



F9J "	85H9	87B	8F5K -B; HF99
j %	& G9DH&\$%%		

%	&	- % ( ) 5' %\$	BI H%#&!% 'H-F8 'GG	% !, 'GGH@
%&	(	- &% , 5- %	<9L '6C @H%!, 'L ' ) 'GG	% !, 'GGH@
%%	&	- &&%+5) (\$	K 5G<9Fž%#&"-B 'L '%\$'C 8 'GG	% !, 'GGH@
%\$	-	- &% , 5- &(	% !, 'GG<YI ' <X '7 Ud 'GWYk '%!, 'H-FXž) "'@	% !, 'GGH@
-	%	- % ( ) 5\$ ' ,	BI Hž%!, 'H-F8 'GG	% !, 'GGH@
,	&	- ' , ) &5%\$	K 5G<9Fž%'GG	% !, 'GGH@
+	.	!	CA #H8	!!
*	.	!	CA #H8	!!
)	&	8%\$\$%* +*	U@ C ž6G7 'BGH5 @5HC BžGF 99D@5H9	*\$*%H' 5'
(	%	8%\$\$%*% !&	U@ C ž6G7 'BGH5 @5HC B '5FA ž: @5B; 9'ACIBH	*\$*%H' 5'
'	%	8%\$\$%*% !%	U@ C ž6G7 'BGH5 @5HC B '5FA ž: @5B; 9'ACIBH	*\$*%H' 5'
&	&	' \$(H' (\$	9M96C @H%#&!% 'H-F8 '	% !, 'GGH@
%	%	8%\$\$%*% %	U@ C ž6G7 '5FA ž: @5B; 9'6F579	*\$*%5`cm
#PA BC "	E HM	D5FHBI A 69F	89G7 F-@HC B	A 5H9F-5@
D5FHG`@GH				

BCHG5B8 HC @F5B7 9G fl B @GCH: 9FK -G9D97 +98L

8-A 9BGC BG5F9-B 'B7 <9G  
 HC @F5B7 9G  
 "LL" ± "\$%  
 "LLL" ± "\$\$)  
 5B; I @F ± "\$") °

% 'BHFDF9H8F5K -B: 'D9F '5GA 9M( " ) !% - (" &"F9A C J 95 @G<5FD98; 9Gž"\$%)! "\$%) " : C F A 57 <B98 D5FHG'FC I B8 ' 5 @98: 9G5DDFC LA 5H@MF"\$&: C F G<99HA 9H5 @D5FHG' " "8C 'BCHG7 5 @: FCA '8F5K -B: " ("5 @A 57 <B-B: : @ -8GA I GH69: I @MGBH: 9H7 ž: I @MK 5HF' GC @ 6 @5B8: F99C: G @ I FžG @7 CB9ž5B8 '7 <@CFB9'  
 A 5HF-5@ :B-G-  
**B #5**  
 B #5 σjWk

**LIGO** 75@CFB-5-BG#H HPC: H97 <BC@; M  
 A 5GG57 <I G9HG-BG#H HPC: H97 <BC@; M  
 GVB-PA 58J5B798 @ C C  
 G 6 GVB-PA GMG  
 B9LH5GGM

D5FHB5A 9  
 U@ C ž5GGM6G7 '5FA : @5B; 9'ACIBH  
 89Gž B9F G'G-5B?@9 & G9D &\$%\$ G9F 8K; "BC"  
 8F5: H9F G'G-5B?@9 && G9D &\$%\$ 7  
 7 <97?9F G'G-5B?@9 && G9D &\$%\$ 8 %\$\$%\* % + j %  
 5DDFC J 5@ G'G-5B?@9 && G9D &\$%\$ G7 5 @. %%\* DFC >97 HCB. G<99H% C: %