Physics of the B Factories

Charmless B decays section

Fergus Wilson

RAL/STFC

Current page breakdown

Sections	Pages	Status (out of 5)	Final #pages
Overview	1	4/5	
Theory	0	0/5	3-4 ?
Two-body	0.5	3/5	1 ?
Quasi-two-body	6	4/5	
Three-body/Dalitz	3	2/5	5 ?
Future outlook	0	4/5	0.5 ?
Tables	4	5/5	
Plots	0	3/5	2 ?
References	3	4/5	?
Total	19		27?

Original goal: 20-25 pages

PBF Charmless B Decays Section

➢ Changes since Summer 2011

- o Added ~1000 measurements for BaBar, Belle, and HFAG

  - A_{CP};
  - Branching Fractions;
  - Longitudinal Polariation F_l;
  - References;
  - HFAG averages

- o New Belle sub-editor: Peter Krizan

  - Both very busy but hope to meet in person Dec 15th.

- o Grammar and spelling partially corrected.
- o Added some new 2011 references to .bib files
- o Currently 19 pages including references
- o All in SVN

BF, A_{CP}, references without HFAG averages

Final state	BABAR results $\mathcal{B}$ ($\times 10^{-6}$)	A_{CP}	Ref.	Belle results $\mathcal{B}$ ($\times 10^{-6}$)	A_{CP}	Ref.
$K^*(1410)^+\pi^-$				< 86		(Garmash, 2007)
$K^*(1410)^0\pi^+$				< 45		(Garmash, 2005)
$K^*(1680)^+\pi^-$	< 25		(Aubert, 2008a)	< 10.1		(Garmash, 2007)
$K^*(1680)^0\pi^+$	< 15		(Aubert, 2005)	< 12		(Garmash, 2005)
$K^*(1680)^0\pi^0$	< 7.5		(Aubert, 2008a)			
$K^+K^+\pi^-$	< 0.16		(Aubert, 2008l)	< 2.4		(Garmash, 2004)
$K^+K^-K^+$	$33.5 \pm 0.9 \pm 1.6$	$-0.02 \pm 0.03 \pm 0.02$	(Aubert, 2006d)	$30.6 \pm 1.2 \pm 2.3$		(Garmash, 2005)
$K^+K^-K^0$	$23.8 \pm 2.0 \pm 1.6$		(Aubert, 2004b)	$28.3 \pm 3.3 \pm 4.0$		(Garmash, 2004)
$K^+K^-\pi^+$	$5.0 \pm 0.5 \pm 0.5$	$0.00 \pm 0.10 \pm 0.03$	(Aubert, 2007l)	< 13		(Garmash, 2004)
$K^+K^-\pi^0$						
K^+K^-	$0.04 \pm 0.15 \pm 0.08$		(Aubert, ????)	$0.09^{+0.18}_{-0.13} \pm 0.01$		(Abe, 2007c)
$K^+K^0_S K^0_S$	$10.7 \pm 1.2 \pm 1.0$	$-0.04 \pm 0.11 \pm 0.02$	(Aubert, 2008p)	$13.4 \pm 1.9 \pm 1.5$		(Garmash, 2004)
$K^+X(1812)$				< 0.32		(Liu, 2009)
$K^+\overline{K}^0$	$1.61 \pm 0.44 \pm 0.09$	$0.10 \pm 0.26 \pm 0.03$	(Aubert, 2006h)	$1.22^{+0.33+0.13}_{-0.28-0.16}$	$0.13^{+0.23}_{-0.24} \pm 0.02$	(Abe, 2007c)
$K^+\pi^+\pi^-(NR)$	$9.3 \pm 1.0^{+6.9}_{-1.7}$		(Aubert, 2008b)	$16.9 \pm 1.3^{+1.7}_{-1.6}$		(Garmash, 2006)
$K^+\pi^+\pi^-$	$54.4 \pm 1.1 \pm 4.6$	$0.028 \pm 0.020 \pm 0.023$	(Aubert, 2008b)	$48.8 \pm 1.1 \pm 3.6$	$0.049 \pm 0.026 \pm 0.020$	(Garmash, 2006)
$K^+\pi^-K^+\pi^-$				< 6.0		(Chiang, 2010)
$K^+\pi^-\pi^+K^-$				< 72		(Chiang, 2010)
$K^+\pi^-\pi^+\pi^-$				< 2.1		(Kyeong, 2009)
$K^+\pi^-\pi^0(NR)$	$4.4 \pm 0.9 \pm 0.5$	$0.07 \pm 0.15 \pm 0.04$	(Aubert, 2008a)	< 9.4		(Chang, 2004)
$K^+\pi^-\pi^0$	$35.7^{+2.6}_{-1.5} \pm 2.2$	$-0.030^{+0.045}_{-0.051} \pm 0.055$	(Aubert, 2008a)	$36.6^{+4.2}_{-4.3} \pm 3.0$	$0.07 \pm 0.11 \pm 0.01$	(Chang, 2004)
$K^+\pi^-$	$19.1 \pm 0.6 \pm 0.6$		(Aubert, ????)	$19.9 \pm 0.4 \pm 0.8$		(Abe, 2007b)
$K^+\pi^0\pi^0$	$15.5 \pm 1.1 \pm 1.6$					
$K^+\pi^0$	$13.6 \pm 0.6 \pm 0.7$	$0.030 \pm 0.039 \pm 0.010$	(Aubert, 2007p)	$12.4 \pm 0.5 \pm 0.6$	$0.07 \pm 0.03 \pm 0.01$	(Abe, 2007b)
$K^+\omega\phi$				< 1.9		(Liu, 2009)
$K^-\pi^+\pi^+$	< 0.95		(Aubert, 2008l)	< 4.5		(Garmash, 2004)
$K^0K^-\pi^+$	$6.4 \pm 1.0 \pm 0.6$		(del Amo Sanchez, 2010b)	< 18		(Garmash, 2004)
$K^0\overline{K}^0$	$1.08 \pm 0.28 \pm 0.11$		(Aubert, 2006h)	$0.87^{+0.25}_{-0.20} \pm 0.09$		(Abe, 2007c)
$K^0\pi^+\pi^-(NR)$	$11.1^{+2.5}_{-1.0} \pm 0.9$		(Aubert, 2009k)	$19.9 \pm 2.5^{+1.7}_{-2.0}$		(Garmash, 2007)
$K^0\pi^+\pi^-$	$50.2 \pm 1.5 \pm 1.8$	$-0.01 \pm 0.05 \pm 0.01$	(Aubert, 2009k)	$47.5 \pm 2.4 \pm 3.7$		(Garmash, 2007)
$K^0\pi^+\pi^0$						
$K^0\pi^+$	$23.9 \pm 1.1 \pm 1.0$	$-0.029 \pm 0.039 \pm 0.010$	(Aubert, 2006h)	$22.8^{+0.8}_{-0.7} \pm 1.3$	$0.03 \pm 0.03 \pm 0.01$	(Abe, 2007c)
$K^0\pi^0$	$10.1 \pm 0.6 \pm 0.4$		(Aubert, 2007p)	$8.7 \pm 0.5 \pm 0.6$		(Fujikawa, 2010)
$K^{*+}K^+K^-$	$36.2 \pm 3.3 \pm 3.6$	$0.11 \pm 0.08 \pm 0.03$	(Aubert, 2006c)			
$K^{*+}K^+\pi^-$	< 6.1		(Aubert, 2006c)			
$K^{*+}K^{*-}$	< 2.0		(Aubert, 2008k)			
$K^{*+}\overline{K}^{*0}$	$1.2 \pm 0.5 \pm 0.1$		(Aubert, 2009c)			

About 10% of the results…
… and on and on for another 4 tables

Final state	BABAR results $\mathcal{B}$ ($\times 10^{-6}$)	A_{CP}	Ref.	Belle results $\mathcal{B}$ ($\times 10^{-6}$)	A_{CP}	Ref.	Averages A_{CP}	$\mathcal{B}$ ($\times 10^{-6}$)
$K^*(1410)^+\pi^-$				< 86		(Garmash, 2007)		< 86
$K^*(1410)^0\pi^+$				< 45		(Garmash, 2005)		< 45
$K^*(1680)^+\pi^-$	< 25		(Aubert, 2008a)	< 10.1		(Garmash, 2007)		< 10
$K^*(1680)^0\pi^+$	< 15		(Aubert, 2005)	< 12		(Garmash, 2005)		< 12
$K^*(1680)^0\pi^0$	< 7.5		(Aubert, 2008a)					< 7.5
$K^+K^+\pi^-$	< 0.16		(Aubert, 2008l)	< 2.4		(Garmash, 2004)		< 0.16
$K^+K^-K^+$	$33.5 \pm 0.9 \pm 1.6$	$-0.02 \pm 0.03 \pm 0.02$	(Aubert, 2006d)	$30.6 \pm 1.2 \pm 2.3$		(Garmash, 2005)	$-0.017 \pm 0.026 \pm 0.015$	33.7 ± 2.2
$K^+K^-K^0$	$23.8 \pm 2.0 \pm 1.6$		(Aubert, 2004b)	$28.3 \pm 3.3 \pm 4.0$		(Garmash, 2004)		24.7 ± 2.3
$K^+K^-\pi^+$	$5.0 \pm 0.5 \pm 0.5$	$0.00 \pm 0.10 \pm 0.03$	(Aubert, 2007l)	< 13		(Garmash, 2004)	$0.00 \pm 0.10 \pm 0.03$	5.0 ± 0.7
$K^+K^-\pi^0$								< 19
K^+K^-	$0.04 \pm 0.15 \pm 0.08$		(Aubert, ????)	$0.09^{+0.18}_{-0.13} \pm 0.01$		(Abe, 2007c)		< 0.41
$K^+K^0_SK^0_S$	$10.7 \pm 1.2 \pm 1.0$	$-0.04 \pm 0.11 \pm 0.02$	(Aubert, 2008p)	$13.4 \pm 1.9 \pm 1.5$		(Garmash, 2004)	-0.04 ± 0.11	11.5 ± 1.3
$K^+X(1812)$				< 0.32		(Liu, 2009)		< 0.32
$K^+\overline{K}^0$	$1.61 \pm 0.44 \pm 0.09$	$0.10 \pm 0.26 \pm 0.03$	(Aubert, 2006h)	$1.22^{+0.33+0.13}_{-0.28-0.16}$	$0.13^{+0.23}_{-0.24} \pm 0.02$	(Abe, 2007c)	0.12 ± 0.18	1.36 ± 0.27
$K^+\pi^+\pi^-(NR)$	$9.3 \pm 1.0^{+6.9}_{-1.7}$		(Aubert, 2008b)	$16.9 \pm 1.3^{+1.7}_{-1.6}$		(Garmash, 2006)		$16.3^{+2.1}_{-1.5}$
$K^+\pi^+\pi^-$	$54.4 \pm 1.1 \pm 4.6$	$0.028 \pm 0.020 \pm 0.023$	(Aubert, 2008b)	$48.8 \pm 1.1 \pm 3.6$	$0.049 \pm 0.026 \pm 0.020$	(Garmash, 2006)	0.038 ± 0.022	51 ± 2.9
$K^+\pi^-K^+\pi^-$				< 6.0		(Chiang, 2010)		
$K^+\pi^-\pi^+K^-$				< 72		(Chiang, 2010)		
$K^+\pi^-\pi^+\pi^-$				< 2.1		(Kyeong, 2009)		< 2.1
$K^+\pi^-\pi^0(NR)$	$4.4 \pm 0.9 \pm 0.5$	$0.07 \pm 0.15 \pm 0.04$	(Aubert, 2008a)	< 9.4		(Chang, 2004)	$0.23^{+0.22}_{-0.28}$	4.4 ± 1.0
$K^+\pi^-\pi^0$	$35.7^{+2.6}_{-1.5} \pm 2.2$	$-0.030^{+0.045}_{-0.051} \pm 0.055$	(Aubert, 2008a)	$36.6^{+4.2}_{-4.3} \pm 3.0$	$0.07 \pm 0.11 \pm 0.01$	(Chang, 2004)	0.00 ± 0.06	$35.9^{+2.8}_{-2.4}$
$K^+\pi^-$	$19.1 \pm 0.6 \pm 0.6$		(Aubert, ????)	$19.9 \pm 0.4 \pm 0.8$		(Abe, 2007b)	-0.098 ± 0.013	19.4 ± 0.6
$K^+\pi^0\pi^0$	$15.5 \pm 1.1 \pm 1.6$							
$K^+\pi^0$	$13.6 \pm 0.6 \pm 0.7$	$0.030 \pm 0.039 \pm 0.010$	(Aubert, 2007p)	$12.4 \pm 0.5 \pm 0.6$	$0.07 \pm 0.03 \pm 0.01$	(Abe, 2007b)	0.051 ± 0.025	12.9 ± 0.6
$K^+\omega\phi$				< 1.9		(Liu, 2009)		< 1.9
$K^-\pi^+\pi^+$	< 0.95		(Aubert, 2008l)	< 4.5		(Garmash, 2004)		< 0.95
$K^0K^-\pi^+$	$6.4 \pm 1.0 \pm 0.6$		(del Amo Sanchez, 2010b)	< 18		(Garmash, 2004)		< 18
$K^0\overline{K}^0$	$1.08 \pm 0.28 \pm 0.11$		(Aubert, 2006h)	$0.87^{+0.25}_{-0.20} \pm 0.09$		(Abe, 2007c)		$0.96^{+0.20}_{-0.18}$
$K^0\pi^+\pi^-(NR)$	$11.1^{+2.5}_{-1.0} \pm 0.9$		(Aubert, 2009k)	$19.9 \pm 2.5^{+1.7}_{-2.0}$		(Garmash, 2007)		$14.7^{+4.0}_{-2.6}$
$K^0\pi^+\pi^-$	$50.2 \pm 1.5 \pm 1.8$	$-0.01 \pm 0.05 \pm 0.01$	(Aubert, 2009k)	$47.5 \pm 2.4 \pm 3.7$		(Garmash, 2007)	-0.01 ± 0.05	49.6 ± 2.0
$K^0\pi^+\pi^0$								< 66
$K^0\pi^+$	$23.9 \pm 1.1 \pm 1.0$	$-0.029 \pm 0.039 \pm 0.010$	(Aubert, 2006h)	$22.8^{+0.8}_{-0.7} \pm 1.3$	$0.03 \pm 0.03 \pm 0.01$	(Abe, 2007c)	0.009 ± 0.029	23.1 ± 1.0
$K^0\pi^0$	$10.1 \pm 0.6 \pm 0.4$		(Aubert, 2007p)	$8.7 \pm 0.5 \pm 0.6$		(Fujikawa, 2010)		9.5 ± 0.8
$K^{*+}K^+K^-$	$36.2 \pm 3.3 \pm 3.6$	$0.11 \pm 0.08 \pm 0.03$	(Aubert, 2006c)				$0.11 \pm 0.08 \pm 0.03$	36 ± 5
$K^{*+}K^+\pi^-$	< 6.1		(Aubert, 2006c)					< 6.1
$K^{*+}K^{*-}$	< 2.0		(Aubert, 2008k)					< 2.0
$K^{*+}\overline{K}^{*0}$	$1.2 \pm 0.5 \pm 0.1$		(Aubert, 2009c)					1.2 ± 0.5
$K^{*+}\pi^+K^-$	< 11.8		(Aubert, 2006c)					< 11.8
$K^{*+}\pi^+\pi^-$	$75.3 \pm 6.0 \pm 8.1$	$0.07 \pm 0.07 \pm 0.04$	(Aubert, 2006c)				$0.07 \pm 0.07 \pm 0.04$	75 ± 10
$K^{*+}\pi^-$	$8.3^{+0.9}_{-0.8} \pm 0.8$	-0.20 ± 0.09	(Aubert, 2009k)	$8.4 \pm 1.1^{+1.0}_{-0.9}$	$-0.21 \pm 0.11 \pm 0.07$	(Garmash, 2007)	-0.19 ± 0.07	$9.4^{+1.3}_{-1.2}$

Longitudinal polarization, references, no averages

	BABAR results		Belle results	
Final state	f_L	Ref.	f_L	Ref.
$K^{*+}\overline{K}^{*0}$	$0.75^{+0.16}_{-0.26} \pm 0.03$	(Aubert, 2009c)		
$K^{*0}\overline{K}^{*0}$	$0.80^{+0.10}_{-0.12} \pm 0.06$	(Aubert, 2008i)		
$K^{*0}\rho^+$	$0.52 \pm 0.10 \pm 0.04$	(Aubert, 2006f)	$0.43 \pm 0.11^{+0.05}_{-0.02}$	(Abe, 2005)
$K^{*0}\rho^0$	$0.57 \pm 0.09 \pm 0.08$	(Aubert, 2006f)		
ωK^{*+}	$0.41 \pm 0.18 \pm 0.05$	(Aubert, 2009g)		
ωK^{*0}	$0.72 \pm 0.14 \pm 0.02$	(Aubert, 2009g)	$0.56 \pm 0.29^{+0.18}_{-0.08}$	(Goldenzweig, 2008)
$\omega K_2^*(1430)^+$	$0.56 \pm 0.10 \pm 0.04$	(Aubert, 2009g)		
$\omega K_2^*(1430)^0$	$0.45 \pm 0.12 \pm 0.02$	(Aubert, 2009g)		
$\omega \rho^+$	$0.90 \pm 0.05 \pm 0.03$	(Aubert, 2009g)		
ϕK^{*+}	$0.49 \pm 0.05 \pm 0.03$	(Aubert, 2007b)	$0.52 \pm 0.08 \pm 0.03$	(Chen, 2005)
ϕK^{*0}	$0.494 \pm 0.034 \pm 0.013$	(Aubert, 2008p)	$0.45 \pm 0.05 \pm 0.02$	(Chen, 2005)
$\phi K_1(1270)^+$	$0.46^{+0.12+0.06}_{-0.13-0.07}$	(Aubert, 2008e)		
$\phi K_2^*(1430)^+$	$0.80^{+0.09}_{-0.10} \pm 0.03$	(Aubert, 2008e)		
$\phi K_2^*(1430)^0$	$0.901^{+0.046}_{-0.058} \pm 0.037$	(Aubert, 2008p)		
$\rho^+\rho^-$	$0.992 \pm 0.024^{+0.026}_{-0.013}$	(Aubert, 2007a)	$0.941^{+0.034}_{-0.040} \pm 0.030$	(Somov, 2006)
$\rho^+\rho^0$	$0.950 \pm 0.015 \pm 0.006$	(Aubert, 2009d)	$0.95 \pm 0.11 \pm 0.02$	(Zhang, 2003)
$\rho^0\rho^0$	$0.75^{+0.11}_{-0.14} \pm 0.04$	(Aubert, 2008c)		
$a_1^\pm a_1^\mp$	$0.31 \pm 0.22 \pm 0.10$	(Aubert, 2009f)		

Table 5. Longitudinal Polarization fractions f_L for BABAR and Belle.

Longitudinal polarization, references, with averages

Final state	BABAR results f_L	Ref.	Belle results f_L	Ref.	Average
$K^{*+}\overline{K}^{*0}$	$0.75^{+0.16}_{-0.26} \pm 0.03$	(Aubert, 2009c)			$0.75^{+0.16}_{-0.26} \pm 0.03$
$K^{*0}\overline{K}^{*0}$	$0.80^{+0.10}_{-0.12} \pm 0.06$	(Aubert, 2008i)			$0.80^{+0.10}_{-0.12} \pm 0.06$
$K^{*0}\rho^+$	$0.52 \pm 0.10 \pm 0.04$	(Aubert, 2006f)	$0.43 \pm 0.11^{+0.05}_{-0.02}$	(Abe, 2005)	0.48 ± 0.08
$K^{*0}\rho^0$	$0.57 \pm 0.09 \pm 0.08$	(Aubert, 2006f)			$0.57 \pm 0.09 \pm 0.08$
ωK^{*+}	$0.41 \pm 0.18 \pm 0.05$	(Aubert, 2009g)			$0.41 \pm 0.18 \pm 0.05$
ωK^{*0}	$0.72 \pm 0.14 \pm 0.02$	(Aubert, 2009g)	$0.56 \pm 0.29^{+0.18}_{-0.08}$	(Goldenzweig, 2008)	0.69 ± 0.13
$\omega K_2^*(1430)^+$	$0.56 \pm 0.10 \pm 0.04$	(Aubert, 2009g)			$0.56 \pm 0.10 \pm 0.04$
$\omega K_2^*(1430)^0$	$0.45 \pm 0.12 \pm 0.02$	(Aubert, 2009g)			$0.45 \pm 0.12 \pm 0.02$
$\omega \rho^+$	$0.90 \pm 0.05 \pm 0.03$	(Aubert, 2009g)			$0.90 \pm 0.05 \pm 0.03$
ϕK^{*+}	$0.49 \pm 0.05 \pm 0.03$	(Aubert, 2007b)	$0.52 \pm 0.08 \pm 0.03$	(Chen, 2005)	0.50 ± 0.05
ϕK^{*0}	$0.494 \pm 0.034 \pm 0.013$	(Aubert, 2008p)	$0.45 \pm 0.05 \pm 0.02$	(Chen, 2005)	0.480 ± 0.0030
$\phi K_1(1270)^+$	$0.46^{+0.12+0.06}_{-0.13-0.07}$	(Aubert, 2008e)			$0.46^{+0.12+0.06}_{-0.13-0.07}$
$\phi K_2^*(1430)^+$	$0.80^{+0.09}_{-0.10} \pm 0.03$	(Aubert, 2008e)			$0.80^{+0.09}_{-0.10} \pm 0.03$
$\phi K_2^*(1430)^0$	$0.901^{+0.046}_{-0.058} \pm 0.037$	(Aubert, 2008p)			$0.901^{+0.046}_{-0.058} \pm 0.037$
$\rho^+\rho^-$	$0.992 \pm 0.024^{+0.026}_{-0.013}$	(Aubert, 2007a)	$0.941^{+0.034}_{-0.040} \pm 0.030$	(Somov, 2006)	$0.977^{+0.028}_{-0.024}$
$\rho^+\rho^0$	$0.950 \pm 0.015 \pm 0.006$	(Aubert, 2009d)	$0.95 \pm 0.11 \pm 0.02$	(Zhang, 2003)	0.950 ± 0.016
$\rho^0\rho^0$	$0.75^{+0.11}_{-0.14} \pm 0.04$	(Aubert, 2008c)			$0.75^{+0.11}_{-0.14} \pm 0.04$
$a_1^{\pm}a_1^{\mp}$	$0.31 \pm 0.22 \pm 0.10$	(Aubert, 2009f)			$0.31 \pm 0.22 \pm 0.10$

Table 4. Longitudinal Polarization fractions f_L for BABAR and Belle.

Outstanding and status

➢ Need to reply to (extensive) HN comments – done but lost when SVN went down.

➢ Reorganise quasi-2-body section – done.
  o Now organised by spin
    • Currently has named sub-sections for each spin but will probably remove for final version.
  o Each sub-section has a comment on the measurements.
  o Each sub-section has a small theory comment.
  o Possibly add BF, Fl plots depending on space.

Spin	Resonances
Axial-vector	3P1: a1(1260), f1(1285), f1(1420), K1A
	1P1: b1(1235), b1(1170), b1(1380), K1B
Vector	K*, ρ, ω, φ
Pseudoscalar	K, π, η, η', χc
Tensor	K*2(1430), f2(1270)
Scalar	a0(980), f0(980)

Outstanding and status

➢ 2011/2012 results – need to go through all numbers and check for updates.

➢ Need to connect with Beneke - waited until experimental section was in a good shape.

➢ Get feedback from Eli, Tom et al…
  - o Hoped to do this before this meeting but foiled by SVN last week.
  - o Will do this first week of December.

➢ Pretty plots ?
  - o need to see what space is left.
  - o Probably a good idea even if exceeds page allocation.

➢ Tables.
  - o need to reorganise by charge and spin, and separate into different tables
  - o Currently one continuous table
  - o Very time-consuming so prefer to do once at the end.

Outstanding and status

➤ Two-body section
- o How much to write? Majority is covered elsewhere.

➤ Biggest problem : how to report Dalitz results
- o (phases, fit fractions, angles) as many results reported in many different ways. – Needs quite a lot of thinking and reading.

➤ Cross-references (to equations etc… in the book):
- o Still needs to be done. Not a problem.

➤ Consistent use of symbols e.g. (α v. φ_2)
- o Not consistent yet. Not a problem.

➤ Biggest problem : how to report Dalitz results
- o (phases, fit fractions, angles) as many results reported in many different ways. – Needs quite a lot of thinking and reading.
- o Some tables available already
  - Fit fractions
  - Phases
  - Magnitudes

Conclusion

➢ Not quite where I'd hoped to be.

➢ Experiment section will meet 12 Jan 2012 deadline.

➢ Theory section will miss 12 Jan 2012 deadline.

➢ Possible problem: I will be away for 4-5 weeks in Jan/Feb 2012.