

AUTISM LOCI

The SignatureChipOS® covers regions of the human genome that are associated with susceptibility to autism or an autism spectrum disorder based on extensive literature review. In addition to its backbone coverage of the genome, the SignatureChipOS® covers more than 1,500 genes involved in developmental disabilities and known syndromes, including coverage over **greater than 150 regions of the genome associated with autism or an autism spectrum disorder**. The SignatureChipOS® is a “whole genome” array and therefore may also identify loci not yet known to be associated with autism. Thus, the autism-related loci covered by the SignatureChipOS® will continue to expand as additional information is learned about the genetic basis of autism.

Established Loci

CHROMOSOME BAND	GENE(S)/ SYNDROME	REFERENCES	CHROMOSOME BAND	GENE(S)/ SYNDROME	REFERENCES
1p34.2	<i>RIMS3</i>	Kumar et al. 2010	16p13.3	<i>TSC2</i> /Tuberous sclerosis	Smalley et al. 1992; Baker et al. 1998; Wong et al. 2006
1q21.1		Szatmari et al. 2007; Mefford et al. 2008; Brunetti-Pierri et al. 2008	16p13.3	<i>CREBBP</i> / Rubinstein-Taybi	Schorry et al. 2008
1q42.2	<i>DISC1</i>	Williams et al. 2009; Kilpinen et al. 2008; Crepel et al. 2010	16p13.11		Ullmann et al. 2007, Hannes et al. 2009
2p16.3	<i>NRXN1</i>	Kim et al. 2008; Szatmari et al. 2007; Wisniewicka-Kowalnik et al. 2010; Ching et al. 2010	16p11.2		Weiss et al. 2008; Kumar et al. 2007; Rosenfeld et al. 2010; Bijlsma et al. 2009
2p16.1p15		Rajcan-Separovic et al. 2007	16q24.3	<i>ANKRD11, ZNF778</i>	Willemsen et al. 2010; Marshall et al. 2008
2q34	<i>MAP2</i>	Pescucci et al. 2003; Mukaetova-Ladinska et al. 2004; Brandau et al. 2008	17p11.2	<i>RAI1</i> /Smith-Magenis, Potocki-Lupski	Moog et al. 2004; Nakamine et al. 2008; Hicks et al. 2008
2q37		Falk et al. 2007; Galasso et al. 2008	17q11.2	<i>NF1</i> / Neurofibromatosis 1	Marui et al. 2004
3p26.3	<i>CNTN4</i>	Roohi et al. 2009; Glessner et al. 2009	17q21.31	<i>MAPT</i>	Grisart et al. 2009
3q29	<i>PAK2, DLG1</i>	Willat et al. 2005; Ballif et al. 2008	20p12.1		Michaelis et al. 1997; Kamath et al. 2009
4p16.3	Wolf-Hirschhorn	Fisch et al. 2008	21 (trisomy)	Down	Kent et al. 1999; Molloy et al. 2009
4p12	<i>GABRA4, GABRA2, GABRB1, GABRG1</i>	Ma et al. 2005; Kakinuma et al. 2008; Vincent et al. 2006	22q11.21	<i>HIRA, TBX1</i> /DiGeorge, Velocardiofacial	Mukaddes et al. 2007; Ramelli et al. 2008; Antshel et al. 2007; Fine et al. 2005; Niklasson et al. 2009
4q35.2	<i>FAT1</i>	Gilling et al. 2008; Chien et al. 2010	22q13.1	<i>ADSL</i> /ADSL deficiency*	Stone et al. 1992
5p13.2	<i>NIPBL</i> / Cornelia de Lange	Bhuiyan et al. 2006; Basile et al. 2007	22q13.33	<i>SHANK3</i> / Phelan-McDermid	Moessner et al. 2007; Durand et al. 2007; Manning et al. 2004; Philippe et al. 2008; Peeters et al. 2008
5q14.3	<i>MEF2C</i>	Nowakowska et al. 2010	Xp22.32p22.31	<i>NLGN4X</i>	Jamain et al. 2003; Kent et al. 2008; Macarov et al. 2007
5q35.3	<i>NSD1</i> /Sotos	Buxbaum et al. 2007	Xp22.13	<i>CDKL5</i>	White et al. 2010; Russo et al. 2009
7q11.23	<i>ELN</i> /Williams	Berg et al. 2007; Herguner et al. 2006; Edelmann et al. 2007; Van der Aa et al. 2009	Xp21.3	<i>ARX</i>	Turner et al. 2002; Stromme et al. 2002; Chaste et al. 2007
7q31.1	<i>FOXP2</i>	Gong et al. 2004; MacDermot et al. 2005; Lai et al. 2000; Feuk et al. 2006	Xp11.22	<i>SMC1A</i> / Cornelia de Lange	Bhuiyan et al. 2006; Basile et al. 2007
8p23.3p23.2		Ozgen et al. 2009; Chien et al. 2010	Xq24	<i>UPF3B</i>	Tarpey et al. 2007; Laumonnier et al. 2009
8p23.1	<i>MCPH1</i>	Glancy et al. 2009; Ozgen et al. 2009	Xq27.3	<i>FMR1</i> /Fragile X	Reddy et al. 2005; Muhle et al. 2004; Szatmari et al. 2007
8q12.2	<i>CHD7</i> /CHARGE	Smith et al. 2005	Xq28	<i>AFF2 (FMR2)</i> /Fragile X E	Abrams et al. 1997
8q22.2	<i>VPS13B</i> /Cohen*	Howlin et al. 2001			
9q34.13	<i>TSC1</i> /Tuberous sclerosis	Wong et al. 2006; Baker et al. 1998			
9q34.3	<i>EHMT1</i>	Stewart & Kleefstra 2007			
10q22.3q23.2		Balciuniene et al. 2007; Alliman et al. 2010			
10q23.31	<i>PTEN</i>	Buxbaum et al. 2007; Butler et al. 2005			
10q25.2	<i>SMC3</i> / Cornelia de Lange	Bhuiyan et al. 2006; Basile et al. 2007			
11p14.1	<i>BDNF</i> /WAGR	Nishimura et al. 2007; Cheng et al. 2009; Xu et al. 2008			
11p13	<i>PAX6</i> /WAGR	Xu et al. 2008; Davis et al. 2008			
11q13.4	<i>DHCR7</i> / Smith-Lemli-Opitz*	Sikora et al. 2006			
12p13.33	<i>CACNA1C</i> /Timothy	Splawski et al. 2004			
13q13.2q13.3	<i>NBEA</i>	Smith et al. 2002; Castermans et al. 2003			
15q11q13	<i>UBE3A, GABRB3,</i> and others	Cook et al. 1997; Buxbaum et al. 2002; Peters et al. 2004; Simon et al. 2010; Hogart et al. 2010			
15q13.2q13.3	<i>CHRNA7</i>	Ben-Shachar et al. 2009; Miller et al. 2009			
15q24		Sharp et al. 2007; McInnes et al. 2010			

* autosomal recessive disorder

This list separates established autism-related loci from other loci of interest (i.e. candidate loci). While rearrangements encompassing established loci indicate a susceptibility for the development of autistic features, an abnormality in a patient known to be autistic in one of the candidate regions may or may not serve as the etiological explanation for their phenotype.

Resolution for detection of rearrangements at these loci ranges from 20 kb to 275 kb. For more information about any specific locus, please contact Signature Genomics.

References may differ in diagnostic criteria used to determine if an individual has autism or an autism spectrum disorder.

continued >

Candidate Loci

CHROMOSOME BAND	GENE(S)/ SYNDROME	REFERENCES	CHROMOSOME BAND	GENE(S)/ SYNDROME	REFERENCES
1p34.3	<i>MTF1</i>	Serajee et al. 2004	7q32.2	<i>UBE2H</i>	Vourc'h et al. 2003
1p21.2p13.2		Piccione et al. 2010	7q35q36.1	<i>CNTNAP2</i>	Alarcon et al. 2008; Arking et al. 2008; Poot et al. 2010
1q23.3q24.2		Della Monica et al. 2007	7q36.2	<i>DPP6</i>	Marshall et al. 2008
1q31.1	<i>PTGS2</i>	Yoo et al. 2008	7q36.3	<i>EN2</i>	Petit et al. 1995; Gharani et al. 2004; Bakkaloglu et al. 2008
1q41	<i>MARK1</i>	Mausson et al. 2008	8p21		Ozgen et al. 2009
2p25.3	<i>SNTG2</i>	Rosenfeld et al. 2010	8q21.3	<i>MMP16</i>	Borg et al. 2002
2p25.2	<i>SOX11</i>	Lo-Castro et al. 2009	8q22.1		Jain et al. 2010
2q14.3	<i>CNTNAP5</i>	Pagnamenta et al. 2010	8q23.3	<i>CSMD3</i>	Floris et al. 2008
2q24.2	<i>SLC4A10</i>	Sebat et al. 2007	8q24.11	<i>EXT1</i>	Li et al. 2002
2q24.3	<i>SCN1A, SCN2A</i>	Weiss et al. 2003; Kamiya et al. 2004; Chen et al. 2010	9p24.1	<i>KDM4C</i>	Kantojarvi et al. 2010; Szatmari et al. 2007; Vinci et al. 2007
2q31.1	<i>SLC25A12</i>	Turunen et al. 2008; Silverman et al. 2008; Ramoz et al. 2008	9q31.2q33.1		Gamerding et al. 2008
2q31.1	<i>DLX1, DLX2</i>	Liu et al. 2009	10p14	<i>GATA3</i>	Verri et al. 2004
2q31.1	<i>RAPGEF4</i>	Bacchelli et al. 2003	10q11.23q21.2		Sebat et al. 2007
2q31.3	<i>ITGA4</i>	Correia et al. 2009; Conroy et al. 2009; Ramoz et al. 2008	10q21.2q21.3	<i>JMJD1C, REEP3</i>	Castermans et al. 2007
2q32.2	<i>INPP1</i>	Serajee et al. 2003	11p15.5	<i>HRAS</i>	Herault et al. 1993; Herault et al. 1995
2q35		Borg et al. 2002	11p15.5	<i>SCT</i>	Yamagata et al. 2002
3p25.3	<i>OXTR</i>	Gregory et al. 2009; Wermter et al. 2010	11p12p11.2	<i>ALX4, EXT2/ Potocki-Shaffer</i>	Swarr et al. 2010
3p14.2	<i>FHIT</i>	Sebat et al. 2007	11q23.1	<i>PTS</i>	Schnetz-Boutaud et al. 2009
3q13.31	<i>DRD3</i>	de Krom et al. 2009	11q23.2	<i>HTR3A</i>	Anderson et al. 2009
3q24	<i>SLC9A9</i>	Morrow et al. 2008	11q24.2	<i>ROBO3, ROBO4</i>	Anitha et al. 2008
3q26.31	<i>NLGN1</i>	Ylisaukko-oja et al. 2005; Glessner et al. 2009	12p12.1	<i>SOX5</i>	Rosenfeld et al. 2010
3q27.1	<i>HTR3C</i>	Rehstrom et al. 2009	12q14.2	<i>AVPR1A</i>	Yirmiya et al. 2006
4q32q34		Ramanathan et al. 2004	12q24.22	<i>NOS1</i>	Kim et al. 2009
5p15.2	<i>SEMA5A</i>	Melin et al. 2006; Weiss et al. 2009	14q32.33		Merritt et al. 2005
5p14	<i>CDH10, CDH9</i>	Wang et al. 2009	15q11.2	<i>CYFIP1</i>	Sahoo et al. 2006; Nishimura et al. 2007; Doornbos et al. 2009
5q14.1	<i>DHFR</i>	Adams et al. 2007	15q13.1	<i>APBA2</i>	Babatz et al. 2009
5q14.3		Ezughra et al. 2010	16p13.3	<i>CACNA1H</i>	Splawski et al. 2006
5q22.2	<i>APC</i>	Zhou et al. 2007; Barber et al. 1994	16p13.3p13.2	<i>A2BP1 (RBFox1)</i>	Sebat et al. 2007; Martin et al. 2007
5q31.1	<i>PITX1</i>	Philippi et al. 2007	16p13.2	<i>GRIN2A</i>	Barnby et al. 2005
5q35.2	<i>DRD1</i>	Hettinger et al. 2008	16p12.1	<i>PRKCB</i>	Lintas et al. 2009
6p22.1		Rosenfeld et al. 2010	17q11.1	<i>NOS2</i>	Kim et al. 2009
6p21.32	<i>C4B</i>	Warren et al. 1991; Odell et al. 2005	17q11.2	<i>SLC6A4</i>	Cook et al. 1997; Klauck et al. 1997; Devlin et al. 2005
6p21.32	<i>HLA-DRB1</i>	Torres et al. 2002; Johnson et al. 2009	17q21.32	<i>ITGB3</i>	Weiss et al. 2006; Coutinho et al. 2007
6p21.2	<i>GLO1</i>	Junaid et al. 2004; Sacco et al. 2007	17q21.32	<i>HOXB1</i>	Ingram et al. 2000
6q16.1	<i>GPR63</i>	Derwinska et al. 2009	17q21.33	<i>CACNA1G</i>	Strom et al. 2009
6q16.3	<i>GRIK2</i>	Jamain et al. 2002; Strutz-Seebohm et al. 2006; Kim et al. 2007	18q12		Gilling et al. 2008
6q23.3	<i>AHI1</i>	Alvarez Retuerto et al. 2008	19q13.32	<i>APOE</i>	Giunco et al. 2009; Persico et al. 2004
6q25.1q25.3		Sukumar et al. 1999	20p13	<i>OXT</i>	Sebat et al. 2007; Yrigollen et al. 2008; Chakrabarti et al. 2009
6q26	<i>PARK2</i>	Glessner et al. 2009	22q13.1	<i>SOX10</i>	Bondurand et al. 2007
7p21.1	<i>TMEM195</i>	Sebat et al. 2007	Xp22.2	<i>GRPR</i>	Ishikawa-Brush et al. 1997; Seidita et al. 2008
7p15.2	<i>HOXA1</i>	Ingram et al. 2000; Conciatori et al. 2004	Xp21.3p21.2	<i>IL1RAPL1</i>	Bhat et al. 2008; Piton et al. 2008
7q11.22	<i>AUTS2</i>	Sultana et al. 2002; Bakkaloglu et al. 2008; Cusco et al. 2009	Xp11.3	<i>MAOA</i>	Cohen et al. 2003; Yoo et al. 2009
7q11.23	<i>STX1A</i>	Nakamura et al. 2008	Xp11.23p11.22		Bonnet et al. 2006
7q22.1	<i>RELN</i>	Persico et al. 2001; Persico et al. 2006	Xp11.22		Qiao et al. 2008
7q22.3	<i>PIK3CG</i>	Serajee et al. 2003	Xp11.22	<i>KDM5C</i>	Adegbola et al. 2008
7q31.1	<i>LAMB1</i>	Hutcheson et al. 2004; Bonora et al. 2005	Xq12	<i>AR</i>	Henningsson et al. 2009
7q31.1	<i>NRCAM</i>	Bonora et al. 2005; Sakurai et al. 2006; Marui et al. 2009	Xq13.1	<i>NLGN3</i>	Jamain et al. 2003; Talebizadeh et al. 2006
7q31.2	<i>MET</i>	Campbell et al. 2006; Sousa et al. 2009; Jackson et al. 2009	Xq22.1	<i>NXF5, NXF2</i>	Grillo et al. 2010
7q31.2	<i>ST7</i>	Vincent et al. 2000	Xq26.3	<i>SLC9A6</i>	Garbern et al. 2010
7q31.2	<i>WNT2</i>	Wassink et al. 2001; Marui et al. 2009	Xq28	<i>SLC6A8/ Creatine deficiency</i>	Poo-Arguelles et al. 2006
7q31.32	<i>CADPS2</i>	Sadakata et al. 2007	Xq28	<i>RPL10</i>	Klauck et al. 2006
7q31.33	<i>GRM8</i>	Serajee et al. 2003; Cusco et al. 2009			

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