



International Particle Physics Outreach Group

Finding the Scientist in Everyone

J. Bondell, University of Melbourne, Australian Representative

S. Goldfarb, *University of Melbourne*

Lepton Photon Conference, Melbourne, Australia, 18 July 2023



Jackie Bondell

- Education and Public Outreach Coordinator, ARC Centre of Excellence for Dark Matter Particle Physics
- Australian Rep to the International Particle Physics Outreach Group
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- @jtkst10 (Twitter)
- Background:
 - Physics Teaching and Education
 - Curriculum Design
 - Teacher Mentoring
 - Accessibility in STEM
 - Technology in Education



An Opportunity with Physics

1 PHYSICS

PHYSICS

1.1 History

Aristotle said a bunch of stuff that was wrong. Galileo and Newton fixed things up. Then Einstein broke everything again. Now, we've basically got it all worked out, except for small stuff, big stuff, hot stuff, cold stuff, fast stuff, heavy stuff, dark stuff, turbulence, and the concept of time.

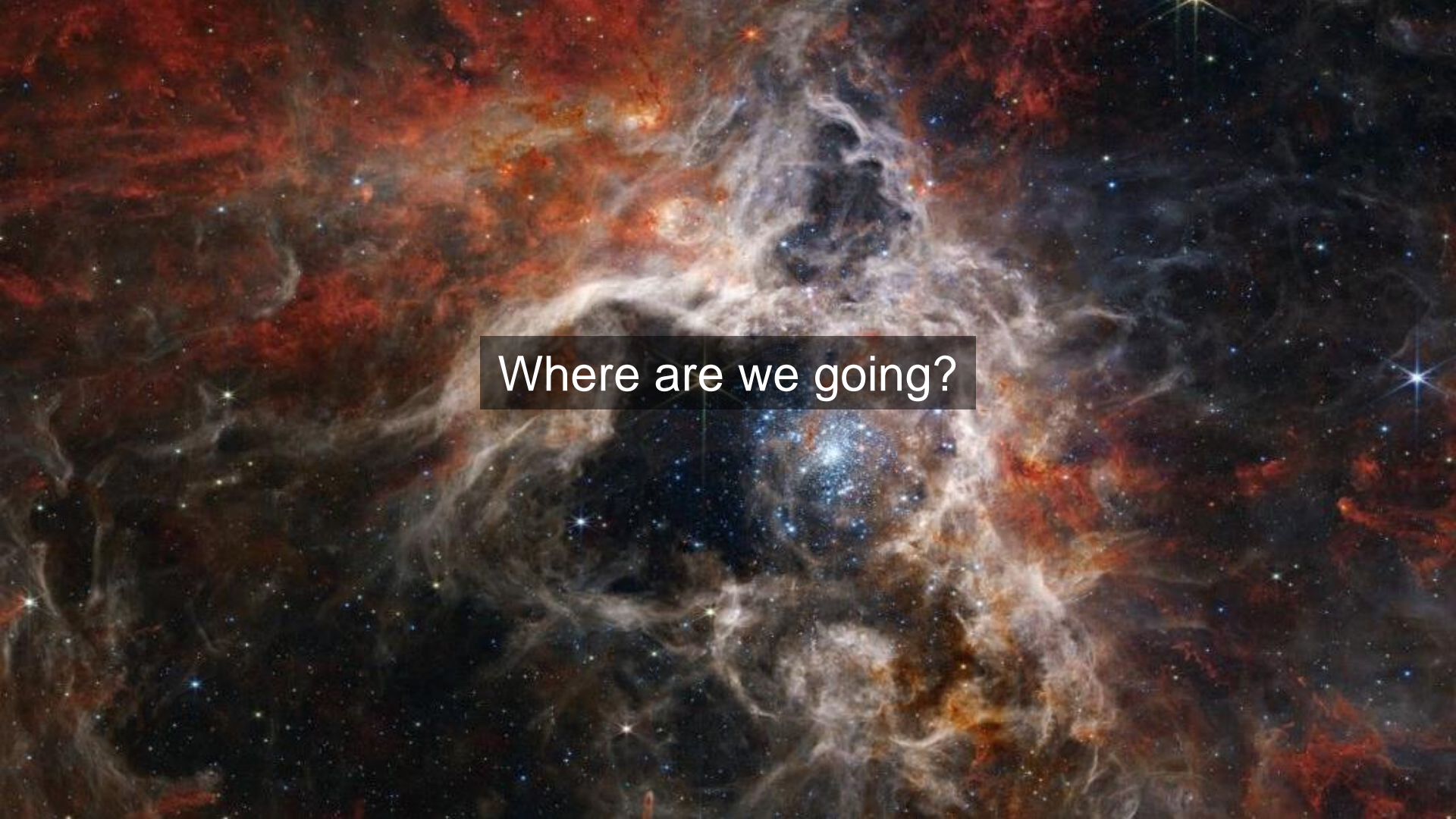
Credit: Science: Abridged Beyond
the Point of Usefulness



An inspiring story

This image depicts the large-scale structure of the universe, showing a complex web of intergalactic filaments and voids. The filaments are composed of gas and dark matter, and they are the primary sites of galaxy formation. The voids are large, empty spaces between the filaments. In the center of the image, there is a dense cluster of galaxies, which is a common feature of this cosmic web. The overall color palette is dominated by deep reds and oranges, with some blue and white highlights from distant stars and galaxies. The text "Where do we come from?" is overlaid on the image, suggesting a philosophical or scientific inquiry into the origins of life and the universe.

Where do we come from?



Where are we going?



What are we made of?

This is a deep-field astronomical image, likely from the Sloan Digital Sky Survey, showing the large-scale structure of the universe. It features a complex network of intergalactic filaments and voids. The filaments are composed of gas and dark matter, and they contain clusters of galaxies. The voids are large, empty spaces between the filaments. The image is dominated by a central cluster of galaxies, which are surrounded by a dense network of filaments. The filaments are colored in shades of red, orange, and yellow, while the voids are dark blue and black. The overall image has a high-contrast, almost abstract appearance, with a central cluster of galaxies and a dense network of filaments and voids.

What are the rules behind all this?

Opportunities with Particle Physics



4 July 2012

PREVIOUS STORY

'NIGHTS into Dreams' HD remake teased by Sega with new picture

Samba ad-supported

Published: Jul 4th, 2012

New Particle Consistent with Higgs Discovered at CERN

The Higgs boson: CERN discover the elusive

By **Vlad Savov** on July 4, 2012 06:53 am Email @vladsavov



1. 遠伝子技術が変える世界
2. スーパープレアの脅威
3. 並行宇宙は実在する
4. 無私最高は戦略

編集部ピックアップ

1. 最悪のシナリオ
2. SARSが残した本当の脅威
3. 最強加速器で発見
4. HIVに感染しない細胞
5. 脳はなぜで分業したのか

Contents

→ 最新号の紹介

BBC NEWS SCIENCE & ENVIRONMENT

Home UK Africa Asia Europe Latin America Middle East US & Canada Business Health World

Play in... Plug into a... [RSS](#)

A July 2012 Last updated at 07:08 GMT

Higgs boson-like particle discovery claimed at CERN

By Paul Rincon Science editor, BBC News website, Science

The Higgs boson-like particle discovery claimed at CERN

The Higgs boson-like particle discovery claimed at CERN

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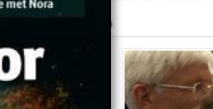
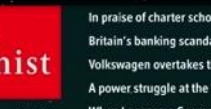
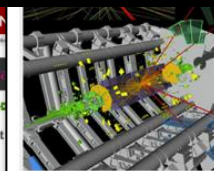
The Higgs boson-like particle discovery claimed at CERN

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The Higgs boson-like particle discovery claimed at CERN

The Higgs boson-like particle discovery claimed at CERN

One Billion Viewers



ALJAZEERA

Programmes Video Blogs Opinion In Depth Business Sport World

PR

Sarmila Bose

Sarmila Bose is Senior Research Fellow in the Politics of South Asia at the University of Oxford.

son: Dark matters in the coverage of the 'god

of media leave out in reporting this scientific breakthrough?

Post: 70 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 | 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 | 299 | 300 | 301 | 302 | 303 | 304 | 305 | 306 | 307 | 308 | 309 | 310 | 311 | 312 | 313 | 314 | 315 | 316 | 317 | 318 | 319 | 320 | 321 | 322 | 323 | 324 | 325 | 326 | 327 | 328 | 329 | 330 | 331 | 332 | 333 | 334 | 335 | 336 | 337 | 338 | 339 | 340 | 341 | 342 | 343 | 344 | 345 | 346 | 347 | 348 | 349 | 350 | 351 | 352 | 353 | 354 | 355 | 356 | 357 | 358 | 359 | 360 | 361 | 362 | 363 | 364 | 365 | 366 | 367 | 368 | 369 | 370 | 371 | 372 | 373 | 374 | 375 | 376 | 377 | 378 | 379 | 380 | 381 | 382 | 383 | 384 | 385 | 386 | 387 | 388 | 389 | 390 | 391 | 392 | 393 | 394 | 395 | 396 | 397 | 398 | 399 | 400 | 401 | 402 | 403 | 404 | 405 | 406 | 407 | 408 | 409 | 410 | 411 | 412 | 413 | 414 | 415 | 416 | 417 | 418 | 419 | 420 | 421 | 422 | 423 | 424 | 425 | 426 | 427 | 428 | 429 | 430 | 431 | 432 | 433 | 434 | 435 | 436 | 437 | 438 | 439 | 440 | 441 | 442 | 443 | 444 | 445 | 446 | 447 | 448 | 449 | 450 | 451 | 452 | 453 | 454 | 455 | 456 | 457 | 458 | 459 | 460 | 461 | 462 | 463 | 464 | 465 | 466 | 467 | 468 | 469 | 470 | 471 | 472 | 473 | 474 | 475 | 476 | 477 | 478 | 479 | 480 | 481 | 482 | 483 | 484 | 485 | 486 | 487 | 488 | 489 | 490 | 491 | 492 | 493 | 494 | 495 | 496 | 497 | 498 | 499 | 500 | 501 | 502 | 503 | 504 | 505 | 506 | 507 | 508 | 509 | 510 | 511 | 512 | 513 | 514 | 515 | 516 | 517 | 518 | 519 | 520 | 521 | 522 | 523 | 524 | 525 | 526 | 527 | 528 | 529 | 530 | 531 | 532 | 533 | 534 | 535 | 536 | 537 | 538 | 539 | 540 | 541 | 542 | 543 | 544 | 545 | 546 | 547 | 548 | 549 | 550 | 551 | 552 | 553 | 554 | 555 | 556 | 557 | 558 | 559 | 560 | 561 | 562 | 563 | 564 | 565 | 566 | 567 | 568 | 569 | 570 | 571 | 572 | 573 | 574 | 575 | 576 | 577 | 578 | 579 | 580 | 581 | 582 | 583 | 584 | 585 | 586 | 587 | 588 | 589 | 590 | 591 | 592 | 593 | 594 | 595 | 596 | 597 | 598 | 599 | 600 | 601 | 602 | 603 | 604 | 605 | 606 | 607 | 608 | 609 | 610 | 611 | 612 | 613 | 614 | 615 | 616 | 617 | 618 | 619 | 620 | 621 | 622 | 623 | 624 | 625 | 626 | 627 | 628 | 629 | 630 | 631 | 632 | 633 | 634 | 635 | 636 | 637 | 638 | 639 | 640 | 641 | 642 | 643 | 644 | 645 | 646 | 647 | 648 | 649 | 650 | 651 | 652 | 653 | 654 | 655 | 656 | 657 | 658 | 659 | 660 | 661 | 662 | 663 | 664 | 665 | 666 | 667 | 668 | 669 | 670 | 671 | 672 | 673 | 674 | 675 | 676 | 677 | 678 | 679 | 680 | 681 | 682 | 683 | 684 | 685 | 686 | 687 | 688 | 689 | 690 | 691 | 692 | 693 | 694 | 695 | 696 | 697 | 698 | 699 | 700 | 701 | 702 | 703 | 704 | 705 | 706 | 707 | 708 | 709 | 710 | 711 | 712 | 713 | 714 | 715 | 716 | 717 | 718 | 719 | 720 | 721 | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 | 734 | 735 | 736 | 737 | 738 | 739 | 740 | 741 | 742 | 743 | 744 | 745 | 746 | 747 | 748 | 749 | 750 | 751 | 752 | 753 | 754 | 755 | 756 | 757 | 758 | 759 | 760 | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769 | 770 | 771 | 772 | 773 | 774 | 775 | 776 | 777 | 778 | 779 | 780 | 781 | 782 | 783 | 784 | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 | 796 | 797 | 798 | 799 | 800 | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810 | 811 | 812 | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821 | 822 | 823 | 824 | 825 | 826 | 827 | 828 | 829 | 830 | 831 | 832 | 833 | 834 | 835 | 836 | 837 | 838 | 839 | 840 | 841 | 842 | 843 | 844 | 845 | 846 | 847 | 848 | 849 | 850 | 851 | 852 | 853 | 854 | 855 | 856 | 857 | 858 | 859 | 860 | 861 | 862 | 863 | 864 | 865 | 866 | 867 | 868 | 869 | 870 | 871 | 872 | 873 | 874 | 875 | 876 | 877 | 878 | 879 | 880 | 881 | 882 | 883 | 884 | 885 | 886 | 887 | 888 | 889 | 890 | 891 | 892 | 893 | 894 | 895 | 896 | 897 | 898 | 899 | 900 | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 | 909 | 910 | 911 | 912 | 913 | 914 | 915 | 916 | 917 | 918 | 919 | 920 | 921 | 922 | 923 | 924 | 925 | 926 | 927 | 928 | 929 | 930 | 931 | 932 | 933 | 934 | 935 | 936 | 937 | 938 | 939 | 940 | 941 | 942 | 943 | 944 | 945 | 946 | 947 | 948 | 949 | 950 | 951 | 952 | 953 | 954 | 955 | 956 | 957 | 958 | 959 | 960 | 961 | 962 | 963 | 964 | 965 | 966 | 967 | 968 | 969 | 970 | 971 | 972 | 973 | 974 | 975 | 976 | 977 | 978 | 979 | 980 | 981 | 982 | 983 | 984 | 985 | 986 | 987 | 988 | 989 | 990 | 991 | 992 | 993 | 994 | 995 | 996 | 997 | 998 | 999 | 1000 | 1001 | 1002 | 1003 | 1004 | 1005 | 1006 | 1007 | 1008 | 1009 | 1010 | 1011 | 1012 | 1013 | 1014 | 1015 | 1016 | 1017 | 1018 | 1019 | 1020 | 1021 | 1022 | 1023 | 1024 | 1025 | 1026 | 1027 | 1028 | 1029 | 1030 | 1031 | 1032 | 1033 | 1034 | 1035 | 1036 | 1037 | 1038 | 1039 | 1040 | 1041 | 1042 | 1043 | 1044 | 1045 | 1046 | 1047 | 1048 | 1049 | 1050 | 1051 | 1052 | 1053 | 1054 | 1055 | 1056 | 1057 | 1058 | 1059 | 1060 | 1061 | 1062 | 1063 | 1064 | 1065 | 1066 | 1067 | 1068 | 1069 | 1070 | 1071 | 1072 | 1073 | 1074 | 1075 | 1076 | 1077 | 1078 | 1079 | 1080 | 1081 | 1082 | 1083 | 1084 | 1085 | 1086 | 1087 | 1088 | 1089 | 1090 | 1091 | 1092 | 1093 | 1094 | 1095 | 1096 | 1097 | 1098 | 1099 | 1100 | 1101 | 1102 | 1103 | 1104 | 1105 | 1106 | 1107 | 1108 | 1109 | 1110 | 1111 | 1112 | 1113 | 1114 | 1115 | 1116 | 1117 | 1118 | 1119 | 1120 | 1121 | 1122 | 1123 | 1124 | 1125 | 1126 | 1127 | 1128 | 1129 | 1130 | 1131 | 1132 | 1133 | 1134 | 1135 | 1136 | 1137 | 1138 | 1139 | 1140 | 1141 | 1142 | 1143 | 1144 | 1145 | 1146 | 1147 | 1148 | 1149 | 1150 | 1151 | 1152 | 1153 | 1154 | 1155 | 1156 | 1157 | 1158 | 1159 | 1160 | 1161 | 1162 | 1163 | 1164 | 1165 | 1166 | 1167 | 1168 | 1169 | 1170 | 1171 | 1172 | 1173 | 1174 | 1175 | 1176 | 1177 | 1178 | 1179 | 1180 | 1181 | 1182 | 1183 | 1184 | 1185 | 1186 | 1187 | 1188 | 1189 | 1190 | 1191 | 1192 | 1193 | 1194 | 1195 | 1196 | 1197 | 1198 | 1199 | 1200 | 1201 | 1202 | 1203 | 1204 | 1205 | 1206 | 1207 | 1208 | 1209 | 1210 | 1211 | 1212 | 1213 | 1214 | 1215 | 1216 | 1217 | 1218 | 1219 | 1220 | 1221 | 1222 | 1223 | 1224 | 1225 | 1226 | 1227 | 1228 | 1229 | 1230 | 1231 | 1232 | 1233



An inspiring story

A deep space image showing a complex galaxy cluster. The center features a bright, dense core of blue and white light, surrounded by intricate, swirling patterns of orange, red, and white nebulae. The background is a dark, star-filled space with numerous small, distant stars visible.

So, what's in the media these days?

WHEN YOU REALISE



	30°	45°	60°
sin	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$
cos	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$
tan	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$

AUSTRALIA ISN'T REAL



"Findings of this development of the vaccine associated"

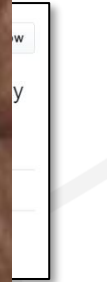
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"We found no acquired cent"



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"I see minute that t





Large Hadron Rap

8.1M views · 13 years ago

alpinekat

Rappin' about CERN's Large Hadron Collider! Links below... Apparently YouTube fixed the sound! Still, Will Barras made two ...

and the things that it discovers

4:49



I'm a Physicist At CERN We've Done Something We Shouldn't Have Done part one

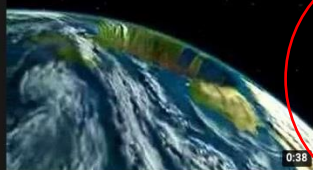
6.5M views · 5 years ago

Paranoid Times

If you like my videos and want to support more content on my heavily censored, demonized channel: * Patreon: ...

CC

18:11



The CERN black hole

5.3M views · 13 years ago

BrainReleaseValve

<http://www.brainreleasevalve.com/> Stolen from Misunderstood Universe. Because its HILARIOUS. Yes, I know this can't happen.

0:38



Why This Stuff Costs \$2700 Trillion Per Gram - Antimatter at CERN

5.2M views · 1 year ago

Physics Girl

There's a factory in Europe that makes antimatter! It's the rarest, most expensive, and potentially the most dangerous material on ...

11:30



Robin and The Backstabbers - Sat dupa Sat (CERN campaign)

5M views · 6 years ago

TheLunoStudio

Sat după sat * e parte a campaniei "România la CERN în 2015" dezvoltată de Luno. Regia: Andrei Fântână DoP: Alex Grigoras ...

4K 3D

2:48



Scientist and the Elite Try to Hide What Really Happened at CERN, Demonic Entities, Extra Dimensions

4M views · 2 years ago

A & Q Productions

Scientist are beginning to get more and more "religious". What has happened at CERN the past few Years? And What are they up ...

CC

35:32



New findings have physicists questioning reality

4M views · 3 years ago

CBS News

Physicists at CERN are working to determine why the equal amounts of matter and antimatter in the universe haven't annihilated ...

3:52

這個組織，平均智商



160+

11:35

一個平均智商超過160的組織每天都在幹什麼， CERN | 老高與小茉 Mr & Mrs Gao

3.9M views · 2 years ago

老高與小茉 Mr & Mrs Gao

推薦播放列表：【未來】<https://goo.gl/Bq54h5> 【傳說】<https://goo.gl/CpmK2Y> 【心理 ...



This Is The Only Place Antimatter Can Survive In The Universe

3.4M views · 4 years ago

Seeker

Scientists at CERN are using the Large Hadron Collider to create and study antimatter, but how are they doing it? Inside The ...

CC

6:31



Cern - The Message (Magdelayna's Apollo Mix)

3.4M views · 6 years ago

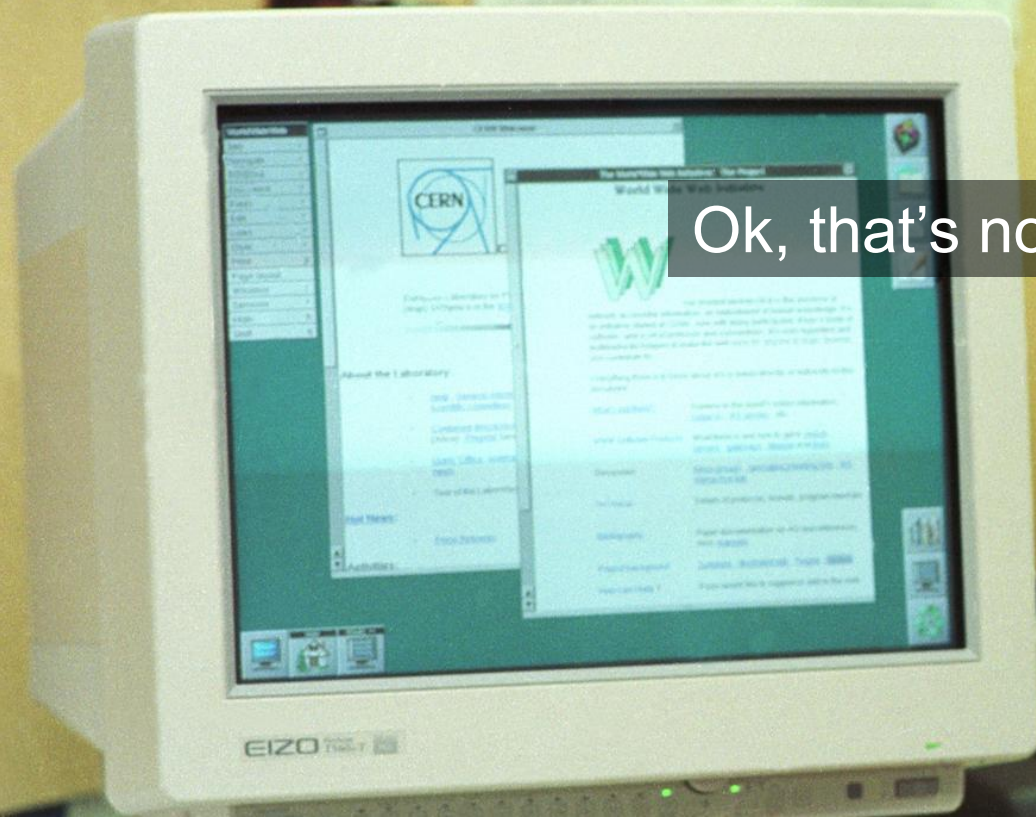
Magdelayna

Please Subscribe to my channel for more sounds like this! My new Artist Album is available here ...

9:08



So, who created this mess?



Ok, that's not fair.



“We found that falsehood diffuses significantly farther, faster, deeper, and more broadly than the truth, in all categories of information, and in many cases by an order of magnitude,” says Sinan Aral, a professor at the MIT Sloan School of Management and co-author of a new paper detailing the findings.

MIT News Office
March 8, 2018





Science Communication



True or verified stories on Twitter take six times longer than fake news to reach 1,500 people

“[Science Education in an Age of Misinformation](#)” (Stanford):

- more educated public would be better-equipped to gauge the trustworthiness of scientific claims and to make well-informed decisions
- “School science cannot anticipate what kind of scientific knowledge will be required to deal with the next science-related, humanitarian crisis,” the authors write.

The background of the slide is a deep-space photograph showing a complex network of intergalactic filaments and voids. The filaments are composed of gas and dust, appearing in shades of red, orange, and white against the dark cosmic background. Numerous stars are visible as bright points of light, some with prominent diffraction spikes. A semi-transparent black rectangular box is centered horizontally across the middle of the image, containing white text.

How can we play a role in combating misinformation and building support for future large-scale projects?

Education, Outreach, Communication

Communication

- **Develop** messages & strategies
- **Optimise** platforms & networks
- **Create** effective material
- **Implement** and evaluate

Education & Outreach

- **Establish Understanding** of scientific process
- **Instil Appreciation** of fundamental research
- **Build Trust** with communities
- **Train Next Generation** of scientists



The Education, Outreach & Communication we do **today** lay the foundation for **tomorrow's** support and secure the **next generation** of scientists.

What is IPPOG?



A **network** of scientists, science educators and communication specialists working across the globe in science education and public engagement for particle physics

A **forum** for the exchange of information and best practices with colleagues from around the world

A **key partner** for promoting and enabling the scientific mission and activities of scientific partners

International Scientific Collaboration

- Active Researchers with Experience in Education & Public Engagement
- Experts in Communication & Education

Global Network

- 39 members: 32 countries, 6 experiments, 1 intl lab (CERN)
- 2 associate members: 2 national labs (DESY, GSI)

Organise Global Activities

- International Particle Physics Masterclasses
- World-Wide Data Day, Global Cosmics, etc.

Support Local Activities

- Sharing of expertise, best practices, material database
- Resources to support events, kick-start activities





IPPOG Timeline

1997 Birth of European Particle Physics Outreach Group (EPOG)

- formed under the joint auspices of ECFA and EPS-HEPP

2005 Birth of International Particle Physics Masterclasses

- now in over 60 countries worldwide

2011 Global Expansion to IPPOG

- Israel, Australia, USA, South Africa, Brazil, India, Mexico,...

2016 Formal Scientific Collaboration

- Memorandum of Understanding

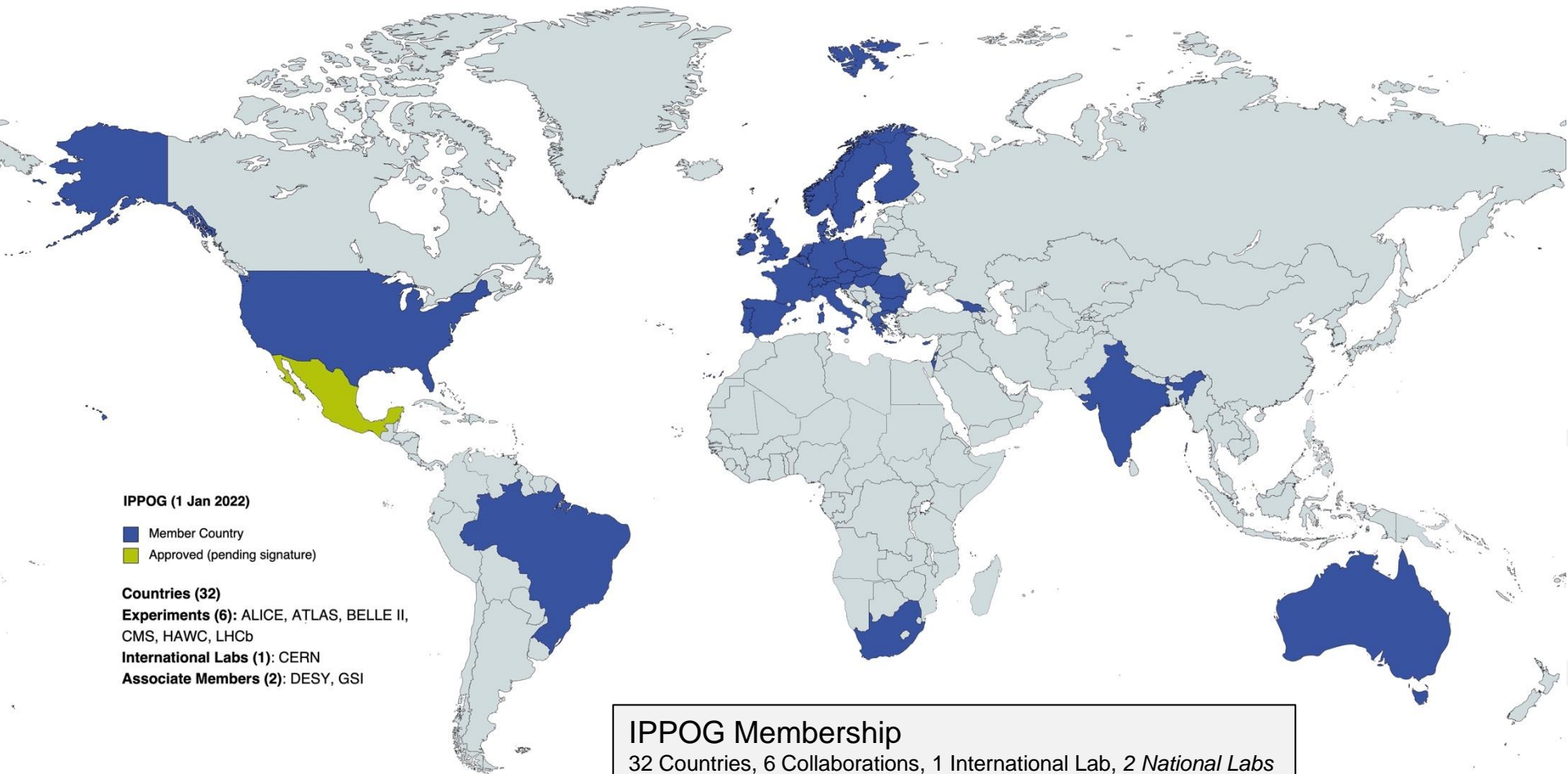
2022 Celebrating 25 Years of Outreach Excellence

- October 29, 2022 at CERN Globe of Science & Innovation



“...the particle physics community has a moral obligation to inform the public on its activities. To do this well, experiences must be shared among countries in view of the need to optimize the use of resources.”

- Chris Llewellyn-Smith, CERN Director General, 1997



IPPOG Membership

32 Countries, 6 Collaborations, 1 International Lab, 2 *National Labs*

Sharing Ideas & Best Practices

IPPOG Meetings

- Two per Year
- Intensive 2.5 Day meetings
- Collaboration Board
- Topics Include: Expanding Masterclasses to New Countries, Exhibits & Public Events, Explaining Particle Physics, Applications for Society, New Masterclasses
- In person with Zoom option for talks



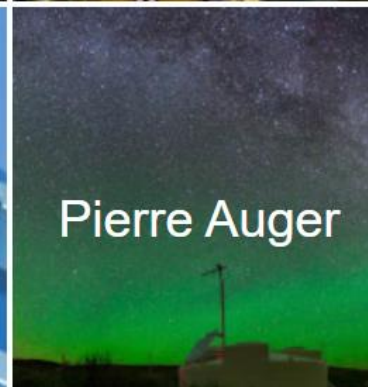
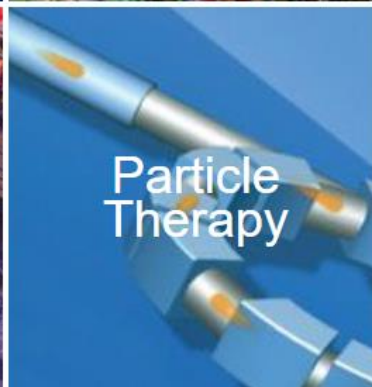
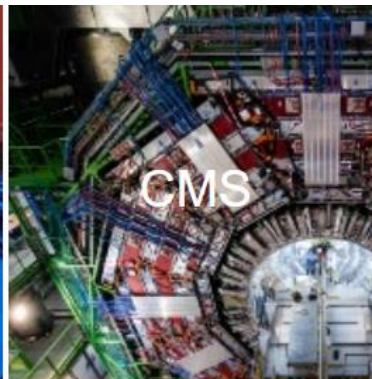
Communication Platforms

International Particle Physics Outreach Group

<https://ippog.org>
<https://facebook.com/ippog>
<https://facebook.com/groups/friends.ippog>
<https://twitter.com/ippogOrg>
<https://instagram.com/ippogOrg>
<https://tiktok.com/@ippogOrg>
<https://linkedin.com/company/ippog>

The International Particle Physics Outreach Group

International Particle Physics Masterclasses



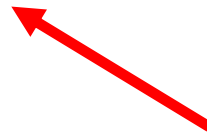
Pilots in 2022:

- Dark Matter
- Quantum Computing

International Particle Physics Masterclasses

The Flagship of IPPOG

- Students become “Researchers for a Day”
- Invited to research institute or university
- Use analysis tools to examine real data
- Worldwide videoconference w/other students
- This program is organized at TU Dresden and at QuarkNet Notre Dame in the framework of the International Particle Physics Outreach Group IPPOG.
- **Expanded into classes for public and/or non-scientific audiences**



Statistics for IMC23

numbers from 2022 in brackets

CERN LHC Masterclasses

211 MCs with
CERN VC (191)

- 99 ATLAS (94)
- 56 CMS (51)
- 26 LHCb (22)
- 30 ALICE (24)

Fermilab LHC Masterclasses

40 MCs with
Fermilab VC (32)

- 29 CMS (22)
- 11 ATLAS (10)

MINERvA Masterclasses 8 MCs (9)

KEK Belle II Masterclasses

16 MCs (11)
5 VCs (3)

Malargue Pierre Auger Masterclasses 12 MCs new! 3 VCs

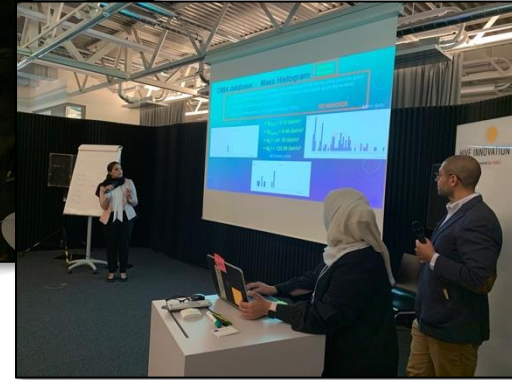
GSI Hadron Therapy Masterclasses

30 MCs (28)
9 VCs (5)

Scientific Process via Masterclasses

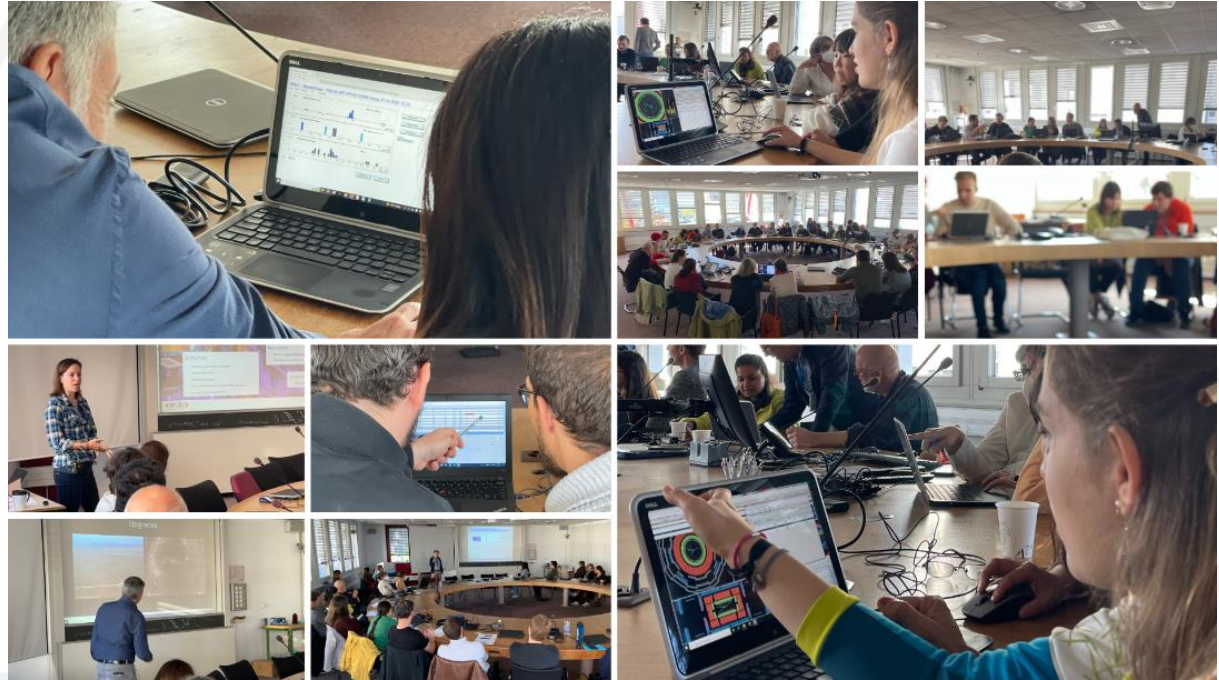
MISK: Teaching the scientific process

- Gave Particle Physics masterclasses to about 160 Saudi executives in a training program
- For 4 weeks, divided group into 5 “collaborations”
- “Spokespersons” taught courses and “Physics Coordinators” presented results



Masterclass for non-science CERN staff

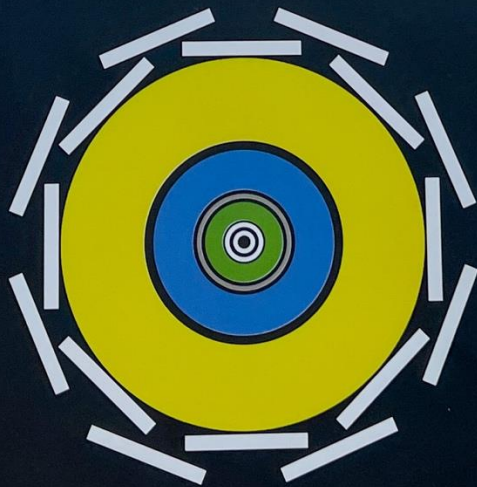
- Opportunity for those who work at CERN to live the experience of research and discovery by putting their hands on particle physics and learn the work of physicists and scientists.
- 40+ attendees at the session



Accelerating Science

It's never too early to start!

Particle Physics for Babies



By Dr Louie Corpe



Thank you!



The International Particle Physics Outreach Group

