Supplemental Material

Cell cycle–related kinase is a direct androgen receptor–regulated gene that drives β-catenin/T cell factor–dependent hepatocarcinogenesis

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Table S2. AR, CCRK and β-catenin immunohistochemical scores in HCC tissues.

Table S3. Primers used for ChIP-PCR and RT-PCR in this study.

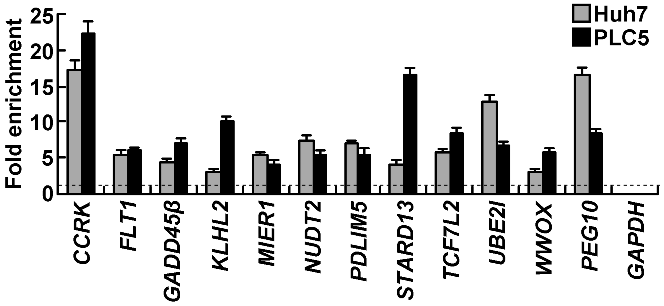

Figure S1. Quantitative ChIP-PCR analysis of AR direct target genes in HCC cells.

Quantitative ChIP-PCR validation of AR occupancy in 10 randomly-selected loci in both Huh7 and PLC5 cells. Fold enrichment represents ratio of DNA amounts pulled-down from AR antibody over IgG control, and each error bar represents standard deviation calculated from triplicates. The fold enrichments of *CCRK* and a known AR target, *PEG10*, are shown. *GAPDH* locus serves as a negative control.

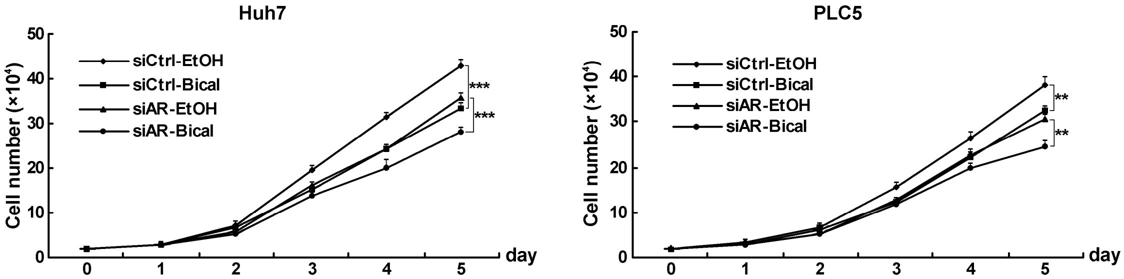

Figure S2. Effect of bicalutamide on HCC cell growth.

Inhibiting AR activity retarded HCC cell growth. Huh7 and PLC5 cells (2×10^4) seeded on 24-well plate were transfected with 25 nM siAR or siCtrl in the presence or absence of 10μM bicalutamide. The cell numbers were determined by trypan blue dye exclusion every 24 hours for 5 consecutive days after transfection.

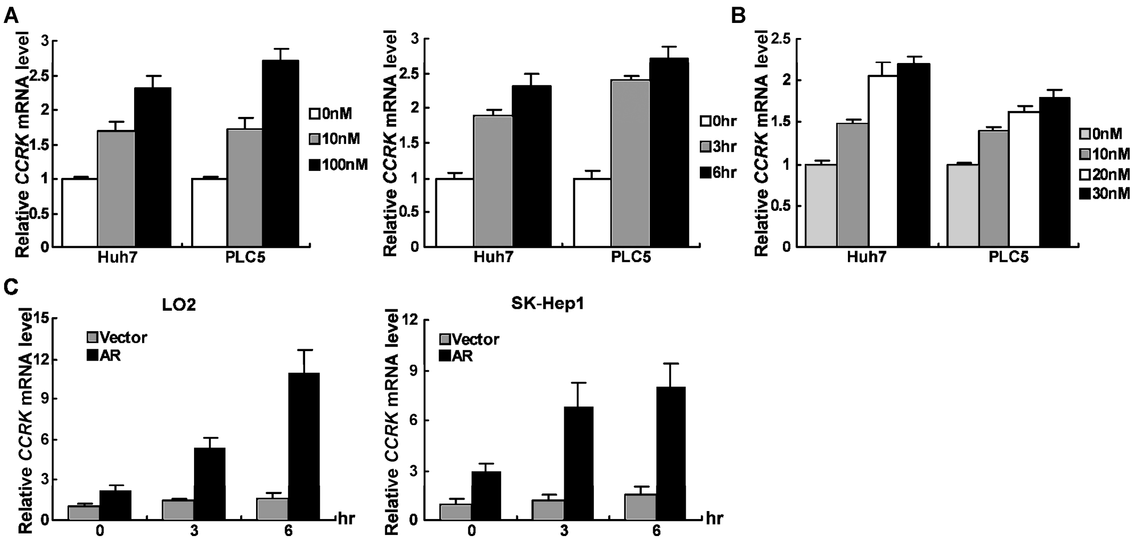

Figure S3. Effects of androgen, AR and protein synthesis inhibitor on *CCRK* gene expression.

(A) R1881 directly affected *CCRK* transcription. Quantitative RT-PCR showed that *CCRK* transcript level was increased by R1881 in a dose- and time-dependent manner in the presence of 50μM cycloheximide. HCC cells were treated with different doses of R1881 for 6 hours (left) or with 100nM R1881 for different periods of time (right). *GAPDH* was used as an internal control. (B) Physiological concentration range of testosterone increased *CCRK* transcript levels. Quantitative RT-PCR analysis of *CCRK* transcript level was performed in HCC cells treated with different doses of testosterone for 6 hours. (C) R1881-induced *CCRK* transcription was AR-dependent. Relative transcript level of *CCRK* was measured by quantitative RT-PCR in AR-expressing or control LO2 (left) and SK-Hep1 (right) cells stimulated with 100 nM R1881 for the indicated time.

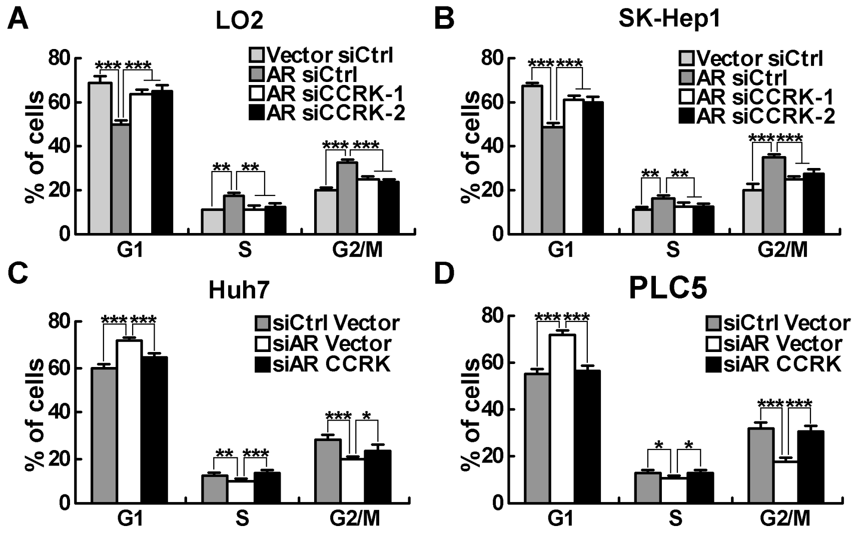

Figure S4. Effect of CCRK on AR-induced cell cycle progression.

(**A** and **B**) AR-induced G1-S cell cycle progression was abrogated by CCRK down-regulation. The cell cycle distribution of R1881-stimulated (**A**) Vec-LO2 and AR-LO2 and (**B**) Vec-SK-Hep1 and AR-SK-Hep1 cells treated with siCtrl, siCCRK-1 or siCCRK-2 were measured by propidium iodide staining and flow cytometry. (**C** and **D**) Ectopic CCRK expression attenuated G1 phase arrest in AR-knockdown cells. Flow cytometry was performed in R1881-stimulated (**C**) Huh7 and (**D**) PLC5 cells transiently transfected with siCtrl or siAR and CCRK-expressing or empty vector. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

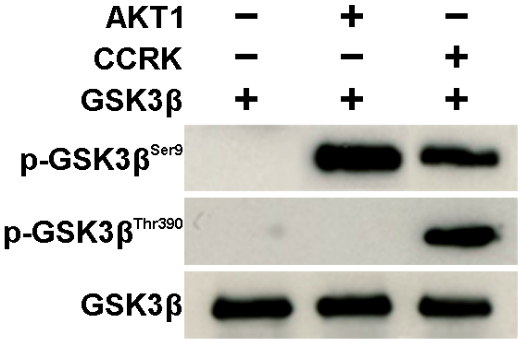

Figure S5. In vitro kinase assay of the phosphorylation of recombinant GSK3β by recombinant CCRK.

Recombinant CCRK directly phosphorylated recombinant GSK3β at Ser9 and Thr390. Proteins were incubated in the presence of ATP, and the reaction products were analyzed by immunoblotting using the same antibodies to Ser9-, Thr390-phosphorylated GSK3β and total GSK3β as that used in Figure 6. AKT1, known to induce phosphorylation of GSK3β at Ser9, was used as a positive control.

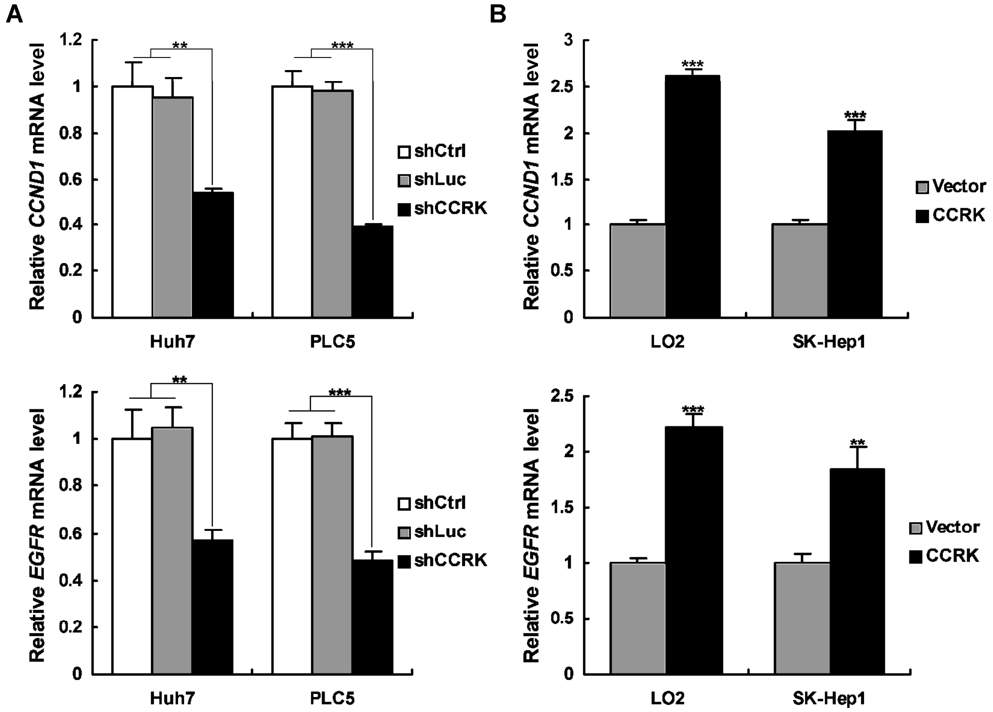

Figure S6. Effect of CCRK on expression of β-catenin pro-proliferative target genes

Expressions of *CCND1* and *EGFR* were modulated by CCRK. (**A**) Compared with shCtrl- and shLuc-transfectants, *CCND1* and *EGFR* expressions were decreased in Huh7 and PLC5 cells stably expressing shCCRK as detected by quantitative RT-PCR. *GAPDH* was used as an internal control. (**B**) Stable expression of CCRK in LO2 and SK-Hep1 cells up-regulated *CCND1* and *EGFR* expressions. $^{**}p < 0.01$, $^{***}p < 0.001$.

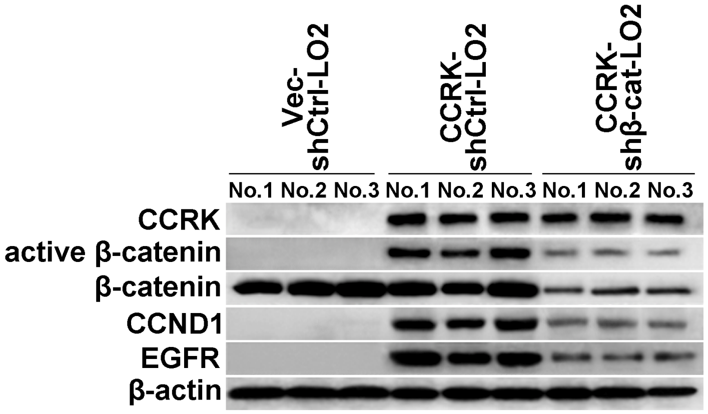

Figure S7. Expression of active β-catenin and its target genes in xenograft tumor tissues. Expressions of CCRK, CCND1, EGFR, active and total β-catenin in the Vec-shCtrl-LO2, CCRK-shCtrl-LO2 and CCRK-shβ-catenin-LO2 xenograft tumor tissues were detected by Western blot. β-actin was used as a loading control.

Table S1. AR direct target genes in Huh7 and PLC5 HCC cells.

Huh7 cell line

[1]Gene	[2]Chromosome	[2]Start	[2]End	[3]MinP[x]
ABCA1	chr9	106703644	106735732	9.90E-04
ACE2	**chrX**	**15526648**	**15534535**	**1.84E-04**
ADAMTSL1	chr9	18458865	18466713	9.59E-04
ADAR	**chr1**	**152844950**	**152871257**	**4.40E-03**
ADH7	chr4	100573321	100580684	3.58E-04
AMN1	**chr12**	**31770868**	**31778797**	**3.59E-03**
APAF1	**chr12**	**97563218**	**97568786**	**5.20E-03**
ARHGEF18	**chr19**	**7346362**	**7413527**	**2.60E-03**
ARL4D	**chr17**	**38827000**	**38835034**	**3.70E-03**
ASF1B	chr19	14091536	14111723	2.56E-04
ATP11C	**chrX**	**138739520**	**138747591**	**8.75E-03**
ATP8A2	**chr13**	**24935793**	**24942454**	**7.69E-04**
B3GALT6	**chr1**	**1157693**	**1162786**	**1.16E-04**
BACH2	**chr6**	**91060808**	**91068712**	**9.55E-03**
BANP	**chr16**	**86537656**	**86566623**	**5.29E-03**
BCL11B	**chr14**	**98805000**	**98813103**	**7.62E-03**
BOLA3	**chr2**	**74210871**	**74233956**	**5.49E-03**
C10orf22	**chr10**	**64229206**	**64237456**	**1.43E-03**
C11orf58	**chr11**	**16712375**	**16719418**	**5.96E-03**
C11orf63	**chr11**	**122253347**	**122264241**	**5.33E-03**
C14orf93	**chr14**	**22526007**	**22554690**	**3.59E-03**
C21orf45	**chr21**	**32571516**	**32575919**	**8.74E-03**
C2orf29	**chr2**	**101230597**	**101237934**	**5.85E-03**
C4orf15	**chr4**	**2200333**	**2218985**	**7.94E-04**
CABP7	**chr22**	**28440904**	**28448865**	**8.56E-03**
CCND1	**chr11**	**69159563**	**69167767**	**1.06E-04**
CCNF	**chr16**	**2414051**	**2448669**	**9.97E-04**
CCRK	**chr9**	**89777119**	**89782729**	**8.74E-04**
CD164	**chr6**	**109807871**	**109815857**	**5.23E-05**
CD3E	**chr11**	**117677776**	**117683219**	**1.97E-04**
CDH2	**chr18**	**24008571**	**24016616**	**3.95E-03**
CDH24	**chr14**	**22592434**	**22600650**	**6.24E-03**
CDH8	**chr16**	**60625209**	**60633709**	**9.80E-05**

CDK5R2	**chr2**	**219527554**	**219535227**	**5.70E-03**
CDK6	**chr7**	**92298051**	**92306286**	**5.95E-03**
CDKN1B	**chr12**	**12756098**	**12764388**	**8.54E-03**
CGA	chr6	87859667	87866767	2.59E-04
CGNL1	**chr15**	**55450860**	**55519987**	**8.17E-06**
CHGB	**chr20**	**5834652**	**5842805**	**9.21E-05**
CHODL	**chr21**	**18533713**	**18541932**	**3.42E-05**
CIAO1	**chr2**	**96295590**	**96300874**	**5.96E-04**
CKS1B	chr1	153213960	153217808	6.70E-04
CLIC6	**chr21**	**34958148**	**34965915**	**4.87E-03**
CLUL1	**chr18**	**584836**	**609132**	**5.63E-03**
CNTFR	**chr9**	**34577338**	**34584652**	**8.74E-03**
COL27A1	chr9	115952688	115960507	2.51E-04
CPXCR1	**chrX**	**87883406**	**87891388**	**8.75E-03**
CPZ	**chr4**	**8640399**	**8647960**	**5.75E-03**
CSNK1D	**chr17**	**77822118**	**77830310**	**9.53E-03**
CTGF	**chr6**	**132311731**	**132319190**	**8.76E-03**
CYR61	**chr1**	**85813751**	**85821729**	**7.56E-04**
DCTN5	chr16	23560390	23562870	2.14E-04
DDX31	**chr9**	**134535770**	**134540982**	**5.33E-05**
DHRS12	chr13	51273871	51281605	3.10E-04
DIS3L	**chr15**	**64367247**	**64375491**	**3.59E-03**
DKK1	chr10	53738570	53746647	8.79E-04
DNAJC5G	**chr2**	**27350115**	**27357824**	**6.52E-04**
DPPA2	chr3	110515580	110521646	2.88E-04
DPPA3	**chr12**	**7749947**	**7757668**	**6.84E-03**
DRD3	**chr3**	**115371150**	**115384135**	**8.88E-03**
DSCR6	**chr21**	**37295531**	**37303244**	**8.03E-03**
DSCR9	**chr21**	**37497423**	**37515952**	**8.46E-03**
DTNA	**chr18**	**30321780**	**30654712**	**7.76E-04**
DUSP21	**chrX**	**44585374**	**44590838**	**5.48E-03**
DYRK1A	**chr21**	**37656075**	**37716752**	**7.46E-03**
EGFLAM	**chr5**	**38290135**	**38483905**	**2.72E-05**
EGR2	**chr10**	**64243403**	**64251556**	**3.26E-03**
EIF1AX	**chrX**	**20067579**	**20074596**	**2.39E-04**
EIF4E	chr4	100066990	100075043	4.76E-04
ENDOGL1	**chr3**	**38509729**	**38515292**	**8.42E-05**
ERH	**chr14**	**68930767**	**68934716**	**6.80E-06**

ESCO1	**chr18**	**17432281**	**17435629**	**8.54E-03**
EVI1	**chr3**	**170344352**	**170352485**	**4.48E-04**
EXOSC3	**chr9**	**37772605**	**37780549**	**2.16E-05**
FAM45B	**chr10**	**120853685**	**129457739**	**5.73E-04**
FAM46C	chr1	117944684	117952583	6.85E-04
FAM62A	**chr12**	**54803103**	**54810819**	**7.53E-03**
FBS1	**chr16**	**30578866**	**30586483**	**3.84E-03**
FBXO15	**chr18**	**69961442**	**69965896**	**3.70E-03**
FGF14	**chr13**	**101364838**	**101857442**	**3.60E-03**
FGFR1	**chr8**	**38432513**	**38450798**	**8.76E-03**
FLI1	**chr11**	**128063784**	**128071748**	**3.84E-03**
FLJ21127	**chr12**	**109530895**	**109538392**	**9.80E-03**
FLT1	**chr13**	**27964543**	**27972661**	**2.18E-04**
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FOS	**chr14**	**74809900**	**74817771**	**8.88E-03**
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GADD45B	**chr19**	**2423856**	**2429726**	**1.17E-04**
GATA5	**chr20**	**60481532**	**60489851**	**4.02E-03**
GDPD2	**chrX**	**69557553**	**69562431**	**5.61E-04**
GFRA2	chr8	21650600	21658150	4.86E-05
GLB1L	chr2	219813005	219818218	2.88E-04
GNAI2	**chr3**	**50238692**	**50251219**	**7.57E-03**
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GRIA4	**chr11**	**104980777**	**104989227**	**7.31E-04**
GRIN2A	**chr16**	**10179347**	**10186292**	**8.34E-03**
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GRM7	**chr3**	**6872719**	**6880482**	**1.63E-05**
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KLHL14	**chr18**	**28604543**	**28612390**	**2.41E-03**
KLHL2	**chr4**	**166342905**	**166463770**	**7.56E-03**
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MAP2K7	chr19	7873549	7877078	3.84E-04
MAP3K5	chr6	137153022	137158517	2.66E-05
MAPRE2	**chr18**	**30870014**	**30878018**	**2.31E-03**
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MAT1A	**chr10**	**82036829**	**82044570**	**8.43E-03**
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MEN1	**chr11**	**64327558**	**64335014**	**1.64E-04**
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MGC26733	**chr2**	**98064908**	**98230344**	**6.24E-04**
MGMT	**chr10**	**131150140**	**131157952**	**4.56E-03**
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NOL4	**chr18**	**30054784**	**30061524**	**1.21E-03**
NOX4	**chr11**	**88861718**	**88869890**	**9.57E-03**
NR2E1	chr6	108588654	108597134	2.38E-04
NRK	chrX	104947942	104955594	7.82E-04
NUDT2	**chr9**	**34314130**	**34331459**	**4.21E-04**
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OR9Q1	**chr11**	**57641047**	**57705597**	**4.05E-03**
OTOA	chr16	21597336	21626076	6.54E-04
PAN3	**chr13**	**27641279**	**27648649**	**4.03E-04**
PAX2	chr10	102489841	102498514	1.57E-04
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PCDH7	**chr4**	**30325765**	**30333629**	**6.10E-04**
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PCID1	**chr11**	**32556607**	**32564063**	**2.05E-03**
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PIP5K2A	**chr10**	**23041096**	**23048726**	**4.35E-05**
PLAGL2	chr20	30239362	30259110	9.04E-04
PLN	**chr6**	**118971500**	**118987764**	**7.59E-03**
PPP2R3A	chr3	137165644	137226608	2.01E-04
PRC1	**chr15**	**89336939**	**89342667**	**2.19E-04**
PRDM5	**chr4**	**122060791**	**122066481**	**1.84E-04**
PRLHR	**chr10**	**120342455**	**120350300**	**1.35E-04**
PRMT3	**chr11**	**20361912**	**20367973**	**6.73E-05**
PTGDR	**chr14**	**51798860**	**51806320**	**6.02E-04**
PTPRT	**chr20**	**41249397**	**41257020**	**8.40E-03**
PVRL2	**chr19**	**50036396**	**50083184**	**5.41E-03**
R3HDM1	**chr2**	**136005646**	**136141865**	**9.56E-03**
RAB28	**chr4**	**13092357**	**13100571**	**6.85E-03**
RAB30	**chr11**	**82458231**	**82465717**	**7.68E-03**
RABGAP1	**chr9**	**124743174**	**124916451**	**8.45E-03**

RABGAP1L	**chr1**	**172390394**	**172686075**	**5.16E-03**
RASL11B	**chr4**	**53417780**	**53425823**	**5.04E-04**
RASSF3	**chr12**	**63285471**	**63292522**	**6.86E-03**
RASSF8	**chr12**	**25998953**	**26005641**	**5.73E-04**
RICTOR	**chr5**	**39107897**	**39113613**	**5.19E-04**
RNF103	**chr2**	**86701144**	**86708020**	**8.45E-03**
RNF122	**chr8**	**33542054**	**33549671**	**9.85E-03**
RNF130	**chr5**	**179372715**	**179436732**	**3.41E-04**
RNF17	**chr13**	**24231354**	**24304582**	**5.55E-03**
RSPO2	**chr8**	**109160982**	**109168013**	**2.61E-04**
RUNX1T1	**chr8**	**93096291**	**93182090**	**3.63E-04**
SALL1	**chr16**	**49740247**	**49748161**	**3.57E-04**
SAMSN1	**chr21**	**14837999**	**14845840**	**8.76E-03**
SCGB1D1	**chr11**	**61711612**	**61716640**	**2.68E-03**
SEMA4D	**chr9**	**91282126**	**91289928**	**6.75E-04**
SERTAD2	**chr2**	**64731894**	**64739516**	**1.30E-05**
SFRS15	**chr21**	**32023827**	**32031453**	**8.52E-03**
SFRS3	chr6	36665106	36672411	1.18E-04
SIAH1	**chr16**	**46954747**	**46982117**	**2.40E-03**
SLC2A4	**chr17**	**7122640**	**7128427**	**9.30E-04**
SLIT1	**chr10**	**98932959**	**98940303**	**3.46E-03**
SMAD7	**chr18**	**44728524**	**44736598**	**6.51E-05**
SNX24	**chr5**	**122205841**	**122211447**	**1.48E-04**
SORBS1	chr10	97185054	97316243	1.80E-04
SOX5	**chr12**	**23991389**	**24612164**	**3.85E-03**
SOX6	chr11	16378944	16459282	2.13E-04
SPG20	**chr13**	**35805495**	**35824248**	**3.64E-04**
SSTR4	**chr20**	**22958743**	**22966641**	**4.64E-04**
ST6GALNAC3	**chr1**	**76307640**	**76315346**	**3.13E-05**
STAG2	**chrX**	**122919322**	**122986516**	**6.21E-04**
STARD13	**chr13**	**32655725**	**32763172**	**3.54E-03**
STATIP1	**chr18**	**31963993**	**31968819**	**6.04E-03**
STOM	**chr9**	**123169762**	**123177476**	**5.85E-03**
TACC3	**chr4**	**1693044**	**1698204**	**6.14E-04**
TAS2R7	chr12	10844147	10849899	3.51E-05
TCF21	**chr6**	**134246927**	**134254747**	**4.90E-05**
TCF7L2	**chr10**	**114694749**	**114702928**	**2.77E-03**
TCL6	**chr14**	**95194152**	**95203571**	**4.50E-04**

TEX13B	**chrX**	**107109621**	**107115901**	**7.52E-04**
THBD	**chr20**	**22975907**	**22982857**	**9.80E-03**
TLE3	**chr15**	**68173699**	**68182765**	**5.48E-03**
TMED3	chr15	77385707	77392715	3.94E-04
TMEM17	**chr2**	**62584425**	**62592297**	**3.29E-04**
TSHZ3	chr19	36459632	36467510	9.23E-04
TSPY1	**chrY**	**9270695**	**9975448**	**3.65E-03**
TTC14	**chr3**	**181797316**	**181805128**	**8.74E-03**
TWF2	**chr3**	**52237659**	**52248179**	**1.88E-07**
TXNDC10	**chr18**	**64530956**	**64538834**	**3.62E-04**
TXNDC3	**chr7**	**37849871**	**37857133**	**3.94E-04**
UBE2I	**chr16**	**1293821**	**1306356**	**9.59E-04**
UPF1	**chr19**	**18799619**	**18806398**	**2.68E-03**
UTS2	**chr1**	**7833210**	**7841176**	**7.97E-04**
VAX1	chr10	118885157	118893254	9.59E-04
VGLL3	**chr3**	**87120644**	**87128306**	**7.50E-03**
VPS35	**chr16**	**45275797**	**45280444**	**5.68E-03**
WWOX	**chr16**	**76685605**	**76693698**	**3.03E-03**
ZBTB16	**chr11**	**113430193**	**113636269**	**5.66E-05**
ZBTB2	**chr6**	**151752230**	**151759706**	**6.86E-04**
ZDHHC6	**chr10**	**114191649**	**114196563**	**6.51E-03**
ZFP36	**chr19**	**44583835**	**44591634**	**2.02E-03**
ZIC3	chrX	136470489	136479034	1.55E-04
ZMAT2	chr5	140059049	140062704	4.04E-05
ZNF157	chrX	47110271	47115056	4.66E-05
ZNF44	**chr19**	**12264345**	**12271193**	**5.01E-04**
ZNF451	**chr6**	**57058090**	**57142944**	**1.04E-04**
ZNF533	chr2	180432074	180439579	7.82E-05
ZNF667	**chr19**	**61678252**	**61685739**	**3.66E-03**

Footnotes:

1. AR target genes in Huh7 cells identified by ChIP-chip. Common targets identified in both HCC cell lines are bolded.
2. The chromosome location and genomic coordinates of the probe in the Agilent human ChIP-chip array that shows significant AR binding in HCC cells by the ChIP Analytics software.
3. The minimal *P*[Xbar] value of the probes corresponding to the AR-bound genes. A gene promoter was considered as positive for AR binding if the probes have P[Xbar] $< 10^{-3}$.

PLC5 cell line

[1]Gene	[2]Chromosome	[2]Start	[2]End	[3]MinP[x]
ACA36	chrX	153644412	153646868	1.46E-04
ACE2	**chrX**	**15526648**	**15534535**	**7.60E-03**
ADAR	**chr1**	**152844950**	**152871257**	**4.02E-04**
ALAS2	chrX	55066889	55078786	2.74E-05
AMN1	**chr12**	**31770868**	**31778797**	**3.62E-04**
ANKRD27	chr19	37852866	37857850	9.45E-04
APAF1	**chr12**	**97563218**	**97568786**	**5.10E-04**
ARHGEF18	**chr19**	**7346362**	**7413527**	**8.85E-04**
ARL4D	**chr17**	**38827000**	**38835034**	**4.76E-04**
ASB12	chrX	63360334	63367558	9.29E-05
ATP11C	**chrX**	**138739520**	**138747591**	**2.02E-04**
ATP8A2	**chr13**	**24935793**	**24942454**	**6.45E-05**
B3GALT6	**chr1**	**1157693**	**1162786**	**5.48E-03**
BACH2	**chr6**	**91060808**	**91068712**	**6.68E-05**
BANP	**chr16**	**86537656**	**86566623**	**2.52E-05**
BCL11B	**chr14**	**98805000**	**98813103**	**7.75E-04**
BOLA3	**chr2**	**74210871**	**74233956**	**6.07E-04**
BTBD12	chr16	3571184	3591118	1.30E-04
C10orf22	**chr10**	**64229206**	**64237456**	**4.45E-04**
C11orf58	**chr11**	**16712375**	**16719418**	**8.88E-04**
C11orf63	**chr11**	**122253347**	**122264241**	**4.88E-05**
C14orf93	**chr14**	**22526007**	**22554690**	**2.77E-04**
C1R	chr12	7056942	7138134	2.81E-05
C21orf45	**chr21**	**32571516**	**32575919**	**2.00E-04**
C2orf29	**chr2**	**101230597**	**101237934**	**9.98E-04**
C4orf15	**chr4**	**2200333**	**2218985**	**5.74E-03**
CA10	chr17	47588732	47597805	1.49E-04
CABP7	**chr22**	**28440904**	**28448865**	**2.53E-04**
CABYR	chr18	19967495	19975890	3.41E-06
CBLL1	chr7	107167982	107174249	2.11E-05
CCDC120	chrX	48797960	48805801	7.86E-05
CCND1	**chr11**	**69159563**	**69167767**	**7.41E-04**
CCNF	**chr16**	**2414051**	**2448669**	**7.46E-03**
CCRK	**chr9**	**89777119**	**89782729**	**2.03E-05**

CD164	**chr6**	**109807871**	**109815857**	**7.59E-03**
CD3E	**chr11**	**117677776**	**117683219**	**8.73E-03**
CDC42EP4	chr17	68817206	68825145	5.28E-04
CDH2	**chr18**	**24008571**	**24016616**	**3.13E-05**
CDH24	**chr14**	**22592434**	**22600650**	**6.54E-04**
CDH8	**chr16**	**60625209**	**60633709**	**8.70E-03**
CDK5R2	**chr2**	**219527554**	**219535227**	**8.79E-05**
CDK6	**chr7**	**92298051**	**92306286**	**1.88E-04**
CDKN1B	**chr12**	**12756098**	**12764388**	**9.51E-05**
CGNL1	**chr15**	**55450860**	**55519987**	**5.70E-03**
CHGB	**chr20**	**5834652**	**5842805**	**4.87E-04**
CHODL	**chr21**	**18533713**	**18541932**	**8.37E-03**
CIAO1	**chr2**	**96295590**	**96300874**	**3.94E-05**
CLGN	chr4	141566657	141571070	9.51E-05
CLIC6	**chr21**	**34958148**	**34965915**	**8.23E-05**
CLUL1	**chr18**	**584836**	**609132**	**2.30E-04**
CNTFR	**chr9**	**34577338**	**34584652**	**2.43E-04**
CPXCR1	**chrX**	**87883406**	**87891388**	**1.06E-04**
CPZ	**chr4**	**8640399**	**8647960**	**8.74E-05**
CRSP2	chrX	40392486	40484955	9.85E-04
CRYGB	chr2	208718064	208723252	1.16E-04
CSNK1D	**chr17**	**77822118**	**77830310**	**3.38E-04**
CTGF	**chr6**	**132311731**	**132319190**	**7.25E-04**
CX3CR1	chr3	39294235	39301590	1.17E-05
CYR61	**chr1**	**85813751**	**85821729**	**8.65E-05**
DCP1B	chr12	1981466	1989372	4.68E-04
DDX31	**chr9**	**134535770**	**134540982**	**4.87E-03**
DENND3	chr8	142202490	142210376	7.55E-04
DHRS3	chr1	12597570	12605805	1.12E-04
DHX36	chr3	155522603	155526544	7.18E-04
DIS3L	**chr15**	**64367247**	**64375491**	**4.89E-04**
DMRT3	chr9	961509	969455	1.16E-04
DNAJC5G	**chr2**	**27350115**	**27357824**	**5.88E-03**
DPPA3	**chr12**	**7749947**	**7757668**	**3.26E-04**
DRD3	**chr3**	**115371150**	**115384135**	**1.73E-05**
DSCR6	**chr21**	**37295531**	**37303244**	**4.20E-05**
DSCR9	**chr21**	**37497423**	**37515952**	**9.23E-05**
DTNA	**chr18**	**30321780**	**30654712**	**5.99E-03**

DUSP21	**chrX**	**44585374**	**44590838**	**2.31E-05**
DYRK1A	**chr21**	**37656075**	**37716752**	**1.09E-04**
EGFLAM	**chr5**	**38290135**	**38483905**	**7.79E-04**
EGR2	**chr10**	**64243403**	**64251556**	**3.86E-04**
EIF1AX	**chrX**	**20067579**	**20074596**	**3.79E-03**
ELOVL4	chr6	80711295	80719368	6.59E-04
ENDOGL1	**chr3**	**38509729**	**38515292**	**5.50E-03**
ERH	**chr14**	**68930767**	**68934716**	**4.53E-03**
ERN2	chr16	23629830	23637654	3.84E-04
ESCO1	**chr18**	**17432281**	**17435629**	**7.74E-04**
EVI1	**chr3**	**170344352**	**170352485**	**7.82E-03**
EXOSC3	**chr9**	**37772605**	**37780549**	**5.42E-03**
EXOSC5	chr19	46590446	46595066	1.73E-05
FAM112A	chr20	41786315	41794567	4.32E-04
FAM45B	**chr10**	**120853685**	**129457739**	**3.28E-06**
FAM62A	**chr12**	**54803103**	**54810819**	**8.68E-04**
FBS1	**chr16**	**30578866**	**30586483**	**6.15E-04**
FBXO15	**chr18**	**69961442**	**69965896**	**1.86E-04**
FBXO8	chr4	175442080	175445819	5.98E-04
FCAR	chr19	60071948	60079204	7.94E-04
FGF14	**chr13**	**101364838**	**101857442**	**3.12E-05**
FGFR1	**chr8**	**38432513**	**38450798**	**3.19E-05**
FLI1	**chr11**	**128063784**	**128071748**	**5.35E-04**
FLJ21127	**chr12**	**109530895**	**109538392**	**7.24E-04**
FLJ45121	chr16	87330769	87335324	2.71E-04
FLT1	**chr13**	**27964543**	**27972661**	**7.41E-03**
FLT3	**chr13**	**27570504**	**27576660**	**4.79E-03**
FOS	**chr14**	**74809900**	**74817771**	**6.12E-05**
FOXA2	**chr20**	**22510624**	**22519425**	**4.78E-05**
GABRA3	**chrX**	**151308976**	**151373033**	**9.83E-03**
GADD45B	**chr19**	**2423856**	**2429726**	**8.72E-03**
GATA5	**chr20**	**60481532**	**60489851**	**2.90E-04**
GDPD2	**chrX**	**69557553**	**69562431**	**7.48E-03**
GNAI2	**chr3**	**50238692**	**50251219**	**6.61E-04**
GPBP1	chr5	56503860	56508171	8.03E-05
GPR87	**chr3**	**152514964**	**152522610**	**6.41E-04**
GRIA4	**chr11**	**104980777**	**104989227**	**8.73E-03**
GRIN2A	**chr16**	**10179347**	**10186292**	**9.76E-05**

GRLF1	**chr19**	**52108410**	**52199363**	**8.75E-04**
GRM7	**chr3**	**6872719**	**6880482**	**3.66E-03**
GRPR	**chrX**	**16046640**	**16054432**	**2.44E-04**
GSC	**chr14**	**94303729**	**94311646**	**6.86E-04**
GSN	chr9	123064818	123104361	1.20E-04
HAP1	**chr17**	**37142033**	**37149847**	**9.82E-04**
HARS2	chr20	18512387	18518738	5.31E-04
HDAC6	**chrX**	**48539924**	**48568152**	**2.15E-04**
HHLA3	chr1	70593103	70598444	9.83E-04
HIST1H2AG	chr6	27209340	27210300	6.67E-05
HNRPD	**chr4**	**83511336**	**83518809**	**1.40E-04**
HOXA10	chr7	27176821	27187227	9.36E-04
HOXC10	**chr12**	**52659869**	**52670337**	**2.57E-05**
HOXC13	**chr12**	**52613426**	**52621431**	**4.89E-03**
HPGD	**chr4**	**175677827**	**175685698**	**7.48E-03**
HS3ST5	chr6	114488200	114496140	7.06E-05
hsa-mir-125b-1	**chr11**	**121473461**	**121481220**	**2.37E-04**
HSCB	**chr22**	**27468154**	**27472034**	**5.98E-03**
HTR2C	chrX	113720089	113965715	1.32E-04
IL17A	**chr6**	**52153710**	**52161460**	**8.47E-03**
IL2	**chr4**	**123594562**	**123600373**	**3.40E-04**
IL27	**chr16**	**28424058**	**28431137**	**4.45E-05**
IL4I1	**chr19**	**55089433**	**55097079**	**5.92E-04**
ITCH	**chr20**	**32413474**	**32562865**	**5.89E-04**
ITFG2	**chr12**	**2786772**	**2793831**	**9.90E-04**
ITGB1BP2	chrX	70437800	70440760	2.02E-04
ITIH1	**chr3**	**52786702**	**52801103**	**8.54E-03**
ITPKB	**chr1**	**224989444**	**224996200**	**2.47E-04**
IYD	chr6	150726421	150734303	3.30E-04
KCNIP4	**chr4**	**20490977**	**21563714**	**8.79E-04**
KCTD17	**chr22**	**35772056**	**35780226**	**6.27E-04**
KDELC2	chr11	107848242	107879622	2.76E-04
KIAA0182	**chr16**	**84197082**	**84206865**	**3.56E-04**
KLF10	**chr8**	**103732779**	**103742600**	**8.53E-05**
KLF4	**chr9**	**109288846**	**109296864**	**3.46E-03**
KLHL14	**chr18**	**28604543**	**28612390**	**1.65E-04**
KLHL2	**chr4**	**166342905**	**166463770**	**2.94E-04**
KLHL30	**chr2**	**238708684**	**238716605**	**4.78E-04**

KLHL5	**chr4**	**38735230**	**38743041**	**3.83E-04**
KLHL6	**chr3**	**184753606**	**184761558**	**4.57E-03**
KRT31	chr17	36805410	36812797	3.43E-05
KRT6C	**chr12**	**51171443**	**51172589**	**6.11E-04**
L3MBTL4	**chr18**	**6299272**	**6409076**	**9.48E-04**
LAMA4	chr6	112679622	112687624	7.45E-04
LCE3B	chr1	150847467	150853584	2.45E-04
LGTN	**chr1**	**204850041**	**204855737**	**2.51E-04**
LMO4	**chr1**	**87561350**	**87572781**	**4.43E-05**
LPHN2	chr1	82033244	82041119	8.43E-04
LUZP1	chr1	23365888	23373020	1.76E-04
LYN	**chr8**	**56949513**	**56957701**	**8.31E-03**
MAPRE2	**chr18**	**30870014**	**30878018**	**3.18E-04**
MAT1A	**chr10**	**82036829**	**82044570**	**1.73E-04**
MC2R	**chr18**	**13873037**	**13910778**	**4.59E-03**
MEIS1	**chr2**	**66510564**	**66518628**	**5.49E-03**
MEN1	**chr11**	**64327558**	**64335014**	**4.57E-03**
MGC26733	**chr2**	**98064908**	**98230344**	**3.54E-03**
MGMT	**chr10**	**131150140**	**131157952**	**7.50E-04**
MIER1	**chr1**	**67163375**	**67171046**	**7.45E-03**
MITF	**chr3**	**69865806**	**70070929**	**8.56E-03**
MMP12	**chr11**	**102248846**	**102256141**	**2.21E-04**
MOCS2	chr5	52438782	52446759	1.81E-04
MORC2	**chr22**	**29691428**	**29699618**	**3.46E-04**
MOSC2	chr1	218983945	219024131	4.00E-04
MPPED2	chr11	30556225	30568471	5.38E-05
MSR1	chr8	16085978	16099420	2.64E-04
MSRB2	**chr10**	**23419235**	**23460940**	**6.59E-03**
MX1	chr21	41720178	41728076	8.03E-04
NCK2	**chr2**	**105829394**	**105836285**	**1.33E-04**
NDST4	**chr4**	**116252619**	**116259865**	**2.74E-04**
NEFH	chr22	28200788	28208661	9.79E-05
NETO1	chr18	68681471	68690910	7.43E-04
NEURL2	chr20	43953187	43957312	9.53E-05
NFATC1	**chr18**	**75253029**	**75263841**	**7.42E-03**
NHN1	chr16	87164352	87166556	1.30E-04
NOL4	**chr18**	**30054784**	**30061524**	**8.96E-04**
NOX4	**chr11**	**88861718**	**88869890**	**1.87E-04**

NUDT2	**chr9**	**34314130**	**34331459**	**8.57E-03**
NUFIP2	**chr17**	**24642755**	**24649732**	**9.26E-04**
OR9Q1	**chr11**	**57641047**	**57705597**	**1.53E-04**
OSGEPL1	chr2	190334140	190341242	8.69E-04
PAN3	**chr13**	**27641279**	**27648649**	**2.94E-05**
PARP12	chr7	139406758	139410930	7.39E-04
PAX7	**chr1**	**18824807**	**18833022**	**7.99E-03**
PCDH7	**chr4**	**30325765**	**30333629**	**8.73E-03**
PCDHGA12	**chr5**	**140784943**	**140792948**	**4.53E-03**
PCID1	**chr11**	**32556607**	**32564063**	**6.89E-04**
PDLIM5	**chr4**	**95587209**	**95594593**	**8.74E-03**
PEX5	chr12	7231705	7236661	4.01E-04
PIGA	chrX	15248015	15268160	1.02E-04
PIP5K2A	**chr10**	**23041096**	**23048726**	**8.02E-03**
PLN	**chr6**	**118971500**	**118987764**	**8.91E-04**
POU4F1	chr13	78073422	78081073	5.39E-04
PRC1	**chr15**	**89336939**	**89342667**	**7.84E-03**
PRDM5	**chr4**	**122060791**	**122066481**	**4.58E-03**
PRLHR	**chr10**	**120342455**	**120350300**	**5.01E-03**
PRMT3	**chr11**	**20361912**	**20367973**	**6.92E-03**
PRPF4B	chr6	3962299	3968859	2.74E-04
PRRC1	chr5	126876206	126889567	6.30E-04
PSMC3	chr11	47402169	47407571	9.40E-04
PTCHD1	chrX	23256567	23265464	7.09E-04
PTGDR	**chr14**	**51798860**	**51806320**	**4.79E-03**
PTPN9	chr15	73656287	73663773	2.96E-04
PTPRT	**chr20**	**41249397**	**41257020**	**1.48E-04**
PVRL2	**chr19**	**50036396**	**50083184**	**2.00E-04**
R3HDM1	**chr2**	**136005646**	**136141865**	**3.63E-05**
RAB28	**chr4**	**13092357**	**13100571**	**2.03E-04**
RAB30	**chr11**	**82458231**	**82465717**	**1.52E-04**
RAB31	chr18	9692866	9700434	7.96E-04
RABGAP1	**chr9**	**124743174**	**124916451**	**1.05E-04**
RABGAP1L	**chr1**	**172390394**	**172686075**	**3.63E-04**
RAI2	chrX	17727596	17735874	3.26E-06
RASL11B	**chr4**	**53417780**	**53425823**	**7.33E-03**
RASSF3	**chr12**	**63285471**	**63292522**	**2.09E-05**
RASSF8	**chr12**	**25998953**	**26005641**	**7.12E-03**

RHOBTB1	chr10	62371394	62432647	1.71E-04
RICTOR	**chr5**	**39107897**	**39113613**	**5.70E-03**
RNF103	**chr2**	**86701144**	**86708020**	**1.38E-04**
RNF122	**chr8**	**33542054**	**33549671**	**2.07E-04**
RNF130	**chr5**	**179372715**	**179436732**	**2.37E-03**
RNF146	chr6	127624447	127651965	4.20E-04
RNF17	**chr13**	**24231354**	**24304582**	**5.57E-05**
RORB	chr9	76296737	76305221	2.44E-05
RPL41	chr12	54794071	54797480	1.01E-04
RSPO2	**chr8**	**109160982**	**109168013**	**7.33E-03**
RUNX1T1	**chr8**	**93096291**	**93182090**	**4.24E-03**
SALL1	**chr16**	**49740247**	**49748161**	**1.76E-06**
SAMSN1	**chr21**	**14837999**	**14845840**	**3.44E-04**
SCGB1D1	**chr11**	**61711612**	**61716640**	**2.79E-04**
SEMA4D	**chr9**	**91282126**	**91289928**	**7.42E-03**
SERTAD2	**chr2**	**64731894**	**64739516**	**7.87E-04**
SETD1A	chr16	30873891	30903504	8.27E-04
SFRS15	**chr21**	**32023827**	**32031453**	**2.22E-04**
SIAH1	**chr16**	**46954747**	**46982117**	**5.85E-04**
SLC15A4	chr12	127862393	127880009	2.28E-04
SLC2A4	**chr17**	**7122640**	**7128427**	**8.73E-03**
SLIT1	**chr10**	**98932959**	**98940303**	**4.32E-04**
SMAD7	**chr18**	**44728524**	**44736598**	**7.85E-03**
SNX24	**chr5**	**122205841**	**122211447**	**5.04E-03**
SOX3	chrX	139412492	139420461	3.35E-04
SOX5	**chr12**	**23991389**	**24612164**	**1.80E-04**
SPG20	**chr13**	**35805495**	**35824248**	**5.69E-03**
SPTBN5	chr15	39971213	39978844	6.28E-04
SPTY2D1	chr11	18610334	18616203	5.00E-04
SRGAP3	chr3	9263509	9270751	7.99E-04
SSR3	chr3	157753189	157760735	1.51E-04
SSTR4	**chr20**	**22958743**	**22966641**	**8.72E-03**
ST6GALNAC3	**chr1**	**76307640**	**76315346**	**8.64E-03**
STAG2	**chrX**	**122919322**	**122986516**	**6.87E-03**
STARD13	**chr13**	**32655725**	**32763172**	**2.18E-04**
STATIP1	**chr18**	**31963993**	**31968819**	**7.60E-04**
STAU2	chr8	74819094	74826642	4.25E-04
STOM	**chr9**	**123169762**	**123177476**	**4.33E-04**

STXBP5	chr6	147561475	147569771	7.57E-04
TACC3	**chr4**	**1693044**	**1698204**	**7.33E-03**
TCF21	**chr6**	**134246927**	**134254747**	**8.53E-03**
TCF7L2	**chr10**	**114694749**	**114702928**	**3.94E-04**
TCL1B	chr14	95218064	95224454	1.41E-04
TCL6	**chr14**	**95194152**	**95203571**	**5.84E-03**
TEX13B	**chrX**	**107109621**	**107115901**	**8.35E-03**
THBD	**chr20**	**22975907**	**22982857**	**6.06E-05**
TIGD2	chr4	90249763	90255555	2.76E-04
TLE3	**chr15**	**68173699**	**68182765**	**7.76E-04**
TMED2	chr12	122630929	122648492	2.63E-04
TMEM17	**chr2**	**62584425**	**62592297**	**8.57E-03**
TRIM72	chr16	31132568	31134549	6.26E-05
TSPY1	**chrY**	**9270695**	**9975448**	**5.56E-05**
TTC12	chr11	112685555	112692968	3.32E-07
TTC14	**chr3**	**181797316**	**181805128**	**2.50E-04**
TWF2	**chr3**	**52237659**	**52248179**	**9.86E-03**
TXNDC10	**chr18**	**64530956**	**64538834**	**8.56E-03**
TXNDC3	**chr7**	**37849871**	**37857133**	**6.21E-03**
UBE1	chrX	46931164	46959474	3.52E-04
UBE2I	**chr16**	**1293821**	**1306356**	**4.15E-05**
UPF1	**chr19**	**18799619**	**18806398**	**1.27E-04**
UTS2	**chr1**	**7833210**	**7841176**	**8.70E-03**
VGLL3	**chr3**	**87120644**	**87128306**	**4.06E-04**
VPS35	**chr16**	**45275797**	**45280444**	**5.17E-04**
WDR42B	chrX	27907041	27914981	6.37E-06
WFDC9	chr20	43693628	43698831	3.37E-04
WWOX	**chr16**	**76685605**	**76693698**	**4.05E-04**
ZBTB16	**chr11**	**113430193**	**113636269**	**5.70E-03**
ZBTB2	**chr6**	**151752230**	**151759706**	**8.72E-03**
ZCCHC7	chr9	37105474	37112644	5.69E-04
ZDHHC6	**chr10**	**114191649**	**114196563**	**1.99E-04**
ZFP36	**chr19**	**44583835**	**44591634**	**8.19E-04**
ZNF44	**chr19**	**12264345**	**12271193**	**5.41E-03**
ZNF451	**chr6**	**57058090**	**57142944**	**9.24E-03**
ZNF667	**chr19**	**61678252**	**61685739**	**2.69E-05**

Footnotes:

1. AR target genes in PLC5 cells identified by ChIP-chip. Common targets identified in both HCC cell lines are bolded.
2. The chromosome location and genomic coordinates of the probe in the Agilent human ChIP-chip array that shows significant AR binding in HCC cells by the ChIP Analytics software.
3. The minimal *P*[Xbar] value of the probes corresponding to the AR-bound genes. A gene promoter was considered as positive for AR binding if the probes have P[Xbar] $< 10^{-3}$.

Table S2. AR, CCRK and β-catenin immunohistochemical scores in HCC tissues.

		CCRK			
		1	2	3	Total
AR	0	9	0	0	9
	1	3	4	2	9
	2	1	5	0	6
	3	1	5	1	7
	Total	14	14	3	31

		CCRK			
		1	2	3	Total
β-catenin	0	13	9	1	23
	1	1	1	2	4
	2	0	1	0	1
	3	0	3	0	3
	Total	14	14	3	31

		β-catenin				
		0	1	2	3	Total
AR	0	8	1	0	0	9
	1	8	1	0	0	9
	2	5	0	1	0	6
	3	2	2	0	3	7
	Total	23	4	1	3	31

Immunohistochemistry was performed in the same cohort of HCC specimens used for the Western blot analysis. Based on sample availability, AR, CCRK and β-catenin staining were performed and scored in 31 HCC specimens. Nuclear AR and β-catenin staining reflects the percentage of positive nuclei whereas cytoplasmic CCRK staining reflects a combination of the percentage of positively-stained cells and the intensity of the stain. All 3 comparisons of the immunohistochemical scores (AR-CCRK, CCRK-β-catenin and AR-β-catenin) were significantly correlated (p = 0.004, 0.032 and 0.024, respectively; 2-sided Pearson Chi-Square test).

Table S3. Primers used for ChIP-PCR and RT-PCR in this study.

Gene	Primer	Sequence	Experiment
CCRK	CCRK-F	5’- CGCAACGGCCCAAAGTAG -3’	ChIP-PCR
	CCRK-R	5’- CCACCCTCCGGCTAACG -3’	
FLT1	FLT1-F	5’- CCTACAGTGAGTTCTCAGAAGTTACCA -3’	ChIP-PCR
	FLT1-R	5’- AGACCGTCAGTTTCCAAGTAACAAG -3’	
GADD45β	GADD45β-F	5’- CCACGCCCAATGTTCAAGTC -3’	ChIP-PCR
	GADD45β-R	5’- AATCCAGGAAGTTGCGGAAA -3’	
KLHL2	KLHL2-F	5’- GTCGAACCCCTTAAGCAAAGAA -3’	ChIP-PCR
	KLHL2-R	5’- CCGTCTGACAGCTAGGCACAT -3’	
MIER1	MIER1-F	5’- CATTTGGATACAAAGAAGATATCTGTTGA -3’	ChIP-PCR
	MIER1-R	5’- CTTTTATTATGCCAGAATCTACCTCCTT -3’	
NUDT2	NUDT2-F	5’- ATCGTGGCAGTTATAGCAGAAGTAAA -3’	ChIP-PCR
	NUDT2-R	5’- ACCCGGCCTGCATTGTTT -3’	
PDLIM5	PDLIM5-F	5’- CTCTCCATGCCTGATTTAGTTCTG -3’	ChIP-PCR
	PDLIM5-R	5’- GAAACATTTGGTAATTTAGGGAGAAAAG -3’	
PEG10	PEG10-F	5’- ATGATGACATCGAGCTCCG -3’	ChIP-PCR
	PEG10-R	5’- GCTGGGTAGTTGTGCATCA -3’	
STARD13	STARD13-F	5’- TACCACCACGCCTGGCTAAT -3’	ChIP-PCR
	STARD13-R	5’- AGGCCGGTGGATCACAAG -3’	
TCF7L2	TCF7L2-F	5’- TACAGCACCAGGCAACGAAA -3’	ChIP-PCR
	TCF7L2-R	5’- TGAATCTCTCCTTCCTTAAATCTCTGA -3’	
UBE2I	UBE2I-F	5’- GTTCTGGTAGTTAACGTGCGTAGGA -3’	ChIP-PCR
	UBE2I-R	5’- AACCACTTCATTCTGCGATTCA -3’	
WWOX	WWOX-F	5’- GAAAGTTCTCTAAAACCAGGAAATCAG -3’	ChIP-PCR
	WWOX-R	5’- TGATTCACAACCTTTGTTTTGCA -3’	
BANP	BANP(a)-F	5'-AGAAGACGGACAGGTGCAAGTAG-3'	RT-PCR
	BANP(a)-R	5'-CACGTGATGGATCTGGAGGTT-3'	
CCND1	CCND1(a)-F	5’-CCGTCCATGCGGAAGATC-3’	RT-PCR
	CCND1(a)-R	5’-ATGGCCAGCGGGAAGAC-3’	
CCRK	CCRK(a)-F	5’-GCACCAGGCATAGCCACTTT-3’	RT-PCR
	CCRK(a)-R	5’-TCCCTGGGCCTAGACTTCTGT-3’	
CCNF	CCNF(a)-F	5'-CAATGCCATCCTGACACACTTT-3'	RT-PCR
	CCNF(a)-R	5'-GCCTCTTGGTCACCTCAGATGT-3'	
CDKN1B	CDKN1B(a)-F	5'-TGCCCTCCCCAGTCTCTCTT-3'	RT-PCR
	CDKN1B(a)-R	5'-CAAGCACCTCGGATTTTTGC-3'	

CDK5R2	CDK5R2(a)-F	5'-CCTTTCCATTTTCCGTTCCTT-3'	RT-PCR
	CDK5R2(a)-R	5'-ACAGGTGCAGGAGGAGAAACA-3'	
CDK6	CDK6(a)-F	5'-AAAGCCCTCTTGAAGCAAAAGA-3'	RT-PCR
	CDK6(a)-R	5'-TGGGAAAGGAGCAAGAGCAT-3'	
EGFR	EGFR-F	3’-ATGTCCGGGAACACAAAGAC-3’	RT-PCR
	EGFR-R	5’-TTCCGTCATAGTTCTTGGAT-3’	
ESCO1	ESCO1(a)-F	5'-AAAAGGAAAGCTCCAGCTAAATAGG-3'	RT-PCR
	ESCO1(a)-R	5'-ACTTTCTACTTCCTCCTTCCATCAAAG-3'	
EVI1	EVI1(a)-F	5'-TGGGTGAGAAGGGCAGTTG-3'	RT-PCR
	EVI1(a)-R	5'-GTTCCCAATCATGTCAGGTGATC-3'	
GADD45β	GADD45β(a)-F	5'-GCTGCCACAAACAAAAAATACAAT-3'	RT-PCR
	GADD45β(a)-R	5'-GACTCTGCCCCCGATGGT-3'	
GAPDH	GAPDH-F	5’- ACAACAGCCTCAAGATCATCAG -3’	RT-PCR
	GAPDH-R	5’- GGTCCACCACTGACACGTTG -3’	
HPGD	HPGD(a)-F	5'-GGCAGTCAAGGAATAAACTACAGTGTA-3'	RT-PCR
	HPGD(a)-R	5'-AGGAGGCTGAACTGTGAATCAAC-3'	
MAPRE2	MAPRE2(a)-F	5'-GCAGTCTGGTGTAGACACTGGAAT-3'	RT-PCR
	MAPRE2(a)-R	5'-GGAGGGCCCTTGTGTTAAAGA-3'	
MEN1	MEN1(a)-F	5'-GTCCAGTGCTCACTTTCCAGAGT-3'	RT-PCR
	MEN1(a)-R	5'-GCCGTGAGTTGCAGCTTGAT-3'	
PNN	PNN-F	5’- CCTTTCTGGTCCTGGTGGAG -3’	RT-PCR
	PNN-R	5’-TGATTCTCTTCTGGTCCGACG -3	
PRC1	PRC1(a)-F	5--CAGCGCAACTTCAGCATTAATT-3'	RT-PCR
	PRC1(a)-R	5'-GTTCTCGCTGAAGCCCAACA-3'	
RABGAP1	RABGAP1(a)-F	5'-ATTACGGGAGCTGTGGACAGA-3'	RT-PCR
	RABGAP1(a)-R	5'-TTTACAGACACGCAACTCAGTCTTT-3'	
SIAH1	SIAH1(a)-F	5'-CAGAAAGTAAAGGTGACATCGGAAA-3'	RT-PCR
	SIAH1(a)-R	5'-AGCTCAAAGGTGTGACTCATCTGT-3'	
STAG2	STAG2(a)-F	5'-CCATGCCTTAATATGCTTGCAA-3'	RT-PCR
	STAG2(a)-R	5'-CTACCACAGCCCAATGCTTGA-3'	
TACC3	TACC3(a)-F	5'-AAGACCAACTTACCACAGATCTGAACT-3'	RT-PCR
	TACC3(a)-R	5'-TCTTGCGGTAGCCCTCGAT-3'	
TCF7L2	TCF7L2(a)-F	5'-GCGCGGGATAACTATGGAAA-3'	RT-PCR
	TCF7L2(a)-R	5'-GTGAAAGGCAAGGATTTAGGAAAC-3'	
UBE2I	UBE2I(a)-F	5'-CTCCTGCCGCTCCTCTCTAGA-3'	RT-PCR
	UBE2I(a)-R	5'-ACAAAGGAAGTGGCGCAGAA-3'	
UPF1	UPF1(a)-F	5'-TGCCTGCCGGCAACTTT-3'	RT-PCR
	UPF1(a)-R	5'-CACCCTCAGTCCCTTCACACA-3'	