25	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.008±0.004	180 ± 40	SOKHOYAN	15A	DPWA	Multichannel

N(1875) → nγ, helicity-1/2 amplitude $A_{1/2}$

NODE=B016PA3
NODE=B016PA3

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
0.004±0.003	−85 ± 35	ANISOVICH	17E	DPWA	Multichannel

N(1875) → nγ, helicity-3/2 amplitude $A_{3/2}$

NODE=B016PA4
NODE=B016PA4

MODULUS ($GeV^{-1/2}$)	PHASE (°)	DOCUMENT ID		TECN	COMMENT
−0.006±0.004	−85 ± 45	ANISOVICH	17E	DPWA	Multichannel

N(1875) BREIT-WIGNER PHOTON DECAY AMPLITUDES

NODE=B016235

N(1875) → pγ, helicity-1/2 amplitude $A_{1/2}$

NODE=B016A1
NODE=B016A1

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.010 to 0.025 (≈ 0.015) OUR ESTIMATE				
−0.013±0.006	SARANTSEV	25	DPWA	Multichannel
−0.013±0.008	[1] HUNT	19	DPWA	Multichannel
0.011±0.001	[1] SHKLYAR	13	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.018±0.010	ANISOVICH	12A	DPWA	Multichannel
0.007±0.008	[1] SHRESTHA	12A	DPWA	Multichannel
0.012	PENNER	02D	DPWA	Multichannel

→ UNCHECKED ←

[1] Statistical error only.

NODE=B016A1;LINKAGE=A

N(1875) → pγ, helicity-3/2 amplitude $A_{3/2}$

NODE=B016A2
NODE=B016A2

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
−0.010 to 0.025 (≈ − 0.005) OUR ESTIMATE				
−0.015±0.006	SARANTSEV	25	DPWA	Multichannel
−0.093±0.009	[1] HUNT	19	DPWA	Multichannel
0.026±0.001	[1] SHKLYAR	13	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−0.007±0.004	SOKHOYAN	15A	DPWA	Multichannel
0.043±0.022	[1] SHRESTHA	12A	DPWA	Multichannel
−0.010	PENNER	02D	DPWA	Multichannel

→ UNCHECKED ←

[1] Statistical error only.

NODE=B016A2;LINKAGE=A

N(1875) → nγ, helicity-1/2 amplitude $A_{1/2}$

NODE=B016A3
NODE=B016A3

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.050±0.009	[1] HUNT	19	DPWA	Multichannel
0.010±0.006	ANISOVICH	13B	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.055±0.021	[1] SHRESTHA	12A	DPWA	Multichannel
0.023	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

NODE=B016A3;LINKAGE=A

$N(1875) \rightarrow n\gamma$, helicity-3/2 amplitude $A_{3/2}$

NODE=B016A4
NODE=B016A4

VALUE ($GeV^{-1/2}$)	DOCUMENT ID		TECN	COMMENT
0.141 ± 0.022	[1] HUNT	19	DPWA	Multichannel
-0.020 ± 0.015	ANISOVICH	13B	DPWA	Multichannel
• • • We do not use the following data for averages, fits, limits, etc. • • •				
-0.085 ± 0.031	[1] SHRESTHA	12A	DPWA	Multichannel
-0.009	PENNER	02D	DPWA	Multichannel

[1] Statistical error only.

NODE=B016A4;LINKAGE=A

N(1875) REFERENCES

NODE=B016

NODE=B016

For early references, see Physics Letters **111B** 1 (1982).

SARANTSEV	25	PR C112 015202	A.V. Sarantsev *et al.*	(Bonn-Gatchina Collab.)	REFID=63294
SEIFEN	25	EPJ A61 173	T. Seifen *et al.*	(CBELSA/TAPS Collab.)	REFID=63593
MUELLER	20	PL B803 135323	J. Mueller *et al.*	(CBELSA/TAPS Collab.)	REFID=60391
HUNT	19	PR C99 055205	B.C. Hunt, D.M. Manley		REFID=59985
ANISOVICH	17B	PL B771 142	A.V. Anisovich *et al.*		REFID=58101
ANISOVICH	17E	PR C96 055202	A.V. Anisovich *et al.*	(BONN, PNPI, JLAB+)	REFID=62311
DENISENKO	16	PL B755 97	I. Denisenko *et al.*		REFID=57504
SOKHOYAN	15A	EPJ A51 95	V. Sokhoyan *et al.*	(CBELSA/TAPS Collab.)	REFID=56757
ANISOVICH	13B	EPJ A49 67	A.V. Anisovich *et al.*		REFID=56147
SHKLYAR	13	PR C87 015201	V. Shklyar, H. Lenske, U. Mosel	(GIES)	REFID=55104
ANISOVICH	12A	EPJ A48 15	A.V. Anisovich *et al.*	(BONN, PNPI)	REFID=54041
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)	REFID=54862
BATINIC	10	PR C82 038203	M. Batinic *et al.*	(ZAGR)	REFID=53552
PENNER	02C	PR C66 055211	G. Penner, U. Mosel	(GIES)	REFID=49129
PENNER	02D	PR C66 055212	G. Penner, U. Mosel	(GIES)	REFID=49130
MART	00	PR C61 012201	T. Mart, C. Bennhold		REFID=47564
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman, T.-S.H. Lee	(PITT, ANL)	REFID=47593
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky *et al.*	(CMU, LBL) IJP	REFID=30064
Also		PR D20 2839	R.E. Cutkosky *et al.*	(CMU, LBL) IJP	REFID=40096