

F]WX hYf]b '[YbY\a][h'Hfi a dg'i a ghf]hhYbY 5VgWX]YVi b[Yb']a '?f]Y[g[YgYhn'

9]bY'F]W\hYf]b']b'DYbbgm\j Ub]U'[YbY\a][h'Hfi a dg 5VgW]YVi b[Yb'a i ha U\simeq\]W\Yf'; Ub[a]h[\]YXYf'dYf'5\]Yb 9bYa]Yg'5\W''



DYbbgmj Ub]UžI G5 !:9]bYF]WkhYf]b']a 'I G!6i bXYgghUUh
DYbbgmj Ub]U`\Uh'_Øfn`]Wk 'X]Y '5VgWk]YVi b['a i ha U»`]WkYf
Ui g`ÀbX]gWkYf'? UfhY``a]h[`]YXYf'Ui Z'XYf'; fi bX`U[Y'XYg' 5`]Yb
9bYa]Yg'5Wh 'j cb'%+-, '[YbY\a][h"8]YgY'9bhgWkY]Xi b['j cb
F]WkhYf]b'GhYd\Ub]Y'<U]bYgžX]Y'j cb'I G!DfÀg]XYbh'8cbU`X'Hfi a d
YfbUbbh'k i fXYžYf`Ui Vh'XYf'I G!FY[]Yfi b[ž'5VgWk]YVi b[Yb'c\bY
fY[i `ÀfYg'J YfZU\fYb'Xi fWkni ZØ\fYb"8]Y'6Y\OfXYb'a ØggYb
YXcWk 'X]Y'VYhfcZZYbYb'A][fUbhYb'a]bXYghYbg'&%'HU[Y']a 'JcfUi g
]bZcfa]YfYb'i bX']\bYb'X]Y'A O[`]Wk_Y]h'[YVYbž'[Y[Yb'X]Y
5VgWk]YVi b['ni 'dfchYgh]YfYb''@Ui h'A Yf_i f']gh'X]Yg'XUg'YfghY
I fhY]`ž'XUg'X]Y'JYfk YbXi b['XYg'?f]Y[g[YgYhnYg'ZØf
5VgWk]YVi b[Yb'i bhYf'Hfi a d'[YbY\a][h"'Ni j cf'\UhhYb'UbXYfY
F]WkhYf'gc'WkY'5bhfÀ[Y'UV[Y'Y\bh"

8 Yf: U``'VYhf]ZZh'Y]bYb'j YbYnc`Ub]gWXYb'A][fUbhYb']b

DYbbgmj Ub]Už'XYggYb'5VgWX]YVi b['j cb'XYf'I G!FY[]Yfi b[
[YZcfXYfh'k]fX"'8]YgY'\UhhY'X]Y'j YbYnc`Ub]gWXY'8fc[YbVUbXY

HfYb'XY'5fU[i U'U`g'Ui g`ÀbX]gWXY'HYffcfcf[Ub]gUh]cb'Y]b[Yghi Zh
i bX'Uf[i a Ybh]Yfhž'XUgg'g]Y']ffY[i `ÀfY'?f]Y[gZØ\fi b['[Y[Yb'XUg
I G!HYff]hcf]i a 'Ui gØVY"'6YfY]hg'ni j cf'k UfYb'a i ha U»`]WXY

A]h[`]YXYf'X]YgYf'6UbXY']b'XUg'< cWXg]WXYf\Y]hg[YZÀb[b]g'7YWch
]b'9`'GU'j UXcf'UV[YgWXcVYb'k cfXYb"

$FYWAh^*WY'<]bhYf[fØbXY'ibX'bYiY$ 9bhk] $W_ib[Yb$

K]Y '5 D 'B Yk g 'VYf]W hY hž '\ Uh'XYf'C VYfghY'; Yf]W hg\cZXYf'I G5 XYf'Hfi a d!5Xa]b]ghfUh]cb'X]Y 'Bi hni b['XYg'5`]Yb'9bYa]Yg'5Wh Yf`Ui Vhži a 'j YbYnc`Ub]gW Y 'A][fUbhYbž'X]Y 'U`g'; Ub[a]h[`]YXYf VYgW i `X][h'k YfXYbž'UVni gW]YVYb"'8]YgY'9bhgW Y]Xi b['VYYbXYh Y]bY'j cfØVYf[Y\YbXY'5i ggYhni b['XYf'5VgW]YVi b[Ybž'X]Y'ni j cf j cb'Y]bYa '6i bXYgf]W hYf'Ub[YcfXbYh'k i fXY"

8]Y'F]W\hYf'VYgh\h][hYbz'XUgg'j YbYnc`Ub]gW\Y'A][fUbhYbz'X]Y'U`g; Ub[a]h[`]YXYf'VYnY]W\bYh'k YfXYbz'XUg'FYW\h'\UVYb'a ØggYbz' [Y[Yb']\fY'5VgW\]YVi b[gVYZY\`Y'fYW\h`]W\'j cfni [Y\Ybz'k cVY] X]Y'J YfZUggi b[ga \hat{\alpha}\righta][_Y]h'XYg'; YgYhnYg']b'XYf'9bhgW\Y]Xi b[i bYfk \hat{\alpha}\bh'V`]YV''8]Y'Hfi a d!5Xa]b]ghfUh]cb'VYhfUW\hYh'X]Y'; Ub[U`g'Y]bY'Y]bXf]b[YbXY'?fUZhz'k Ug'Xi fW\'X]Y'VYfY]hg'YfZc`[hYb5VgW\]YVi b[Yb'j cb'ØVYf'%' \$'A\hat{\alpha}\bYfbz'X]Y'XYa'HfYb'XY'5fU[i Uni [YgW\f]YVYb'k YfXYbz'j YfXYi h`]W\h'k]fX''

?cbhfcj YfgYb i bX FYU_h]cbYb

8]Y'G]hi Uh]cb'YffY[h'gck c\`'dc`]h]gW\Yg'U'g'Ui W\'ÒZZYbh`]W\Yg

\deltahYfYggY"'5bk \(\alpha\)hY'XYf'5a Yf]WUb'7]j]\'@\VYfh]Yg'I b]cb'fb7@ \(\bar{V}\) \(\alpha\) \

a]ggVfUi W\Yž'XUg'i fgdfØb[`]W\'ZØf'Yf_`ÀfhY'?f]Y[Y'_cbn]d]Yfh k i fXYž'i bX'9]bk UbXYfi b[ggW\i hnfYW\hY'i a [Y\Y"

8cbU`X`Hfi a d`i bX`gY]bY`JYfVØbXYhYb`\UVYb`a Y\fZUW\`VYhcbhž
XUgg`X]Y`I G5`Y]bYf` \(\phi\) Ug]cb \(\circ\)\`Y[\U`Yf`9]bk\UbXYfYf

[Y[YbØVYfghY\Ybž'k\Ug`Xi\fW\`[Ygh]Y[YbY`:\YghbU\a\Yb`Ub`XYf`I\G!
;\fYbnY`ni\`A\YI\]_c`i\bhYfghf]W\Yb`k\]fX"\8]YgY`ØVYfgh]Y[\Yb`]b`XYb
`YhnhYb`nk\Y]`\\J\fYb`Yk\Y]`g`&`A\]``]cbYb`dfc`\\J\f"`Hfi\a\d\VYnY]W\\bYhY`UW\h``UhY]bUa\Yf]_Ub]gW\Y`_f]a\]bY``Y`;\fi\ddYb\Z\Y]bgW\`]Y\rightarrow`]W\\ThYb`XY\5fU[i\U`i\bX`A\G!%'\Z`U`g`\Ui\g`\AbX]gW\Y\HYffcfcf[\Ub]gUh]cbYb\"

 $8]Y : 57@ gck]Y : X]Y : Cf[Ub]gUh]cb : 8 YacWfUWm: cfk UfX : VUhhYb Y]bY : ? `U[Y : [Y [Yb : Hfi a d : Y]b [YfY]Wk hži a : ZØbZ : j YbYnc `Ub]gWk YA ÅbbYf : j cf : XYf : 5 VgWk]Y Vi b [: ni : gWk ØhnYb ": 9]b : I G!6Yn]f_gf]Wk hYf V `c W_]YfhY : XUfUi Z \]b : X]Y : 8 YdcfhUh]cbYbž : k Ug : ni : Y]bYa : gcZcfh][Yb6Yfi Zi b [gj YfZU \ fYb : XYg : \(\delta \) gh]na]b]ghYf]i a g : ZØ \ fhY ": 6 Yc VUWk hYf g]bX : g]Wk : YXc Wk : i bY]b][: ØVYf : X]Y : 5 i gk]f_i b [Yb : XYf : U_hi Y : Ybi fhY] ``]Wk Yb : 9 bhk]W_`i b [Yb : i bX : XYfYb : ni _ØbZh][Y : fYWk h`]Wk Y a d`]_Uh]cbYb"$

8 YhU]`g	
J c f ZU``	HYffcf]ga i g
Cfh	DYbbgmj Ub]Uži G5
: YghbU\a Yb	%' \$
EiY``Yb	• k k k "a Yf_i f"XY
	• UdbYk g"Wca

6 Ygi WX Yb 'G]Y 'i bg 'Ui Z 'b!U["XY