

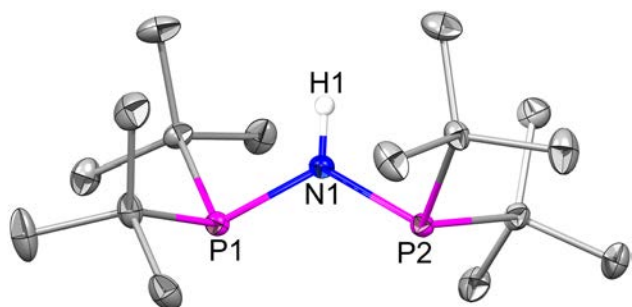
## SUPPLEMENTARY MATERIAL

### **Zwitterionic CS<sub>2</sub> adducts of bis(dialkylphosphino)amines: syntheses, spectroscopy and structures**

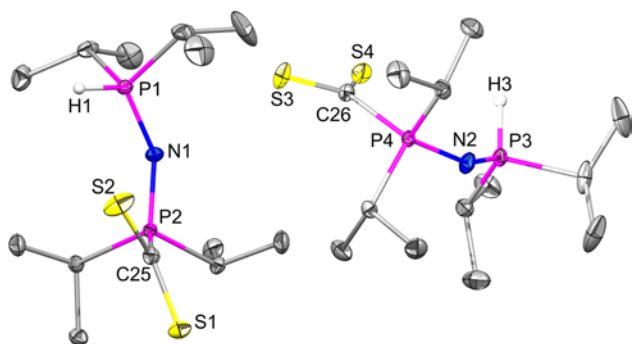
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**Figure S1.** The X-ray crystal structure of **2**. Ellipsoids are drawn at 50% probability. For clarity, C-H hydrogen atoms have been omitted.



**Figure S2.** The X-ray crystal structure of **3** showing both molecules present in the asymmetric unit. Ellipsoids are drawn at 50% probability. For clarity, C-H hydrogen atoms have been omitted.

**Table S1.** Bond lengths and angles for **2**.

P1-N1	1.7173(11)	P1-C5	1.8834(14)
P1-C1	1.8959(14)	P2-N1	1.7157(11)
P2-C13	1.8912(14)	P2-C9	1.8928(13)
C1-C4	1.530(2)	C1-C2	1.532(2)
C1-C3	1.537(2)	C5-C6	1.5307(19)
C5-C8	1.536(2)	C5-C7	1.536(2)
C9-C10	1.525(2)	C9-C12	1.536(2)
C9-C11	1.536(2)	C13-C15	1.5292(19)
C13-C14	1.5332(19)	C13-C16	1.5379(19)
N1-P1-C5	100.80(6)	N1-P1-C1	102.61(6)
C5-P1-C1	108.82(6)	N1-P2-C13	103.18(6)
N1-P2-C9	100.56(6)	C13-P2-C9	108.69(6)
P2-N1-P1	125.49(6)	C4-C1-C2	109.51(13)
C4-C1-C3	109.46(12)	C2-C1-C3	107.32(12)
C4-C1-P1	116.34(10)	C2-C1-P1	111.37(10)
C3-C1-P1	102.28(10)	C6-C5-C8	108.81(12)
C6-C5-C7	108.93(12)	C8-C5-C7	106.67(11)
C6-C5-P1	116.58(10)	C8-C5-P1	108.87(9)
C7-C5-P1	106.54(9)	C10-C9-C12	108.74(12)
C10-C9-C11	108.00(12)	C12-C9-C11	107.80(12)
C10-C9-P2	110.28(10)	C12-C9-P2	115.88(10)
C11-C9-P2	105.83(9)	C15-C13-C14	109.33(11)
C15-C13-C16	109.92(12)	C14-C13-C16	106.53(11)
C15-C13-P2	115.88(9)	C14-C13-P2	111.66(10)

**Table S2.** Bond lengths and angles for **3**.

P1-N1	1.5712(11)	P1-C1	1.8081(15)
P1-C4	1.8198(14)	P2-N1	1.5816(11)
P2-C7	1.8168(13)	P2-C10	1.8296(13)
P2-C25	1.8372(13)	P3-N2	1.5685(12)
P3-C16	1.8166(14)	P3-C13	1.8192(14)
P4-N2	1.5839(12)	P4-C19	1.8150(13)
P4-C22	1.8264(14)	P4-C26	1.8344(13)
S1-C25	1.6725(13)	S2-C25	1.6665(13)
S3-C26	1.6708(14)	S4-C26	1.6719(13)
C1-C3	1.517(2)	C1-C2	1.520(3)
C4-C6	1.528(2)	C4-C5	1.528(2)
C7-C9	1.5287(19)	C7-C8	1.5318(18)
C10-C12	1.5274(19)	C10-C11	1.5327(18)
C13-C14	1.526(3)	C13-C15	1.534(2)
C16-C17	1.527(2)	C16-C18	1.5305(19)
C19-C21	1.5291(19)	C19-C20	1.533(2)
C22-C23	1.528(2)	C22-C24	1.5288(19)
N1-P1-C1	112.57(7)	N1-P1-C4	111.60(6)
C1-P1-C4	108.53(7)	N1-P2-C7	106.08(6)
N1-P2-C10	111.58(6)	C7-P2-C10	107.91(6)
N1-P2-C25	115.41(6)	C7-P2-C25	109.76(6)
C10-P2-C25	105.91(6)	N2-P3-C16	115.10(6)
N2-P3-C13	107.86(6)	C16-P3-C13	109.71(7)
N2-P4-C19	107.73(6)	N2-P4-C22	106.41(6)
C19-P4-C22	109.53(6)	N2-P4-C26	116.43(6)
C19-P4-C26	107.05(6)	C22-P4-C26	109.57(6)
P1-N1-P2	145.16(8)	P3-N2-P4	143.36(8)
C3-C1-C2	110.69(14)	C3-C1-P1	110.63(12)
C2-C1-P1	112.21(12)	C6-C4-C5	110.25(12)
C6-C4-P1	109.75(10)	C5-C4-P1	112.32(10)
C9-C7-C8	111.33(11)	C9-C7-P2	110.82(9)
C8-C7-P2	109.77(9)	C12-C10-C11	110.93(11)
C12-C10-P2	111.40(9)	C11-C10-P2	114.05(9)
C14-C13-C15	111.05(14)	C14-C13-P3	109.29(12)
C15-C13-P3	111.58(11)	C17-C16-C18	111.07(12)

C17-C16-P3	110.43(9)	C18-C16-P3	113.57(10)
C21-C19-C20	111.10(11)	C21-C19-P4	111.10(9)
C20-C19-P4	108.98(9)	C23-C22-C24	111.37(12)
C23-C22-P4	116.64(10)	C24-C22-P4	110.01(10)
S2-C25-S1	128.06(8)	S2-C25-P2	115.74(7)
S1-C25-P2	116.03(7)	S3-C26-S4	129.30(8)
S3-C26-P4	113.72(7)	S4-C26-P4	116.98(7)

**Table S3.** Bond lengths and angles for **4**.

P1-N1	1.575(2)	P1-C1	1.839(3)
P1-C5	1.849(3)	P2-N1	1.582(2)
P2-C17	1.850(3)	P2-C13	1.874(3)
P2-C9	1.881(3)	S1-C17	1.671(3)
S2-C17	1.663(3)	C1-C2	1.517(4)
C1-C4	1.536(4)	C1-C3	1.538(4)
C5-C7	1.529(4)	C5-C6	1.536(4)
C5-C8	1.539(4)	C9-C12	1.532(4)
C9-C10	1.535(4)	C9-C11	1.538(4)
C13-C16	1.532(4)	C13-C14	1.535(4)
N1-P1-C1	113.39(13)	N1-P1-C5	107.76(12)
C1-P1-C5	114.18(13)	N1-P2-C17	115.60(12)
N1-P2-C13	108.97(13)	C17-P2-C13	103.47(13)
N1-P2-C9	104.44(12)	C17-P2-C9	111.00(13)
C13-P2-C9	113.67(12)	P1-N1-P2	152.46(16)
C2-C1-C4	109.8(3)	C2-C1-C3	110.2(2)
C4-C1-C3	107.3(2)	C2-C1-P1	110.22(19)
C4-C1-P1	107.60(19)	C3-C1-P1	111.5(2)
C7-C5-C6	109.2(2)	C7-C5-C8	108.5(2)
C6-C5-C8	109.4(2)	C7-C5-P1	105.6(2)
C6-C5-P1	110.9(2)	C8-C5-P1	113.15(19)
C12-C9-C10	108.8(2)	C12-C9-C11	107.8(2)
C10-C9-C11	107.9(2)	C12-C9-P2	107.95(18)
C10-C9-P2	115.0(2)	C11-C9-P2	109.1(2)
C16-C13-C14	107.6(2)	C16-C13-C15	108.8(2)
C14-C13-C15	109.4(2)	C16-C13-P2	114.7(2)
C14-C13-P2	107.36(18)	C15-C13-P2	108.9(2)
S2-C17-S1	128.56(17)	S2-C17-P2	117.04(16)
S1-C17-P2	114.21(16)		