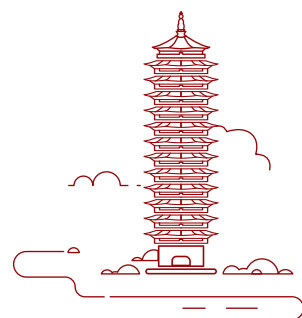


U.P.S.



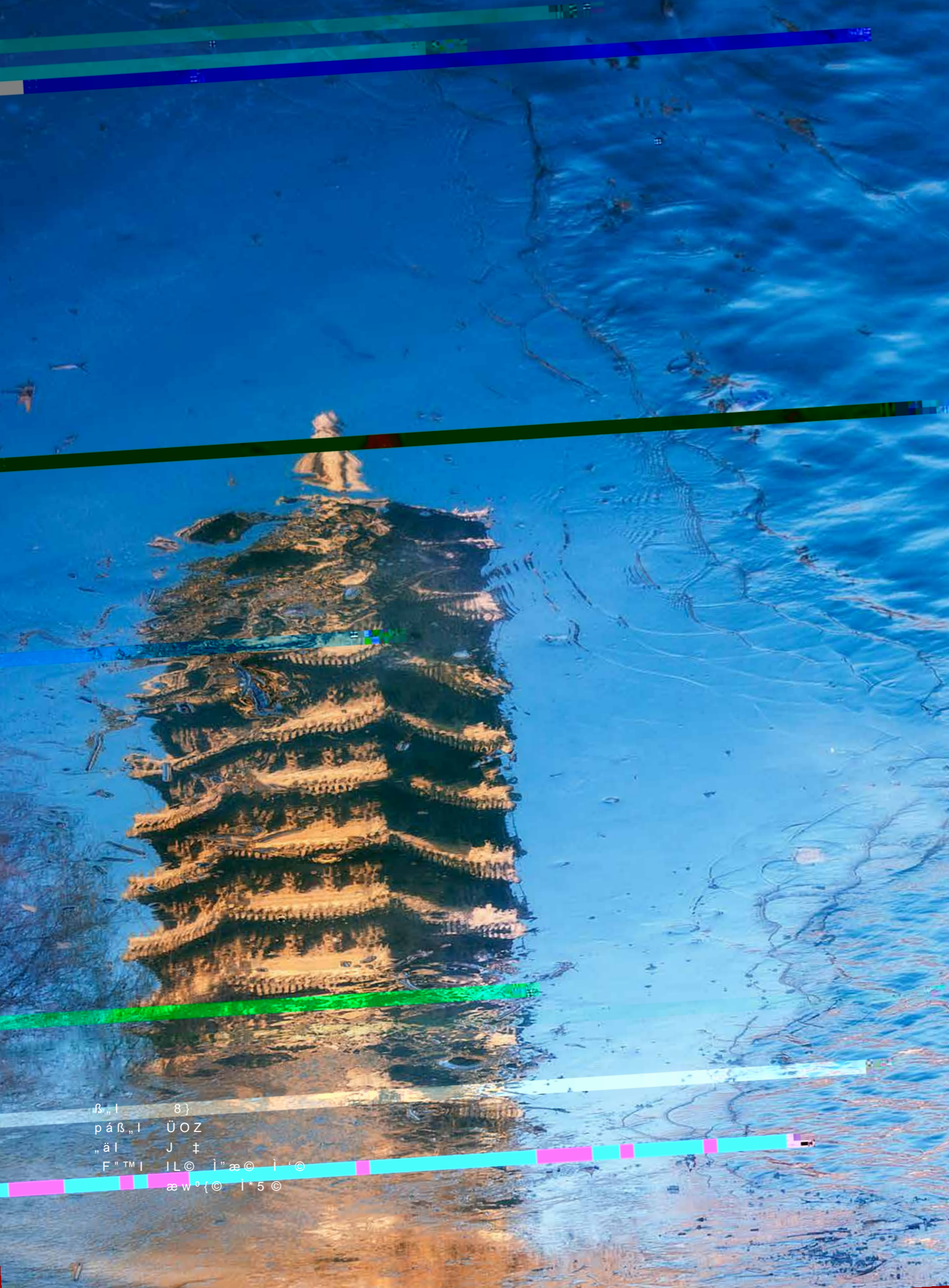
北京大学数学科学学院
School of Mathematical Sciences
Peking University



ANNUAL REPORT

2020

数学科学学院
年度报告



8)
p á B „ l Ü O Z
„ ä l J †
F " T M l l l © i " æ © i ' ©
æ w ° { © l * 5 ©

#•# ÿ Dear Message



Ku T à
•æ ææ Â

ò;J`%O ' ;~ñ < /; ·ò;HCuU@Á.;\ ·Á07;
—òŽ·Q;C ··ów~J ^~8MÍHC000^2xLO;š > æ x...D;
J- p o½7c ½8±§;j?šñX °{xácÀX G[0
·ò;HC áÍCg+æw,~ñÄ É ñF;š]· ÑÍ;ÑŕPª
Oßg;^%Q ·æ! k8i\íæ JŠĀ0§L{;š~ñù ó56»%;R
ø*·ié% ;´* 3½·óì3½-·ì3½gw-ì3½o ì3½ 'É.ŽJ
Š°{ (- áí
ò;JgÚ~ñ8æ;HC/%] æ %z;3Š°{ Ø8 YÍŽ L
{µg; %;x@·æxwšÖ 8æGaJHCÁ@µ!O(Y4µñL{'Cì4OS
!fò)—4 Úæ7 7ÍŽ/L{µg;HCÁ·æp%.7ÿ *G€·Q;Š!f
%ª—ò)50ŽµgY(gwJp·æ#% yÿ"2ŠØB O ò·S "2Š
€eó·V*G[íp"· c_ w~õ †ò rI~š R'gXÿŽØ6æ73~
÷ Š†Á kOfááíáíCG[µilù' \í
·ò;!fò)µg>ó@;@e ;Ç^'šÍHCGa !·æ"æ'CxwJ8
(Ø8·æª9!fò)"æ'gXJ d Ž ^xæ;GapØ8·æQ,!fò)ó
ÿJª9's C ò Á {; 53i'½íë{pBó'sÿæw æí
ò;HC ·B)~ó;g+~ñ;š k^"Qö.1° u£Bz)-t í
HC æwšJÝæ d?xG[µiJ PØ8·æ!°·„ S xĀĀ /·æd?
8Rí3o \$ PÚĀā·æ8R íí
·ò;HCY^ f^'°°{íá<„óš~ñù Ž3µg'Ù Ø6{y;'
} JŠ°{ ñ7& áí B %„.Ā~°;· ò %Kù°;èQ
è ^5÷2ç(áéí
ò Øā2 p; «}ÚĀQĀÔ fšxMH' Ky½·m šÚ'uí
hHCš' ·ò .nšOw;÷ HC É_òª;Niá7± í

8}
ò % Æ

A c Contents

•“p “K• j Ó Ò w
Annual Report
School of Mathematical
Sciences

2020

01

>®K(->õ
Highlights

06

02

9 ð E*Ø
Tackle COVID-19
Together

14

03

“.p '@ë
Academic
Affairs

18

04

ç z & ”
Education

24

05

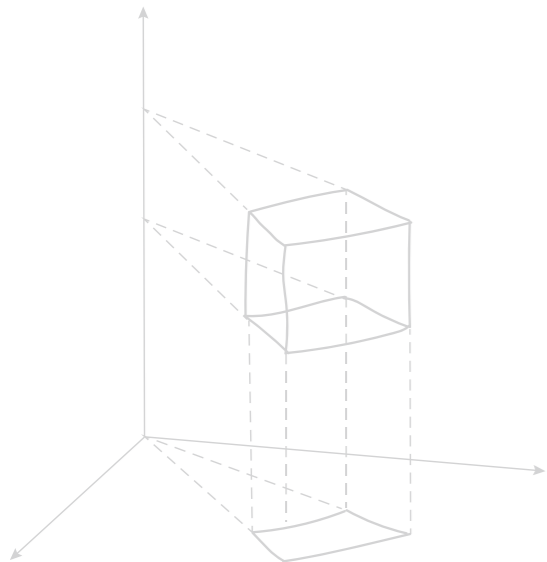
.p-A ‰
Research

34

06

BM³ \ ¾
Supports

44



01

Annual Report School of Mathematical Sciences 2020

Annual Report
School of Mathematical
Sciences

2020

Z ñ • " Z ð = /ø
• L • Õ E * Ø ò LK! † " .p - A %oo
.p - A = É Ö È .p " Á * Ø
• " ÷ £ Á * U † 5B F Fú %æ È Ö ' Ñ Ö
† 5B F @ ñ]
" .p @ ñ] %oo
™ ž • " † " - A / £ Z ð = /ø
- D T • " C ç z & " † " - A @ Õ G
\$ © 4 [/ 8 Õ
M 4 8 • 8 ä • * u E %oo 52 / \$
E 8 8 ä 0 Y n š w Z * L • j .p - f
M ' € E 6 4 » * G ; Á * U • " " G G
æ € E 6 g Ÿ - w •) 3 4 @ Ì " G) 3 , G = ...
\\ 7 8 ä j Ku 6 Ç L • j .p " f
(™ ' E 6 j Ö * ä • L • j .p "
' F b B q Ö ; ,
(Ì N Æ B L B P + ± A + 8 Û / 3 ' - m ' E 6
N Ä ! * ä 3 Ö - " n Y .p A + 8
{ 8 8 • 8 ä D Û / P 0 v " N † " : 5 f
" * L ° N Ö 8 ä j Ö - P 8 • 7 ¶

x © • æ x w G a

g ñ 0 Ì " æ ' 0 {



' G g ° § æ ^ -





p • æ # % y ÿ ”
* ” 2 Š € e

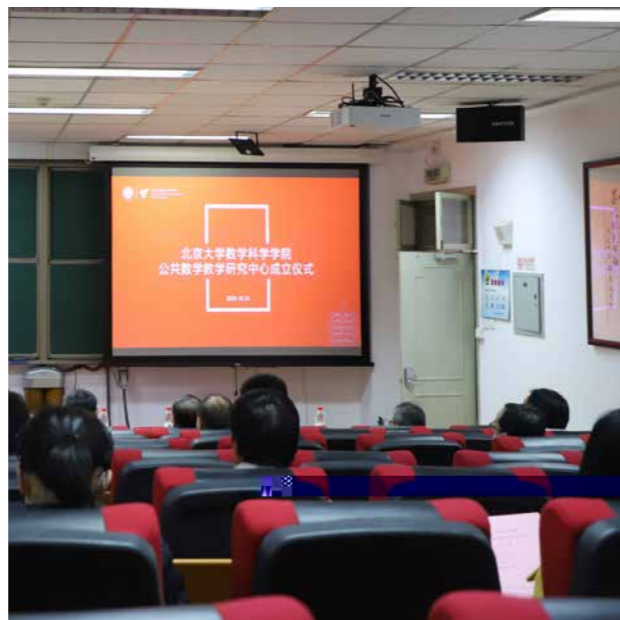
ò % ; ” 2 Š • ' Y
" æ — è " 2 Š Ø B € e °
Š , ; , · Ñ Î Ú , J - ; Ü — 1 " Š Ā
g Ū 1 G [ì - u B Ì N G F " í
á © ; % Æ ; " 2 Š Ø B
¤ æ # ; æ C š ' C μ ñ /
æ ' Y Á ! f ò) ì (Š Ā á © 1 2
• € V í

æ € e ° {

ò % ; ” 2 Š æ o Á '
Ā æ € e y ° { í æ G a — . 5
O † 7 Ÿ 1 ; ú — • ö F " í
Đ Ô · æ € e • ö — í Ú F " R

!•æ"æ'CxwGa

p · f « B æ + £ J Ā Ē • æ " 2 f Ç § ; " ä
! • æ · " æ ú ; š æ £ " - š 8 § f Ç % ; æ + £
! • æ · á ^ i ; ó ò % Æ d 0 G a !
• æ " æ ' C x w ; " ! • æ · " æ ' C ; R ç é % J Š
1 " í · S ž J B J ; x w G € & a x i 5 Q ù l P † ì
A f ? í æ 8 ; 8 (Đ S ! • æ · . % z " í ' g X ; ! O
g w ! • æ · . . " Ÿ 5 Š ì 2 ì æ © μ 0 Ž 1 " í
- ò ò ; æ C † J æ % ' ; m M J » ;
2 · - N — ² B 1 G L ; z f , R · • æ Ý ó © ·
· - N í O Ñ %] { — ; á - μ μ ; ø á ø " ì Ā ² V Ñ
1 " 7 . ; š R · ó © ½ » ² ä ; % V ; B ì Ç ^ " 4 " æ
Ú í , ' g T £ (z • æ Ý ! ó © · 4 Ž • æ " # ì \$ % ;
3 - = • " ì # ì \$ % — R " ì # í ò ä æ 0 !
& P " Í L ' (z Ā ! • æ · í



B ¾ › ° . ˉ °

ò % z ; æ • | B 2 ò % ç ò
(° ; % Æ G a '] @ 1 ° { 8 ; Ü O Z ž Ā ž J 8
Ā í] ° { 8 8 ; 3 S 3 ½ ì 3 % X I ; g w J © ° y ;
, % μ í % Æ ; B ¾ › ° . d
0 - ° í æ Á æ £ ó % Š ì z ` C ì # 1 C ì % " C
% Æ () ^ † 8 (% › ° . # 1 " X ; f) " ° . ì
° . Ú # ÷ È ¥ Ž ° { ½ ' í X % Á z ` μ ì % " μ ä 0 ;
Ā] T / ì z ` ; , c / ì # Ā T " 0 J á ^ J % " ì %
F " ¶ ; È ¢ % ' ; \$ Q , c 0 " ¢ Ú í , ' B ¾ › °
° . Y (~ ; % 1 : / ' Ç ; • ` ò % Æ g ° ;
% z † Ž y í



8Yñf• Ž °{è&B

ò % Æ½á;
8XšÖ !ÿ8Xö Øááí

x!x=|Ž- ëU
Ž °{è;Ö !& ! *ëUíH
Ž °{èÿ&Bí

8Yñ JÒ 8æ•æ ææ
xwžßJí•æ#% y"2ŠØ
wßJí"JÒ 8æ•æ ææ
æ %z—´.=•æª9!fò){c



8ñjG%¿Ž°ÊÁ y•ææXX#



...µG%Ð´.S•1R`æX1 XG€

v*¶„,á SxŽ_ò •R

ò % Æ;šFÈŽ· Ç•_ò æ•X
(ë0½; ¶' „,á SxŽ_ò •R;H v*¶"
ÿ•ÿRŠÍ

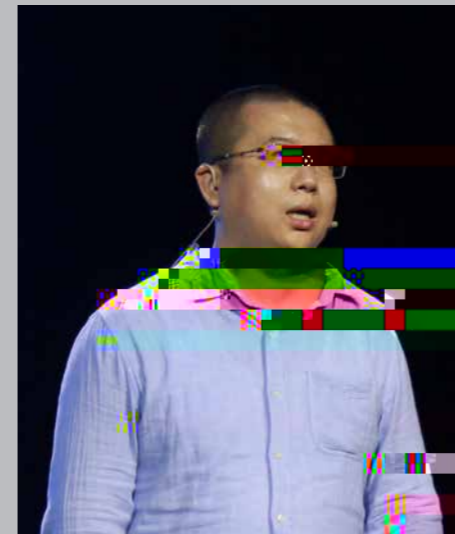
v*¶ JÒ 8æð6² "ÿ;çŽ Uc_ò æó
Û•jèí5 ß6'C—ëç«7WuÁ=••w;š Q Q
l1wì Q -öN0Á Q - (-)—ŽµT)j · uØ
6Gg;ç1"—ë Ž —9_ò•æ í

xŽ_ò •Rçš æèl8 Žá·Û æ "l¼
òza Æx=8;Šì ŠkŽ é!O8; ·;
çxŽ ••gT_ò æ ?•RŠÍ

Ö8R` æxw [ž"ÿ÷"žJe -í

"i÷• ò J _ò æR

ò % Æ;xŽ æ È ò J _ò æR•R!;
H "i÷"ÿ,%š3-+x B(-ī —1"È¥ MEëGpÿRŠ
o•Rèè.í"i÷Á†Tō #L{y - µ ME &\$Ve` - #©
È¥;%a &\$Ve` - #© 1;?# ' %Áu3ÀOÈ¥ ó
?MEJME Ž æ # %FNBJMMZ "c p c p ç 1GÁ;# ÿ
" òÖ1 O B(-ī ; ç3-+Á-Wu'Y ·Ök™È¥;Á6
•æ šÛ ÿī Ga%j,· Ø6GgJME %FNBJMMZ Á¿Ž æ
#,PMMhS "c ·Öī #+POTTPO .VTUBUBī ŽÈ¥í J æR—
J _ò æRç€ J æRóÛXza ;^Ðò€%.S;šlx
æš8;€ ;l;z¶ ÔRŠ;È°•1 æRìÑæ æRìw' æ
Rì;/ æRì.ì•7 æR—•7 æRí J _ò æRÉšRµs
xŽØaâcØ6 y- æ•7Gg ì g?% _ò •!í

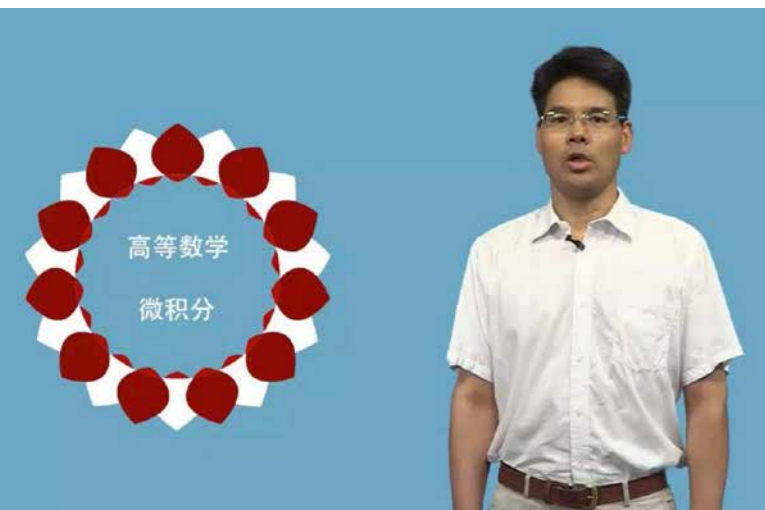


ò Ž U c _ ò æ
ó Ũ + ° P í

H - "ÿ, ' Š, p d 3 - I b Á r I W u ÿ %
ò Ž U c _ ò æ ó Ũ + ° Š, í - B 6 ' C í W u
x d 3 - » • R † 0 % K - r I W u x Ç > j 3 È ¥ í
š » • R ' C x ; í Ø K Á ! L { I • } Ú G O K
Ñ ; J u 3 ° x a T g ½ · Ũ š ° 6 O Ô Ç ² ; +
O ñ N M E » · I b x · Ô ' - ò - J B Q V O P W
Ñ 0 Á 0 í í š Ç > j 3 µ g ; } Ũ š · H F O F S J D N H
¾ " O P T P W š ò * \$. ½ " c · Ô í í 1 " ' C G
g ' è š % V L F . B U I + " E W . B U I + & V S
% J G G F S F O U J B M (F P N ; \$ B M D 7 B S 1 B S U J B
Ž Ž Ā P • æ > f ½ í



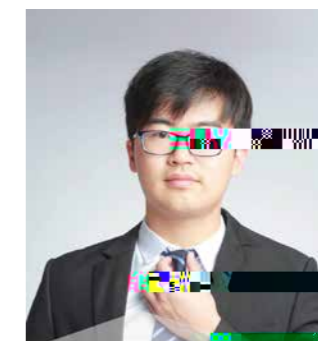
D * f • Ò Ê 4 Ž æ £ " æ P Í R



; î . . p r % l ó @ ÿ %
ë { Ž . 7 5 . .
ò % ; " 2 Š Ē ē { Ž . 7 5 . . c G
g ; H ; î " ÿ . . p r % l ó @ ÿ % % x í
; î Ā š æ p " x ò ; Ā 0 ž J • æ ó @ . . " æ
° { í 5 · ö w - N ö l † 9 c l ? ä • ; + 8 æ p ò
æ w æ ^ • æ ó @ · Q , " { y í - ; 5 ^ ò (z Ð Ā p 3
r % l ÿ - p r % l ó @ ÿ p # · ÿ 3 ½ (· ; Ç Ò 8 •
æ æ \$ Ê () i ó · 0 ² Ç a 3 ½ . . ! í

æ w 3 S ° • ò \$ 4 f X

H 5 w > ; f • Ò 8 æ p æ w e ~ R f ÿ ;
ÿ R Š ^ Ð ò € % · S ; Ç Ò 8 æ w \$ 4 f X í á ò í ; H æ
Ō ^ • Ÿ Š 8 R í
5 w J · ³ f • ò p Ò 8 æ æ w ò !
- ÿ ; æ æ w ^ ò f • Ÿ R Š í



Daa %



P U J O

02

9 ð E*Ø Tackle COVID-19 Together

•“p “K• j Ó Ò w
Annual Report
School of Mathematical
Sciences

2020

‡ 1è ðF 4YU' € *Ø ðK_ ÔKh (E
Å T U3i T) p ÈU' • È KÉ † “p-A
K_Ø: Í - M4-U' • L>³, Å ç ð
KL Ñ7W ‡M 6 ¼U'0-•K_ ÔJ /Ei i



, òwŠ ; j ^ ñ ù p dM

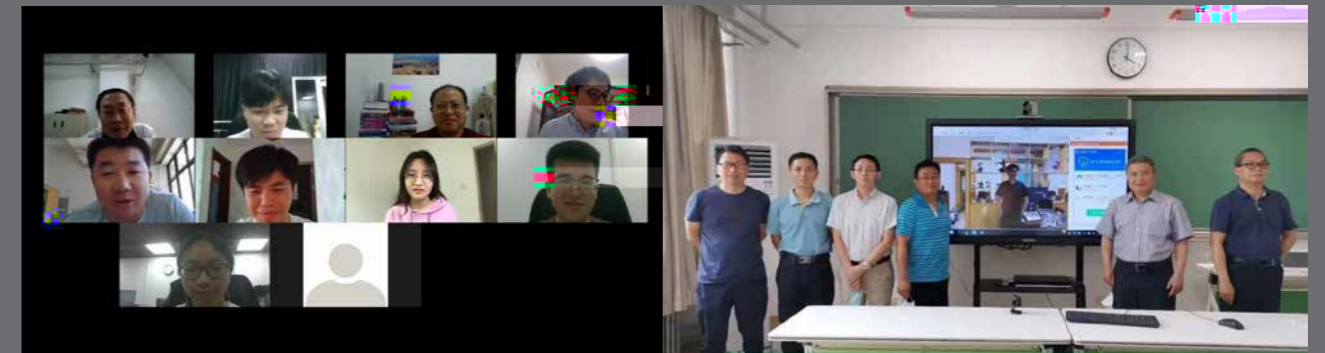
p 8š3ÿ 'š; § ' * " æ '

æ 0ÿp 8š3ÿá ; § ' * ñ 0Í "æ ' dâ á ; > d p # 0 Å ä " ; # 0 Å ä æ ; # 0 Å ä ' ÿ Å²
! (ò) ' 50Í

U3i † " æL•U' ò ä ä æ 0! (z Å 3 ½ . ; ! & 3! S æ w Å 3 ½ " æ 3 - í æ ÿ - " í C
) J ' 2! %] 7 í 1 " í 8 ? (; ' * . ' 0 ½ 3 ; ^ % Q k 8! í

U3i . p-A æL•U' " í 0ÿ « ð w l : ± í Ñ « É . ; ' * 3 ½ æ 7 X í 3 ½ o í 3 ½ ' É . í 3 ½ ; j í 3 ½
w j É . Ž J Š ° { (- á í

U3i 0 • D Ò æL•U' ! ' x P S C E È ' C w « š 3 • ó ó • j æ o í o æ á í i o E 1 Å ? # x o • ó
ú 0ÿ k . Å • ó ; p C E È w (- C E È ' • É í

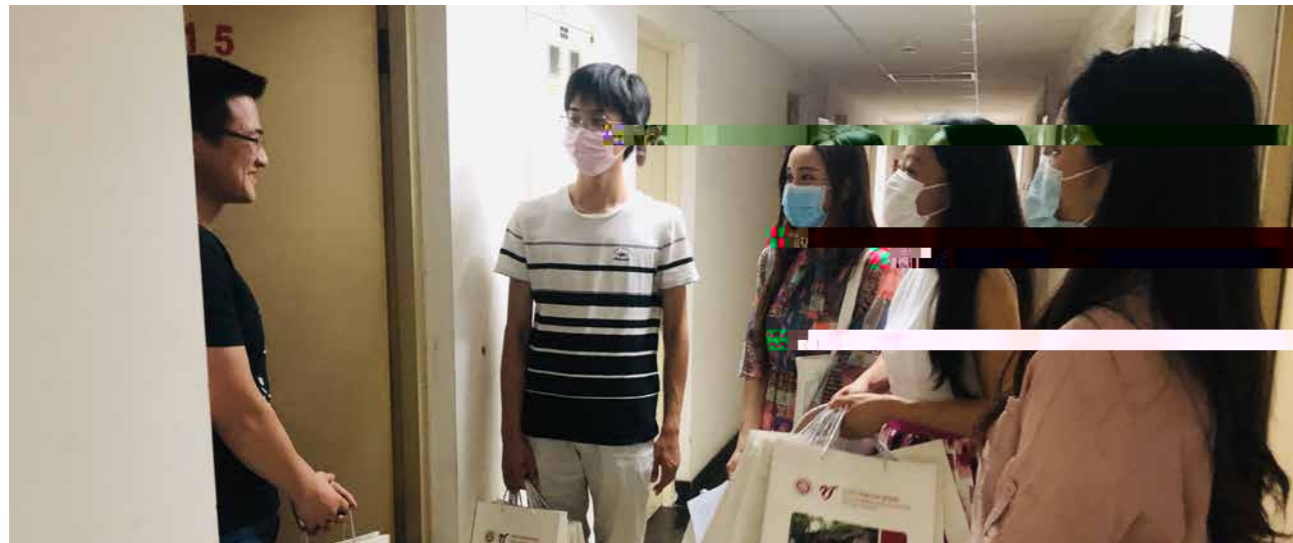


U3i * L æL•U' š , ' C w * w æ * + - í ñ - æ - ' % È r² Ç - N ñ N - Ñ « © 1 w Ô) š 3 , ° í
š 3 © ' P F - í š 3 - Ž N 0 (- ù G ð ' C w * w - ° (í ò l ' 8 ; ð 3 ½ - ° ; Å - • æ © á í x ! ;
æ w 3! í š - Ô (S ° w x ; \$ < H) P ð # w ; P ° # w í

U3i : í æL•U' p \$ 8 . S 5 , # 0 (æ - £ † 0 Ç © 1 L æ w Ü O J V % ; ' * æ w J Š - _ 5 (- á ; æ
" - æ ° , ó ; - y a † i r . í k H - f - Ž µ 0 3 © % ; ² Ç ä , p 3 - _ 0 j i ' & - " È l . + . Ž Å í - = © ÿ
m ') " Ô æ w J Š - j , # Ñ © 1 - M E í



ù-)~p·8^aÿ g8& !w



g+~ñ;æw°{© ì,,p4% ;%]Š;8;æ .ìæw\$ðŽœ4^%~°{t ;7TËÝ;+TË-;
NGpÙ.€ -βJ - ¼ Ô!ÿ ðN"-áí~ñ•Q 5Ñ/ùG POæ ñF Š;%a·ì< ;
^Æ·+·ËË;V~ 8Šþp M~ýIÄ·Ý;ë+ Pš£æw; \ ¼(È xS;ó8; ÁœÈ'êç,Ž3~J
ë+ Pš'Oæ;+·W ä ìw3ìæÈŽñF; 0 .ñ\; 0'Ž(È+~ x!Sš+ Pš æw;
â^Æâ"È"-;~€ POæ Áf è°{í

Š0J»ä0™K;(Yp• J»;HOØ\ÿ¼';IÿðNBz;é°Oæ) -¶í©1 ~ xH.š+w1*%æw;
Ù1< ;+· POæ;â^~ñ¼w1 .;é°3½w1\$œ... rŽJë+C@^2w;T Pæw 0'Ž(È
-+;é° Pæw,°ÚÑ^2ê°;3½(Y -{Jë+¶š 1æw|j <'æwGaÄŠ°{8; ù•+;+·
"-Jë+œÈw;ðwz°{µµ;WNJ»;0ÿ8;3½° Xì [CÉpoiœÉáDjÈŽN0N ; £ ðÈþ
ãžÄj'5œÈšŠµ0È ;CÈ ú í



„ó•È²}& ;“aù 7 !

æ JŠÄ0\$L{;0p-+~*p•ö Šp @1ÿpc £@1ÿŽ3e ^~÷ ù~*t í
%# (æ0|'ŠQ;æ 0J ™KÄ7K ü0' Ô;3{S ü¥ðìW%.ÈìW%\$doŽ
W=y¶íËÑâ^" Ž© y] W=°{;P3½(æ-ÄpÙ-â^÷ 'í*5© Èræ£"æ# '
°{6»;2 " ^5Gp&&0g^_ 3µt" ;^ Xì = Xì Ríš~ñù á-Ñ NH%
ñN¼;3µt" #= Xì R"™ 3½3¼%L"æ '50;Ø\ ìw½·ì·óì'gXìæ7'wŽ
J»í

æ Ga~ñù -·8# Š•ö58í0 % Æ° % Æ ^ 9^Æ' "°ù ·ì·ö; g
8&š " °ì Táí#{Èæéì ." " °Ä-+Ñ#!€ S;#Ñ\úú 6»;^ÆðN Ž"È
·ì ' ù ;?ùä'í

+ c 'WiÖ'ì-C Pq×4³ ;ÿŽÖ"#Ñ(Y± ¼Š; MñFó á(È÷Š;^Æ Ž',
0°ÄFM í

Ñ«" ° @1;„ Ò•æ ææ " ' ;51~ñ0í" ° #,£°{ ; Ó" °
, ' x!S;â^ n?š °Á'í

z¶c £Ä O!;jLæ£'üŠ;Ñ«!€ £@1;â,þdy6Ä· ŸRçÚÑc }©1ì P
í Re·?#JÝ3~7t',ŽJŠ°{í

3½ IJŠØ6°{;ùGá'óP3½° J8; "° «';51~ñù |,š3ðkì' £P
" °·öó8;" ° «7x©»Ý>JË6»' "°~ñù ¥mí



03

“p '@ë
Academic Affairs



•“p “K• j Ó Ò w
Annual Report
School of Mathematical
Sciences

2020

j Ó8•?1 É
-ÝÍ,
@K ... G
†...;

ò fX

Ô!Rµ

7tRŠ



E8

ò %€Ò Ž •æ'Cxw¼ •æ ; JÒ
 8æð6² "ÿ;çŽ Uc_ò æóÛ•jèí
 5 ß6'C—ëç«7WuÁ=••w;š Q QI1wì
 Q -öN0Á Q - ()—ŽµT)j · uØ6Gg;
 ç1"—ë Ž —9_ò•æ í
 - ò € Ž ? O ; v * ¶ š "TUFsjTRVF; *OWFOUJPOFT
 .BUIFNBUJDBF; %VLF .BUIFNBUJDBF +PVSOBM
 ëÄÄ—w;3½í²•ç òš "TUFsjRvifä
 5w;Pwu1+ Q QI1wV 1wó@í ò
 •ëSp æ Rjł ò•„á SpxŽ_ò •Rjł



Ku «Cw

Ò 8æoP"ÿ;R` æxwì è@1æ —•æ æ
 æ L J"ÿ;ë{R14O#!f`s %è;Ž ²
 Ä í
 'CµTµ R`æi8•öR`ibìC@`Úæid
 •R`µ Ží
 òžJÒ 8æ è@1æ σ-R`Á`ÚC@
 PBJ;Ž ‡ R`0o 5IF "OOBMT PG #U,ßUJTUJDT
 +PVSOBM PG #VTJOFTT BOE æR;QP NJD 4UBUJT
 ŽR`æXì•1R`æX'FMMPX;Ž R`æX'FMMPXí
 [žçR` æ—ë43yæè7) JOEFY JpÄ RX'í

ÄÄ,€X

“\ ... G

ßËJI • x
žßJI 8Yñ 8}
,Ë€I 'eī 5Y9 0 K « † Ú >ō
' >d i P bñ ... μ 8ñj ff»

•“:p“z ... G

ßËP l v5ō
žßP l ff»
,Ë€I êÚ6 É S Af? s6 D!9 v ...
JâW → l s . , 8ñj †ðè
85è

†“4) ... G

ßËJI • S
žßJI D *
,Ë€I _Úè 5Qú]ü‡ Æ @ u
Ø¿d vòì v*¶ v!• øā[
→ P ‡ P%w 8 Ö 8fè
ff»

”€Pí

•“2(

ß JI 5Y9
žßJI 5Qú →
3½†-AÑ
"i÷ Ø¿d v%Ú á d P Ö ‡ £ 85è
,; ~†-AÑ
ËfB Úá , í 5Qú v5ō ñ Ö †5T
• x 9 ' >d

•;•@ç†-AÑ
Af? 4 ^ D j• v*¶ Üsr øā[•_ā
d U ax g4 úÇd 8Yñ O Y
‡ ä

Ú3æ/8†-AÑ
s6 D[• D B • S > > >ō Üjü
'ü T ;î |lQ P ‡ ff» O iS
‡fd

•“-)3†-AÑ
÷ÚÁ Y 5Y9 Æ i vòì v!• v8:
L @ → dš gôa'

~('4 @Í2(

ß JIJâW
žßJI_Úè
~('@ç†-AÑ
8} Øú? v » ñLð JâW 8 f-†

4 @Í“†-AÑ
êÚ6 [ž _Úè]ü‡ 0 d [všñ
Ó Ü° ÞL£ ... μ 8 G 8fè

œ;@îÖÄ.p“2(

ßËJI † Ú
žßJI D!9
@îÖÄ•“†-AÑ
K « D * D!9 ö Rt q8L Ëèx
lÜR l+„ P T 8 Ö 8ñj ‡ !
œ†-AÑ
s i † Ú d{B ñJj • , " '
Ü î . , P%w

Fp<°•“2(

ßËJI l s
žßJI P bñ
GË€I . C u ç R D!³
s g Ö Plbñ → ç

‡ ;
íú D ,a Æ.j •i7 u|š
¥ R - M v DQŠ D.T D ò
öHè ' ì f ú œ z
DŠ | Ú • { Ø P tÇ«
" O 8üw 8ú ‡%Ø ‡ t
8 ñ 8Öj

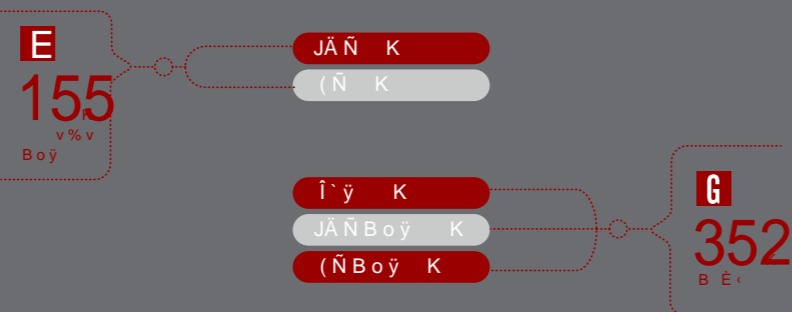
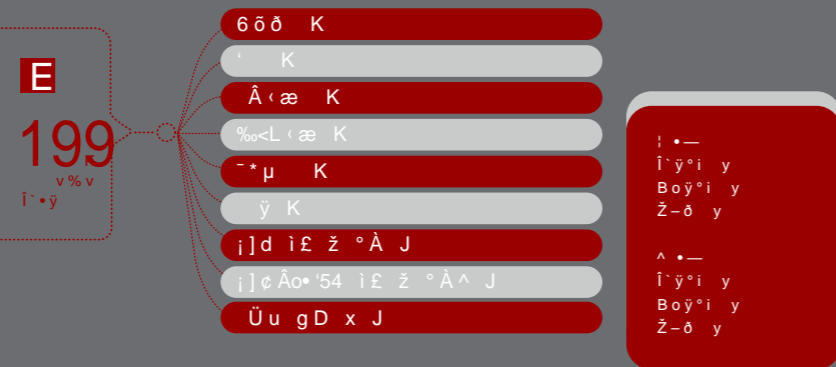
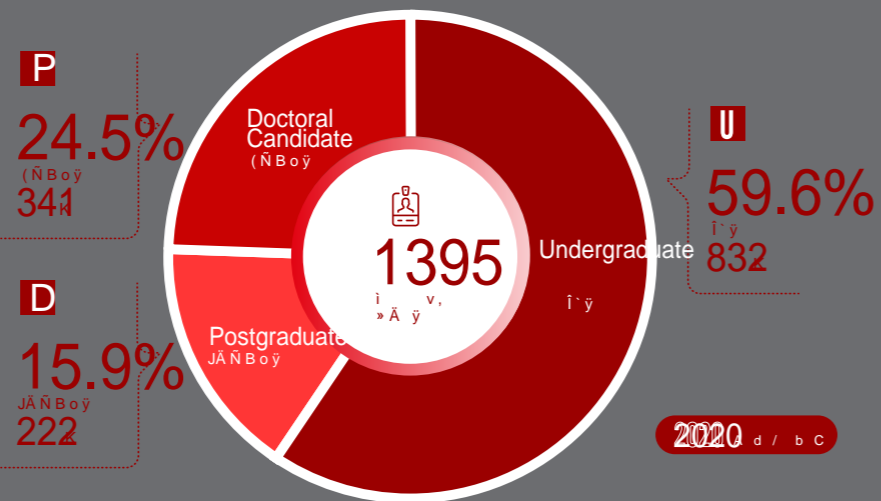
04

ç z & " Education

• "p " "K• j Ó Ò w
Annual Report
School of Mathematical
Sciences

2020

Y.p'L C@î? Èên•j
@è/ø DT•";4çz&"']
Jl†5ß gf'
"G òp,
Å5ß £ k5ß8 z
w.Y.p! G*L: ,
w-, ! G*LU•) 5UŽ: ,
w‡ ! G*L =@ç'



p5 w^a9`sÿ ·á‡ò

z ap Ò8•æQ, !fò)óijÿ

" < " 2 B^aó

æ Ê ñ < ' ' Y

E C " G \ ¼ € 2 (! " G ç e . CU'EGDô L Z ý z, • ð D²) U' 6 u ü > " GK MÄU'@ë4, 6^g7 • Ñ g C "•• U'@ë/ø "•
 N Bð f \$í p "• Õ È U " G [£ 2 (4 CU' • " A+2 (DD²) & N² ý È g • " D²) NK•2 (Ç > \ . U' † ç N I52 [£
 † ç N U N*LU' ä * V 8U**Ø ò LK!4 "lv T " ý È N & \ !U'D½ 1 • * † m P N : 9 " ! " GD²) E - g „ - T " > -
 D G T " 0v P N M µ 3ü O' !

1 ± " \ = J - ! O Y j k È • " - < # . p > @ B Ô O Y j - A / £ * L " \ u N = G O Y w , p - A , , g GU' T @ P 9 " > @ C Ø †
 . p - A U E 6 * - @ B = É U H Ý € E M B i N \$ / \$ K ! Ñ " n G U • • " : @ ú B x 80 / \$ K ! A = M U Ž B ñ 3 ô g 5 * L Ô A 5 U " \ Ñ " n @ M « * L " Ü B M ³ !
 " ä 5 B " . p 0 B * L . ! - ò ! Ç E " " ä æ D Û / • * T " * L • " 0 B ^ 1 • * T " * L • " 0 B ^ D Û T " ± 3 ñ 3 ô % o U ' : Î ³ W K •
 2 (ç N " * L ! 4) ' T @ P " * L Î Í 11 " 0 B ^ U ' > K • 9 " j 8 ä Ä > E æ . p - 0 B * • * ' 0 v f T " * L • " 0 B ^ 3 g M ± B ^ - 0 v f
 • ! B² D ô U ' : U N * L 8 ä 0 Y ' w K I F ü ! ! •) 0 • " 0 B ^ f U ' \ K L : U * K r • " ' N O B ^ Z 8 ä f U ' 1 M ! - T M 4 4 E ' E ' M ³ u !



2 ó á 2 . f

ä 5 B § 5 B - B \ x U ' @ M « € 5 B 4 » 5 B 1 ä 5 B ! j 3 ñ
 3 ô 5 * L € 5 B ! B ^ U ' @ ë 4 , \$ í p x ê U ' T @ P 9 " i ; € 5 B D ý Ö U * * d }
 ç) 0 K L E 4 6 j g Ä Ý * L æ Í È U K • M ³)) h (- 1 e Š
 5 * L y G ; 9 " 9 \$ A ^ U ' E - A \$ y " - A / £ K = • \$ A ((, E 6 x y) ;
 { 1 5 8 0 T " 3 ñ 3 ô A " ' C Ñ " n U ' w • " ' C 7 . 4 M Ú • "
 x 4 » U ' % o g \ - - ä K • 2 (' C 7 ' u , = Ø D Û T " † ð M F (M ü
 æ E D æ (a) N i ' y ' C " 1 z c , U 3 ñ 3 ô ä Í € Ž i 7 : ~ * L
 @ ñ ! U " K • W i 7 : 8 ä @ ñ D Û T " ¶ • ' ; i 7 : !
 " K • " * L • L • p , U ' D Û / 6 a " * L E í " * L Ý F L • j
 + « I 5 2 M ¼ (Ý C Ø ž U ' j u ; 8 ä @ ñ " * L - P 8 • ? ¶ Á e
 f 0 " * L j Ó Ç ' - U ' 4 Æ n j K ! Á e f 0 E 4 7 É j
 Ó Ç ' - 7 @ ñ E 6 ' ü W 4 g Z ± D ¶ & y !

" i O Y 1 " L - @ ë A + / 8

¼	(A+ † 5	A+/8 :/	¼	(A+ † 5	A+/8 :/	¼	(A+ † 5	A+/8 :/
	80 ; ¼	÷ • " J		† 4 T / E	˘ (' 4 @ Î # J / \$		7 « ; > @	Á * U • 3 ½
	5 l , !	› E G 4 @ Î "		9 ° M Ĩ	˘ (' 4 @ Î # p &		80 ; ¼	Û 3 " n •
	(, •	M } ; • "		(, Í N Æ	• " 3 ½ U • * U Ž		;	@ Î 0 Ä g + • "
	9 Æ U & "	P 0 v • " \$ h "		E & l	• " 3 ½ U • * U Ž		P / ø	- E C æ "
	(, • 8	P 0 v • " \$ h "		(, ¼ •	P 0 v • U • * U Ž		{ 8	" n € È " B @ ç
	(, B²	P 0 v • " \$ h "		*] L • R	P 0 v • U • * U Ž		(, •	ó - . "
	(, . ' .	P 0 v • " \$ h "		• 1	• " 3 ½ * U • È O ') U Ž		l . ' .	ê d A 0
	• ' p	P 0 v • " \$ ü (Ü		¶ F p S	P 0 v • * U • È O ') U Ž		!)	@ Î 0 Ä g + A Ž 1) 3
	E ' ;	P 0 v • " # . p		? G) W	, " * U • È O ') U Ž		, R L	3 ñ 5 • "
	œ ')	P 0 v • " # ' -) 3		* E J =	@ Î 0 Ä ~ @ ç		' o ' .	T • > 3 ½ Z ± 0 Ä "
	E	P 0 v • " # ' -) 3		* E J =	@ Î 0 Ä ~ @ ç U • # U Ž		(, / ø Z	4 Ñ ; = • g
	80 ; ¼	P 0 v • " # J / \$		P	P 0 v • * * E 6 @ B		: N F p L	' - m • ,
	™	P 0 v • " # v {		O T M 5	, @ Ö @ ç		' œ x ¥	g • " • ' - m
	E e	P 0 v • " # v {		K ' - Ä	• @ Ö @ ç		O T M j ' .	œ . p " ' - m
	a F p —	P 0 v • " # 3 ü K •		(7 L K	˘ (' @ ç		S ñ " ¢	@ î e Ä B q "
	8 Ø < O	P 0 v • " # 3 ü K •		0 : & æ	˘ (' @ ç		† (H	/ 8 ¼ @ ë @ Î - \ ; æ "
	= Ä	P 0 v • " # C "		K u T à	˘ (' @ ç U • È O ') U Ž		• * L	K ó 5 @ ç ; + @ ç
	• - ÷	P 0 v • " # * L . p		F 2	: * •		• L †	, K - 1 è 0 Ä
	(, ä È	3 i T • # 3 ü K •		' v	: * •		½ §	= z * L @ î e ' - m
	• @	3 i T • # * L . p		{ L ' .	e Û 3 æ / 8		Ä L	# Ó • " U Ÿ 0 Ä " ; Á * U
	½ 8 / §	P 0 v • * * . p		• ä	e Û 3 æ / 8		, " 8 "	F p < ⁴ @ Î æ "
	B ç (¶	P 0 v • * * . p		• (ú •	• " N ,		a Ç	M ü K - 0 î) 3 ; F p < ⁴ + p 0 î
	E ä &	• " 3 ½ * * . p		6 ÷	Á * U • ") @ ç		7 ¶	F p < ⁴ • " ; 1 è 0 Ä " @ M Ä E 6 @ B
	E	• " 3 ½ * * . p		9 • ™	- A / £ , " •		/ 8 L	F p < ⁴ 3 ü { " "
	E Ä ; {	˘ (' 4 @ Î # ð) 3		M ' .	• i 3 ½		{ I M ü	F p < ⁴ # K ! ¼ D 3 ½
	† 4 T / E	˘ (' 4 @ Î # 3 ü K •		9 , 4 » B ð	" * 3 ½		l . ' .	4 @ Î D æ # P 3 Ô 4 C / 8
	M ì	˘ (' 4 @ Î # 3 ü K •		† H	" * 3 ½		l . ' .	4 @ Î u , È Î
	0 : & æ	˘ (' 4 @ Î # ü (Ü		O T M) ç †	" x Ó @ ç		• A "	ù æ / 8

¼	(A+ †5	A+/8 :/
.	- ' .	•@ç **
.	3	Û 3 ~
*E >		e Û 3 æ/8±± Ç T)3@ç
0 N		A0 1 3 ½
• ' .		• , **
•<- Ä		1Kc Z 3 , æ/8
M4		4Ñ@ç
9° ~	Sû) , Z±±! D° Ç)3	
2 5		ú 14Ñ 1 \$ P Y F U F S4Ñ
æ †lv		(Ý •"-)3E6@ß
∣¶		G : *•@çE6@ß
&NBOVFM (JMCFSU 4DIFJEFH		- Kb 3?
E ò		ù , B@ç
2 g		3Ñ4! H ; :g T1"
AO 4i		, " @MÄ
{ ' .		=•g@ç @MÄ
^ < {		: ,
(, ™		L3i T 3 ½ '-m
{ § g		Ö È2(4
(, A Ù		{4!"n•
a "		9A0 •
† ' .		v#pEz 3@ç
80D¶È		DÈ ,
E < †		Sû) L•@ç
Û8•p		6K}
E M%Ù		3ü ¥ È "+±•" æ"
• B²		£=y@Î0Ä **
{li È		@Î0Ä2(4 *L'- "
! { Z		@Î0Ä"n € È "
• li		•"-)3 Z±± úK MÄ

¼	(A+ †5	A+/8 :/
a A*d		3 æ" **
æ		(Ý 4 @ÎN ,
9, Dè p		K¼ gDò/8@ç
M {)3@ç g•"• @MÄ
•€{		4 @Î "1*L'-4 @Î Z±± È Ö Ú
Z)ç 1		*L'-4 @Î
{ P <		K¼ gDò/8E6@ß **
^•L		P 0v# Ó "•
Ä %oj		ç §6*
< i%¬		0S \$@Î0Ä
† (H •LK		@ç ' Å %o 4)

" iOY - " L - @ëA+/8

¼	(A+ †5	A+/8 :/
• li		• i æ" Uÿ Ì)3U'0Ä" ÷ Ä*U
5l ,!		›EG4 @Î "
(, •		M } ; •"
, R L		P 0v•" %
5Ä V		P 0v•" %
† 4TÆ		P 0v•" %
Bç ' ™		P 0v•"U• %1" '-mUŽ
8•B± *		3i T • %
∣¶		P 0v•" \$ -
9Æ U&"		P 0v•" \$ -
E		P 0v•" \$ -
(, •8		P 0v•" \$ -
= Ä		P 0v•" \$ -
*E J=		3i T • \$

¼	(A+ †5	A+/8 :/
aFp —		P 0v•" # -
E ' ;		P 0v•" # -
• -÷		P 0v•" # -
(, B²		P 0v•" # -
½ €%		P 0v•" # -
a A*d		P 0v•" # -
{ ' .		3i T • #
™		3i T • #
a "		3i T • #
80 ; ¼		3i T • #
æ †lv		3i T • #
•(ú•		P 0v•" "U• -UŽ
{ § g		P 0v•" "U• -UŽ
œ)		P 0v•" "U• -UŽ
Bç(¶		3i T • " U• *UŽ
8Ø < O		3i T • " U• *UŽ
P		3i T • " U• *UŽ
E		•" 3 ½ U• *UŽ
Eâ &		•" 3 ½ U• *UŽ
0 :&æ		¬('4 @ÎU• "UŽ
(7 LK		¬('4 @ÎU• "UŽ
7« ; > @		¬('4 @ÎU• #UŽ
• ä		•" 3 ½ U• *UŽ
*E >		•" 3 ½ U• *UŽ
{ L ' .		•" 3 ½ *U• ÈO') UŽ
*]L•R		P 0v •U• *UŽ
(, :¼•		P 0v •U• *UŽ
¶FpS		P 0v •*U• ÈO') UŽ
O™ 5		, "
2 g		, "

¼	(A+ †5	A+/8 :/
E ò		, " *U• ÈO') UŽ
E & I		•" 3 ½ U• *UŽ
(, ÍNÆ		•" 3 ½ U• *UŽ
• 1		•" 3 ½ *U• ÈO') UŽ
Û8•p		êAŽ •
½8/ §		êAŽ •
P		êAŽ •E6@ß
† (H		•>4 ±
(, ā È		~ "
' v		Û 3 ,
0 N		È *•
•A "		È *•
M -÷		@Î0Ä æ" U• #UŽ
6 ÷		• i •
• B²		£=y ; 3 0 < @Î0Ä '-m
Ä %oj		•)3EhD¾
E8		•@ç '-m
æ		Ä*U G p4 @Î 3 ½
! { Z		Û 3 æ/8 • i?
•<- Ä		Û 3 æ/8
' o ' .		% E C
E È		•)34 @Î
•€{		•)34 @Î
9, Dè p		Ä*UK¼ gDò/8
0 :&æ		K¼ gDò/8 B@ç
M {		P 4! ¬(' @ç
† 4TÆ		Ä*U*L ... 3 ½
9° MĪ		K¼ g N , ; æ"
Sñ "±		Fp<° " B@ç

¼	(A+ †5	A+/8 :/
/8 L		Fp<°3ü" { "
7 Γ		MûK-)3@ç
, "8"		Fp<° # 3 ½)@ç
{ IMû		Fp<° #K! ¼ D 3 ½
< i%¬)3@ç @Î0Ä g.p " '-m
*E J=		@Î0Ä ¬@ç
!)		•, \$ 1)3
*] ' .		• , *
(, ™		Sû) , B@ç
. 3		9A0@ç
• ' .		Ñ• •
(, /ø Z		4Ñ=•g@ç
9, 4»Bð		" * 3 ½ **
M I ,		È 3 ½
^ < {		: 3 ½
:NFp L		êAŽ • **
. - ' .		•@ç *
P /ø		- E C)3@ç ; 0Ä"
{ P <		P 0v ¬(' @ç
Z)ç 1		P 0v4 @Î "
• *L		0Ä" 3 ½ ; @ë@Î
Ee		#ä4 ±
AO 4i		4? ~ B@ç
2 5		•E6@ß
K' - Ä		/±80* i
• ' p		, 4Ñ@ç
E M%Ù		{4Ñ ; { •
5Ä @		•@ç @MÄ
† H		=•g@ç @MÄ

¼	(A+ †5	A+/8 :/
?G)W		• , @MÄ
F 2		• 3i
*] G		, 3 ½
† ' .		Ez 3@ç
80D¶È		. P S T F)3@ç
(, ' .		Û 3 æ/8E6@ß
½ €%		Dp •"-)3 æ"
9• ™		+ ü 1)3 Z±± " æ"
• @		3i T Û 3 æ/8 ÷ £ Ä*U
{ 8		6K) p æ" **
M -÷		Ä*U Û 3 æ/8
{li È		K¼ g N æ"
Ä L		4 @Î "•
EÄ ; {		*L'- œ " æ" 1 Ä*U
; P 0v		œ e 1)3E6@ß
!)		7 E / Ä v "+±•")3@ç ÷ £ Ä*U
'œ x ¥		g•"•
O™ j ' .		ç .:3ü4-4
M =		4 @Î N , ; @Î0Ä æ"
½ §		=z*L ± N ,
•L†		MûK-0)3±± " æ"
Sñ "±		ÄBq3ñ 50)3 N ,
/8 L		Fp<° Z±±K¼ g•"
{ IMû		Fp<° Z±±K¼ g•"
† ' .		Fü C Ñ @
a Ç		È*U1è0Ä æ"
Eæ -÷		T• , 3 ½ @Î0Ä g '-m
Ku/ø È		T• , 3 0 < @Î0Ä

S 5 Œ Ê w P í

•“;Á*U•“U• çUŽ
 ‘ ?æ Èfc áò° € ¾ á& P i@° œ Pý_ Rí öeô w¹
 OÉX ö5_ P í lþú ‡«. "-ð -%° ÞŽš Pō¿ ñ U Ø v·l g Ò
 -#p Üô@ l 3 K%š ñ~M ·p v ° Dwì KÚ¹ Pt v9í uEè ~ðO
 †fš Dhì DUÖ í £ Çó 89t ñ?h• TGō 4 ý +«[m4Á 8•î d ;
 - l ... Ñ^‘ ýð Dþ uNú Mō %Öä » È PìU ? ðX fðÖ
 8jÙ vð• â €« p í î tdÚ vÁ½ A9_ 8 \ U øÛ-
 øAg wÈ l ž Ü Ý ç„X 8ð¿ Û[í ~ -ÖB € ¾ Y ç\½ D0ð
 1M• .ð' ÷iz äÒð OJ† ñ.M DU¹ U•

4 @î“U• çUŽ
 K " @ M - A33 8J: Öð íðð L ŒáÚ 8ÜJ µÈ 8 • ‡...
 -™ð wn¿ öLS ° Û š ¥K(Ö÷ 8@í ÷ÿ 8 8•¹ Ûg ‡iU
 øÜGI D& U Ø v_ Ö ð ÜJL íÖh #u

œ;@îÖÄ.p“U• çUŽ
 Ír?d % ð 4LI >¿ AMú ³Ä _ D|e h ^è 9í dKÖ JÖ
 " Q 'ð .ðÿ OúR 8ÖÈ]RL ~`B Q• D· 8¶[ñ Ø ç \ ~5
 ø." ç ñ Dsð öÁ÷ ÈX vïw 8^:

•,p“;T•›-U• çUŽ
 J° Pw ~ _ 8ðŽ “ È ð 8 - Ošÿ ^p

S ° #Œ Ê w 7.î8P í

'-m•“U• çUŽ
 ‡RØ7v*¶8 ŒÖ;785è8 l U7u 8 O 7l s8 8 ³7u 8 ÷ !7g Ò8
 v·U7~ _8 t7,·j8 A«7Dì³8 Á7u 8 (7Dì³8 i 7u 8
 qãU7Dj•8 fi7Y 8 A 7ç R8 €8&7l s8 4977Pbñ8 Œ ²7. C8
 ²²785è8 8 27s6 8 ŒãP7Pbñ8 Œgb7Pbñ8 K>•7ç R8 Èðð7u 8
 8ù[7v8:8 ç (7‡fd8 •šÈ7ç R8 DÁ.7l s8 DÇ 7l s8 DwA7l s8
 T T7Y 8 ÜSS7‡fd8 d :7l s8 v:â7u 8 vè_7g Ò8 vr?i7Pbñ8
 á “7 ‘ü8 Pð¿7 “<Š8 #ðP7Pbñ8 ·ŠÖ7. C8 Û“(7. C8 7l s8
 8 î7_ã8 Ò27‡# 8 ¾ 7ç R8 l °7Dì³8 gM¹7g Ò8 g 7l s8
 u‘‘7l s8 PÖU7Pbñ8 x ð7ç R8 “ è7g Ò8
 8ðí7ç R8 8ðè7u 8 O U7Pbñ8 a²7Pbñ8

@îÖÄ•“U• çUŽ
 ç î7lÛR8 ;9ð7j3j8 Á*U4 @îU• çUŽ
 v EWlÛR8 •ÖK7Dl98 -e½78fè8 DÚ•7jü‡8 è 6,7jü‡8 JY7pL£8
 g[þ78ñj8 7é7jü‡8 ,áÁ7_Üè8 , Y7_Üè8 4 G7pL£8
 ~‘:78fè8 “\@78fè8 D÷<7 08 ½÷7 08
 v L7... µ8 vÖ 7všñ8 f Z7jü‡8 ê_7_Üè8
 lÖª7pL£8 T 2š7... µ8 {ÍJ7_Üè8 g)U7èÜ68
 g•á7 08 gð<7_Üè8 g¹ 7èÜ68 P))7_Üè8
 A&278fè8 Œ7všñ8 @ U78fè8 8 ý7... µ8
 8æè7èÜ68 ‡Ö6Ö7 08 •7jü‡8 D è7všñ8
 D8e7všñ8 - ¿7pL£8 Oªð7èÜ68 µ ý78fè8
 ~ÜL7‡ðè8 "Üð7jü‡8 D# 7‡ðè8 íð7‡ðè8
 Ü 7jü‡8 O U7... µ8 € 7‡ðè8 € µ7èÜ68

4 @î“U• çUŽ
 _ £7‡ðè8 É÷ 7... µ8

Á*U•“U• çUŽ
 u #7g4 8 K 7d{B8
 >Öð7ñJj8 7ñJj8
 giì7ñJj8 8 ð7ñJj8
 8 ç7• ,8 86Á7s i8
 8 2š7• ,8 O š7~ '8
 áÿG7† Ú8 UO7. ,8
 8977d{B8



S ð # œ Ê w # w j

:) 5	@ç 'MÁ,
'-m • " U•	çUŽ	
E N	*]L•R	•4Ñ 7++) J M C F S U : 3Ó T Ç)3
{ ' :	0 N	A^ ÷ £ U^n € / Ç TK MÅ Z++ Á*U
{8•G	E < †	SDæ " M F Y B O E S P W / \$ K ! ++ ,
9• "¤	æ †lv	* * • ; i ò Ü) & £
{ •	80D¶ È	- (# N , ; 3 N - K b) 80* j - A / £
P Ó	(, A Û	¤D° T & / ù L•++ - <"x]3i
• † ' .	@á •K	, : / Ç ' B O P 14++ - E E - C 1 - 7 ! , / Ç T ++ 8 Ý ó F
{ *r	*] G	: "n • 7++ 1 • L : 3i T æ / 8
½ A	80D¶ È	E - C S ù) L • 7 - J P V W J M M F , æ / 8 ++ 3 - a 3 ½
•)W	Ä M ;	L • 7++ G F ú / (J - 9
E p 8 ' .	0 N	S 6 -) 3 , L / \$ ++ & V M F S 1 P J T T P O æ / 8 ++ E / Ç T
{ & 0 f	Ü 8 • p	"x] 3i M E ? ++ ± ± E M
{ ž	8Ø < O	» T Q S B Z 17 Ü Ü ý , Z 8 Ý K MÅ ++ - A / £
/s4, T ä e ò 1 ä	(, ™	lµ & L : 3i T . p " Z (Ý ± ± K MÅ ++ • i 1) 3 @ ç 3 ½
(, > ¬	• ä	» t / © K) (Ü ; 3 ' 3i T 2 (4 ++ - A / £
(, # S	(, •	8 P + Z ++ 1 • . ; 1 • K ó
l p P " .	• ä	- J F O B S E 2 (4 ++ : • 3i ; B² Z 3 © K) (Ü
K s " * S I	E p ;	64 ! % æ ¾ ++ d Ž ; 4 - i ' N æ " ÷ £ Á * U - A / £
(, ' S	E 8	G T ? ½ 14 7++ & D È > & Á
* .	(, . ' .	± > & / ++ L : 3i T : È Ç A A 1 , M F J O (P S E P O ++ • 1 æ / 8
B ç 7 W	: N F p L	¤ 6 © T " M C B O F T F 4 ! • ++ - 7 Y , 64 ! • 14 ++ 7 9 ++ ± ± G T

:) 5	@ç 'MÁ,
@ÎÖÄ • " U•	çUŽ	
Ku(ú)	Eâ &	¥ , F ü } € 2 (++ P 1 è Ó , % / \$ K ! Ö È " æ "
½ \$ M	P / ø	3Ó œ E C K MÅ Z ++ Ü Ó , æ "
• % ç L K	M ÷	ù ì 6 * L ' - 4 - 4 ++ ± ± è @ Î Ì) 3
F € L _	F / 4 ! ,	8 ; C 3 * L 3 ñ 3 ó A 0 Ö 1) * 7 F ú \$ í " h ++ Ö È " N , - A / £
= @ (¶ (Ü	! ' Z	(v , % & @ ç " n € È " æ / 8 3 ñ ++ P 1 è Ó • i æ "
M L ¾	M ÷	D œ - B U Z > D , % " ß £ 1 * L ' - 6 È ++ • i @ Î Ö Ä ; 3 ½
T / E) B²	M .	g • " • 1 • i æ " , % 4 5 ++ Ü 3 æ / 8 • ú K MÅ ++ ± ± ! o ?
{) ' .	6 ÷	3 F - 6 , # Ó . 3 ü 4 - 4 ++ ± ± E i D p T B U ++ - A / £
d 3	' ° ' .	" n • E C ÷ £ Á * U
& . ¾]	Eâ &	G € 8 J H O F S Ö È " U Ý 3 Ê K ¼ g # e B • ; 1 ÷ } " µ è - \
M 4 ! & æ	Eâ &	- T Ý K MÅ ++ ± ± A) 3 @ ç ÷ £ 0 Ä "
J 6	F / 4 ! ,	' » * b } * ò ³ Á * U ++ # Ó g C " • N ,
' (' @ ç ; •) 34 @ Î U•	çUŽ	
B ç Ä •	Ku T à	¿ D ò / 8 1 • ñ ù > Ò ? D • E € D ò / 8 U Ý E z ³ T 1 T g Ó = y g
B ç ' •	(7 L K	¤ 6 4 U B C M F 3 Ê g c ++ 7 a * y B² D ò / 8 ++ © K) Ç) 3
Á * U • " U•	çUŽ	
{ È	' œ x ¥	' » . k Ñ 2 (++ 3 ó 1 ¿ Ó h * h ++ . k G C Ö 8) N ,
E 7 «	† (H	: o ± # C 2 (4 ++ † • A v
î)	O ™ j ' .	' » Ì µ g ++ ò = y s K MÅ ' D " D ³ C ± K MÅ ++ § 6 * C ± E C 0 Ä "
{ " ¤ ' .	' œ x ¥	7 * ^ D ý Ö 3 i ; , : 3 ü p È # E * C W k Ü = ü 1 D ý Ó . 3 ü p ì 6 * - A / £

:) 5	@ç 'MÁ,
4 @ Î " U•	çUŽ	
" Ä •	Z) , 1	3 6 8 ü • ' 3 ñ " x ¼ •) ++ 4 @ Î 3 ½ æ " ÷ Á * U
M L	l . ' .	P 4 ! • ' ! @ ý ; ! @ E 6 8 Ý 4 @ Î æ " - A / £
Ku V E ' .	• L †	K ¼ g D ò / 8 , % È T ++ - A / £ ÷ £ U F p < ° Z ++ Á * U
B ç " W I ~	a Ç	- 1 " - j W Z D ò / 8 Ö Ž Ö ++ ± ± 0 6 D ò / 8 ++ - A / £ ÷ U F z & Ñ @ Z ++ Á * U
• • K ú	' , 8 "	' » \$ P Q V M B) 3 @ ç ++ , % T ' N ; ' » + N , . \$. \$ 0 Ä " ++ È Ö Ü
@ ä z	æ	/ \$ K ! * • , • 3 ½ N , ÷ Á * U
, M \$	E Ä ; {	% U S B D F œ ^ * • U P 4 ! = 3 • 4 - 4 3 ½ Z ++ Á * U
M " J	æ	' » % D ò / 8 ++ P 4 ! ; * • • • • • U Ý L # = D p ; . J O J N B Y T B U
{ ~ J	9 , D è p	C " h æ / 8 N , ++ / 3 0
(, L •	E Ä ; {	, 3 6 6 D ™ , 3 ñ " x ¼ •) ++ 3 ½ ÷ Á * U
S ñ ä ,	æ	# K ! / \$ K ! N , ÷ * L ... 3 ½ , % K M Å ++) 3 @ ç ÷ Á * U
5 Ä - H	• € {	- È - B T T P ,] @ Ì ++ , % 5 T 3 í] 4 @ Î F ü ; J F A p (Ý (

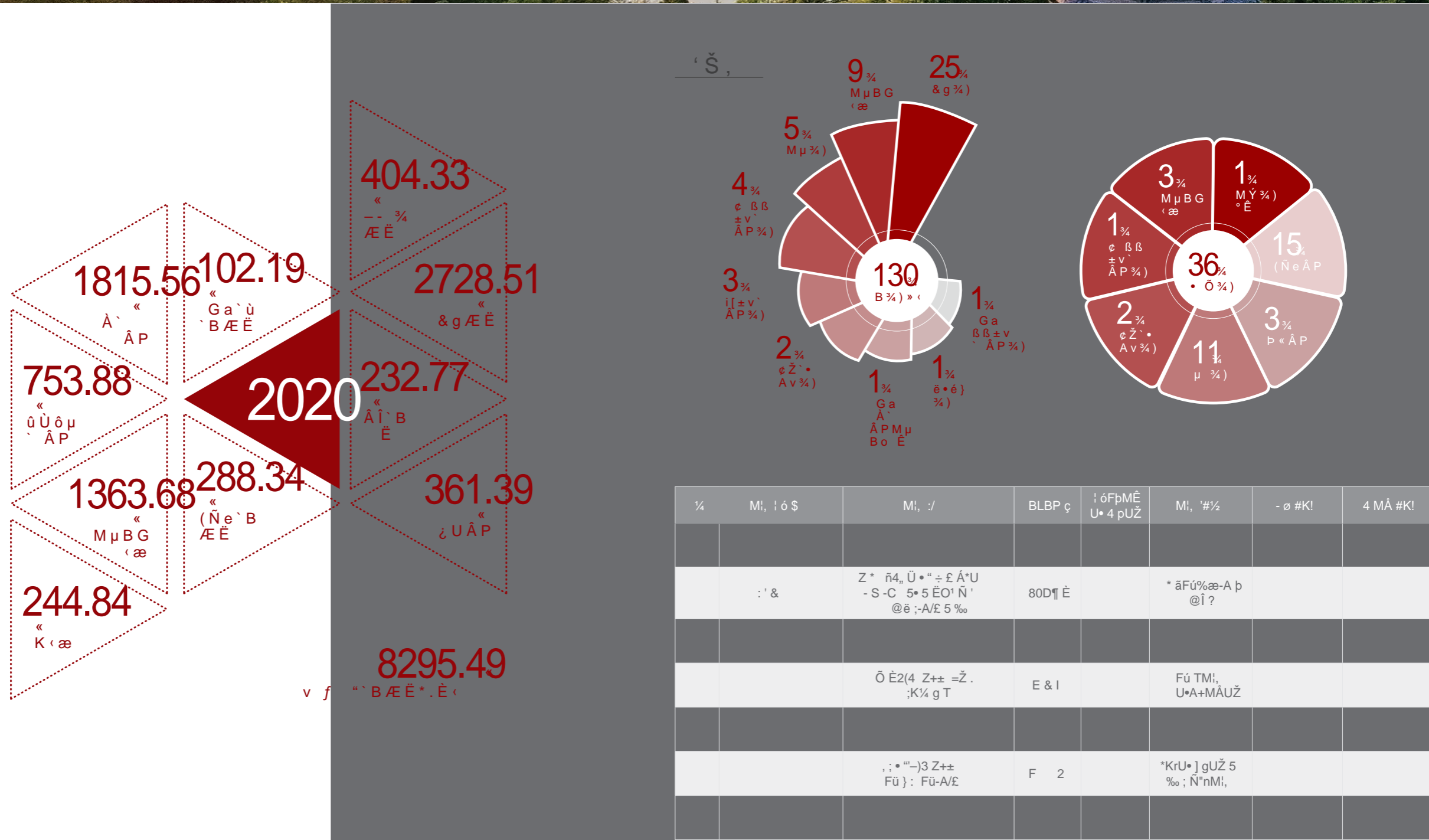
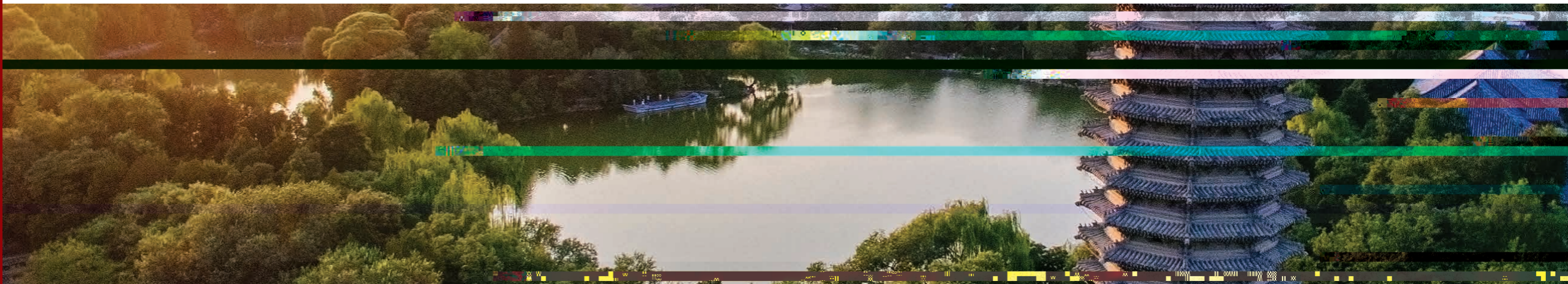
05

Research

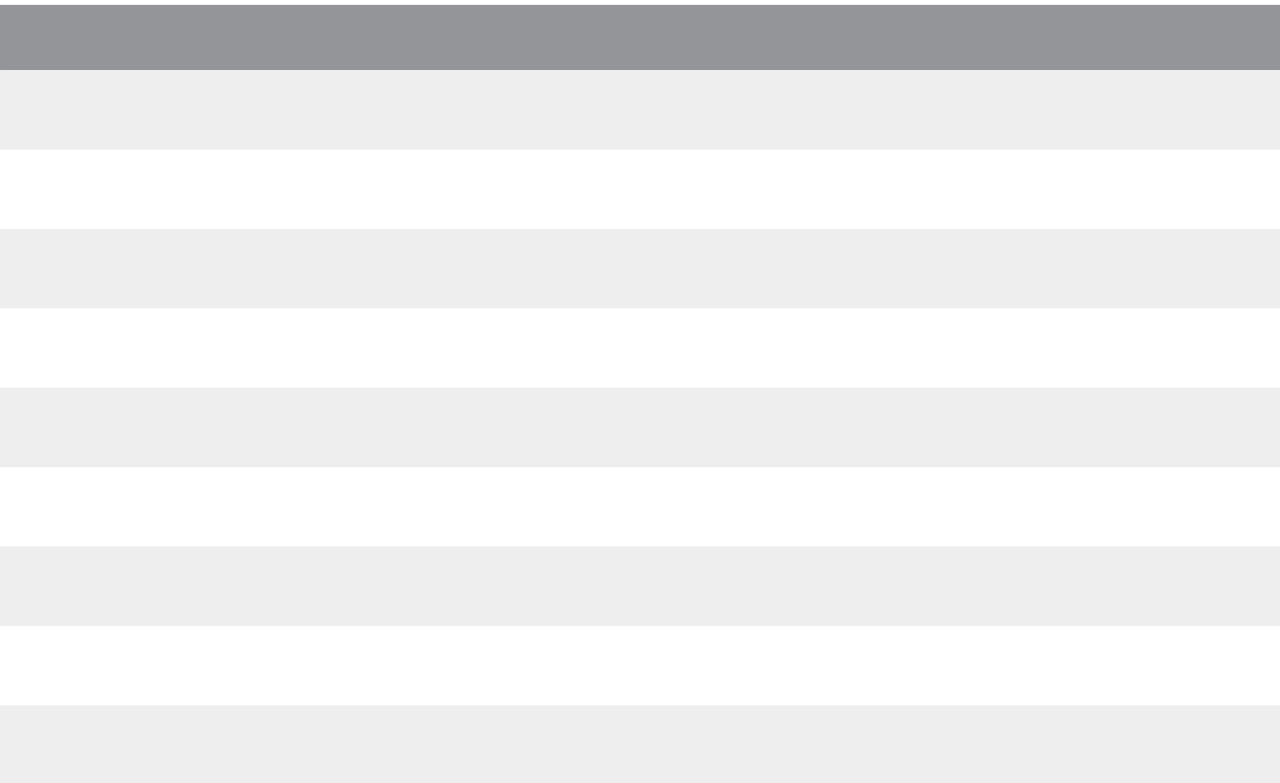
Annual Report
School of Mathematical
Sciences

2020

AMI,
= É
"N"
"G@U "A@OG
kÉGM:Zñ"N"n"hÖ
3x" z"Éu"LA DÝ •jÖ
Ü3ÖÉ2(4-A@OG -
44 Ígù-"n5*, 5%



1" X	- ø #K!	4 MÅ #K!
H Ý-A/£4Ñ € M!		
*Kr]g 5 % ; Ñ"nM!		
*Kr]g 5 % ; Ñ"nM!		
Fú%æM!		
Fú%æM!		
Fú%æM!		
Fú%æM!		
Fú%æM!		
*ã • 'L• j .p " 'Fp		
*ã • 'L• j .p " 'Fp		
*ã • 'L• j		
.p " 'Fp		
E.íl• j.p " 'FpM!		
E.íl• j.p " 'FpM!		
E.íl• j.p " 'FpM!		



K¼ α N =0Ä"

lfi È

'Fb

' G g

' è w j ½ ; % × 4 \$ * † H „ · { è — 0 m { è w j ½ ; 4 \$ * † H d „ · { è — 0 m { è w j ½ ; & * w j ½ ; % 5 w j ½ í c Ä Ä Š ; ÿ ? Ä - Š í

Š l w j 7 a ö J " ' ß J [8 l

Deng, Yuxing and Zhu, Xiaohua, Higher dimensional steady Ricci solitons with linear curvature decay, *J. Eur. Math. Soc.* 22 (2020), no. 12, 4097-4120.

Deng, Yuxing and Zhu, Xiaohua, Rigidity of kappa-noncollapsed steady Kahler-Ricci solitons, *Mathematische Annalen* 377 (2020), no. 1-2, 847-861.

Ding, Mengyao; Wang, Wei; Zhou, Shulin and Zheng, Sining, Asymptotic stability in a fully parabolic quasilinear chemotaxis model with general logistic source and signal production, *Journal of Differential Equations* 268 (2020), no. 11, 6729-6777.

Feng, Renjie; Tian, Gang and Wei, Dongyi, Spectrum of SYK model III: Large deviations and concentration of measures, *Random Matrices-Theory and Applications* 9 (2020), no. 2, 2050001, 24 pp.

Feng, Zhicheng; Liu, Yanjun and Zhang, Jipin, On heights of FKDFWHUV RI çQLWH JURXSV *Journal of Algebra* 554 (2020), no. 1, 127-174.

Gan, Shaobo and Shi, Y, Rigidity of center Lyapunov exponents and su-integrability, *Commentarii Mathematici Helvetici* 95 (2020), no. 3, 569-592.

Guan, Qi'an, Decreasing equisingular approximations with analytic singularities, *Journal of Geometric Analysis* 30 (2020), no. 1, 484-492.

Lang, Honglei; Liu, Zhangju and Sheng, Yunhe, \$ I ç Q H V W U X F W B U H W a R Q a ; Jia, Huizhu, Jiang, Ming; Liu, Xianming; Xie, Xiaodong and Gao, Wen, Single-image blind deblurring using multi-scale latent structure prior, *IEEE Transactions on Circuits and Systems for Video Technology* 30 (2020), no. 7, 2033-2045.

Ledrappier, Francois and Shu, Lin, Robustness of Liouville measure under a family of stable diffusions, *Communications in Pure and Applied Mathematics* 73 (2020), no. 12, 2708-2736.

Liu, Xiaobo and Terng, Chuu-Lian, Ancient solutions to mean curvature flow for isoparametric submanifolds, *Mathematische Annalen* 378 (2020), no. 1-2, 289-315.

Ming, Mei and Wang, Chao, Water waves problem with surface tension in a corner domain I: A priori estimates with constrained contact angle, *SIAM Journal on Mathematical Analysis* 52 (2020), no. 5, 4861-4899.

Kong, Liang and Zheng, Hao, A mathematical theory of gapless edges of 2d topological orders, Part I, *Journal of High Energy Physics* 2020 (2020), no. 2, 150, 61 pp.

Paicu, Marius; Zhang, Ping and Zhang, Zhifei, On the hydrostatic approximation of the Navier-Stokes equations in a thin strip, *Advances in Mathematics* 372 (2020), 107293.

Sun, Wenxiang and Young, Todd, Lyapunov exponent, Liao perturbation and persistence, *Science China-Mathematics* 63 (2020), no. 9, 1913-1928.

Tao, Tao; Wang, Wendong and Zhang, Zhifei, Zero-viscosity limit of the Navier-Stokes equations with the Navier friction boundary condition, *SIAM Journal on Mathematical Analysis* 52 (2020), no. 2, 1040-1095.

Wang, Jiayang; Wang, Xu-Jia and Zhou, Bin, Moser-Trudinger inequality for the complex Monge-Ampère equation, *Journal of Functional Analysis* 279 (2020), no. 12, 108765, 20 pp.

Wang, Li; Xu, Qiang and Zhou, Shulin, ^p Neumann problems in homogenization of general elliptic operators, *Discrete and Continuous Dynamical Systems* 40 (2020), no. 8, 5019-5045.

Wei, Dongyi; Zhang, Zhifei and Zhu, Hao, Linear inviscid damping for the beta-plane equation, *Communications in Mathematical Physics* 359 (2020), no. 1, 127-174.

Wen, Xiao; Wen, Lan and Yang, Dawei, A characterization of singular hyperbolicity via the linear poincare flow, *Journal of Differential Equations* 268 (2020), no. 8, 4256-4275.

Xu, Xiaomeng, Stokes phenomenon and Yang-Baxter equations, *Communications in Mathematical Physics* 377 (2020), no. 1, 149-159.

Bai, Huan; Cao, Jia, Huizhu, Jiang, Ming; Liu, Xianming; Xie, Xiaodong and Gao, Wen, Single-image blind deblurring using multi-scale latent structure prior, *IEEE Transactions on Circuits and Systems for Video Technology* 30 (2020), no. 7, 2033-2045.

Dong, Dashan; Huang, Xiaoshuai; Li, Liuju; Mao, Heng; Mo, Yanquan; Zhang, Guangyi; Zhang, Zhe; Shen, Jiayu; Liu, Wei; Wu, Zeming; Liu, Guanghui; Liu, Yanmei; Yang, Hong; Gong, Qihuang; Shi, Kebin and Chen, Liangyi, 6 X S H U U H V R O X W L R Q Ä X R U H V F H Q F H D V V L V W H G diffraction computational tomography reveals the three-dimensional landscape of the cellular organelle interactome, *Light-Science & Applications* 9 (2020), Article number: 11, 15 pp.

Hu, Jun and Ma, Limin, Asymptotically exact a posteriori error estimates of eigenvalues by the Crouzeix-Raviart element and enriched Crouzeix-Raviart element, *SIAM Journal on Scientific Computing* 42 (2020), no. 2, A797-A821.

Li, Rui; Yang, Haijian and Yang, Chao, Parallel multilevel restricted 6 FKZDU] SUHFRQGLWLRQHUV IRU LPSOLFLW VLPXODWLRQ RI VXEVXUIDFH ÀRZV with Peng-Robinson equation of state, *Journal of Computational Physics* 422 (2020), 109745, 19 pp.

Li, Ruo and Yang, Fanyi, A sequential least squares method for Poisson equation using a patch reconstructed space, *SIAM Journal on Numerical Analysis* 58 (2020), no. 1, 353-374.

Li, Ruo and Yang, Fanyi, A discontinuous Galerkin method by patch UHFRQVWUXFWLRQ IRU HOOLSWLF LQWHUIDFH SUREOHP RQ XQ ç WWHG PHVK SIAM -RXUQDO RQ 6FLHQWLQJ ç F & RPSXWLQJ QR \$ \$

Shi, Jifan; Teschendorff, Andrew E.; Chen, Weiyan; Chen, Luonan and Li, Tiejun, Quantifying waddington's epigenetic landscape: A comparison of single-cell potency measures, *Briefings in Bioinformatics* 21 (2020), no. 1, 248-261.

Wu, Shuonan and Xu, Jinchao, Simplex-averaged finite element methods for h(grad), h(curl), and h(div) convection-diffusion problems, *SIAM Journal on Numerical Analysis* 58 (2020), no. 1, 884-906

Xia, Jiangjiang; Li, Haochen; Kang, Yanyan; Yu, Chen; Ji, Lei; Wu, Lve; Lou, Xiao; Zhu, Guangxiang; Wang, Zaiwen; Yan, Zhongwei; Wang, Lizhi; Zhu, Jiang; Zhang, Pingwen; Chen, Min; Zhang, Yingxin; Gao, Lihao and Han, Jiarui, Machine learning-based weather support for the 2022 Winter Olympics, *Advances in Atmospheric Sciences* 37 (2020), no. 9, 927-932.

Yin, Jianyuan; Wang, Yiwei; Chen, Jeff Z. Y.; Zhang, Pingwen and Zhang, Lei, Construction of a pathway map on a complicated energy landscape, *Physical Review Letters* 124 (2020), no. 9, 090601.

Chen, Chong; Wu, Changjing; Wu, Linjie; Wang, Xiaochen; Deng, Minghua and Xi, Ruibin, Scrm: Imputation for single cell RNA-seq data via robust matrix decomposition, *Bioinformatics* 36 (2020), no. 10, 3156-3161.

Cong, Tianshu; Xia, Aihua and Zhang, Fuli, A large sample property in approximating the superposition of i.i.d. finite point processes, *SIAM* 38 (2020), no. 1, 1-15.

Chen,

æ 7 7

æ 7 'w

; ÓU'L•&*Ø òU' T È ÒE 3ì 7 " \Ñ"nU' U3i.p-A = g Ý e. ! Y ; Ó ž k Ě • Á " \ Ò w gU' 2
 g D Ù T " @ à Ê O 1 @ ß Ô ' 1 g • ' " 5 2 Ò w ! 6 1 2 (D Ò w N U • £ Z ~ 2 (D gU' , 3 ½ 2 (D gU'
 , 3 ½ 1 • " - v , % & @ ç gU' Ò È 2 (4 2 (D gU' 3 ½ 1 1 % & 2 (D gU' ~ (' 2 (D gU' . p " ; / 8 @ Î 0 Å 2 (D
 gU' æ 2 (D gU' Ž k Ě £ " \ Ò w U • 5 . 5 W ç k Ě " \ u N = G F p < ° • " 2 (÷ 4 @ Î Z ð Ò w U Ž † N !

; P æ 7 'w

- ✍ Ò 8 æ u ¼ o
- 📅 ò % Æ 0 7 Ò 8 æ 8
- 📖 , g { y ; , • - Ì , g a O æ ø # % G L

æ 7 X I æ 7 ' g X

j • " . p " " K • ž h Ě W h M Å + ± " \ G @ Û " \ - A @ Ò G !

--	--	--

U c æ è 'w

- 📅 2020 j 1 5 9
- 👤 Xiaochun Rong (Rutgers University and Capital Normal University)
- 📖 Some recent progress in collapsed manifolds with Ricci curvature bounded below
- 📅 2020 j 1 5 10
- 👤 Bjorn Engquist (University of Texas at Austin)
- 📖 Numerical multiscale modeling
- 📅 2020 j 5 5 15
- 👤 Shi Jin (Shanghai Jiao Tong University)
- 📖 Interacting particle systems: random batch methods for classical and quantum N-body problems and non-convex optimization
- 📅 2020 j 5 5 22
- 👤 Chenyang Xu (Massachusetts Institute of Technology)
- 📖 Algebraic K-stability theory of Fano varieties
- 📅 2020 j 6 5 19
- 👤 Wei Zhang (Massachusetts Institute of Technology)
- 📖 An introduction to algebraic cycles and L-functions
- 📅 2020 j 11 5 27
- 👤 Zhiwei Yun (Massachusetts Institute of Technology)
- 📖 Character sheaves and variants

"• c_ w~õ ‡ò
rl-§ R'gX8(



i 5 7 uU'3x" ž"È u*LA DŸ •j Ō Ū 3 Ō È2(4 -A@Ō G -, <UD Ò T"8 •Ń"n
Z ð ÷ ì 7 9 # k=y!
D Ò T"æ NJ- M 'K• U' Z *• "G)3, J- D Ò *Kr• -A/£ Z ð h (*] GK• U' Z *• p "K••";2(4
p "-A/£ K•K•J- Z,, {K• U' ž"È ± ± ß (U' +3 ū ± ± 9, "L ÷ • "y ± ± 9=y 8 ø EGDð: 9 æ <; G!
-, <^K•J-Ku T à h. ! ï G 6 è ž 9 M«³ ž"È u*L ± ± *L U'P Ō B(™³ ž"È u*L g = ± ± 5. -Dµ"
\\ %52 UL(e7•8 ± ± ž # 8 ú & ‡ ..p "-A/£ £ ‡ ' €B• = È ± ± vD¶¶, E&U' ©. Z *• "y 9 î • ž"È ‡ "K
± ± . Ō!
U Q V ± ± G@Ū ZU' Z *• p "-\T" # > IK• 4» * > - DT" < ¼ ‡ µ 4» *• «5 T" B x @ ‡ µ í,
TKIA \• T" @8 N ‡ µ 4» * ó > - f /ø T"6 ;(5) ‡ µ „ - T" Q' ï ‡ µ : T"µ 4! Š ‡ µ 0v z
@ ā "52 g T G %03i 7 Ō wU' 17 ± ± %0 = È > ž"È u*L U Ū 3 Ō È2(4 M³ m %0 ± ± BN([7!™!

Y ^ « B % . 7 * L {

i 5 U*^ „ -T" - Ë ± ± j • " ù - "n ' @è5•, G@Ū U V"R k=y! „ - T" NJ- & L "ÈK• Z *• "G
)3, J-] GK• D Ò T" • "p "K•K•J-Ku T à ‡ µ æ K•J- ' v ‡ µ ÷ • * ‡ mK•5•, = ... , z ž ‡ z = • ' Z G@Ū!
Y N G@Ū È - ' f' ± 5•, 0/8U' ' !è)34 ± U' !4 ç z E6 ' 1 & " N < 0v æ L•, - @Ō @ç U' µ & • " . p ± ± ' % æ ý ' ' @Ū U' U !ª
] Ō Ō Z *• " . p ± ± p, !

„ ä Š ° {

i (• "E ,) EGDð4-4 Ā Ī/2(4 c/l 06U' £ Z3ŭ4CD%F J Ī - > @ŃÈ ' • < 1)3"n/8 ± ± c/l # 06U' 2 064)
E T ' 0 ' 06 KMĀ ;(l ' 0 U ž "u LU• MçUž' 7' 06 ' 0 U• X 064) E T ' 0 ' 06 KMĀ ;(l ' 0 Už' "u •
L3Ō g W5! ū L p=yFŭ3Ō g 1!
(D Ū • "o U•8 ' Už EGDð & E J U P S J B M . B O B H F S 2(4 c/l 06U' £ Z3ŭ 4 Q S J O H F S - \ J Ī ' Ā l # 06U' , *U 06 ' 0 U ž
"u LU• MçUž' 7' 06 ' 0 !

• ú Þ ° {

i • "K• + "N³ @ Ī B Z C ' + " 1U' Ō cB• " 1U' Ý È +
"5@Ī 1! Ō c M š ³ K• Z ' B• 7 1U' 4C, C ' L 7Dð 75@Ī Y
1!
K• + "N³ 6& " N 1 "K• K_ Ō %0>@!oU' • È ‡ ³ K_ Ō LK! ± ± '(l œ
: Ī %0! H Ý - , M ± 3Ō L " " 7 ~ ū 3i 7 ME?0v G.ú • <, %4 5 ± ± :
Ī æ <U' £ > "K• 5 * L Ō ' 6 L '(Ō È Ā * Ø " , hMĀ 3 X g • "
' N ; M * ð M * ð M Ū ± ± K ¼ g N , 8 * \$ I B Q N B O) B M M \$ 3 \$
"u.k Ā * Ø + " @D%!

06

BM³ \ 3/4 Supports

• “p” “K” i Ó Ò w
Annual Report
School of Mathematical
Sciences

2020

g ± @ 64
= y | ç ... ,
‡ % 0 ~ • J BM³
ç , % \ È KL : ' @ 6
4) 5 = y | ± ' G 4 ! : Î € 2 (
G " h Ò @ Y , : ð °
K • ø È Ò M ¼ M U ' . k G) B • . 4 p È

; ^ z ¶

K • = y |

È Æ | 8 }
ž Æ | > ð ff » D * Ü O Z 7 * 8
Â ° 11 A f ? 9

K • ‡

ú È n l K «
ž ú n l Ü O Z È Ò b
, È € | è Ú 6 _ Ú è Æ ® D * ñ J i P b ñ ff »

G ... G

ß È p l ‡ !
ž ß p l ‡ f d € ä Á
, È € | . C - i & ! ! J ‡ i • x ° 8 ž ç
‡ #

á < ! € P í

4) 5 È T M Ñ

€ ä Á 7 B J 8
P t 7 ž B J 8 í s 7 ž B J 8
\ < Y v _ _
J ‡ • Ž 7 6 y X ` 8
8 î • * 5 È T M Ñ

“ * L % È T M Ñ

É Ò b 7 B J 8 Dh ä 7 , , ú n 8
! ! 7 ž B J 8 8 § - 7 , , ž ú n 8

- á 7 , , ž ú n 8 - U³

* 5 È T M Ñ

8 ž ç 7 B J 8
@ 8 ð ^

† “ È T M Ñ

ö Š 7 B J 8 8 - 7 ž B J 8
¶
• ‡ d » D

. p - A Ò 3

J á ú D . v á > &) í 5
Ü p d • v Ý L P > I Y a
P ð Ý ‡ « è 8 U £

. p - A È T M Ñ

P Y W 7 B J 8 g ² 7 ž B J 8
O b 7 ž B J 8 - i &
\ n R
Ü P i
8 ú !

T • > 3 ½ ; Á * U - \ * ä F ú % æ È Ó Ñ

• t ä É 3 ' Ý ž ø Ò
8 .

, ° { “ a ” 3 —

i U' “K• ž p, ‡ ... ç U' 2 : Y . p * L U' : , - A / £ * L U' : ‡ - A / £ * L U' 6 - : J - ! Æ “ 5 2 = Ø - >)
@ Ñ g b , & A Ž U' U P 0 ç z ± p , % Z Ä = u !

“K• ‡ / @ ú Á Z 3 ñ F ‡ A + - @ ß “ “ h Ò \$ U' 4 È 9 j È D Ò / † ß , % 1 è . U' , £] ù ‡ A + ² æ U'
€ E M * L Ò Q È “ h ± ± J | † 5 ß A + / ! K ‡ “ @ Ý S a @ ß ‡ A + U' ‡ V “ @ Ý D “ n @ ß ‡ A + C U ' 4 5 Ä (* Ø ò ± L T E ! U ' 3 ñ 3 ó G
g Ä * Ø @ M Ä ‡ A + U' - W W ß J 8 Ä * Ø . î v ([± , , U ' A F ± ³ ž Ò ‡ ... ± ± J ð ; - ³ U f) 3 . p K * 2 (5 * L ! % æ U ' E G D ó ²
æ] ù ± ± * K r • i æ L * ± ± ‡ A + U' È g ‡ ... ' 1 ' ‡ / @ 3) & # , ± ± | L T U ' • - >) @ Ñ @ ó € z J F 4) : o ± ± * K r • i U' ! Í ‡
Ç ± ± ž Ò h v “ !



! ° { > ó P % z

80 ; ¼ = Ø 5 ... (g “K• N Ä z † † † µ U' “ = ’ † † 2 (D 5 y z / \$ + ! N Ä N ù N C B E @ 5 y - A / £ Ä z ç ... U ' 5 ... * U M - g T •
> 3 ½ ; Á * U - \ * ä / 8 È Ó Ñ ! 5 ... æ - A / £ ... ! Ä L E G D ó U F O V S F @ ñ] U' x t g J - 5 ... æ † µ ! 5 • 5 5 ... (K u « C w g • “
. p “K• † µ U' 6 G M ! ç , % æ ' Ò È !

薪
火
相

\$ ' \;ëXìCÇ^'§

ìK•ø ð ÒM% M Uÿ) Sñ+À O™ a• 7ü%É•8ä ÿÜK³-A/£ f U , { Eİİ8ä0Y¹ w.þ " İ2O f Uª x(Ü8ä
 ÿ>-9Æ Ü "52 f U@à•K'8ä ÿ,þ A • f U("ä ÄLC8ä ÿ5+BJA f U zK•ø U0Y¹ wKIFü!!•"0 B" Z Ö8ä T fU'
 £ Z(, I+Ë Mİç Ep 8äFþ f U/Ó"+Ä8äJ# f U <J "È 5Ä T8äJ f U { Í# Ku }• Bç¹ TÆ 6 7 Ku 6• W = € M § p8ä E
 .í f!
 'Fþ Kó æL•U' Y ÿ Ó ° ²\@İ]BS)B• ç!> . þU' ° C2\@İ]BS)B•4» p þ! Ý@ë/øİþ | f "Fþ 4
 0«0Y 6 L -J K•ø f "Fþ '0Y¹ L ;"•þ -H Ý f "Fþ |@ÛU'7 'U' Y ÿ Ó ž 6K•3Ö f Ö "Fþ M!!





微信公众号

网站: www.math.pku.edu.cn

