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!

"##\$%&'(%)*!+, %-.\$%*. /!

##\$%&'()*+,-./0.12!3!45!*+!5(2!,"!)6!78.-.!(.-!9!-.:0&-./!/*'0; .+),<. ; (&%(10)!=*6!
>!?!1.%* @A!)*)!8.!B*+*-,!C&-.')*!-(weiskott@bc.edu). F.:0&-./!/*'0; .+),!&+'%0/.G!!

"6 #+!'##\$%&'(%)*!0)12H!&+'%0/&+I!(!%,)!*J!-.%D(+)!K+I%,8!'*0-,.,6!

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>6 #!\$. ((. !!)0!/, ##)1(!0)2!3), !!#1)/#. &(%4.!'-4%/)1H!. ; (&% /!,. \$(-(). %2!12!2*0-!
(/D&,*-!)!)*8.!B*+*-,!4-*1-(; !C&-.')*!-6!78&,%)).-!,8*0%!/; (L.!'%(-!)8()!2*0-!
\$-*,\$.')&D.!(/D&,*-!L+* @,!(+!/\$\$-*D.,!2*0-!\$(+!,J*-)8.!\$-*\$*,./!)8.,&H!(+!
(I-. .,!)*)!0\$. -D&, !&)6!!

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M6 #!#1)/#. &(, /!*J!>NM!\$(1.,6!78.!\$-*,\$.')0,!&!(!-*(/N; (\$!*J!2*0-!\$-*0.')H!@8.)8.-!
'-&)'(%*-'-.)&D.6!P!)*8.!\$-*0.')!&,!'-&)'(%H!)8.!\$-*,\$.')0,!; (2!,0!1.,!)&!)8.*-.)&'(%
(\$\$-*('86P)!8*0%/'%(-%2!),() !@8()!.Q),!2*0!@888)(L.!0\$H!(+/!)!@8()!. +/6!
RO-)8.-H!&!)8*0%!/; (L.!'%(-!@8()!L&+/? ,A!*J!\$-.\$(-)8*+!2*0!8(D.H!.&.)8.-!&+!2*0-!
'*0-,.@*-L!*-!1.2*+/H!)!0+/-.) (L.!)*8.!\$-*0.')6!B.-. !&,!(+!.Q(; \$%!*J!)8.!-&)'(%
\$-\$,\$.')0.6!

#!'-.)&D.!\$-*,\$.')0,!(%*!%(2!*0!)8.!, '*\$.*!J!)8.!\$-*0.')H!(,!@. %H(, !&),!\$-*\$*,./!
J*-,; 6!5(+2!@-&).-,!%L.!*)!,)(-!)8.!\$-*,\$.')&D.!@8)8!(!\$(-(1-(\$8!*-!)@*!@-&)).+!&+!
(!,'.+.!J-*;)8.!&; (I&+./!+*D.%(+!
&+)-*/0')*-2!\$(-(1-(\$8!*J!)8.!\$-*\$*,./!; .; *&-6!F.' .+)\$-\$*\$*(% !&+!\$*-)2H!J&)'&+H!
(+!/'-.)&D.!+*+J&)'&+6!!

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S6 " *!' **)'((-!1.'-%*5!\$/6!
78.!+0; 1.-!*J!(-)&'%,!(+!/+1**L,!@888D(-2!(+!/,8*0%/!1.!@*-L./!*0)!@8)8!2*0-!
(/D&,*-H!10)!8*0%!/!&D.!)8.!* ; &)).!(!,.+.!.!J!2*0-!\$-\$*\$*,./!-. .,(-'86!5(L.!
'%(-!@8&'8!@*-L,!2*0!8(D.!(%.(/2!-. (/H!(+!/@8&'8!2*0!\$%(+)*!-. (/6!T-.)&D.!
@-&).-,!8*0%!/&+'%0/.)!%) (,)!>1**L,!(//-. ,&+!!'-(J)!(+U*-!)8.!-D&, &*+!\$-*'. ,.,6!
V-&).-,!*J).+!&+'%0/.,.D.-(%1**L,!)8()!8(D.!1..+!&+,\$&-&+!!*-!&+J%0.+)(%&+!)8.&-!
@-&)&+!|\$-\$*'. ,.,6!!

P+!(//&)&*+!)*)8.!(0)8*-(+!/)8)%H!1.!,0-.!)*)&+'%0/.!>NM!,.+. +'. ,!*J!2*0-!*@+!
'* ; ; .+)(-2!J*-'! ('8!1**LH!'-.)&D.!*-'-&)'(%H!*+!2*0-!(+*+)(./!-. (/&+!I%,)6!V82!
&!)8&,!1**L!*-!(-)&
2*0!)8&+L!2*0!; (2!0., !&)W!P!J!2*0!(%. (/2!L+* @!)8.!@*-L!&+!:0.,)&*+H!8* @!8(, !&!
&+J%0.+./!2*0-!)8&+L&+!W!B.-. !2*0!'(+!J&+!/, *; .!, (; \$%!#++*)(./!-. (/&+!I%,),!J*-'!
1*)8!'&)'(%(+!/'-.)&D.!\$-*0.')6!!

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36 61%(*5!7' 2#\$.!

N"3!\$(1.!-&)'(M\$(\$.-!&!; *,)!8.%\$J0%!P!

)8.! '*; ; &))..!) *!,..!(!@*-L!)8()!/.; *+,-().!(!,0,)(&+./!(-!0; .+)6!V-8)&+! !
,(: \$% ,!(-.!. (/!'(-.J0%2!) *!8.%\$!/.).-; &+.!2*0-!\$-. \$(-)&*+!) *!0+/.-)(L.!(!%+!H!

N"3!\$(1.,!&!-. '*; ; .+/. /6!!

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% "#-0!)0!3), 1!(1' */&1%#(!
X*0-!)-(+, '-&\$)!+.. /,!) *!&+ '%0/.!)8.!+(; .,!*J!' *0-,,!) (L.+!(,!@.%M(,' *0-,,!
+0; 1.-,H!(+/!!-(/.,!J*-1(%M' *0-,,H!&+ '%0/&+!J(%M,.; .,).-!*J!00+&*-12. (-6!78.!
B*+*-,!T*; ; &))..!*'' (&*+(%2!(,L,!((\$%&' (+),!) *!,01; &)!,\$-&+!!!-(/.,6!!

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8%2.\$%*.9!"##\$%&'(%)* /!' 1.!-, .!: ' 3!;/(!<3!!=>: ?!8@.!A)*)1!/B) 2 2%((.!.!1./ .14./!
(@. !1%5@(!*) (!()#1)&. //!' (.!)1!%*&) 2#\$. (.!'##\$%&'(%)* /?!!

##\$%&'(+),!(-. !+*)&J&./!*J!)8.&-!(\$%&')&*+!,)(0,!12!; &/N5(26!#' '\$). /!(\$%&'(+),!-. !&).-!
J*-!K=YZ!99[[6["!/0-&+! !/-*\$N(//!\$. -&* /!&+!)8. !J&-),)!@..L!*J!J(%M,.; .,).-6!!

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