

,±,íflfvfVftf”,íftfHfO fe][fuf< fGf~f...fŒ][fVftf”,ðflf”/flft,É,·,é,½,ß,ÉŽg—p,³,ê,Ü,·]B

Direct3D ,Å,í]AD3D fn][fhfEfFfA fAfNfZf%ofŒ][fVftf”,‰ooÅ”\,ÈffffBfXfvfŒfC fAf_fvf^,¤Afо][fefbfNfX
ftfHfO,Ü,½,ífe][fuf< ftfHfO,ì,¢,,ê,©,ðŽÅ]s,Å,«,é,±,Æ,ð]ðŒ[],Æ,µ,Ä,¢,Ü,·]B^ê•”,ífQ][f€,Å,í]AD3D
fn][fhfEfFfA”\—í,ð]³Sm,ÉSm”F,·,é,±,Æ,È,]Afe][fuf< ftfHfO ftf|][fg,ð—v<[],·,é,à,ì,¤, ,è,Ü,·]B ,±
,íflfvfVftf”,ð'l'ð,·,é,Æ]AŠmŽÅ,É]A,»,¤,µ,½fQ][f€,ð NVidia fOf‰oftfBfbfNfX
fvf]fZfbfT,Å]³]í,É”®]i,³,é,±,Æ,¤,Å,«,Ü,·]B

,±,ê,ç,ìflfvfVf#f”,ðŽg—p,·,é,Æ[]Afhf%ofoCfo,ìfAf“f`fGfCfŠfAfX<@”\,ðfRf“fgf[]f^ç,Å,«,Ü,·[]B
fAf“f`fGfCfŠfAfX,Æ,í[]A3D flfufWfFfNfg,ì%o[],ðŠš,ç,©,É,μ[]AŠp’£,Á,½•”•^a,ð,È,,·žè-
@,Å,·[]BfAf“f`fGfCfŠfAfX,ð—LŒø,É,μ,Ä,à[]A,·,x,Ä,í Direct3D fvfvfOf%ofo€
,^afCf[]fW,É’í,μ,Äž©“®“I,ÉfAf“f`fGfCfŠfAfX,ð[]s,¤,±,Æ,É,í,È,ç,È,¢,ì,Å[]A,²[]^Ó,-
,^¾,^³,¢[]BfAf“f`fGfCfŠfAfX,ð[]^³í,É<@”\,^³,^¹,é,í[]AfAvfvfŠfP[]fVf#f”,É,æ,éfTf|[]fg,^a•K—v,Å,·[]B

fAf“f`fGfCfŠfAfX fTf“fvfŠf“fO-@,δ'l'δ,Å,«,Ü,·B
fAfvfŠfP█[fvf#f“,lfpftfH█[f}f“fX,l'¬“x,Æ█AfCf██[fW•iŽ,_,³,í'l,δ-p,¢,Ä█Ý'è,Å,«,Ü,·B

fOf‰oſtſBſbſNſX fvſſZſbſT,ÅŽg—p.,éŽ©“® Mip f}ſbſſf“fO-@,đ'l'đ,Å,«,Ü,·B
2 -{ü,Ü,٪,í 3 -{ü MIP f}ſbſſf“fO-@,đ'l'đ,Å,«,Ü,·B2 -{ü-@,Å,í^é”Ê“l,ÉfpſtſHſſf}ſ“fX,¤Eüä,µA3 -
{ü-@,Å,íCfſſfW•iž,¤Eüä,µ,Ü,·B

Mip f}fbfv, i LOD (Level of Detail) fofofCfAfX, ð'2® , Å, «, Ü, · B
fofofCfAfX, ð'á, ÙÝ'è, ·, é, AEfCf[] [fW•iŽ, ^CEüä, µAfofCfAfX, ð[], -
ÙÝ'è, ·, é, AEfAfvfŠfP[] [fVfH“, ifpftfH[] [f] f“fX, ^CEüä, µ, Ü, · B u Å, , ifCf[] [fW•iŽ, v, ©, c u Å, , ifpftfH[] [f] f“
fX, v, Ü, Å A, , c, ©, ¶, ßÙÝ'è, ^, ê, ½ 5 , Å, ifofCfAfX'!, ©, c'!ð, Å, «, Ü, · B

fOf‰o ftfBfbfNfX fvflfZfbfT, æfefNfXf`ff, ð<L‰o „,·,é,½,ßlAŽw'è,³,ê,½—e—È,Ü,ÀfVfXfef€ fflf,fŠ,ð—~—
p,À,«,é,æ,¤,ÉlY'è,À,«,Ü,· (ffffBfXfvfŒfC fAf_fvf^,ÉfCf“fXfgllf<,³,ê,À,¢,éfllf,fŠ,É‰oÁ,¡,Ä)lB

fllf: fefNfXf`ff<L‰o —p,ÉŽg—p,À,«,éfVfXfef€ fflf,fŠ,ilÀ'å—e—È,ílAfRf“fsf...
llf^,ÉfCf“fXfgllf<,³,ê,½•—l RAM ,l—e—È,ð,à,Æ,É,µ,ÄŽZlo,³,ê,Ü,·lBfVfXfef€ RAM ,l—e—È,²l
‰oÁ,·,é,ÆlAllY'è,À,«,é'l,à'å,«,,È,è,Ü,·lB

,±,ilY'è,ilAAGP fffBfXfvfŒfC fAf_fvf^,ð“lÚ,µ,À,¢,éfVfXfef€,É,í‰oel,µ,Ü,¹,ñlB

NVidia fOf%o ftfBfbfNfX fvftfZfbfT, íAMip f}fbfv, ðŽ©“®”I, É¶¶¬, ·, é, ±, Æ, ÅfofXŒo—R, jfefNfXf`ff“]’—
Œø—!, ð¶ã, °AfAfvfŠfP¶[fVftf“, lfptfH¶[f}f“fX, ðŒü¶ã, ³, ¹, é, ±, Æ, ², Å, «, Ü, ·B

, µ, ©, µ^ê•”, jfAfvfŠfP¶[fVftf“, Å, íAMip f}fbfv, jŽ©“®”I, É¶¶¬, ²—LŒø, É, È, Á, Ä, ç, é, Æ, AfCf¶¶[fW, ²¶³¶í, É•\ Ž!, ³, ê, È, ç, ±, Æ, ², , è, Ü, ·B, ±, x, µ, ½-â’è, ð‰Œ^, ·, é, É, íAfCf¶¶[fW, ²¶³¶í, É•\ Ž!, ³, ê, é, Ü, ÅAMip
f}fbfv, jŽ©“®”I, É¶¶¬fŒfxf<”, ðŒ, , ç, µ, Ä, , ¾, ³, çB Mip f}fbfv fŒfxf<”, ðŒ, , ç, ·, ±, Æ, ÅA’½,-
jé‡AfefNfXf`ff, j, , ê, åuŒp, ¬-Úv, ð‰œð¶Á, Å, «, Ü, · (fpftfH¶[f}f“fX, í’½'á‰º, µ, Ü, ·)B

,±,íflfvfVfjf“,É,æ,Á,Ä]A3 -{ü MIP f}fbfv-@,ífffBfUfŠf“fO,ð—LŒø,É,µ,Ü,·]B
Mip f}fbfv,ífffBfUfŠf“fO,ð—LŒø,É,·,é,±,Æ,Á]AfCf[]fW•iŽ,ð'½]á
‰‰,³,¹,ÄfAfvfŠfP[]fVfjf“,ífpftfH[]f}f“fX,ðŒü]ã,³,¹,é,±,Æ,³,Á,«,Ü,·]BfCf[]fW•iŽ,ð'á‰‰,³,¹,Ä,àŒ©,½-
Ú,É,í•³,©,ç,È,í]A,±,í<”\,ð—LŒø,É,µ,ÄfpftfH[]f}f“fX,íŒü]ã,ð]},Á,Ä,,¾,³,¢]B

,±,íflfvfVff”,É,æ,èÅAftf<fxNfŠ[]“ OpenGL fAfvfŠfP[] [fVff”,ífy[] [fW”½“],ð—
LŒø,É,µÅfpftfH[] {f} f”fx,ðŒüå,³,¹,Ü,·B,±,íflfvfVff”,³–³Œø,É,É,Ä,Ä,¢,éêÅAOpenGL
íÅCŒä•û,ífofbftf@,©,ç’O•û,ífofbftf@,Ö,í”½“],í,½,ß,Éfrfbfg fuf[]fbfN“]’—,ðŽg—p,µ,Ü,·B

,±,ìflfvfVftf“,ðÙÝ’è,·,é,±,Æ,ÅAfytflfW,ì”½“]Œä,É<§“I,É VBlank ‘Ò<@,ðÙs,¤,æ,¤,Éfhf
‰fCfo,ðÙY’è,Å,«,Ü,·ÙB
,±,ìflfvfVftf“,ð-³Œø,É,µ,Å,“,ÆŒAftfŒŒ[fgŒf,ð‰œ-Ê,ìfSftfŒfbfVf... fŒŒ[fg,æ,è’å,«,-
ÙÝ’è,Å,«,Ü,·,¤AfCfŒŒ[fg•iZ,¤¹,È,í,ê,é,ì,ÅA•\Z,É‰œe<¤,¤o,½,è•\Z,ì’[,¤Ø,ê,é,±,Æ,¤, ,è,Ü,·ÙBfhf
‰fCfo,¤ VBlank ‘Ò<@,ðÙs,!,é,æ,¤,ÉŒA,±,ìflfvfVftf“,ð—LŒø,É,µ,Å,,¾,³,¢ÙB

•Ü'¶,µ,½fJfXf^f€Ý'è (,Ü,½,íuTweakv) ,jfŠfXfgB,±,jfŠfXfg,©,ç€-Ü,ð'l'ð,·,é,AEÅAÝ'è,¤•\žl,³,ê,Ü,·BÝ'è,ð"K—p,³,¹,é,É,íÅA[OK] ,Ü,½,í["K—p] f{f^f",ð'l'ð,µ,Ü,·B

Œ>ØY,¡ØY'è ([Direct3D ,¡ØÚØ×ØY'è] f_fCfAfO,¡ØY'è,àŠÜ,P
,ðfjfXf^f€uTweakv,AE,μ,Ä•Ù'¶,μ,Ü,·ØB•Ù'¶,μ,½ØY'è,íØã<L,ðfjfXf^f€ØY'èfSfXfg,É'Ç‰Á,³,ê,Ü,·ØB
"Á'è,¡ Direct3D fQ[f€
,ÅØA"K,ÈØY'è,¤Œ©,Å,©,Á,½ØêØ‡ØA,» ,¡ØY'è,ðfjfXf^f€ØY'è,¡ØuTweakv,AE,μ,Ä•Ù'¶,μ,Ä,“,AEØAfQ[f€
,ðŠJŽn,·,é'O,É,·,î,â, Direct3D ,¤ØY'è,Å,«,é,¡,ÅØAŠefIfvfvf“,ðŒÅ•Ê,ÉØY'è,·,éŽeŠO,¤È,·,Ü,·ØB

Œ>Í·Ý'è,ðfJfxf^f€Í·Ý'è,í·uTwweak·v,Æ,μ,Ä•Ü'¶,μ,Ü,·B•Ü'¶,μ,%Í·Ý'è,í·ã<L,ðfJfxf^f€Í·Ý'èfŠfxfg,É'Ç
‰oÁ,³,é,Ü,·B

"Á'è,í OpenGL
fAfvfŠfP[fVf]f“,Å·À“K,È·Ý'è,ªŒ©,À,©,À,%Í·ê#A,»,í·Ý'è,ðfJfxf^f€Í·Ý'è,í·uTwweak·v,Æ,μ,Ä•Ü'¶,μ,Ä,“,,-
,ÆŒAfvf]fOf‰of€,ðŠJŽn,·,é'O,É,·,î,â, OpenGL
,ªÍ·Ý'è,À,«,é,ì,Å·AŠeflfvfVf]f“,ðŒÂ•Ê,É·Ý'è,·,éŽeŠÔ,ªÈ,~,Ü,·B

ſſfg,ÀŒ»Ý'l'ð,³,ê,Ä,¢,éf]fxf^f€Ý'e,ðíœ,μ,Ü,·B

,·,×,Ã,ìÝ'è,ð‰„ŠúÝ'è'l,É-ß,µ,Ü,·B

Direct3D ,í'Ç‰ÁÙÝ'è,ðf]fXf^f}fcfY,À,«,éf_fCfAfO,ð•\ž!,µ,Ü,·ÙB

,±,ìflfvfVfjf“,Å[]AfefNfZf< (fefNfXf` ff fGfŒf[]“fg) —p,ìfn[]fhfEfFfA fefNfXf` ff,ì”z'u[]Ý'è,ð•ï[]X,µ,Ü,·[]B
,±,é,ç,ì’I,ð•ï[]X,·,é,±,Æ,Å[]ACŒ³,ìfefNfZf<,²'è<,³,é,é[]ê[]S,ð•ï[]X,µ,Ü,·[]B‰%Šú[]Ý'è,í[]ADirect3D ,ìžd—
I,É[],Á,Ä,¢,Ü,·[]B fftfgfEfFfA,ì’t,É,í[]ACŒ³,ìfefNfZf<,ð,¢,,é,©,ì[]ê[]S,É'è<,·,é,±,Æ,ð—
v<[],·,é,à,ì,à, ,é,Ü,·[]B,»,¤,µ,½fAfvfŠfP[]“fVfjf“,Å,í[]ACŒ³,ìfefNfZf<,ð[]Ä'è<,·,é,±
Æ,ÅfCf[]“fW•iž,²Œü[]ã,µ,Ü,·[]B
'²[]®,Å,Ü,Ý,ðŽg,Á,Ä[]ACŒ³,ìfefNfZf<,ì[]ê[]S,ðfefNfZf<,ì[]¶[]ã<÷,©,ç't[]S,ìŠÔ,Å'²[]®,µ,Ä,,³/₄,³,¢[]B

,±,íflfvfVftf”,É,æ,èACPU ,äfOf‰ftfBfbfNfX f`fbfv,Å^—,³,ê,é’O,É€”õ,Å,«,éftfŒ[f€,í”,ð§ŒÀ,μ,Ü,·(VSYNC ,³Œø,É,È,Á,Ä,¢,éê‡)B

,,ç,©,¶,ßfŒf”f_fŠf”fO,³,ê,éftfŒ[f€,í”,ä’½,-,È,é,ÆAfWftfCfXfefBfbfN AfQ[f€fpfbfh AfL[f{fh,È,ç,íffffofCfX,Ö,í”½‰ož,É,“,̄,éu“ü—íf‰ofOv,ä’·,-,È,éê‡,¤, ,è,Ü,·B

fQ[f€’†,ÉAfRf”fsf...f^,ÉÚ’±,³,ê,Ä,¢,é”ü—íffffofCfX,©,ç,í”ü—í,É’†,μ,ÄA-³/₄,ç,©,É”½‰ož,ä’x,ê,Ä,¢,éê‡,íA,±,í’I,ð¬,³,,μ,Ä,,³/₄,³,¢B

,·,×,Ã,ìÝ'è,ð‰„ŠúÝ'è'l,É-ß,µ,Ü,·B

OpenGL fAfvfŠfP[fVf#f", Å•\Ž|, ^, ê, Ä, ç, éfCf[]fW•iŽ, ð'²®®, µ, Ü, ·B
 , jfCf[]fW•iŽ, ÉÅ“K‰»v, Å, íAÅ, , ï‰æŽ, ð“³/₄, é, ½, ßA‰oÅ”\
 , ÈŒÀ, èÅ, , jfCf[]fW•iŽ, ÄfefNfXf ff, ðfŒf“f_fŠf“fO, µ, Ü, ·B
 , jfpftfH[f}f“fX, ÉÅ“K
‰»v, Å, íAfAfvfŠfP[fVf#f", jfpftfH[f}f“fX, ðŒüä, ^, é, ½, ßAfcf[]fW•iŽ, ð—
 , Ä, µ, ÄfefNfXf ff, ðfŒf“f_fŠf“fO, µ, Ü, ·B
 , uÅ“K‰»v, Å, íAä<L 2, Å, l@"\, ð'g, Ÿ‡, ^, ÄŽg—p, µ, Ü, ·B, ±, ê, a‰šúÝ'è'l, Ä, È, Ä, ç, Ü, ·B

fhf%ofCfo, OpenGL Šg'£<@"\,ì **GL_KTX_buffer_region** ,)Žg—p,ð‰Å"\,É,µ,Ü,·□B,±,ìŠg'£<@"\,ðfTf|
□lfg,·é 3D f,fffŠf“fO fAfvfŠfP□[fVftf“,ífpftfH□[f}f“fX,ðŒü□ã,³,¹,é,±,Æ,²,Å,«,Ü,·□B

GL_KTX_buffer_region Šg'£<@"\,²—LŒø,É,È,Á,Ä,¢,é,Æ,«,ÉŒAfŒŒ[f]f<,jffffl fŒf,fŠ,¡Žg—p,ð‰„\ ,É,µ,Ü,·ŒB,½,¾,µŒA—~—p,Å,«,éfŒŒ[f]f< frffffl fŒf,fŠ,² 8MB ^Œ‰º,¡ŒêŒ‡ŒAff...fAf< fvŒŒŒ[f“Šg'£<@"\fTf| œfg,¡—LŒø,É,È,ë,Ü,¹,ñŒB

PCI fefNfXf`ff fq[]fv, i[]A'åfTfCfY, öŽw'è, µ, Ü, · B
[]•², Éf[]f, fŠ, ð“<Ú, µ, ½ PCI fvfxfef€, Å, ±, i'I, ð'‰oÅ, ³, ¹, é, æ[]A^é•”, i OpenGL
fAfvfŠfP[]fvff“, i fptfH[]f}f“fX, ð”“, µ, œü[]ä, ³, ¹, é, ±, æ, ², Å, «, Ü, · B
f[]f: OpenGL fefNfXf`ff<L‰o —p, ÉŽg—p, Å, «, éfvfxfef€ f[]f, fŠ, i[]A'å—e—È, í AfRf“fsf...
[]f^, ÉŽæ, è•t, , c, ê, Ä, ¢, é•” — RAM, i—e—È, É, æ, èŒ^è, µ, Ü, · Bfvfxfef€ RAM
, ², ¹, , é, i[]A[]Å'å'l, à'å, «, È, è, Ü, · B
, ±, i[]Y'è, í AAGP fffBfxfvfŒfC fAf_fvf^, ð“<Ú, µ, Ä, ¢, éfvfxfef€, È, í‰oë<ç, µ, Ü, ¹, ñ B

'2®,Â,Ü,Ý,ðŽg,Á,ÄÅA'!'\ð,µ,½fjf‰o[f`ffff"flf<,]-¾,é,³AfRf"fgf‰ofXfgÅAfKf"f} 'I,ð'2® ,Â,«,Ü,·B
fjf‰o[•â³'²® ,ðŽg—p,µ,ÄÅAfñ[fX fCf[]fW,Æ•žlf‰ofCfX,ìo—
í,Æ,išÔ,Å¶¶,¶,é<P"x,ì,î,ç,Â,«,ð•â³,·,é,±,Æ,ª,Â,«,Ü,·B fCf[]fW^—fAfvfŠfP[]fVf#f“,ðŽg—p,µ,Ä,¢
,éê‡A,±,ì<@"\,É,æ,Á,ÄfCf[]fW (žÊ^,É,Ç) ,ðf,fjf^,É•ž;:,·,é,Æ,«,ìfjf‰o[,ð,³,ç,É³Šm,ÉÅŒ» ,·,é,±
,Æ,ª,Â,«,Ü,·B
,Ü,½ÅA'½,,ì 3D fAfNfZf‰fŒ[]fefbfh fQ[]f€,ÅÅA•ž;:,ªÂ,·,¬,ÄfvfŒfC,Â,«,È,¢,±,Æ,ª, ,è,Ü,·B
,·,x,Ä,ìf`ffff"flf<,Ä,ì"™ ,É-¾,é,³,âfKf"f} 'I,ðå,°,é,ìA•ž;:,ª-¾,é,,È,èfvfŒfC,µ,â,·,È,è,Ü,·B

,Â,Ü,Ý,ðŽg—p,µ,Ä¤A'²¤®,·,éƒjƒ‰¤[f`ffff“ƒ|ƒ<,ð'l'ð,µ,Ü,·¤B¤Ô¤A—î¤A¤Â,)f`ffff“ƒ|ƒ<,ðŒÂ•Ê,É'²¤®,µ,½,è¤A3¤F,ð“-Žž,É'²¤®,Å,«,Ü,·¤B

fjfo%o[<È]ü,ðfOf%oftfbfN•\Ž!,μ,½,à,ìBfRf“fgf%ofXfg]A-¾,é,³Afkf“f},ð'²]®,·é,AE]A,±
,í<È]ü,²fŠfAf<f^fCf€,Å•í‰»»,μ,Ü,·]B

,±,íflfvfVff“,ð'l'd,·,é,AE[]Windows ,ºÄ<N“®,µ,½,AE,«,É,±,±,ÅÝ'è,µ,½ff
‰[‘²®,”ž©”I,É•œŒ³,³,ê,Ü,·B

**f[]f,: fRf“fsf...[]f^,äflfbfgf[]fN,Å“®ì,µ,Ä,ç,éê#Af]f‰[,³,²®,,³,ê,é,í Windows
,ÉfOflf“,µ,½Œä,Å,·B**

•Ü'¶,µ,½ƒƒ‰Œ[,ƒƒXƒ^ƒ€ŒÝ'èƒŠƒXfgŒB,±,ƒŠƒXfg,©,çŒ€-Ú,ð'l'ð,·,é,ÆŒAŒÝ'è,²•\Ž!,³,ê,Ü,·ŒB

Œ>ÙÙ,ìfjf‰Ù[ÙÙÙ'è,ðfjfXf^f€ÙÙÙ'è,Æ,µ,Ä•Ù'¶,µ,Ü,·ÙB•Ù'¶,µ,%ÙÙÙ'è,íÙÙÙ'è,ìfjfXf^f€ÙÙÙ'èfÙÙÙfg,É'Ç
‰ÙÙ,³,ê,Ü,·ÙB

fŠfXfg,ÀŒ»]Ý'l'ð,³,ê,Ä,¢,éfjf‰o[l,]fjfXf^f€]Ý'è,ð]íœ,μ,Ü,·]B

,·,×,Ä,]f]f%o□[’l,ðfn□[fhfEfFfA□o%o×Žž,ì□Ý’è,É-ß,μ,Ü,·□B

f,fjf^ f^fCf~f“fO f.[]fh,ð'l'ð,μ,Ü,·[]B

□uŽ©“@CEYloLv,Å,í[]AWindows ,³f,fjf^ ,©,ç“K[]Ø,Èf^fCf~f“fO[]•ñ,ð'¼Úžó[]M,μ,Ü,·[]B,±,ê,²[]%oŠú[]Y’è,Æ,È,Á,Ä,¢,Ü,·[]BCEÄ,¢CE^ ,if,fjf^ ,Å,í[]A,±,ì<@”\,³fTf|[]fg,³,ê,Ä,¢,È,¢,±,Æ,³, ,è,Ü,·,ì,Å,²’[]Ó,,³/4,³,¢[]B

□u^ê”Èf^fCf~f“fO•už@[]v ,Ü,½,í[]uGTF[]v,í[]A[]V,μ,¢fn[]fhfEfFfA,ì'å•”•³,Åžg—p,³,ê,Ä,¢,é<Kši,Å,·[]B

□u“Æ—sf,fjf^ f^fCf~f“fO[]v ,Ü,½,í[]uDMDT[]v,í[]A^ê•”,ìfn[]fhfEfFfA,Åžg—p,³,ê,Ä,¢,éCEÄ,¢<Kši,Å,·[]B,²žg—p,ìfn[]fhfEfFfA,Å DMT ,³,ê,Ä,¢,é[]ê[],í[]A,±,ìflfvfVf[]f“,ð—LCEø,É,μ,Ä,-,³/4,³,¢[]B

,±,íflfvfVff„,ð'l'ð,µ,ÄÅAfhf%ofoCfo,É,æ,éfjflf,íflffffbfVf...,ð-³Œø,É,µ,Ü,·B
"Á'è,ífAfvfŠfPflfVff„,ížÀs't,ÉÅAf}fEfX fjlflf,³í,É•\ž;,³,ê,È,©,Á,½,è•\ž;,³—,ê,½éø#Afjlflf
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fjjf...[],©,ç'l'ð,μ,Ä,·,î,â,“K—p,³,¹,é,±,Æ,ª,Å,«,Ü,·B,Ü,½,±,ìfjjf...[],É,íA‰oŠúÝ'è,É-ß,·€-Ú,â
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TV o—í,ÀŒ»ÝŽg—p,³,ê,Ä,¢,éŒ`Ž®,Æ'n^æ,ìÝ'e,ðŽ!,µ,Ü,·B

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