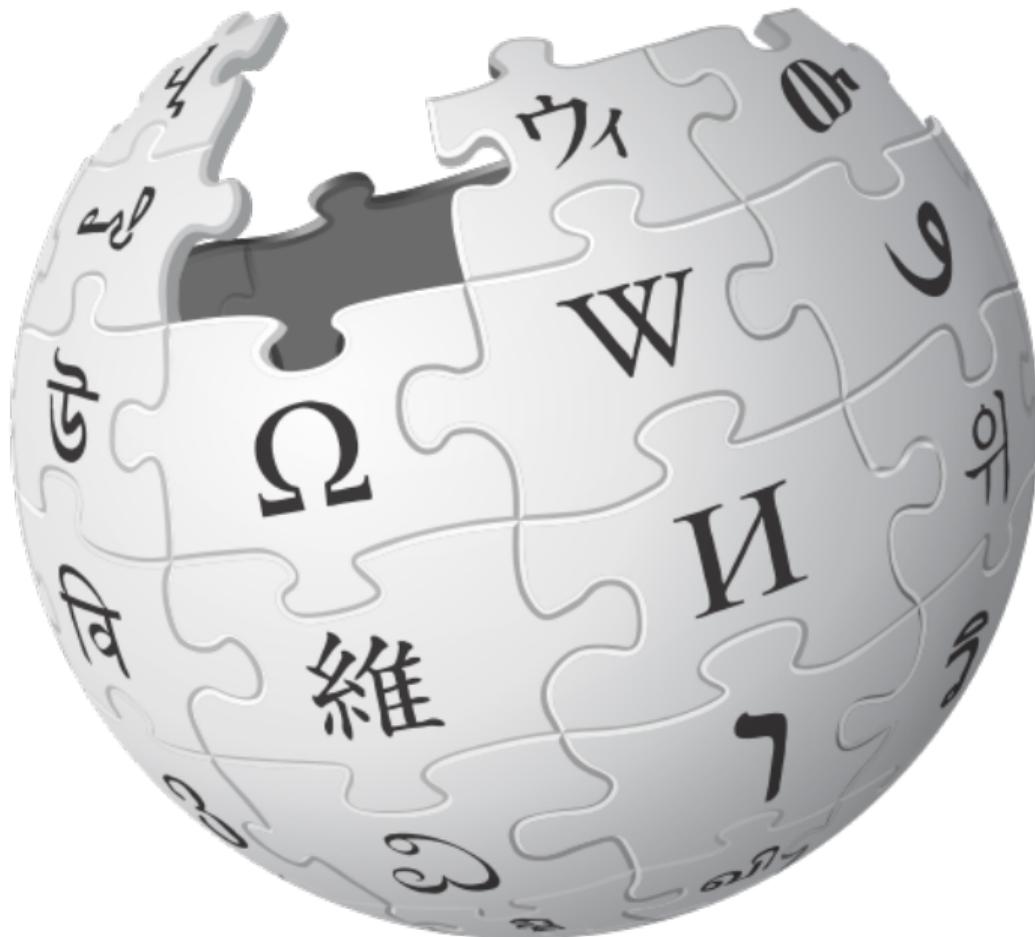


Pre-read for Tuesday, November 5: Predictability of life trajectories

Matthew J. Salganik

COS 597E/SOC 555 Limits to prediction
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Initial sequencing and analysis of the human genome

International Human Genome Sequencing Consortium*

** A partial list of authors appears on the opposite page. Affiliations are listed at the end of the paper.*

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Genome Sequencing Centres (Listed in order of total genomic sequence contributed, with a partial list of personnel. A full list of contributors at each centre is available as Supplementary Information.)

Whitehead Institute for Biomedical Research, Center for Genome Research: Eric S. Lander¹, Lauren M. Linton¹, Bruce Birren^{1,2}, Chad Nusbaum¹, Michael C. Zody¹, Jennifer Baldwin¹, Keri Devos¹, Ken Dewar¹, Michael Doyle¹, William FitzHugh¹, Reed Funke¹, Diane Gage¹, Katrina Harris¹, Andrew Heaford¹, John Howard¹, Lisa Kane¹, Jessica Lehoczky¹, Rosie LeVine¹, Paul McEwan¹, Kevin McKernan¹, James Medrano¹, Jill P. Mesirov¹, Cher Miranda¹, William Morris¹, Jerome Naylor¹, Christina Raymond¹, Mark Rose¹, Ralph Santos¹, Andrew Sheridan¹, Carrie Souza¹, Nicole Stange-Thomann¹, Nikola Stojanovic¹, Aravind Subramanian¹ & Dudley Wymann¹

The Sanger Centre: Jane Rogers², John Sulston², Rachael Ainscough², Stephen Beck², David Bentley², John Burton², Christopher Clew², Nigel Carter², Alan Coulson², Rebecca Deadman², Panos Deloukas², Andrew Dunham², Ian Dunham², Richard Durbin², Lisa French², Darren Graffham², Simon Gregory², Tim Hubbard², Sean Humphray², Adrienne Hunt², Matthew Jones², Christine Lloyd², Amanda McMurray², Lucy Matthews², Simon Mercer², Sarah Milne², James C. Mullikin², Andrew Mungall², Robert Plumb², Mark Ross², Ratna Showkhet² & Sarah Sims²

Washington University Genome Sequencing Center: Robert H. Waterston³, Richard K. Wilson³, Linda W. Hillier³, John D. McPherson³, Marco A. Marra³, Elaine R. Mardis³, Lucinda A. Fulton³, Asil T. Chimwalla³, Kymbalie H. Pepin³, Warren R. Gish³, Stephanie L. Chissoe³, Michael C. Wendt³, Kim D. Delehaunty³, Tracie L. Miner³, Andrew Delehaunty³, Jason B. Kramer³, Lisa L. Cook³, Robert S. Fulton³, Douglas L. Johnson³, Patrick J. Minx³ & Sandra W. Clifton³

US DOE Joint Genome Institute: Trevor Hawkins⁴, Elbert Branscomb⁴, Paul Prelik⁴, Paul Richardson⁴, Sarah Wenning⁴, Tom Slezak⁴, Norman Doggett⁴, Jan-Fang Cheng⁴, Anne Olsen⁴, Susan Lucas⁴, Christopher Elkin⁴, Edward Überbacher⁴ & Marvin Frazier⁴

Baylor College of Medicine Human Genome Sequencing Center: Richard A. Gibbs⁵, Donna M. Muzny⁵, Steven E. Scherer⁵, John B. Bouck⁵, Erica J. Sodergren⁵, Kim C. Worley⁵, Catherine M. Rives⁵, James H. Gorrell⁵, Michael L. Metzker⁵, Susan L. Nayor⁵, Raju S. Kucherlapati⁵, David L. Nelson⁵, & George M. Weinstock⁵

RIKEN Genomic Sciences Center: Yoshiyuki Sakai⁶, Aso Fujiyama⁶, Masahira Hattori⁶, Tetsushi Yada⁶, Atsushi Toyoda⁶, Takehiko Itoh⁶, Chituru Kawagoe⁶, Hidetoshi Watanabe⁶, Yasutomo Tokai⁶ & Todd Taylor⁶

Genoscope and CNRS UMR-8030: Jean Weissenbach^{7,8}, Roland Heilig⁷, William Saurin⁷, Francois Artiguenave⁷, Philippe Brottier⁷, Thomas Brûlé⁷, Eric Pelletier⁷, Catherine Robert⁷ & Patrick Wincker^{7,8}

GTC Sequencing Center: Douglas R. Smith⁹, Lynn Doucette-Stamm⁹, Marc Rubenfield⁹, Keith Weinstock⁹, Hong Mei Lee⁹ & JoAnn Dubois⁹

Department of Genome Analysis, Institute of Molecular

Biotechnology: André Rosenthal¹², Matthias Platzer¹², Gerald Nyakatura¹², Stefan Taudien¹² & Andreas Rump¹²

Huanning Yang¹³, Jun Yu¹³, Jian Wang¹³, Guyang Huang¹⁴ & Jun Gu¹⁵

Mulligenome Sequencing Center, The Institute for Systems Biology: Leroy Hood¹⁶, Lee Rowen¹⁶, Anup Madan¹⁶ & Shizhen Qin¹⁶

Stanford Genome Technology Center: Ronald W. Davis¹⁷, Nancy A. Federspil¹⁷, A. Pia Abolt¹⁷ & Michael J. Proctor¹⁷

Stanford Human Genome Center: Richard M. Myers¹⁸, Jeremy Schmutz¹⁸, Mark Dickson¹⁸, Jane Grimwood¹⁸ & David R. Cox¹⁸

University of Washington Genome Center: Maynard V. Olson¹⁹, Rajinder Kaul¹⁹ & Christopher Raymond¹⁹

Department of Molecular Biology, Keio University School of Medicine: Nobuyoshi Shimizu²⁰, Kazuhiko Kawasaki²⁰ & Shinsei Minoshima²⁰

University of Texas Southwestern Medical Center at Dallas: Glen A. Evans²¹, Maria Athanasiou²¹ & Roger Schultz²¹

University of Oklahoma's Advanced Center for Genomics Technology: Bruce A. Roe²², Feng Chen²² & Huaiqin Pan²²

Max Planck Institute for Molecular Genetics: Juliane Ramser²³, Hans Lehrach²³ & Richard Reinhardt²³

Cold Spring Harbor Laboratory, Lita Annenberg Hazen Genome Center: W. Richard McCombie²⁴, Melissa de la Bastide²⁴ & Neillay Dedhia²⁴

GBF—German Research Centre for Biotechnology: Helmut Blocker²⁵, Klaus Hornischer²⁵ & Gabriele Nordiek²⁵

*** Genome Analysis Group (listed in alphabetical order, also includes individuals listed under other headings)**

Richa Agarwal²⁶, L. Aravinda²⁶, Jeffrey A. Bailey²⁶, Alex Bateman²⁶, Serafin Batzoglou²⁶, Eva Birney²⁶, Peter Bork^{26,28}, Daniel G. Brown²⁶, Christopher B. Burtt²⁶, Lorenzo Cerutti²⁶, Helen-Chun Lin Chen²⁶, Deanna Church^{26,28}, Michael Clamp²⁶, Richard R. Copely²⁶, Tobias Doerge^{26,28}, Sean R. Eddy²⁶, Evan E. Eshke²⁶, Terrence S. Fugger²⁶, James Galagan²⁶, James G. R. Gilbert²⁶, Cyrus Honarvar²⁶, Yoshihide Hayashizaki²⁶, David Haussler²⁶, Henning Hermjakob²⁶, Karsten Hockamp²⁶, Wonhee Jang²⁶, L. Steven Johnson²⁶, Thomas A. Jones²⁶, Simon Kasif²⁶, Ark Kasparyan²⁶, Scott Kennedy²⁶, W. James Kent²⁶, Paul Kiths²⁶, Eugene V. Koonin²⁶, Ian Korf²⁶, David Kulp²⁶, Doron Lancet²⁶, Todd M. Lowe²⁶, Aroffe Mclysaght²⁶, Tarjei Mikkelsen²⁶, John V. Moran²⁶, Nicola Mulder²⁶, Victor J. Pollara²⁶, Chris P. Ponting²⁶, Greg Schuler²⁶, Jörg Schulz²⁶, Guy Slater²⁶, Arian F. A. Smith²⁶, Elia Stupka²⁶, Joseph Szustakowski²⁶, Danièle Thierry-Mieg²⁶, Jean Thierry-Mieg²⁶, Lukas Wagner²⁶, John Wallis²⁶, Raymond Wheeler²⁶, Alan Williams²⁶, Yuri I. Wolf²⁶, Kenneth H. Wolfe²⁶, Shiaw-Pyng Yang²⁶ & Ru-Fang Yeh²⁶

Scientific management: National Human Genome Research Institute, US National Institutes of Health: Francis Collins²⁹, Mark S. Guyer²⁹, Jane Peterson²⁹, Adam Fleischman²⁹, Kris A. Wetterstrand²⁹; Office of Science, US Department of Energy: Aristides Patrinos²⁹; The Wellcome Trust: Michael J. Morgan²⁹



Combined Measurement of the Higgs Boson Mass in pp Collisions at $\sqrt{s} = 7$ and 8 TeV with the ATLAS and CMS Experiments

G. Aad *et al.*^{*}

(ATLAS Collaboration)[†]

(CMS Collaboration)[‡]

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- G. Aad,^{85,†} B. Abbott,^{113,†} J. Abdallah,^{151,†} O. Abdinov,^{11,†} R. Aben,^{107,†} M. Abolins,^{90,†} O. S. AbouZeid,^{158,†} H. Abramowicz,^{155,†} H. Abreu,^{152,†} R. Abreu,^{203,†} Y. Abulaiti,^{146a,146b,b†} B. S. Acharya,^{164,164b,b†} L. Adamczyk,^{38a,†} D. L. Adams,^{28,†} J. Adelman,^{108,†} S. Adomeit,^{103,†} T. Adye,^{131,†} A. A. Afzalider,^{74,†} T. Agatominic-Jovin,^{13,†} J. A. Aguilar-Saavedra,^{12a,12b,†} S. P. Ahlen,^{22,†} F. Ahmedov,^{102,†} G. Aielli,^{133a,133b,†} H. Alkenstedt,^{146a,146b,†} T. P. Åkesson,^{81,†} G. Akimoto,^{155,†} A. V. Akimov,^{96,†} G. L. Alberghi,^{20a,20b,†} J. Albert,^{109,†} S. Albrand,^{53,†} M. J. Alcomada Verzini,^{71,†} M. Aleksić,^{30,†} I. N. Aleksandrov,^{65,†} C. Alexa,^{20a,†} G. Alexander,^{153,†} T. Alexopoulos,^{10,†} M. Althroop,^{113,†} G. Altimonti,^{91a,8} L. Alio,^{85,†} J. Alison,^{31,†} S. P. Alkire,^{35,†} B. M. M. Allbrooke,^{18,†} P. P. Allport,^{74,†} A. Aloisio,^{104a,104b,†} A. Alonso,^{36,†} F. Alonso,^{71,†} C. Alpigiani,^{76,†} A. Altheimer,^{35,†} B. Alvarez Gonzalez,^{20,†} D. Álvarez Piqueras,^{167,†} M. G. Alviggi,^{104a,104b,†} B. T. Amadio,^{15,†} K. Amako,^{66,†} Y. Amaral Contimino,^{24,†} C. Ameling,^{23,†} D. Amidei,^{80,†} S. P. Amor Dos Santos,^{126a,126c,†} A. Amorim,^{126a,126b,†} S. Amoroso,^{48,†} N. Anram,^{153,†} G. Amundsen,^{23,†} C. Anastopoulos,^{116,†} L. S. Anzu,^{90,†} N. Andari,^{20,†} T. Andeen,^{35,†} C. F. Anders,^{20b,†} G. Anders,^{30,†} J. K. Anders,^{24,†} K. J. Anderson,^{11,†} A. Andrezza,^{94a,94b,†} V. Andrei,^{20a,†} S. Angelidakis,^{8,†} I. Angelozzi,^{107,†} P. Anger,^{44,†} A. Angerami,^{35,†} F. Anghinolfi,^{30,†} A. V. Anisenkov,^{109,†} N. Anjos,^{12,†} A. Annovi,^{93,†} M. Antonelli,^{47,†} A. Antonov,^{98,†} J. Antos,^{144b,†} F. Anulli,^{132a,†} M. Aoki,^{66,†} L. Aperio Bella,^{18,†} G. Arابيذز,^{97,†} Y. Araújo,^{60,†} J. P. Araújo,^{126a,†} A. T. H. Arce,^{45,†} F. A. Arditti,^{74,†} J. Argandoña,^{80,†} S. Argyropoulos,^{42,†} M. Arik,^{78a,†} A. J. Armbruster,^{20,†} O. Arnaez,^{30,†} V. Arnal,^{82,†} H. Arnold,^{48,†} M. Arratia,^{76,†} O. Arshan,^{21,†} A. Artamonov,^{97,†} G. Artoni,^{73,†} S. Asai,^{155,†} N. Asibul,^{12,†} A. Ashkenazi,^{153,†} B. Åsman,^{146a,146b,†} L. Asquith,^{149,†} K. Assamagan,^{25,†} R. Astalos,^{144,†} M. Atkinson,^{165,†} N. B. Atlay,^{141,†} B. Auerbach,^{6,†} K. Augusten,^{128,†} M. Auroousseau,^{145b,†} G. Avolio,^{30,†} B. Axen,^{15,†} M. K. Ayoub,^{117,†} G. Azuelos,^{30,†} M. A. Baak,^{30,†} A. E. Baas,^{56a,†} C. Bacci,^{136a,134b,†} H. Bachacou,^{136,†} K. Bachas,^{154,†} M. Backes,^{30,†} M. Backhaus,^{16,†} E. Badescu,^{26a,†} P. Bagiaci,^{132a,132b,†} C. Bagnai,^{97,†} Y. Bai,^{33a,†} T. Baches,^{35,†} J. T. Barnes,^{131,†} O. K. Baker,^{178,†} P. Ballek,^{129,†} T. Balestri,^{148,†} F. Ballí,^{84,†} E. Baines,^{88,†} S. Van Banerjee,^{175,†} A. E. Bannoura,^{175,†} H. S. Bansil,^{18,†} L. Barak,^{30,†} S. P. Baranov,^{96,†} E. L. Barberio,^{28,†} D. Barberis,^{85,†} T. Barillari,^{101,†} M. Barisonzi,^{164a,164b,†} T. Barklow,^{143,†} N. Barklow,^{28,†} S. L. Barnes,^{94,†} B. M. Barnett,^{151,†} R. M. Barnett,^{151,†} Z. Barnovska,^{8,†} A. Baroncelli,^{134a,†} G. Barone,^{49,†} A. J. Barr,^{120,†} F. Barreiro,^{82,†} J. Barreiro Guimaraes da Costa,^{57,†} R. Bartoldus,^{143,†} A. E. Barton,^{72,†}

- P. Bartos,^{144a,†} A. Bassalat,^{117,‡} A. Basye,^{165,§} R. L. Bates,^{53,||} S. J. Batista,^{158,†} J. R. Batley,^{28,†} M. Battaglia,^{137,†}
 M. Baute,^{132a,132b,†} F. Bauer,^{136,†} H. S. Bawa,^{143,†} J. B. Beacham,^{113,†} M. D. Beattie,^{72,†} T. Beau,^{30,†} P. H. Beauchemin,^{161,†}
 R. Beccerle,^{124a,124b,†} P. Bechle,^{21,†} H. P. Beck,^{17,†} K. Becker,^{120,†} M. Becker,^{33,†} S. Becker,^{100,†} M. Beckingham,^{170,†}
 C. Becot,^{117,†} A. J. Beddall,^{196,†} A. Beddall,^{196,†} V. A. Bednyakov,^{65,†} C. P. Bee,^{148,†} L. J. Beemster,^{107,†} T. A. Beermann,^{175,†}
 M. Begel,^{25,†} J. K. Behr,^{120,†} C. Belanger-Champagne,^{117,†} W. H. Bell,^{46,†} G. Bella,^{153,†} L. Bellagamba,^{20,†} A. Bellervie,^{29,†}
 M. Bellomo,^{67,†} K. Belotskiy,^{96,†} O. Beltramello,^{30,†} O. Benary,^{153,†} D. Benchekroun,^{175a,†} M. Bender,^{100,†}
 K. Bendtz,^{146a,146b,†} N. Benekos,^{10,†} Y. Benhamou,^{153,†} E. Benlhar Noccioli,^{49,†} J. A. Benitez Garcia,^{159b,†}
 D. P. Benjamin,^{45,†} J. R. Beminger,^{23,†} S. Bentvelzen,^{107,†} L. Beresford,^{120,†} M. Beretta,^{47,†} D. Berge,^{107,†}
 E. Berganeas Kuutmann,^{166,†} N. Berger,^{7,†} F. Bergius,^{168,†} J. Beringer,^{152,†} C. Bernard,^{22,†} N. R. Bernard,^{46,†} C. Bernius,^{100,†}
 F. U. Bernlochner,^{21,†} T. Berry,^{77,†} P. Berta,^{120,†} C. Bertella,^{83,†} G. Bertoli,^{146a,146b,†} F. Beritolucci,^{124a,124b,†} C. Berutsche,^{113,†}
 D. Berutsche,^{113,†} M. I. Besana,^{91,†} G. J. Besjes,^{106,†} O. Bessidkaiia Bylund,^{146,146b,†} M. Bessner,^{42,†} N. Besson,^{136,†}
 C. Betancourt,^{48,†} S. Bethke,^{101,†} A. J. Bevan,^{76,†} W. Bhimji,^{46,†} R. M. Bianchi,^{128,†} L. Bianchini,^{5,†} M. Bianco,^{101,†}
 O. Biebel,^{100,†} S. P. Bienniek,^{76,†} M. Biglietti,^{124,†} J. Bilbao De Mendozaib,^{94,†} H. Bilokon,^{67,†} M. Bindl,^{34,†} S. Binet,^{177,†}
 A. Biegel,^{192,†} C. Bini,^{132a,132b,†} C. Black,^{130,†} J. E. Black,^{143,†} K. M. Black,^{22,†} D. Blackburn,^{138,†} R. E. Blair,^{6,†}
 J.-B. Blanchard,^{136,†} J. E. Blanco,^{77,†} T. Blazek,^{144,†} I. Bloch,^{42,†} C. Blocker,^{23,†} W. Blum,^{83,†} U. Blumenschein,^{154,†}
 G. J. Bobbink,^{107,†} V. S. Bobrovnikov,^{109,†} S. S. Bobetta,^{81,†} A. Bocci,^{45,†} C. Bock,^{100,†} M. Boehler,^{48,†} J. A. Bogaerts,^{30,†}
 A. G. Bogdanchikov,^{109,†} C. Bohm,^{146a,†} V. Boisvert,^{77,†} T. Bold,^{38a,†} V. Bolden,^{26a,†} A. S. Boldyreva,^{99,†} M. Bomben,^{20,†}
 M. Bona,^{76,†} M. Boonekamp,^{136,†} A. Borisov,^{130,†} G. Borissow,^{72,†} S. Borroni,^{42,†} J. Borfeldt,^{100,†} V. Bortolotto,^{60a-60c,†}
 K. Bos,^{107,†} D. Boscherini,^{20a,†} M. Bosman,^{12,†} J. Boudreau,^{125,†} J. Bouffard,^{2,†} E. V. Bouhouva-Thacker,^{72,†}
 D. Boumediene,^{34,†} C. Bourdarios,^{117,†} N. Bousson,^{114,†} A. Boveia,^{30,†} J. Boyd,^{30,†} I. R. Boyko,^{65,†} I. Bozic,^{13,†}
 J. Bracnik,^{161,†} A. Brandt,^{8,†} G. Brandt,^{54,†} O. Brando,^{56a,†} U. Bratzler,^{56,†} B. Brau,^{46,†} J. E. Brau,^{116,†} H. M. Braun,^{175a,†}
 S. F. Brazzale,^{164a,164c,†} K. Brendlinger,^{122,†} A. J. Brennan,^{88,†} I. Brenner,^{107,†} R. Bremmer,^{166,†} S. Bressler,^{172,†}
 K. Bristow,^{145,†} T. M. Bristow,^{46,†} D. Britton,^{55,†} D. Britzger,^{42,†} H. P. Brochu,^{20,†} I. Brock,^{21,†} R. Brock,^{90,†} J. Bronner,^{101,†}
 G. Brooijmans,^{35,†} T. Brooks,^{77,†} W. K. Brooks,^{11,†} J. Brosamer,^{15,†} E. Brosa,^{116,†} J. Brown,^{55,†}
 P. A. Bruckman de Renstrom,^{96,†} D. Bruncko,^{144b,†} R. Bruneliere,^{44,†} A. Brun,^{20a,†} G. Bruni,^{20a,†} M. Bruschi,^{20a,†}
 L. Bryngmark,^{107,†} T. Buanes,^{14,†} Q. Buat,^{142,†} P. Bucholz,^{141,†} A. G. Buckley,^{53,†} S. I. Bud,^{26a,†} I. A. Budagov,^{65,†}
 F. Bueher,^{48,†} L. Bugge,^{119,†} M. K. Bugge,^{119,†} O. Bulekov,^{96,†} D. Bullock,^{8,†} H. Burckhardt,^{30,†} S. Burdin,^{74,†}
 B. Burghgraeve,^{108,†} S. Burke,^{131,†} I. Burmeister,^{43,†} E. Busato,^{54,†} D. Bischier,^{48,†} V. Buscher,^{83,†} P. Bussey,^{55,†}
 C. P. Buszello,^{166,†} J. M. Butler,^{22,†} A. I. Butt,^{3,†} C. M. Buttar,^{53,†} M. J. Butterworth,^{76,†} P. Butt,^{107,†} W. Buttiner,^{28,†}
 A. Butazu,^{53,†} R. Vykyacky,^{109,†} S. Cabrera Urbán,^{167,†} D. Caforio,^{128,†} V. M. Cairo,^{37a,37b,†} O. Cakir,^{34,†} P. Calafuria,^{15,†}
 A. Calandri,^{136,†} G. Calderini,^{103,†} P. Califayan,^{100,†} L. P. Caloba,^{26c,†} D. Calvet,^{34,†} S. Calvet,^{34,†} R. Camacho Toro,^{31,†}
 S. Camarda,^{42,†} P. Camari,^{113a,113b,†} D. Cameron,^{119,†} L. M. Caminada,^{15,†} R. Caminal Armadans,^{12,†} S. Campaña,^{30,†}
 M. Campanelli,^{78,†} A. Campanero,^{148,†} V. Canale,^{104a,104b,†} A. Canepa,^{126a,†} M. Canete,^{76,†} J. Cantero,^{33,†}
 R. Cantrell,^{126a,†} T. Cao,^{40,†} M. D. M. Capaen Garrido,^{103,†} I. Caprini,^{20a,†} M. Caprini,^{20a,†} M. Capua,^{17a,37b,†} R. Caputo,^{33,†}
 R. Cardarelli,^{135a,†} T. Carli,^{30,†} G. Carlini,^{104a,†} L. Carmignani,^{91,91b,†} S. Caron,^{106,†} E. Carquin,^{32a,†} G. D. Carrillo-Montoya,^{8,†}
 J. R. Carter,^{28,†} J. Carvalho,^{126a,126b,†} D. Casadei,^{78,†} M. P. Casado,^{12,†} M. Casolino,^{12,†} E. Castaneda-Miranda,^{145b,†}
 A. Castelli,^{107,†} V. Castille Giménez,^{167,†} N. F. Castro,^{126b,†} P. Catastini,^{27,†} A. Catinaccio,^{30,†} J. R. Catmore,^{119,†}
 A. Catta,^{30,†} J. Caudron,^{131,†} V. Cavaliere,^{165,†} D. Cavalli,^{21a,†} M. Cavalli-Sforza,^{12,†} V. Cavassini,^{124a,124b,†}
 R. Cherkaoui El Mouslih,^{135c,†} V. Chemerinyat,^{11,†} E. Cheu,^{7,†} L. Chevalier,^{138,†} V. Chiarella,^{47,†} J. T. Chidlers,^{6,†}
 G. Chiodini,^{18,†} A. S. Chisholm,^{18,†} R. T. Chislett,^{78,†} A. Chitan,^{26a,†} M. V. Chizhov,^{65,†} K. Choi,^{41,†} S. Chouridou,^{9,†}
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- S. Wilbur,^{301,2} R. Yohay,^{301,2} R. Cousins,^{302,3} P. Everaerts,^{302,2} C. Farrell,^{302,2} J. Hauser,^{302,2} M. Ignatenko,^{302,2} G. Rakness,^{302,2} D. Soltzberg,^{302,2} T. Vakulov,^{302,2} M. Weber,^{302,2} K. Burt,^{303,2} R. Clare,^{303,2} J. Ellison,^{303,2} J. W. Gary,^{303,2} G. Hanson,^{303,2} J. Heilman,^{303,2} M. Ivova Rikova,^{303,2} P. Jandir,^{303,2} E. Kennedy,^{303,2} F. Lacroix,^{303,2} O. R. Long,^{303,2} A. Luthra,^{303,2} M. Maliberti,^{303,2} M. Olmedo Negrete,^{303,2} A. Shrinivas,^{303,2} S. Sumowidagdo,^{303,2} H. Wei,^{303,2} S. Wimpenny,^{304,3} J. G. Branson,^{304,3} G. B. Cerati,^{304,3} S. Cittolin,^{304,3} R. T. D'Agnolo,^{304,3} A. Holzner,^{304,3} R. Kelley,^{304,3} D. Klein,^{304,3} J. Letts,^{304,3} I. Macneill,^{304,3} D. Olivito,^{304,3} S. Padhi,^{304,3} M. Pieri,^{304,3} M. Sani,^{304,3} V. Sharma,^{304,3} S. Simon,^{304,3} M. Tadel,^{304,3} Y. Tu,^{304,3} A. Vartak,^{304,3} S. Wasserbaech,^{304,3} C. Welke,^{304,3} F. Würthwein,^{304,3} A. Yagil,^{304,3} G. Zevi Della Porta,^{304,3} D. Barge,^{305,2} J. Bradmiller-Feld,^{305,2} C. Campagnari,^{305,2} A. Dishaw,^{305,2} V. Dutta,^{305,2} K. Flowers,^{305,2} M. Franco Sevilla,^{305,2} P. Geffert,^{305,2} C. George,^{305,2} F. Golf,^{305,2} L. Gouskos,^{305,2} J. Gran,^{305,2} J. Incandela,^{305,2} C. Justus,^{305,2} N. McCall,^{305,2} S. D. Mullin,^{305,2} J. Richman,^{305,2} D. Stuart,^{305,2} I. Suarez,^{305,2} W. To,^{305,2} C. West,^{305,2} J. Yoo,^{305,2} D. Anderson,^{306,2} A. Apresyan,^{306,2} A. Bornheim,^{306,2} J. Bunn,^{306,2} Y. Chen,^{306,2} J. Duarte,^{306,2} A. Mott,^{306,2} H. B. Newman,^{306,2} C. Pena,^{306,2} M. Pierini,^{306,2} M. Spiropulu,^{306,2} J. R. Vlimant,^{306,2} S. Xie,^{306,2} R. Y. Zhu,^{306,2} V. Azzolini,^{307,2} A. Calambu,^{307,2} B. Carlson,^{307,2} T. Ferguson,^{307,2} Y. Iiyama,^{307,2} M. Paulini,^{307,2} J. Russ,^{307,2} M. Sun,^{307,2} H. Vogel,^{307,2} I. Vorobev,^{307,2} J. Cumalat,^{308,2} W. T. Ford,^{308,2} A. Gaz,^{308,2} F. Jensen,^{308,2} A. Johnson,^{308,2} M. Krohn,^{308,2} T. Mulholland,^{308,2} U. Nauenberg,^{308,2} J. G. Smith,^{308,2} K. Stenson,^{308,2} S. R. Wagner,^{308,2} J. Alexander,^{309,2} A. Chatterjee,^{309,2} J. Chaves,^{309,2} J. Chu,^{309,2} S. Dittmer,^{309,2} N. Eggert,^{309,2} N. Mirman,^{309,2} G. Nicolas Kaufman,^{309,2} J. R. Patterson,^{309,2} A. Rinkevicius,^{309,2} A. Ryd,^{309,2} L. Skinnari,^{309,2} L. Soffi,^{309,2} W. Sun,^{309,2} S. M. Tan,^{309,2} W. D. Teo,^{309,2} J. Thom,^{309,2} J. Thompson,^{309,2} J. Tucker,^{309,2} Y. Weng,^{309,2} P. Wittich,^{309,2} S. Abdulla,^{310,2} M. Albrow,^{310,2} J. Anderson,^{310,2} G. Apollinari,^{310,2} L. A. T. Bauerdtick,^{310,2} A. Beretvas,^{310,2} J. Berryhill,^{310,2} P. C. Bhan,^{310,2} G. Bella,^{310,2} K. Burkett,^{310,2} J. N. Butler,^{310,2} H. W. K. Cheung,^{310,2} F. Chlebana,^{310,2} S. Cihangir,^{310,2} V. D. Elvira,^{310,2} I. Fisk,^{310,2} J. Freeman,^{310,2} E. Gottschall,^{310,2} L. Gray,^{310,2} D. Green,^{310,2} S. Grinendahl,^{310,2} O. Gutscche,^{310,2} R. J. Hamlon,^{310,2} D. Hare,^{310,2} R. M. Harris,^{310,2} J. Hirschauer,^{310,2} H. Hooberman,^{310,2} Z. Hu,^{310,2} S. Jindariani,^{310,2} M. Johnson,^{310,2} U. Joshi,^{310,2} A. W. Jung,^{310,2} B. Klimek,^{310,2} B. Kreis,^{310,2} S. Kwan,^{310,2} S. Lammel,^{310,2} J. Linacre,^{310,2} D. Lincoln,^{310,2} R. Lipton,^{310,2} T. Liu,^{310,2} R. Lopes De Sa,^{310,2} J. Lykken,^{310,2} K. Maeshima,^{310,2} J. M. Marafatto,^{310,2} V. I. Martinez Outschoorn,^{310,2} S. Maruyama,^{310,2} D. Mason,^{310,2} P. McBride,^{310,2} P. Merkel,^{310,2} K. Mishra,^{310,2} S. Mirena,^{310,2} S. Nahm,^{310,2} C. Newman-Holmes,^{310,2} V. O'Dell,^{310,2} O. Prokofyev,^{310,2} E. Sexton-Kennedy,^{310,2} A. Soha,^{310,2} W. J. Spalding,^{310,2} L. Spiegel,^{310,2} L. Taylor,^{310,2} S. Tkaczyk,^{310,2} N. V. Tran,^{310,2} L. Uplegger,^{310,2} E. W. Vaandering,^{310,2} C. Vernieri,^{310,2} M. Verzocchi,^{310,2} R. Vidal,^{310,2} A. Whitebeck,^{310,2} F. Yang,^{310,2} H. Yin,^{310,2} D. Acosta,^{311,2} P. Avery,^{311,2} P. Bortignon,^{311,2} A. Carneiro,^{311,2} M. Carter,^{311,2} D. Curry,^{311,2} S. Das,^{311,2} C. Di Giovanni,^{311,2} R. D. Field,^{311,2} M. Fisher,^{311,2} I. K. Fury,^{311,2} J. Hugon,^{311,2} J. Konigsberg,^{311,2} A. Korytov,^{311,2} J. F. Low,^{311,2} P. Ma,^{311,2} K. Matchev,^{311,2} H. Mei,^{311,2} P. Milenovic,^{311,2} G. Mitselmakher,^{311,2} L. Muniz,^{311,2} D. Rank,^{311,2} L. Shchutskova,^{311,2} M. Snowball,^{311,2} D. Sperka,^{311,2} S. J. Wang,^{311,2} J. Yelton,^{311,2} S. Hewamanage,^{312,2} J. Linn,^{312,2} P. Markowitz,^{312,2} G. Martinez,^{312,2} J. L. Rodriguez,^{312,2} A. Ackert,^{312,2} J. R. Adams,^{312,2} T. Adams,^{312,2} A. Askew,^{312,2} J. Bochenek,^{312,2} B. Diamond,^{312,2} J. Haa,^{312,2} S. Hapogian,^{312,2} V. Hapogian,^{312,2} K. F. Johnson,^{312,2} A. Khatiwada,^{312,2} H. Prosper,^{312,2} V. Veeraraghavan,^{312,2} M. Weinberg,^{312,2} V. Bhopatkar,^{312,2} M. Hohlmann,^{312,2} H. Kalakrety,^{312,2} D. Mareska-paleck,^{312,2} T. Roy,^{312,2} F. Yumiceva,^{312,2} M. R. Adams,^{312,2} L. Apanashevich,^{312,2} D. Berry,^{312,2} R. R. Betts,^{312,2} I. Bucimski,^{312,2} R. Cavanagh,^{312,2} O. Evdokimov,^{312,2} L. Gauthier,^{312,2} C. E. Gerber,^{312,2} D. J. Hofman,^{312,2} P. Kurt,^{312,2} C. O'Brien,^{312,2} I. D. Sandoval Gonzalez,^{312,2} C. Silkworth,^{312,2} P. Turner,^{312,2} N. Varelas,^{312,2} Z. Wu,^{312,2} M. Zakaria,^{312,2} B. Billi,^{312,2} W. Clarida,^{312,2} K. Diliz,^{312,2} S. Durgut,^{312,2} P. Turner,^{312,2} N. Varelas,^{312,2} Z. Wu,^{312,2} M. Zakaria,^{312,2} B. Billi,^{312,2} W. Clarida,^{312,2} K. Diliz,^{312,2} A. Mestvirishvili,^{312,2} A. Moeller,^{312,2} J. Nachtmann,^{312,2} H. Ogul,^{312,2} Y. Onel,^{312,2} F. Ozrok,^{312,2} A. Penzo,^{312,2} C. Snyder,^{312,2} P. Tan,^{312,2} E. Tiras,^{312,2} J. Wetzel,^{312,2} K. Yi,^{312,2} I. Anderson,^{312,2} B. A. Barnett,^{312,2} B. Blumenfeld,^{312,2} D. Fehling,^{312,2} L. Feng,^{312,2} A. V. Grisits,^{312,2} P. Maksumovic,^{312,2} C. Martin,^{312,2} K. Nash,^{312,2} M. Osherson,^{312,2} M. Swartz,^{312,2} M. Xian,^{312,2} Y. Xin,^{312,2} P. Baringer,^{312,2} A. Bean,^{312,2} G. Benelli,^{312,2} C. Bruner,^{312,2} J. Gray,^{312,2} R. P. Kenny III,^{312,2} D. Majumder,^{312,2} M. Malek,^{312,2} M. Murray,^{312,2} D. Noonan,^{312,2} S. Sanders,^{312,2} R. Stringer,^{312,2} Q. Wang,^{312,2} J. S. Wood,^{312,2} I. Chakaberia,^{312,2} A. Ivanov,^{312,2} K. Kaadze,^{312,2} S. Khalil,^{312,2} M. Makouski,^{312,2} Y. Maravin,^{312,2} L. K. Saini,^{312,2} N. Skhirtladze,^{312,2} I. Svintradze,^{312,2} S. Toda,^{312,2} D. Lange,^{312,2} F. Rebassoo,^{312,2} D. Wright,^{312,2} C. Anelli,^{321,2} A. Baden,^{321,2} O. Baron,^{321,2} A. Bellomi,^{321,2} B. Calvert,^{321,2} S. C. Eno,^{321,2} C. Ferraioli,^{321,2} J. A. Gomez,^{321,2} N. J. Hadley,^{321,2} S. Jabeen,^{321,2} R. G. Kellogg,^{321,2} T. Kolberg,^{321,2} J. Kunkle,^{321,2} Y. Lu,^{321,2}

- A. C. Mignerey,^{321,†} K. Pedro,^{321,‡} Y. H. Shin,^{321,§} A. Skuja,^{321,§} M. B. Tonjes,^{321,§} S. C. Tonwar,^{321,§} A. Apyan,^{322,§} R. Barberi,^{322,§} A. Baty,^{322,§} K. Bierwagen,^{322,§} S. Brandt,^{322,§} W. Busza,^{322,§} I. A. Cali,^{322,§} L. Di Matteo,^{322,§} G. Gomez Ceballos,^{322,§} M. Goncharov,^{322,§} D. Gulhan,^{322,§} G. M. Innocenti,^{322,§} M. Klute,^{322,§} D. Kovalsky,^{322,§} Y. S. Lau,^{322,§} Y.-J. Lee,^{322,§} A. Levin,^{322,§} P. D. Luckey,^{322,§} C. Mcginn,^{322,§} X. Niu,^{322,§} C. Paus,^{322,§} D. Ralph,^{322,§} C. Roland,^{322,§} G. Roland,^{322,§} G. S. F. Stephens,^{322,§} K. Sumorok,^{322,§} M. Varma,^{322,§} D. Velicanu,^{322,§} J. Veverka,^{322,§} J. Wang,^{322,§} T. W. Wang,^{322,§} B. Wyslouch,^{322,§} M. Yang,^{322,§} V. Zhukova,^{322,§} B. Dahmes,^{323,‡} A. Finkiel,^{323,‡} J. Gude,^{323,‡} P. Hansen,^{323,‡} S. Kalafut,^{323,‡} S. C. Kao,^{323,‡} K. Klapoetke,^{323,‡} Y. Kubota,^{323,‡} Z. Lesko,^{323,‡} J. Mans,^{323,‡} S. Nourbakhsh,^{323,‡} N. Rueckstuhl,^{323,‡} R. Rusack,^{323,‡} N. Tambe,^{323,‡} J. Turkewitz,^{323,‡} J. G. Acosta,^{324,§} S. Oliveros,^{324,§} E. Avdeeva,^{324,§} K. Bloom,^{324,§} S. Bose,^{324,§} D. R. Claes,^{324,§} A. Dominguez,^{324,§} C. Fangmeier,^{324,§} R. Gonzalez Suarez,^{324,§} K. Kamaliieddin,^{324,§} J. Keller,^{324,§} D. Knollton,^{324,§} I. Kravchenko,^{324,§} J. Lazo-Flores,^{324,§} F. Meier,^{324,§} J. Monroe,^{324,§} F. Ratnikov,^{324,§} J. E. Siado,^{324,§} G. R. Snow,^{324,§} M. Alyari,^{324,§} J. Dolen,^{324,§} J. George,^{324,§} A. Godshalk,^{324,§} I. Lashvili,^{324,§} J. Kaisen,^{324,§} A. Kharchilava,^{324,§} A. Kumar,^{324,§} S. Rappoccio,^{324,§} G. Alverson,^{324,§} E. Barberis,^{324,§} D. Baumgartner,^{324,§} M. Chasco,^{324,§} A. Horiangtham,^{324,§} A. Massironi,^{324,§} M. D. Morse,^{324,§} D. Nash,^{324,§} T. Orimoto,^{324,§} R. Teixeira De Lima,^{324,§} D. Trocino,^{324,§} R.-J. Wang,^{324,§} D. Wood,^{324,§} J. Zhang,^{324,§} K. A. Hahn,^{324,§} A. Kubik,^{324,§} N. Mucia,^{324,§} N. Odell,^{324,§} B. Pollack,^{324,§} A. Podziknyak,^{324,§} M. Schmitt,^{324,§} S. Stoynev,^{324,§} K. Sung,^{324,§} M. Trovato,^{324,§} M. Velasco,^{324,§} S. Won,^{324,§} A. Brinkerhoff,^{324,§} N. Dev,^{324,§} M. Hildreth,^{324,§} C. Jessop,^{324,§} D. J. Karmgard,^{324,§} N. Kellams,^{324,§} K. Lannon,^{324,§} S. Lynch,^{324,§} N. Marinelli,^{324,§} F. Meng,^{324,§} C. Mueller,^{324,§} Y. Musienko,^{324,§} T. Pearson,^{324,§} M. Planer,^{324,§} R. Ruchti,^{324,§} G. Smith,^{324,§} N. Valls,^{324,§} M. Wayne,^{324,§} M. Wolf,^{324,§} A. Woodland,^{324,§} L. Antonelli,^{330,‡} J. Brinson,^{330,‡} B. Bylsma,^{330,‡} L. S. Durkin,^{330,‡} S. Flowers,^{330,‡} A. Hart,^{330,‡} C. Hill,^{330,‡} R. Hughes,^{330,‡} K. Kotov,^{330,‡} T. Y. Ling,^{330,‡} B. Liu,^{330,‡} W. Luo,^{330,‡} D. Paugh,^{330,‡} M. Rodenburg,^{330,‡} H. W. Wilson,^{334,‡} O. Driga,^{334,‡} P. Elmer,^{334,‡} J. Hardinbrook,^{334,‡} P. Hebst,^{334,‡} S. A. Koay,^{334,‡} P. Lujan,^{334,‡} D. Marlow,^{334,‡} T. Medvedeva,^{334,‡} M. Mooney,^{334,‡} J. Olsen,^{334,‡} C. Palmer,^{334,‡} P. Piroue,^{334,‡} X. Quan,^{334,‡} H. Saka,^{334,‡} D. Stickland,^{334,‡} C. Tully,^{334,‡} S. J. Werner,^{334,‡} A. Zuranski,^{334,‡} V. E. Barnes,^{334,‡} D. Benedetti,^{334,‡} D. Bortolotto,^{334,‡} L. Gutay,^{334,‡} M. K. Jha,^{334,‡} M. Jones,^{334,‡} K. Jung,^{334,‡} M. Kress,^{334,‡} N. Leonardo,^{334,‡} D. H. Miller,^{334,‡} N. Neumeister,^{334,‡} F. Primavera,^{334,‡} B. C. Radburn-Smith,^{334,‡} X. Shi,^{334,‡} I. Shipsey,^{334,‡} D. Silvers,^{334,‡} J. Sun,^{334,‡} A. Svatkovskiy,^{334,‡} F. Wang,^{334,‡} W. Xie,^{334,‡} L. Xu,^{334,‡} J. Zablocki,^{334,‡} N. Parashar,^{334,‡} J. Stupak,^{334,‡} A. Adair,^{334,‡} B. Akgun,^{334,‡} Z. Chen,^{334,‡} K. M. Ecklund,^{334,‡} F. J. M. Geurts,^{334,‡} M. Guibault,^{334,‡} W. Li,^{334,‡} B. Michlin,^{334,‡} M. Northup,^{334,‡} B. P. Padley,^{334,‡} R. Redjimi,^{334,‡} J. Roberts,^{334,‡} J. Rorie,^{334,‡} Z. Tu,^{334,‡} J. Zabel,^{334,‡} B. Betchart,^{334,‡} A. Bodek,^{334,‡} P. de Barbaro,^{334,‡} R. Demina,^{334,‡} Y. Eshaq,^{334,‡} T. Ferbel,^{334,‡} M. Galanti,^{334,‡} A. Garcia-Bellido,^{334,‡} P. Goldenzweig,^{334,‡} J. Han,^{334,‡} A. Harel,^{334,‡} O. Hindrichs,^{334,‡} A. Khukhunashvili,^{334,‡} G. Petruzzo,^{334,‡} M. Verzetti,^{334,‡} L. Demortier,^{334,‡} S. Arora,^{337,‡} A. Barker,^{337,‡} J. P. Chou,^{337,‡} C. Conteras-Campana,^{337,‡} E. Conteras-Campana,^{337,‡} D. Duggan,^{337,‡} D. Ferencz,^{337,‡} Y. Gershtein,^{337,‡} R. Gray,^{337,‡} E. Halkiadakis,^{337,‡} D. Hidas,^{337,‡} E. Hughes,^{337,‡} S. Kaplan,^{337,‡} R. Kumarawalkam Elayavalli,^{337,‡} A. Lath,^{337,‡} S. Panwalker,^{337,‡} M. Park,^{337,‡} S. Salur,^{337,‡} S. Schnetzer,^{337,‡} D. Sheffield,^{337,‡} S. Somalwar,^{337,‡} R. Stone,^{337,‡} S. Thomas,^{337,‡} P. Thomassen,^{337,‡} M. Walker,^{337,‡} M. Foerster,^{338,‡} G. Riley,^{338,‡} K. Rose,^{338,‡} S. Spanier,^{338,‡} A. York,^{338,‡} O. Bouhalil,^{339,‡} A. Castaneda Hernández,^{339,‡} M. Dalchenko,^{339,‡} M. De Mattia,^{339,‡} A. Delgado,^{339,‡} S. Dildick,^{339,‡} R. Eusebi,^{339,‡} W. Flanagan,^{339,‡} J. Gilmore,^{339,‡} T. Kamon,^{339,‡} V. Krutelyov,^{339,‡} R. Montalvo,^{339,‡} J. Mueller,^{339,‡} I. Ospenkov,^{339,‡} Y. Pakhotin,^{339,‡} R. Patel,^{339,‡} A. Perloff,^{339,‡} J. Roe,^{339,‡} A. Rose,^{339,‡} A. Safonov,^{339,‡} A. Tatarinov,^{339,‡} K. A. Ulmer,^{339,‡} N. Akchurin,^{340,‡} C. Cowden,^{340,‡} J. Damgov,^{340,‡} C. Dragoiu,^{340,‡} P. R. Dadero,^{340,‡} J. Faulkner,^{340,‡} S. Kunori,^{340,‡} K. Lamichhane,^{340,‡} S. W. Lee,^{340,‡} T. Liteiro,^{340,‡} S. Undleeb,^{340,‡} I. Volobouev,^{340,‡} E. Appelt,^{341,‡} A. G. Delanney,^{341,‡} S. Greene,^{341,‡} A. Gurrola,^{341,‡} R. Janjam,^{341,‡} W. Johns,^{341,‡} C. Maguire,^{341,‡} Y. Mao,^{341,‡} A. Melo,^{341,‡} P. Sheldon,^{341,‡} B. Snook,^{341,‡} S. Tso,^{341,‡} J. Velkovska,^{341,‡} Q. Xu,^{341,‡} M. W. Arenton,^{342,‡} S. Bourne,^{342,‡} B. Cox,^{342,‡} B. Francis,^{342,‡} J. Goodell,^{342,‡} R. Hironsky,^{342,‡} A. Ledovskoy,^{342,‡} H. Li,^{342,‡} C. Lin,^{342,‡} C. Neu,^{342,‡} E. Wolfe,^{342,‡} J. Wood,^{342,‡} F. Xia,^{342,‡} C. Clarke,^{343,‡} R. Han,^{343,‡} P. E. Karchin,^{343,‡} C. Kottachchi Kankanaam Don,^{343,‡} P. Lamichhane,^{343,‡} J. Sturdy,^{343,‡} D. A. Belknap,^{343,‡} D. Carlsmith,^{344,‡} M. Cepeda,^{344,‡} A. Christian,^{344,‡} S. Daus,^{344,‡} L. Dodd,^{344,‡} S. Duric,^{344,‡} E. Friis,^{344,‡} B. Gomber,^{344,‡} R. Hall-Wilton,^{344,‡} M. Herndon,^{344,‡} A. Hervé,^{344,‡} P. Klabbbers,^{344,‡} A. Lanaro,^{344,‡} A. Levin,^{344,‡} K. Long,^{344,‡} R. Loveless,^{344,‡} A. Mohapatra,^{344,‡} I. Ojalvo,^{344,‡} T. Perry,^{344,‡} G. A. Pierro,^{344,‡} G. Polese,^{344,‡} I. Ross,^{344,‡} T. Ruggles,^{344,‡} T. Sarangi,^{344,‡} A. Savin,^{344,‡} A. Sharma,^{344,‡} N. Smith,^{344,‡} W. H. Smith,^{344,‡} D. Taylor,^{344,‡} and N. Woods^{344,‡}

(ATLAS Collaboration)[†]
(CMS Collaboration)[‡]

- ¹Department of Physics, University of Adelaide, Adelaide, Australia
²Physics Department, SUNY Albany, Albany, New York, USA
³Department of Physics, University of Alberta, Edmonton, Alberta, Canada
⁴Department of Physics, Ankara University, Ankara, Turkey
⁵Department of Physics, TOBB University of Economics and Technology, Ankara, Turkey
⁶LAPP, CNRS/IN2P3 and Université Savoie Mont Blanc, Annecy-le-Vieux, France
⁷High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois, USA
⁸Department of Physics, University of Arizona, Tucson, Arizona, USA
⁹Department of Physics, The University of Texas at Arlington, Arlington, Texas, USA
¹⁰Physics Department, University of Athens, Athens, Greece
¹¹Institute of Physics, Azerbaijan Academy of Sciences, Baku, Azerbaijan
¹²Institut de Física d'Altes Energies and Departament de Física de la Universitat Autònoma de Barcelona, Barcelona, Spain
¹³Institute of Physics, University of Belgrade, Belgrade, Serbia
¹⁴Department for Physics and Technology, University of Bergen, Bergen, Norway
¹⁵Physics Division, Lawrence Berkeley National Laboratory and University of California, Berkeley, California, USA
¹⁶Department of Physics, Humboldt University, Berlin, Germany
¹⁷Albert Einstein Center for Fundamental Physics and Laboratory for High Energy Physics, University of Bern, Bern, Switzerland
¹⁸School of Physics and Astronomy, University of Birmingham, Birmingham, United Kingdom
¹⁹Department of Physics, Bogazici University, Istanbul, Turkey
²⁰Department of Physics, Dugdu University, Istanbul, Turkey
²¹Department of Physics Engineering, Gaziantep University, Gaziantep, Turkey
²²INFN Sezione di Bologna, Bologna, Italy
²³Dipartimento di Fisica e Astronomia, Università di Bologna, Bologna, Italy
²⁴Physikalisches Institut, University of Bonn, Bonn, Germany
²⁵Department of Physics, Boston University, Boston, Massachusetts, USA
²⁶Department of Physics, Brandeis University, Waltham, Massachusetts, USA
²⁷Universidade Federal do Rio De Janeiro COPPEE/UFJF, Rio de Janeiro, Brazil
²⁸Electrical Circuits Department, Federal University of Juiz de Fora (UFJF), Juiz de Fora, Brazil
²⁹Federal University of São João del Rei (UFSJ), São João del Rei, Brazil
³⁰Instituto de Física, Universidade de São Paulo, São Paulo, Brazil
³¹Physics Department, Brookhaven National Laboratory, Upton, New York, USA
³²National Institute of Physics and Nuclear Engineering, Bucharest, Romania
³³National Institute for Research and Development of Isotopic and Molecular Technologies, Physics Department, Cluj Napoca, Romania
³⁴University Politehnica Bucharest, Bucharest, Romania
³⁵West University in Timisoara, Timisoara, Romania
³⁶Departamento de Física, Universidad de Buenos Aires, Buenos Aires, Argentina
³⁷Cavendish Laboratory, University of Cambridge, Cambridge, United Kingdom
³⁸Department of Physics, Carleton University, Ottawa, Ontario, Canada
³⁹CERN, Geneva, Switzerland
⁴⁰Enrico Fermi Institute, University of Chicago, Chicago, Illinois, USA
⁴¹Departamento de Física, Pontificia Universidad Católica de Chile, Santiago, Chile
⁴²Departamento de Física, Universidad Técnica Federico Santa María, Valparaíso, Chile
⁴³Institute of High Energy Physics, Chinese Academy of Sciences, Beijing, China
⁴⁴Department of Modern Physics, University of Science and Technology of China, Anhui, China
⁴⁵Department of Physics, Nanjing University, Jiangsu, China
⁴⁶School of Physics, Shandong University, Shandong, China
⁴⁷Department of Physics and Astronomy, Shanghai Key Laboratory for Particle Physics and Cosmology, Shanghai Jiao Tong University, Shanghai, China
⁴⁸Physics Department, Tsinghua University, Beijing 100084, China
⁴⁹Laboratoire de Physique Corpusculaire, Clermont-Ferrand, France
⁵⁰Nevis Laboratory, Columbia University, Irvington, New York, USA
⁵¹Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark

- ^{37a}INFN Gruppo Collegato di Cosenza, Laboratori Nazionali di Frascati, Frascati, Italy
^{38b}Dipartimento di Fisica, Università della Calabria, Rende, Italy
^{39a}AGH University of Science and Technology, Faculty of Physics and Applied Computer Science, Krakow, Poland
^{39b}Marian Smoluchowski Institute of Physics, Jagiellonian University, Krakow, Poland
⁴⁰Institute of Nuclear Physics Polish Academy of Sciences, Krakow, Poland
⁴¹Physics Department, Southern Methodist University, Dallas, Texas, USA
⁴¹Physics Department, University of Texas at Dallas, Richardson, Texas, USA
⁴²DESY, Hamburg and Zeuthen, Germany
⁴³Institut für Experimentelle Physik IV, Technische Universität Dortmund, Dortmund, Germany
⁴⁴Institut für Kern- und Teilchenphysik, Technische Universität Dresden, Dresden, Germany
⁴⁵Department of Physics, Duke University, Durham, North Carolina, USA
⁴⁶SUPA-School of Physics and Astronomy, University of Edinburgh, Edinburgh, United Kingdom
⁴⁷INFN Laboratori Nazionali di Frascati, Frascati, Italy
⁴⁸Fakultät für Mathematik und Physik, Albert-Ludwigs-Universität, Freiburg, Germany
⁴⁹Section de Physique, Université de Genève, Geneva, Switzerland
⁵⁰INFN Sezione di Genova, Genova, Italy
^{51b}Dipartimento di Fisica, Università di Genova, Genova, Italy
^{51c}E. Andronikashvili Institute of Physics, Iv. Javakhishvili Tbilisi State University, Tbilisi, Georgia
^{51d}High Energy Physics Institute, Tbilisi State University, Tbilisi, Georgia
⁵²II. Physikalisches Institut, Justus-Liebig-Universität Gießen, Gießen, Germany
⁵³SUPA-School of Physics and Astronomy, University of Glasgow, Glasgow, United Kingdom
⁵⁴II. Physikalisches Institut, Georg-August-Universität, Göttingen, Germany
⁵⁵Laboratoire de Physique Subatomique et de Cosmologie, Université Grenoble-Alpes, CNRS/IN2P3, Grenoble, France
⁵⁶Department of Physics, Hampton University, Hampton, Virginia, USA
⁵⁷Laboratory for Particle Physics and Cosmology, Harvard University, Cambridge, Massachusetts, USA
⁵⁸Kirchhoff-Institute für Physik, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany
⁵⁹Physikalisches Institut, Ruprecht-Karls-Universität Heidelberg, Heidelberg, Germany
⁶⁰ZITI Institut für technische Informatik, Ruprecht-Karls-Universität Heidelberg, Mannheim, Germany
⁶¹Faculty of Applied Information Science, Hiroshima Institute of Technology, Hiroshima, Japan
⁶²Department of Physics, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong, China
⁶³Department of Physics, The University of Hong Kong, Clear Water Bay, Kowloon, Hong Kong, China
⁶⁴Department of Physics, The Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, China
⁶⁵Department of Physics, Indiana University, Bloomington, Indiana, USA
⁶⁶Institut für Astro- und Teilchenphysik, Leopold-Franzens-Universität, Innsbruck, Austria
⁶⁷University of Iowa, Iowa City, Iowa, USA
⁶⁸Department of Physics and Astronomy, Iowa State University, Ames, Iowa, USA
⁶⁹Joint Institute for Nuclear Research, JINR Dubna, Dubna, Russia
⁷⁰KEK, High Energy Accelerator Research Organization, Tsukuba, Japan
⁷¹Graduate School of Science, Kobe University, Kobe, Japan
⁷²Faculty of Science, Kyoto University, Kyoto, Japan
⁷³Kyoto University of Education, Kyoto, Japan
⁷⁴Department of Physics, Kyushu University, Fukuoka, Japan
⁷⁵Instituto de Física La Plata, Universidad Nacional de La Plata and CONICET, La Plata, Argentina
⁷⁶Physics Department, Lancaster University, Lancaster, United Kingdom
⁷⁷INFN Sezione di Lecce, Lecce, Italy
⁷⁸Dipartimento di Matematica e Fisica, Università del Salento, Lecce, Italy
⁷⁹Oliver Lodge Laboratory, University of Liverpool, Liverpool, United Kingdom
⁸⁰Department of Physics, Jozef Stefan Institute and University of Ljubljana, Ljubljana, Slovenia
⁸¹School of Physics and Astronomy, Queen Mary University of London, London, United Kingdom
⁸²Department of Physics, Royal Holloway University of London, Surrey, United Kingdom
⁸³Department of Physics and Astronomy, University College London, London, United Kingdom
⁸⁴Louisiana Tech University, Ruston, Louisiana, USA
⁸⁵Laboratoire de Physique Nucléaire et de Hautes Energies, UPMC and Université Paris-Diderot and CNRS/IN2P3, Paris, France
⁸⁶Física institutionen, Lunds universitet, Lund, Sweden
⁸⁷Departamento de Física Teórica C-15, Universidad Autónoma de Madrid, Madrid, Spain
⁸⁸Institut für Physik, Universität Mainz, Mainz, Germany
⁸⁹School of Physics and Astronomy, University of Manchester, Manchester, United Kingdom
⁹⁰CP3PM, Aix-Marseille Université and CNRS/IN2P3, Marseille, France
⁹¹Department of Physics, University of Massachusetts, Amherst, Massachusetts, USA
⁹²Department of Physics, McGill University, Montreal, Quebec, Canada

- ⁸⁸School of Physics, University of Melbourne, Victoria, Australia
⁸⁹Department of Physics, The University of Michigan, Ann Arbor, Michigan, USA
⁹⁰Department of Physics and Astronomy, Michigan State University, East Lansing, Michigan, USA
⁹¹Dipartimento di Fisica, Università di Milano, Milano, Italy
⁹²B.I. Stepanov Institute of Physics, National Academy of Sciences of Belarus, Minsk, Republic of Belarus
⁹³National Scientific and Educational Centre for Particle and High Energy Physics, Minsk, Republic of Belarus
⁹⁴Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA
⁹⁵Group of Particle Physics, University of Montreal, Montreal, Québec, Canada
⁹⁶P.N. Lebedev Institute of Physics, Academy of Sciences, Moscow, Russia
⁹⁷Institute for Theoretical and Experimental Physics (ITEP), Moscow, Russia
⁹⁸National Research Nuclear University MEPhI, Moscow, Russia
⁹⁹D.V. Skobeltsyn Institute of Nuclear Physics, M.V. Lomonosov Moscow State University, Moscow, Russia
¹⁰⁰Fakultät für Physik, Ludwig-Maximilians-Universität München, München, Germany
¹⁰¹Max-Planck-Institut für Physik (Werner-Heisenberg-Institut), München, Germany
¹⁰²Nagasaki Institute of Applied Science, Nagasaki, Japan
¹⁰³Graduate School of Science and Kobayashi-Maskawa Institute, Nagoya University, Nagoya, Japan
¹⁰⁴INFN Sezione di Napoli, Napoli, Italy
¹⁰⁵Departamento de Física, Università di Napoli, Napoli, Italy
¹⁰⁶Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico, USA
¹⁰⁷Institute for Mathematics, Astrophysics and Particle Physics, Radboud University Nijmegen/Nikhef, Nijmegen, Netherlands
¹⁰⁸Nikhef National Institute for Subatomic Physics and University of Amsterdam, Amsterdam, Netherlands
¹⁰⁹Department of Physics, Northern Illinois University, DeKalb, Illinois, USA
¹¹⁰Budker Institute of Nuclear Physics, SB RAS, Novosibirsk, Russia
¹¹¹Department of Physics, New York University, New York, New York, USA
¹¹²The Ohio State University, Columbus, Ohio, USA
¹¹³Faculty of Science, Okayama University, Okayama, Japan
¹¹⁴Homer L. Dodge Department of Physics and Astronomy, University of Oklahoma, Norman, Oklahoma, USA
¹¹⁵Department of Physics, Oklahoma State University, Stillwater, Oklahoma, USA
¹¹⁶Falcký University, RCPMT, Olomouc, Czech Republic
¹¹⁷Center for High Energy Physics, University of Oregon, Eugene, Oregon, USA
¹¹⁸LAL, Université Paris-Sud and CNRS/IN2P3, Orsay, France
¹¹⁹Graduate School of Science, Osaka University, Osaka, Japan
¹²⁰Department of Physics, University of Oslo, Oslo, Norway
¹²¹Department of Physics, Oxford University, Oxford, United Kingdom
¹²²INFN Sezione di Pavia, Pavia, Italy
¹²³Dipartimento di Fisica, Università di Pavia, Pavia, Italy
¹²⁴Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania, USA
¹²⁵National Research Centre "Kurchatov Institute" B.P.Konstantinov Petersburg Nuclear Physics Institute, St. Petersburg, Russia
¹²⁶INFN Sezione di Pisa, Pisa, Italy
¹²⁷Dipartimento di Fisica E. Fermi, Università di Pisa, Pisa, Italy
¹²⁸Department of Physics and Astronomy, University of Pittsburgh, Pittsburgh, Pennsylvania, USA
¹²⁹Laboratorio de Instrumentación e Física Experimental de Partículas-LIP, Lisboa, Portugal
¹³⁰Faculdade de Ciências, Universidade de Lisboa, Lisboa, Portugal
¹³¹Department of Physics, University of Coimbra, Coimbra, Portugal
¹³²Centro de Física Nuclear da Universidade de Lisboa, Lisboa, Portugal
¹³³Departamento de Física, Universidade do Minho, Braga, Portugal
¹³⁴Departamento de Física Teórica y del Cosmos and CAFPE, Universidad de Granada, Granada (Spain), Portugal
¹³⁵Dep Física and CEFITEC of Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Caparica, Portugal
¹³⁶Institute of Physics, Academy of Sciences of the Czech Republic, Praha, Czech Republic
¹³⁷Czech Technical University in Prague, Praha, Czech Republic
¹³⁸Faculty of Mathematics and Physics, Charles University in Prague, Praha, Czech Republic
¹³⁹State Research Center Institute for High Energy Physics, Protvino, Russia
¹⁴⁰Particle Physics Department, Rutherford Appleton Laboratory, Didcot, United Kingdom
¹⁴¹INFN Sezione di Roma, Roma, Italy
¹⁴²Dipartimento di Fisica, Sapienza Università di Roma, Roma, Italy
¹⁴³INFN Sezione di Roma Tor Vergata, Roma, Italy
¹⁴⁴Dipartimento di Fisica, Università di Roma Tor Vergata, Roma, Italy
¹⁴⁵INFN Sezione di Roma Tre, Roma, Italy
¹⁴⁶Dipartimento di Matematica e Fisica, Università Roma Tre, Roma, Italy

- ¹³⁵Faculté des Sciences Ain Chock, Réseau Universitaire de Physique des Hautes Energies-Université Hassan II, Casablanca, Morocco
- ¹³⁶Centre National de l'Energie des Sciences Techniques Nucléaires, Rabat, Morocco
- ¹³⁶Faculté des Sciences Sénia, Université Cadi Ayyad, LPHEA-Marrakech, Morocco
- ¹³⁶Faculté des Sciences, Université Mohamed Premier et LPTPM, Oujda, Morocco
- ¹³⁶Faculté des sciences, Université Mohammed V-Agdal, Rabat, Morocco
- ¹³⁶DSM/IRFU (Institut de Recherches sur les Lois Fondamentales de l'Univers), CEA Saclay (Commissariat à l'Energie Atomique et aux Energies Alternatives), Gif-sur-Yvette, France
- ¹³⁷Santa Cruz Institute for Particle Physics, University of California Santa Cruz, Santa Cruz, California, USA
- ¹³⁸Department of Physics, University of Washington, Seattle, Washington, USA
- ¹³⁹Department of Physics and Astronomy, University of Sheffield, Sheffield, United Kingdom
- ¹⁴⁰Department of Physics, Shinshu University, Nagano, Japan
- ¹⁴¹Fachbereich Physik, Universität Siegen, Siegen, Germany
- ¹⁴²Department of Physics, Simon Fraser University, Burnaby, British Columbia, Canada
- ¹⁴³SLAC National Accelerator Laboratory, Stanford, California, USA
- ¹⁴⁴Faculty of Mathematics, Physics & Informatics, Comenius University, Bratislava, Slovak Republic
- ¹⁴⁵Department of Subnuclear Physics, Institute of Experimental Physics of the Slovak Academy of Sciences, Kosice, Slovak Republic
- ¹⁴⁶Department of Physics, University of Cape Town, Cape Town, South Africa
- ¹⁴⁷Department of Physics, University of Johannesburg, Johannesburg, South Africa
- ¹⁴⁸School of Physics, University of the Witwatersrand, Johannesburg, South Africa
- ¹⁴⁹Department of Physics, Stockholm University, Stockholm, Sweden
- ¹⁵⁰The Oskar Klein Centre, Stockholm, Sweden
- ¹⁵¹Physics Department, Royal Institute of Technology, Stockholm, Sweden
- ¹⁵²Departments of Physics & Astronomy and Chemistry, Stony Brook University, Stony Brook, New York, USA
- ¹⁵³Department of Physics and Astronomy, University of Sussex, Brighton, United Kingdom
- ¹⁵⁴School of Physics, University of Sydney, Sydney, Australia
- ¹⁵⁵Institute of Physics, Academia Sinica, Taipei, Taiwan
- ¹⁵⁶Department of Physics, Technion Israel Institute of Technology, Haifa, Israel
- ¹⁵⁷Raymond and Beverly Sackler School of Physics and Astronomy, Tel Aviv University, Tel Aviv, Israel
- ¹⁵⁸Department of Physics, Aristotle University of Thessaloniki, Thessaloniki, Greece
- ¹⁵⁹International Center for Elementary Particle Physics and Department of Physics, The University of Tokyo, Tokyo, Japan
- ¹⁶⁰Graduate School of Science and Technology, Tokyo Metropolitan University, Tokyo, Japan
- ¹⁶¹Department of Physics, Tokyo Institute of Technology, Tokyo, Japan
- ¹⁶²Department of Physics, University of Toronto, Toronto, Ontario, Canada
- ¹⁶³TRIUMF, Vancouver, British Columbia, Canada
- ¹⁶⁴Department of Physics and Astronomy, York University, Toronto, Ontario, Canada
- ¹⁶⁵Faculty of Pure and Applied Sciences, University of Tsukuba, Tsukuba, Japan
- ¹⁶⁶Department of Physics and Astronomy, Tufts University, Medford, Massachusetts, USA
- ¹⁶⁷Centro de Investigaciones, Universidad Antonio Narino, Bogota, Colombia
- ¹⁶⁸Department of Physics and Astronomy, University of California Irvine, Irvine, California, USA
- ¹⁶⁹INFN Gruppo Collegato di Udine, Sezione di Trieste, Udine, Italy
- ¹⁷⁰ICTP, Trieste, Italy
- ¹⁷¹Dipartimento di Chimica, Fisica e Ambiente, Università di Udine, Udine, Italy
- ¹⁷²Department of Physics, University of Illinois, Urbana, Illinois, USA
- ¹⁷³Department of Physics and Astronomy, University of Uppsala, Uppsala, Sweden
- ¹⁷⁴Department of Physics, University of British Columbia, Vancouver, British Columbia, Canada
- ¹⁷⁵Department of Physics and Astronomy, University of Victoria, Victoria, British Columbia, Canada
- ¹⁷⁶Department of Physics, University of Warwick, Coventry, United Kingdom
- ¹⁷⁷Waseda University, Tokyo, Japan
- ¹⁷⁸Department of Particle Physics, The Weizmann Institute of Science, Rehovot, Israel
- ¹⁷⁹Department of Physics, University of Wisconsin, Madison, Wisconsin, USA
- ¹⁸⁰Fakultät für Physik und Astronomie, Julius-Maximilians-Universität, Würzburg, Germany
- ¹⁸¹Fachbereich C Physik, Bergische Universität Wuppertal, Wuppertal, Germany
- ¹⁸²Department of Physics, Yale University, New Haven, Connecticut, USA
- ¹⁸³Yerevan Physics Institute, Yerevan, Armenia
- ¹⁸⁴Centre de Calcul de l'Institut National de Physique Nucléaire et de Physique des Particules (IN2P3), Villeurbanne, France
- ¹⁸⁵Yerevan Physics Institute, Yerevan, Armenia
- ¹⁸⁶Institut für Hochenergiephysik der OeAW, Wien, Austria

- ¹⁸¹National Centre for Particle and High Energy Physics, Minsk, Belarus
¹⁸²Universiteit Antwerpen, Antwerp, Belgium
¹⁸³Vrije Universiteit Brussel, Brussel, Belgium
¹⁸⁴Université Libre de Bruxelles, Bruxelles, Belgium
¹⁸⁵Ghent University, Ghent, Belgium
¹⁸⁶Université Catholique de Louvain, Louvain-la-Neuve, Belgium
¹⁸⁷Université de Mons, Mons, Belgium
¹⁸⁸Centro Brasileiro de Pesquisas Físicas, Rio de Janeiro, Brazil
¹⁸⁹Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil
¹⁹⁰Universidade Estadual Paulista, São Paulo, Brazil
¹⁹¹Universidade Federal do ABC, São Paulo, Brazil
¹⁹²Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria
¹⁹³University of Sofia, Sofia, Bulgaria
¹⁹⁴Institute of High Energy Physics, Beijing, China
¹⁹⁵State Key Laboratory of Nuclear Physics and Technology, Peking University, Beijing, China
¹⁹⁶Universidad de Los Andes, Bogotá, Colombia
¹⁹⁷University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, Split, Croatia
¹⁹⁸University of Split, Faculty of Science, Split, Croatia
¹⁹⁹Institut Rudjer Bosković, Zagreb, Croatia
²⁰⁰University of Cyprus, Nicosia, Cyprus
²⁰¹Charles University, Prague, Czech Republic
²⁰²Academy of Scientific Research and Technology of the Arab Republic of Egypt, Egyptian Network of High Energy Physics, Cairo, Egypt
²⁰³National Institute of Chemical Physics and Biophysics, Tallinn, Estonia
²⁰⁴Department of Physics, University of Helsinki, Helsinki, Finland
²⁰⁵Helsinki Institute of Physics, Helsinki, Finland
²⁰⁶Lappeenranta University of Technology, Lappeenranta, Finland
²⁰⁷DSM/IRFU, CEA/Saclay, Gif-sur-Yvette, France
²⁰⁸Institut Pluridisciplinaire Hubert Curien, Université de Strasbourg, Université de Haute Alsace Mulhouse, CNRS/IN2P3, Strasbourg, France
²⁰⁹Centre de Calcul de l'Institut National de Physique Nucléaire et de Physique des Particules, CNRS/IN2P3, Villeurbanne, France
²¹⁰Université de Lyon, Lyon, Université Claude Bernard Lyon 1, CNRS-IN2P3, Institut de Physique Nucléaire de Lyon, Villeurbanne, France
²¹¹Institute of High Energy Physics and Information, Tbilisi State University, Tbilisi, Georgia
²¹²RWTH Aachen University, I. Physikalisches Institut, Aachen, Germany
²¹³RWTH Aachen University, III. Physikalisches Institut A, Aachen, Germany
²¹⁴RWTH Aachen University, III. Physikalisches Institut B, Aachen, Germany
²¹⁵Deutsches Elektronen-Synchrotron, Hamburg, Germany
²¹⁶University of Hamburg, Hamburg, Germany
²¹⁷Institut für Experimentelle Kernphysik, Karlsruhe, Germany
²¹⁸Institute of Nuclear and Particle Physics (INPP), NCSR Demokritos, Aghia Paraskevi, Greece
²¹⁹University of Athens, Athens, Greece
²²⁰University of Ioannina, Ioannina, Greece
²²¹Wigner Research Centre for Physics, Budapest, Hungary
²²²Institute of Nuclear Research ATOMKI, Debrecen, Hungary
²²³University of Debrecen, Debrecen, Hungary
²²⁴National Institute of Science Education and Research, Bhubaneswar, India
²²⁵Panjab University, Chandigarh, India
²²⁶University of Delhi, Delhi, India
²²⁷Saha Institute of Nuclear Physics, Kolkata, India
²²⁸Bhabha Atomic Research Centre, Mumbai, India
²²⁹Kata Institute of Fundamental Research, Mumbai, India
²³⁰Indian Institute of Science Education and Research (IISER), Pune, India
²³¹Institute for Research in Fundamental Sciences (IPM), Tehran, Iran
²³²University College Dublin, Dublin, Ireland
^{233a}INFN Sezione di Bari, Bari, Italy
^{233b}Università di Bari, Bari, Italy
^{234a}Politecnico di Bari, Bari, Italy
^{234b}INFN Sezione di Bologna, Bologna, Italy
^{235b}Università di Bologna, Bologna, Italy

- ²³⁵*INFN Sezione di Catania, Catania, Italy*
²³⁶*Università di Catania, Catania, Italy*
²³⁷*CNFSM, Catania, Italy*
²³⁸*INFN Sezione di Firenze, Firenze, Italy*
²³⁹*Università di Firenze, Firenze, Italy*
²⁴⁰*INFN Laboratori Nazionali di Frascati, Frascati, Italy*
²⁴¹*INFN Sezione di Genova, Genova, Italy*
²⁴²*Università di Genova, Genova, Italy*
²⁴³*INFN Sezione di Milano-Bicocca, Milano, Italy*
²⁴⁴*Università di Milano-Bicocca, Milano, Italy*
²⁴⁵*INFN Sezione di Napoli, Napoli, Italy*
²⁴⁶*Università di Napoli "Federico II," Napoli, Italy*
²⁴⁷*Universitá della Basilicata, Roma, Italy*
²⁴⁸*Università G. Marconi, Roma, Italy*
²⁴⁹*INFN Sezione di Padova, Padova, Italy*
²⁵⁰*Università di Padova, Padova, Italy*
²⁵¹*INFN Sezione di Trento, Trento, Italy*
²⁵²*Università di Trieste, Trieste, Italy*
²⁵³*INFN Sezione di Pavia, Pavia, Italy*
²⁵⁴*Università di Pavia, Pavia, Italy*
²⁵⁵*INFN Sezione di Perugia, Perugia, Italy*
²⁵⁶*Università di Perugia, Perugia, Italy*
²⁵⁷*INFN Sezione di Pisa, Pisa, Italy*
²⁵⁸*Università di Pisa, Pisa, Italy*
²⁵⁹*Scuola Normale Superiore di Pisa, Pisa, Italy*
²⁶⁰*INFN Sezione di Roma, Roma, Italy*
²⁶¹*Università di Roma, Roma, Italy*
²⁶²*INFN Sezione di Torino, Novara, Italy*
²⁶³*Università di Torino, Novara, Italy*
²⁶⁴*Università del Piemonte Orientale, Novara, Italy*
²⁶⁵*INFN Sezione di Trieste, Trieste, Italy*
²⁶⁶*Università di Trieste, Trieste, Italy*
²⁶⁷*Kangwon National University, Chunchon, Korea*
²⁶⁸*Kyungpook National University, Daegu, Korea*
²⁶⁹*Chonbuk National University, Jeonju, Korea*
²⁷⁰*Chonnam National University, Institute for Universe and Elementary Particles, Kwangju, Korea*
²⁷¹*Korea University, Seoul, Korea*
²⁷²*Seoul National University, Seoul, Korea*
²⁷³*University of Seoul, Seoul, Korea*
²⁷⁴*Sungkyunkwan University, Suwon, Korea*
²⁷⁵*Vilnius University, Vilnius, Lithuania*
²⁷⁶*National Centre for Particle Physics, Universiti Malaya, Kuala Lumpur, Malaysia*
²⁷⁷*Centro de Investigación y de Estudios Avanzados del IPN, Mexico City, Mexico*
²⁷⁸*Universidad Iberoamericana, Mexico City, Mexico*
²⁷⁹*Benedictine Universidad Autónoma de Puebla, Puebla, Mexico*
²⁸⁰*Universidad Autónoma de San Luis Potosí, San Luis Potosí, Mexico*
²⁸¹*University of Auckland, Auckland, New Zealand*
²⁸²*University of Canterbury, Christchurch, New Zealand*
²⁸³*National Centre for Physics, Quaid-I-Azam University, Islamabad, Pakistan*
²⁸⁴*National Centre for Nuclear Research, Swierk, Poland*
²⁸⁵*Institute of Experimental Physics, Faculty of Physics, University of Warsaw, Warsaw, Poland*
²⁸⁶*Laboratório de Instrumentação e Física Experimental de Partículas, Lisboa, Portugal*
²⁸⁷*Joint Institute for Nuclear Research, Dubna, Russia*
²⁸⁸*Petersburg Nuclear Physics Institute, Gatchina (St. Petersburg), Russia*
²⁸⁹*Institute for Nuclear Research, Moscow, Russia*
²⁹⁰*Institute for Theoretical and Experimental Physics, Moscow, Russia*
²⁹¹*P.N. Lebedev Physical Institute, Moscow, Russia*
²⁹²*Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow, Russia*
²⁹³*State Research Center of Russian Federation, Institute for High Energy Physics, Protvino, Russia*
²⁹⁴*University of Belgrade, Faculty of Physics and Vinca Institute of Nuclear Sciences, Belgrade, Serbia*
²⁹⁵*Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (CIEMAT), Madrid, Spain*

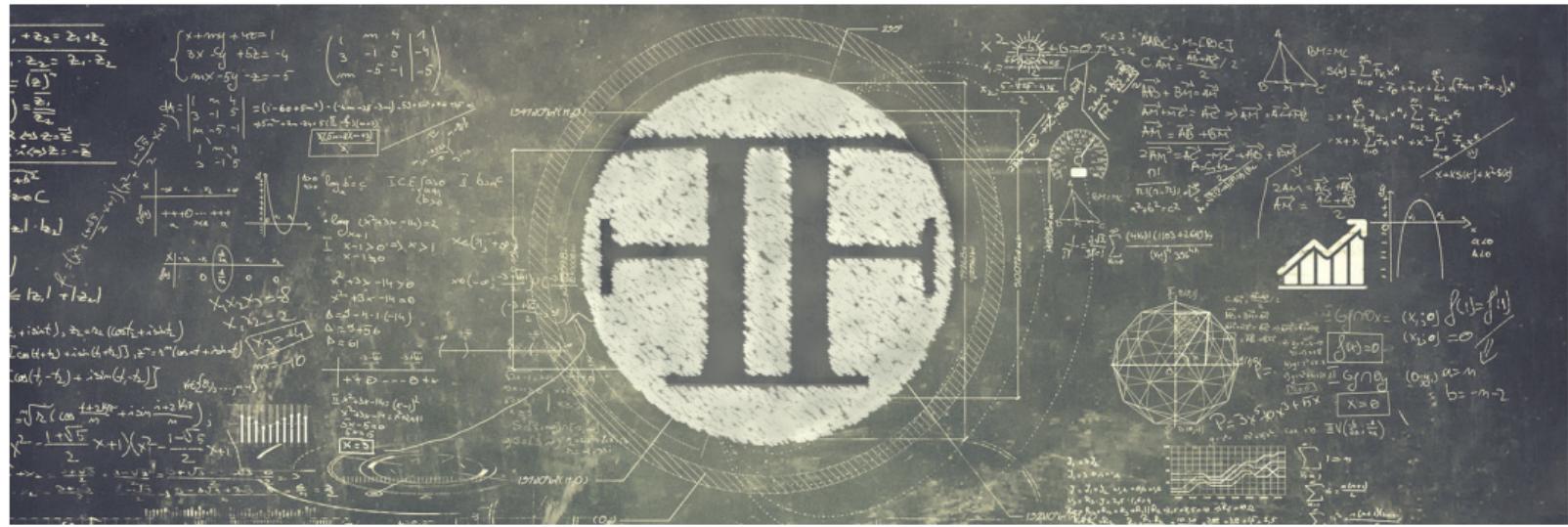
- ²⁷⁷Universidad Autónoma de Madrid, Madrid, Spain
²⁷⁸Universidad de Oviedo, Oviedo, Spain
²⁷⁹Instituto de Física de Cantabria (IFCA), CSIC-Universidad de Cantabria, Santander, Spain
²⁸⁰CERN, European Organization for Nuclear Research, Geneva, Switzerland
²⁸¹Paul Scherrer Institut, Villigen, Switzerland
²⁸²Institute for Particle Physics, ETH Zurich, Zurich, Switzerland
²⁸³Universität Zürich, Zurich, Switzerland
²⁸⁴National Central University, Chung-Li, Taiwan
²⁸⁵National Taiwan University (NTU), Taipei, Taiwan
²⁸⁶Chulalongkorn University, Faculty of Science, Department of Physics, Bangkok, Thailand
²⁸⁷Cukurova University, Adana, Turkey
²⁸⁸Middle East Technical University, Physics Department, Ankara, Turkey
²⁸⁹Bogazici University, Istanbul, Turkey
²⁹⁰Istanbul Technical University, Istanbul, Turkey
²⁹¹Institute for Scintillation Materials of National Academy of Science of Ukraine, Kharkov, Ukraine
²⁹²National Scientific Center, Kharkov Institute of Physics and Technology, Kharkov, Ukraine
²⁹³University of Bristol, Bristol, United Kingdom
²⁹⁴Rutherford Appleton Laboratory, Didcot, United Kingdom
²⁹⁵Imperial College, London, United Kingdom
²⁹⁶Brunei University, Uxbridge, United Kingdom
²⁹⁷Baylor University, Waco, Texas, USA
²⁹⁸The University of Alabama, Tuscaloosa, Alabama, USA
²⁹⁹Boston University, Boston, Massachusetts, USA
³⁰⁰Brown University, Providence, Rhode Island, USA
³⁰¹University of California, Davis, Davis, California, USA
³⁰²University of California, Los Angeles, Los Angeles, California, USA
³⁰³University of California, Riverside, Riverside, California, USA
³⁰⁴University of California, San Diego, La Jolla, California, USA
³⁰⁵University of California, Santa Barbara, Santa Barbara, California, USA
³⁰⁶California Institute of Technology, Pasadena, California, USA
³⁰⁷Carnegie Mellon University, Pittsburgh, Pennsylvania, USA
³⁰⁸University of Colorado at Boulder, Boulder, Colorado, USA
³⁰⁹Cornell University, Ithaca, New York, USA
³¹⁰Fermilab National Accelerator Laboratory, Batavia, Illinois, USA
³¹¹University of Florida, Gainesville, Florida, USA
³¹²Florida International University, Miami, Florida, USA
³¹³Florida State University, Tallahassee, Florida, USA
³¹⁴Florida Institute of Technology, Melbourne, Florida, USA
³¹⁵University of Illinois at Chicago (UIC), Chicago, Illinois, USA
³¹⁶The University of Iowa, Iowa City, Iowa, USA
³¹⁷Johns Hopkins University, Baltimore, Maryland, USA
³¹⁸The University of Kansas, Lawrence, Kansas, USA
³¹⁹Kansas State University, Manhattan, Kansas, USA
³²⁰Lawrence Livermore National Laboratory, Livermore, California, USA
³²¹University of Maryland, College Park, Maryland, USA
³²²Massachusetts Institute of Technology, Cambridge, Massachusetts, USA
³²³University of Minnesota, Minneapolis, Minnesota, USA
³²⁴University of Mississippi, Oxford, Mississippi, USA
³²⁵University of Nebraska-Lincoln, Lincoln, Nebraska, USA
³²⁶State University of New York at Buffalo, Buffalo, New York, USA
³²⁷Northeastern University, Boston, Massachusetts, USA
³²⁸Northwestern University, Evanston, Illinois, USA
³²⁹University of Notre Dame, Notre Dame, Indiana, USA
³³⁰The Ohio State University, Columbus, Ohio, USA
³³¹Princeton University, Princeton, New Jersey, USA
³³²Purdue University, West Lafayette, Indiana, USA
³³³Purdue University Calumet, Hammond, Indiana, USA
³³⁴Rice University, Houston, Texas, USA
³³⁵University of Rochester, Rochester, New York, USA
³³⁶The Rockefeller University, New York, New York, USA

- ³³⁷Rutgers, *The State University of New Jersey, Piscataway, New Jersey, USA*
³³⁸University of Tennessee, Knoxville, Tennessee, USA
³³⁹Texas A&M University, College Station, Maryland, USA
³⁴⁰Texas Tech University, Lubbock, Texas, USA
³⁴¹Vanderbilt University, Nashville, Tennessee, USA
³⁴²University of Virginia, Charlottesville, Virginia, USA
³⁴³Wayne State University, Detroit, Michigan, USA
³⁴⁴University of Wisconsin, Madison, Wisconsin, USA

^aDeceased.

- ^aAlso at Department of Physics, King's College London, London, United Kingdom.
^aAlso at Institute of Physics, Azerbaijan Academy of Sciences, Baku, Azerbaijan.
^aAlso at Novosibirsk State University, Novosibirsk, Russia.
^aAlso at TRIUMF, Vancouver, BC, Canada.
^aAlso at Department of Physics, California State University, Fresno, CA, USA.
^aAlso at Department of Physics, University of Fribourg, Fribourg, Switzerland.
^aAlso at Departamento de Física e Astronomia, Faculdade de Ciências, Universidade do Porto, Portugal.
^aAlso at Tomsk State University, Tomsk, Russia.
^aAlso at CPPM, Aix-Marseille Université and CNRS/IN2P3, Marseille, France.
^aAlso at Università di Napoli Parthenope, Napoli, Italy.
^aAlso at Institute of Particle Physics (IPP), Canada.
^aAlso at Particle Physics Department, Rutherford Appleton Laboratory, Didcot, United Kingdom.
^aAlso at Department of Physics, St. Petersburg State Polytechnical University, St. Petersburg, Russia.
^aAlso at Louisiana Tech University, Ruston, LA, USA.
^aAlso at Institut Català de Recerca i Estudis Avançats, ICREA, Barcelona, Spain.
^aAlso at Department of Physics, National Tsing Hua University, Taiwan.
^aAlso at Department of Physics, The University of Texas at Austin, Austin, TX, USA.
^aAlso at Institute of Theoretical Physics, Ila State University, Tbilisi, Georgia.
^aAlso at CERN, Geneva, Switzerland.
^aAlso at Georgian Technical University (GTU), Tbilisi, Georgia.
^aAlso at Ochanomizu Academic Production, Ochanomizu University, Tokyo, Japan.
^aAlso at Manhattan College, New York, NY, USA.
^aAlso at Institute of Physics, Academia Sinica, Taipei, Taiwan.
^aAlso at LAL, Université Paris-Sud and CNRS/IN2P3, Orsay, France.
^aAlso at Academia Sinica Grid Computing, Institute of Physics, Academia Sinica, Taipei, Taiwan.
^aAlso at School of Physics, Shandong University, Shandong, China.
^aAlso at Moscow Institute of Physics and Technology State University, Dolgoprudny, Russia.
^aAlso at Section de Physique, Université de Genève, Geneva, Switzerland.
^aAlso at International School for Advanced Studies (SISSA), Trieste, Italy.
^aAlso at Department of Physics and Astronomy, University of South Carolina, Columbia, SC, USA.
^aAlso at School of Physics and Engineering, Sun Yat-sen University, Guangzhou, China.
^aAlso at Faculty of Physics, M.V.Lomonosov Moscow State University, Moscow, Russia.
^aAlso at National Research Nuclear University MEPhI, Moscow, Russia.
^aAlso at Department of Physics, Stanford University, Stanford, CA, USA.
^aAlso at Institute for Particle and Nuclear Physics, Wigner Research Centre for Physics, Budapest, Hungary.
^aAlso at Department of Physics, The University of Michigan, Ann Arbor, MI, USA.
^aAlso at Discipline of Physics, University of KwaZulu-Natal, Durban, South Africa.
^aAlso at University of Malaya, Department of Physics, Kuala Lumpur, Malaysia.
^aAlso at Vienna University of Technology, Vienna, Austria.
^aAlso at CERN, European Organization for Nuclear Research, Geneva, Switzerland.
^aAlso at State Key Laboratory of Nuclear Physics and Technology, Peking University, Beijing, China.
^aAlso at Institut Pluridisciplinaire Hubert Curien, Université de Strasbourg, Université de Haute Alsace Mulhouse, CNRS/IN2P3, Strasbourg, France.
^aAlso at National Institute of Chemical Physics and Biophysics, Tallinn, Estonia.
^aAlso at Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow, Russia.
^aAlso at Universidade Estadual de Campinas, Campinas, Brazil.
^aAlso at Centre National de la Recherche Scientifique (CNRS)-IN2P3, Paris, France.
^aAlso at Laboratoire Leprince-Ringuet, Ecole Polytechnique, IN2P3-CNRS, Palaiseau, France.
^aAlso at Joint Institute for Nuclear Research, Dubna, Russia.
^aAlso at Ain Shams University, Cairo, Egypt.

- ³⁷ Also at British University in Egypt, Cairo, Egypt.
³⁸ Also at Helwan University, Cairo, Egypt.
³⁹ Also at Suez University, Suez, Egypt.
⁴⁰ Also at Cairo University, Cairo, Egypt.
⁴¹ Also at Fayoum University, El-Fayoum, Egypt.
⁴² Also at Université de Haute Alsace, Mulhouse, France.
⁴³ Also at Brandenburg University of Technology, Cottbus, Germany.
⁴⁴ Also at Institute of Nuclear Research ATOMKI, Debrecen, Hungary.
⁴⁵ Also at Eötvös Loránd University, Budapest, Hungary.
⁴⁶ Also at University of Debrecen, Debrecen, Hungary.
⁴⁷ Also at Wigner Research Centre for Physics, Budapest, Hungary.
⁴⁸ Also at University of Visva-Bharati, Santiniketan, India.
⁴⁹ Also at King Abdulaziz University, Jeddah, Saudi Arabia.
⁵⁰ Also at University of Ruhuna, Matara, Sri Lanka.
⁵¹ Also at Isfahan University of Technology, Isfahan, Iran.
⁵² Also at University of Tehran, Department of Engineering Science, Tehran, Iran.
⁵³ Also at Plasma Physics Research Center, Science and Research Branch, Islamic Azad University, Tehran, Iran.
⁵⁴ Also at Università degli Studi di Siena, Siena, Italy.
⁵⁵ Also at Purdue University, West Lafayette, IN, USA.
⁵⁶ Also at International Islamic University of Malaysia, Kuala Lumpur, Malaysia.
⁵⁷ Also at Consejo Nacional de Ciencia y Tecnología, Mexico, Mexico.
⁵⁸ Also at Institute for Nuclear Research, Moscow, Russia.
⁵⁹ Also at Institute of High Energy Physics and Informatization, Tbilisi State University, Tbilisi, Georgia.
⁶⁰ Also at St. Petersburg State Polytechnical University, St. Petersburg, Russia.
⁶¹ Also at National Research Nuclear University "Moscow Engineering Physics Institute" (MEPhI), Moscow, Russia.
⁶² Also at California Institute of Technology, Pasadena, CA, USA.
⁶³ Also at Faculty of Physics, University of Belgrade, Belgrade, Serbia.
⁶⁴ Also at Facoltà Ingegneria, Università di Roma, Roma, Italy.
⁶⁵ Also at National Technical University of Athens, Athens, Greece.
⁶⁶ Also at Scuola Normale e Sezione dell'INFN, Pisa, Italy.
⁶⁷ Also at University of Athens, Athens, Greece.
⁶⁸ Also at Warsaw University of Technology, Institute of Electronic Systems, Warsaw, Poland.
⁶⁹ Also at Institute for Theoretical and Experimental Physics, Moscow, Russia.
⁷⁰ Also at Albert Einstein Center for Fundamental Physics, Bern, Switzerland.
⁷¹ Also at Adiyaman University, Adiyaman, Turkey.
⁷² Also at Mersin University, Mersin, Turkey.
⁷³ Also at Cag University, Mersin, Turkey.
⁷⁴ Also at Piri Reis University, İstanbul, Turkey.
⁷⁵ Also at Gazioglu University, Tokat, Turkey.
⁷⁶ Also at Ozyegin University, İstanbul, Turkey.
⁷⁷ Also at Izmir Institute of Technology, Izmir, Turkey.
⁷⁸ Also at Marmar Sinan University, İstanbul, İstanbul, Turkey.
⁷⁹ Also at Marmara University, İstanbul, Turkey.
⁸⁰ Also at Kafkas University, Kars, Turkey.
⁸¹ Also at Yıldız Technical University, İstanbul, Turkey.
⁸² Also at Hacettepe University, Ankara, Turkey.
⁸³ Also at Rutherford Appleton Laboratory, Didcot, United Kingdom.
⁸⁴ Also at School of Physics and Astronomy, University of Southampton, Southampton, United Kingdom.
⁸⁵ Also at Instituto de Astrofísica de Canarias, La Laguna, Spain.
⁸⁶ Also at Utah Valley University, Orem, UT, USA.
⁸⁷ Also at University of Belgrade, Faculty of Physics and Vinca Institute of Nuclear Sciences, Belgrade, Serbia.
⁸⁸ Also at Argonne National Laboratory, Argonne, IL, USA.
⁸⁹ Also at Erzincan University, Erzincan, Turkey.
⁹⁰ Also at Texas A&M University at Qatar, Doha, Qatar.
⁹¹ Also at Kyungpook National University, Daegu, Korea.



Fragile Families Challenge

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment



An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

An overly simple view of stratification research.

$$Y = \underbrace{\beta_1 X_1 + \beta_2 X_2}_{\text{Predictable component}} + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

Unpredictable component

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

- Academic achievement
- Occupation
- Income

Predictable component

Unpredictable component

An overly simple view of stratification research.

$$Y = E(Y | \vec{X}) + \epsilon$$

Attainment

Predictable component

Unpredictable component

Theories focus on the predictable component, but empirically the unpredictable component dominates

$$\hat{y} \quad \& \quad \hat{\beta}$$

Mullainathan and Spiess (2017)

Why should we care about the predictability of social outcomes?

Why should we care about the predictability of social outcomes?

- ▶ Scientific reasons

Why should we care about the predictability of social outcomes?

- ▶ Scientific reasons
 - ▶ Basic social fact

Why should we care about the predictability of social outcomes?

► Scientific reasons

- Basic social fact
- Discovery

Why should we care about the predictability of social outcomes?

- ▶ Scientific reasons
 - ▶ Basic social fact
 - ▶ Discovery
- ▶ Policy reasons



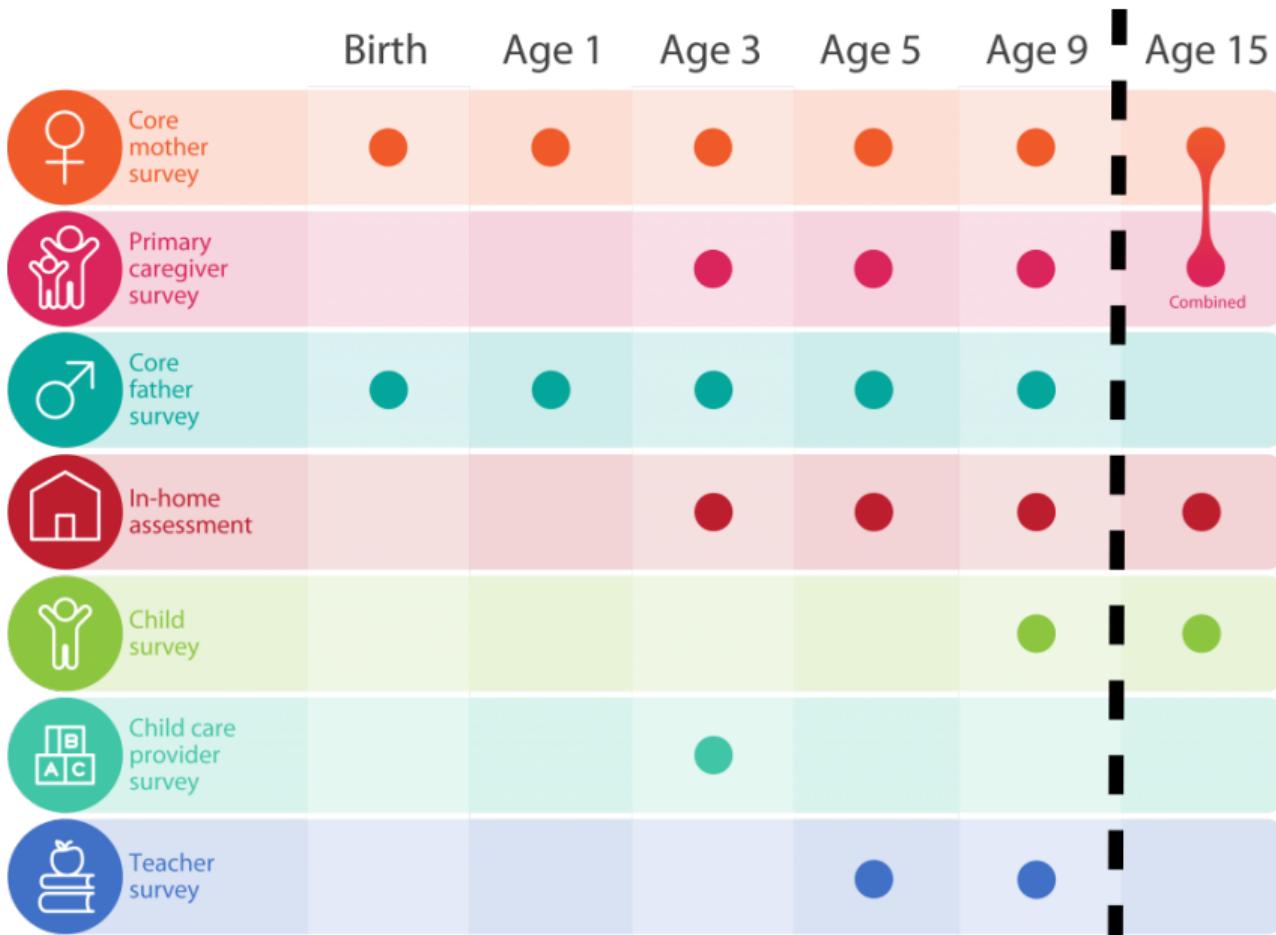
FF Fragile Families

& Child Wellbeing Study
PRINCETON | COLUMBIA



- ▶ Birth cohort panel study
- ▶ ≈ 5,000 children born in 20 U.S. cities with an over-sample of non-marital births
- ▶ Followed from birth through age 15
- ▶ Already used in hundreds of papers and dozens of dissertations

	Birth	Age 1	Age 3	Age 5	Age 9
 Core mother survey	●	●	●	●	●
 Primary caregiver survey			●	●	●
 Core father survey	●	●	●	●	●
 In-home assessment			●	●	●
 Child survey					●
 Child care provider survey			●		
 Teacher survey				●	●



4,242 families

Birth to age 9
12,942 features

Age 15
1,500 features

4,242 families

Birth to age 9
12,942 variables

Information about child and family

Background data

Age 15
6 variables

Training

Leaderboard

Holdout

Outcome
data

Outcomes

- ▶ Child: GPA (continuous), Grit (continuous)
- ▶ Household: Eviction (binary), Material hardship (continuous)
- ▶ Primary care giver: Job training (binary), Job loss (binary)

457 researchers applied to participate. Many worked in interdisciplinary teams. Goal:
Make a prediction that minimizes mean square error on the hold-out set

$$MSE_{\text{holdout}} = \frac{\sum_{i \in \text{holdout}} (\hat{y}_i - y_i)^2}{n_{\text{holdout}}}$$

More on privacy and ethics audit: Lundberg et al. (2019)

Using a large, high-quality social science dataset collected since birth and modern machine learning methods, how accurately can we predict outcomes from children, parents, and families?

$$R_{holdout}^2 = 1 - \frac{\sum_{i \in holdout} (\hat{y}_i - y_i)^2}{\sum_{i \in holdout} (\bar{y}_{train} - y_i)^2}$$

Using a large, high-quality social science dataset collected since birth and modern machine learning methods, how accurately can we predict outcomes from children, parents, and families?

$$R^2_{holdout} = 1 - \frac{\sum_{i \in holdout} (\hat{y}_i - y_i)^2}{\sum_{i \in holdout} (\bar{y}_{train} - y_i)^2}$$

Before I show the results, let's vote . . .

Measuring the predictability of life outcomes with a scientific mass collaboration

Matthew J. Salganik^{a,1}, Ian Lundberg^a , Alexander T. Kindel^a, Caitlin E. Ahearn^b, Khaled Al-Ghoneim^c, Abdullah Almaatouq^{d,e} , Drew M. Altschul^f , Jennie E. Brand^{b,g}, Nicole Bohme Carnegie^h , Ryan James Comptonⁱ, Debanjan Datta^j, Thomas Davidson^k, Anna Filippova^l, Connor Gilroy^m, Brian J. Goodeⁿ, Eaman Jahani^o, Ridhi Kashyap^{p,q,r} , Antje Kirchner^s, Stephen McKay^t , Allison C. Morgan^u , Alex Pentland^e, Kivan Polimis^v, Louis Raes^w , Daniel E. Rigobon^x, Claudia V. Roberts^y, Diana M. Stanescu^z, Yoshihiko Suhara^e, Adaner Usmani^{aa}, Erik H. Wang^z, Muna Adem^{bb}, Abdulla Alhajri^{cc}, Bedoor AlShebli^{dd}, Redwane Amin^{ee}, Ryan B. Amos^y, Lisa P. Argyle^{ff} , Livia Baer-Bositis^{gg}, Moritz Büchi^{hh} , Bo-Ryehn Chungⁱⁱ, William Eggert^{jj}, Gregory Faletto^{kk}, Zhilin Fan^{ll}, Jeremy Freese^{gg}, Tejomay Gadgil^{mm}, Josh Gagné^{gg}, Yue Gaoⁿⁿ, Andrew Halpern-Manners^{bb}, Sonia P. Hashim^y, Sonia Hausen^{gg}, Guanhua He^{oo}, Kimberly Higuera^{gg}, Bernie Hogan^{pp}, Ilana M. Horwitz^{qq}, Lisa M. Hummel^{gg}, Naman Jain^x, Kun Jin^{rr} , David Jurgens^{ss}, Patrick Kaminski^{bb,tt}, Areg Karapetyan^{uu,vv}, E. H. Kim^{gg}, Ben Leizman^y, Naijia Liu^z, Malte Möser^y, Andrew E. Mack^z, Mayank Mahajan^y, Noah Mandell^{ww}, Helge Marahrens^{bb}, Diana Mercado-Garcia^{qq}, Viola Mocz^{xx}, Katariina Mueller-Gastell^{gg}, Ahmed Musse^{yy}, Qiankun Niu^{ee}, William Nowak^{zz}, Hamidreza Omidvar^{aaa}, Andrew Or^y, Karen Ouyang^y, Katy M. Pinto^{bbb}, Ethan Porter^{ccc}, Kristin E. Porter^{ddd}, Crystal Qian^y, Tamkinat Rauf^{gg}, Anahit Sargsyan^{eee}, Thomas Schaffner^y, Landon Schnabel^{gg}, Bryan Schonfeld^z, Ben Sender^{fff}, Jonathan D. Tang^y, Emma Tsurkov^{gg}, Austin van Loon^{gg}, Onur Varol^{ggg,hhh} , Xiafei Wangⁱⁱⁱ, Zhi Wang^{hhh,jjj}, Julia Wang^y, Flora Wang^{ff}, Samantha Weissman^y, Kirstie Whitaker^{kkk,lli}, Maria K. Wolters^{mmm}, Wei Lee Woonⁿⁿⁿ, James Wu^{ooo}, Catherine Wu^y, Kengran Yang^{aaa}, Jingwen Yin^{ll}, Bingyu Zhao^{ppp}, Chenyun Zhu^{ll}, Jeanne Brooks-Gunn^{qqq,rrr}, Barbara E. Engelhardt^{y,ii}, Moritz Hardt, Dean Knox^z, Karen Levy^{ttt}, Arvind Narayanan^y, Brandon M. Stewart^a, Duncan J. Watts^{uuu,vvv,www} , and Sara McLanahan^{a,1}

Pre-read for Tuesday, November 5: Predictability of life trajectories

Matthew J. Salganik

COS 597E/SOC 555 Limits to prediction
Fall 2020, Princeton University