Born 12th September 1953, Ichapur, India

All India Higher Secondary School Examination Certificate, 1969

BSc 1972; MSc 1974, Indian Institute of Technology (IIT), Kharagpur

PhD in Physics 1982, Tata Institute of Fundamental Research (TIFR), Bombay;
Research Associate, Cosmic Rays Group, 1979–84;

Visiting Fellow, International School of Advanced Studies (SISSA), Trieste, 1983

Research Associate, Theory Division, European Organisation for Nuclear Research (CERN), Geneva 1984-85

Visiting Fellow, Department of Astrophysics, University of Oxford, 1985–86

Research Associate, HEP Theory Group, Rutherford Appleton Laboratory (RAL), Chilton, 1987–88

Staff Member, Rudolf Peierls Centre for Theoretical Physics, University of Oxford, since 1990:
Glasstone Fellow, 1990–92; Visiting Scholar, Wolfson College, 1991–93; PPARC Advanced Fellow, 1992–97; Research Fellow, Wolfson College, 1993–97; Departmental Lecturer, 1997–98; Tutor in Physics, Pembroke College, 1997–98; University Lecturer & Fellow of Linacre College, 1998–21; Reader, 2000; Professor, 2006; Head, Particle Theory Group, 2011–19; Emeritus Professor, 2021– ; Emeritus Fellow, Linacre College, 2021–

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Research interests: Particle astrophysics & cosmology; High energy astrophysics; Particle phenomenology

Awards:

- ▷ Indian National Science Talent Scholarship, 1969–78
- ▷ Glasstone Research Fellowship in Science, University of Oxford, 1990–92
- ▷ UK Science & Technology Facilities Council: Rutherford Fellowship, 1992–97; Senior Fellowship, 2006–09
- ▷ Niels Bohr Professorship, University of Copenhagen, 2013–18
- ▷ IUPAP-TIFR Homi Bhabha Medal & Prize, 2017
- ▷ (Shared) Bruno Rossi Prize of the American Astronomical Society to the IceCube Collaboration, 2021

Academic Service (selected):

- ▷ Particle Data Group: Member (Astrophysics & Cosmology section), 2001–
- ▷ Editorial Board: SciPost (Senior Fellow) 2017– ; Pramana 2013–20; European Physical Journal C 2012–15
- ▷ International Center for Theoretical Physics Asia-Pacific (ICTP-AP), Beijing: Scientific Council, 2019–
- ▷ Gruber Cosmology Prize: Advisory Board, 2014–20
- ▷ IUPAP: Commission C4, AstroParticle Physics, 2021– ; Working Group 10 (ApPIC), 2014–21
- ▷ European Centre for Astro Particle Theory (EuCAPT): Founder Member & Steering Committee, 2019–20
- ▷ Astroparticle Physics European Coordination (ApPEC): Programme Review Committee, 2005–09; Science Advisory Committee, 2009–12
- ▷ Astroparticle Physics European Research Area Network (ASPERA): Working Groups, 2006–12
- ▷ ASTRONET: Science Vision Working Group (Panel A), 2006–08
- ▷ Astroparticle Physics Group, Institute of Physics: Founder Member & Steering Committee, 2006–08
- ▷ STFC Programmatic Review: Chair, Particle Astrophysics Advisory Panel, 2008
- ▷ Helmholtz Gemeinschaft: Review Panels — Astroparticle Physics, 2011; DESY, 2018
- ▷ Helmholtz Alliance on Astroparticle Physics: International Advisory Board, 2012–17
- ▷ Cherenkov Telescope Array: Requirements Review Panel, 2012; Review of 'Key Science Projects', 2014
- ▷ KM3NeT: Scientific & Technical Advisory Committee, 2013–20
- ▷ Danish Council for Independent Research (FNU): Peer Review Panel — Physics and Astronomy, 2010–12

**Research Experience:** My research interests are focussed on particle astrophysics and cosmology. My key contributions have been in cosmic ray phenomenology, in using the early universe as a laboratory for new physics, and in seeking a physical understanding of dark matter & dark energy.

**Cosmic Rays & High Energy Astrophysics**: I began research in 1974 in experimental cosmic ray studies using plastic track detectors flown on balloons and *SKYLAB*. We showed that heavy nuclei in low energy cosmic rays are not fully ionised, implying a relatively local origin [452]. To investigate this further we designed an experiment *Anuradha* flown on *SPACELAB III*, which had a rotating detector to make time resolved measurements, in order to use the Earth's magnetic field as a momentum filter.

We investigated cosmic ray acceleration by plasma turbulence and the non-thermal radiation which probes such environments. By combining radio, X-ray and $\gamma$-ray data on the young supernova remnant (SNR) *Cassiopeia A* we showed that the magnetic field in the radio emitting region has been significantly amplified over the compressed interstellar field [2]. Second-order Fermi acceleration by plasma turbulence generated via the deceleration of the supernova blast wave naturally yields the observed (slightly convex) power-law electron spectrum, and explains the rapid rise in synchrotron luminosity accompanied by spectral flattening of young SNRs entering the Sedov-Taylor phase [4]. Our analytic solution to the transport equation explains the temporal and spectral evolution of the radio emission from *Cassiopeia A*. We are experimentally testing such ideas using high powered lasers to reproduce a lab-scale version of SNR shocks [103, 421] and $\gamma$-ray bursts [424]. Recent successes include a demonstration that thermal particles can be accelerated to relativistic energies by the two-stream instability [420], and measurement of the 'cosmic ray' diffusion rate in a turbulent plasma [423].

I noted [3] that old SNRs in the radiative phase which have expanded to large sizes in the hot interstellar medium can account for the 'diffuse' synchrotron radio emission from the Galaxy, thus reconciling the modest magnetic field values inferred from Faraday rotation with the higher values inferred from the synchrotron luminosity. The closest of these stand out as the 'radio loops' which extend to high galactic latitudes and we showed that the angular power spectrum of the galactic emission is well matched by the contribution on $\sim (1-10)^0$ scales from $\mathcal{O}(10^4)$ such old SNRs [85]. We discovered that one of these, Loop I, is visible in supposedly 'foreground-cleaned' maps of the cosmic microwave background (CMB), with its anomalous microwave emission possibly arising from magnetised dust grains [90, 97]. Part of it crosses the sky region from which the BICEP2 experiment detected '$B$-mode' polarisation, which was interpreted as due to gravitational waves from inflation but subsequently shown by the *Planck* satellite to arise from dust emission.

A nearby SNR may also be responsible for the positron excess in cosmic rays seen by *PAMELA* and confirmed by AMS-02, which has been speculated to be due to DM annihilation or decay. We investigated the possibility that the positron secondaries created near the shock wave will themselves be accelerated and acquire a harder spectrum than the primary electrons. By fitting to the $e^- + e^+$ spectrum measured by *Fermi*, we were able to pick out the most plausible SNR source configuration by doing Monte Carlo simulations [66]. Such nearby SNRs would have a $\gamma$-ray brightness consistent with the unidentified extended Galactic plane sources and be detectable in TeV energy neutrinos. Other secondary-to-primary ratios e.g. B/C and $\bar{p}/p$ should also then flatten with energy [65] — following invited discussions with the *AMS-02* collaboration, this prediction is being now experimentally checked to pin down this astrophysical background to signals of new physics [89, 109].

Another context in which second-order Fermi acceleration of electrons is important is the $\gamma$-ray emission from the 'Fermi bubbles' — the giant bi-lobar structure at the Galactic Centre. We have shown that inverse-Compton scattering of starlight and CMB photons by electrons fits the spectrum and morphology of the bubbles, and that the electrons can be accelerated on the necessary short time scale by plasma turbulence behind the shocks driven by a jet-like outflow a few million years ago from the black hole at the Galactic Centre [78].

I was a member of the *Pierre Auger Observatory* when it detected the expected 'GZK suppression' of the ultra-high energy cosmic ray (UHECR) flux which may be due to propagation effects or inherent to the cosmic accelerators [150, 158]. I also work on *IceCube* [294, 296] which made the first observation of high energy neutrinos of cosmic origin [242, 250, 257, 266, 273] and has recently identified a flaring blazar as a source [318, 316]. IceCube has also made competitive measurements of atmospheric neutrino

oscillations [243, 264, 285, 306] and placed strong constraints on a sterile neutrino [284, 298]. My main contribution to these experiments has been to provide phenomenological inputs for the science analyses. For example searches for ultrahigh energy neutrinos require knowledge of their deep inelastic scattering cross-section which we have computed using parton distribution functions measured at HERA [59, 79]. A study of neutrino absorption by the Earth confirms our calculation up to PeV energies [311, 354], as does a measurement of the inelasticity distribution [320, 354], thus constraining new physics. Another key target of *Auger* and *IceCube* is the 'cosmogenic' neutrino flux [205, 249, 315] which we have computed by analysing the intergalactic propagation of UHE cosmic protons, and imposing the constraint from *Fermi* on the concomitant $\gamma$-ray background [71]. Motivated by the observation that the chemical composition is getting heavier at the highest energies [157], we studied the intergalactic propagation of UHE heavy nuclei and showed that the cosmogenic neutrino flux is then reduced substantially [48, 55, 58, 61]. I have also joined the *Cherenkov Telescope Array* collaboration [409, 410] and participated in defining its science requirements [411, 445], in particular concerning searches for new physics [413, 415].

**Particle Physics & the Early Universe**: My work has developed and refined the constraints on fundamental physics coming from cosmology and astrophysics. All particles, known or as yet undiscovered, would have been created in the early universe; analysis of their possible effects on the CMB and the light element abundances from Big Bang nucleosynthesis (BBN), enables interesting constraints to be derived on their properties. The production and interactions of particles can also have observable effects in astrophysical objects such as the Sun and supernovae. Such arguments have provided useful guidance on physics beyond the Standard $SU(3) \otimes SU(2) \otimes U(1)$ Model of particle physics [21].

By combining cosmological constraints with laboratory bounds on leptonic mixing, we demonstrated that the $\nu_\tau$ must be stable against weak decay, hence lighter than $2m_e$ [6]. With the subsequent discovery of large-angle neutrino mixing, stronger mass bounds follow, but these arguments remain relevant to other hypothetical neutral leptons e.g. sterile neutrinos. We calculated the 'thermalisation redshift' above which a large electromagnetic energy release in the early universe (e.g. from decaying $\nu_\tau$s) would be instantly converted into blackbody radiation by radiative Compton scattering, leaving no (Bose-Einstein) distortion in the observed spectrum [6]. We showed that even tiny releases of hydrogen-ionising radiation would broaden the last scattering surface and noticeably damp the acoustic peaks in the CMB angular power spectrum [31] — this has proven to be the most stringent constraint on late-time annihilations (or decays) of relic particles, enabling precision data from the *Planck* satellite to rule out such annihilations as the source of the *PAMELA/AMS-02* anomaly

The bounds on leptonic mixing above came from our search for sterile neutrinos in the 1982 CERN 'beam dump' using the *Big European Bubble Chamber* [143] — this is still the best such bound [112]. When monojet events seen by the *UA1* experiment were interpreted as due to a light gluino, I proposed a search which ruled them out from the absence of any excess of neutral current-like events [142]. We also set a stringent bound on the magnetic moment of tau neutrinos [13] from the absence of any excess of forward scattered electrons. This also constrains dark photons or milli-charged particles [108].

We showed that the thermal production of massive gravitinos can be disastrous for cosmology, implying a constraint on the temperature to which the universe reheated at the end of inflation [7]. The most restrictive bound comes from consideration of the potential overproduction of D and $^3$He through the photodisintegration of $^4$He by radiation cascades triggered by high energy photons from gravitino decays. This implies that the baryon asymmetry cannot have been created at the GUT scale and has motivated theoretical attempts to generate it by alternative means such as 'leptogenesis' which is linked to neutrino mass [32]. In subsequent work we further refined these bounds and derived new constraints on high energy neutrinos and $\gamma$-rays produced through the decay of superheavy metastable relic particles [11, 41], which have excluded 'top-down' sources for UHECRs [144, 147].

Such arguments have wide application, e.g. the Next-to-Minimal-Supersymmetric Standard Model (NMSSM) which addresses the '$\mu$ problem' in the MSSM by introducing an additional singlet, is inconsistent with cosmology [19]. Unacceptable domain walls form at $SU(2) \otimes U(1)$ symmetry breaking due to the underlying $Z_3$ symmetry — the wall network can decay through non-renormalisable terms that violate it but these induce tadpole divergences which destabilise the hierarchy and reintroduce the hierarchy problem. A similar argument rules out a mass below 11 meV for DFSZ axions [113].

We showed that in supergravity-based inflationary models, the Hubble parameter cannot exceed the gravitino mass [18]. Gravitino overproduction is avoided if the inflaton is in a hidden sector and its potential is suffficiently flat if it is a Goldstone mode [25]. Taking non-renormalisable terms into account, inflation can occur as low as the electroweak scale but still generate the required amplitude of density perturbations [39]. Topological inflation can be realised in the 'racetrack' model which solves the dilaton runaway problem [54]. Moreover, other scalar fields can undergo symmetry breaking phase transitions *during* inflation, introducing spectral features [26] and associated non-Gaussianity [67]. We developed a robust technique for deconvolving CMB and large-scale structure data [87] and have found marginal evidence for spectral features [95]. This can be encoded in the EFT of inflation [105].

We proposed that quantum gravity effects might be detectable by looking for high energy Lorentz invariance violation (LIV) through e.g. energy-dependent arrival time dispersion in cosmologically distant $\gamma$-ray bursts [28]. Observations by Cherenkov telescopes and *Fermi* have however ruled out a LIV term $\propto E_\gamma^2/M_{\rm Pl}$ in the dispersion relation. However a theoretically more plausible term $\propto E_\gamma^3/M_{\rm Pl}^2$ can decohere oscillations of cosmic neutrinos and alter their flavour ratios away from the large-angle mixing based expectation at a level detectable by *IceCube* [50]

We calculated the error correlation matrix for BBN and highlighted systematic uncertainties in inferring the primordial abundances [29], which allow an additional light neutrino (or equivalent particle) [33]. This imposes constraints on e.g. an additional $Z'$ to which singlet neutrinos are coupled [8], on a 'time-varying cosmological constant' [23], on photon mixing [27] and on a light neutralino [83].

**Dark Matter & Dark Energy**: We showed that neutralino DM in the NMSSM can be significantly lighter than the weak scale [15] Alternatively the DM may consist of very massive metastable particles e.g. bound states from the hidden sector of SUSY breaking. The high energy neutrino flux from their decays is detectable in underground experiments and requires that the lifetime be $> 10^{16}$ yr [14]. When UHECRs were detected beyond the expected 'GZK cutoff' we proposed that these arise from the slow decays of such particles clustered in the galactic halo [30] — the observed spectrum is well matched by that expected from QCD fragmentation [41], while the expected small anisotropy in arrival directions should be detectable with forthcoming data [38]. Although this model for UHECRs was subsequently disfavoured by *Auger* [144, 147] it remains relevant e.g. for interpreting the *IceCube* events as due to decaying DM [314].)

Using dynamical arguments to infer their DM content, we emphasised that dwarf spheroidal galaxies are attractive search targets for $\gamma$-rays from DM annihilation or decay [45, 77, 92]. However DM may have an asymmetry like baryons and *not* annihilate — accreted DM can then affect heat transport in the Sun and potentially solve the 'Solar composition problem' as well as alter Solar neutrino fluxes [68]. Such DM arises in models of new strong dynamics [73, 76] and can have different couplings to protons and neutrons, thus potentially reconciling conflicting experimental results [80]. Noting that the limits set on the DM mass and scattering cross-section by nuclear recoil detectors is sensitive to the assumed DM velocity distribution, we developed a halo-independent method for fair comparison of results from different experiments [82]. We discussed collider probes of such new vector interactions [84]. We reassessed the claim for DM self-interactions the apparent offset between a gravitationally lensed galaxy and its DM halo in *A3827* [93], noting that the required cross-section implies a potentially observable separation between the galaxies and DM in merging clusters [88, 138].

The breaking of scale-invariance of primordial perturbations due to phase transitions occurring during inflation can affect cosmological parameter extraction from CMB and other data, in particular doing away with the need for dark energy [37, 44, 57, 63]. Our analysis of the Type Ia supernova Hubble diagram also shows that the evidence for cosmic acceleration is *marginal* [94]. Our understanding of structure formation as due to gaussian initial fluctuations is inconsistent with the larger than expected number of merging clusters [91], as well as the anomalously large observed correlations between the CMB and stacked voids [81]. The local bulk flow is also deeper and faster than is expected in the $\Lambda$CDM model [74]. Moreover the cosmic acceleration inferred from the Hubble diagram of Type Ia supernovae is anisotropic in the heliocentric frame [104], so cannot be interpreted as due to a Cosmological Constant [139]. Recently we established that in the cosmic rest frame where the CMB is isotropic, the matter distribution as traced by radio sources & quasars is in fact anisotropic at $> 5\sigma$ [107, 110], thus challenging the foundational Friedmann-Lemaître-Robertson-Walker metric assumption of the standard cosmology.

**Invited Talks at Conferences & Workshops:**

1. ICHEP 85: International Conference on High Energy Physics, Bari, Jul 1985
2. ISMD 86: XXVI International Symposium on Multiparticle Dynamics, Seewinkel, Jun 1986 [118]
3. UK HEP Theory X'mas Meeting, Rutherford Appleton Laboratory, Chilton, Dec 1987
4. NATO ASI: *Observational Tests of Cosmological Inflation*, Durham, Dec 1990 [119]
5. UK HEP Theory X'mas Meeting, Rutherford Appleton Laboratory, Chilton, Dec 1990
6. UK HEP Cosener's House Forum: *Dark Matter*, Abingdon, Jun 1991
7. UK Institute of Physics Discussion Meeting: *Dark Matter*, London, Jun 1991
8. NORDIC meeting on Theoretical Physics, Copenhagen, Aug 1993
9. XI DAE Symposium on High Energy Physics, Shantiniketan, Jan 1994
10. UK HEP Forum: *New Horizons in Astroparticle Physics*, Abingdon, Feb 1994
11. UK HEP Forum: *Particle Cosmology*, Abingdon, Jun 1994
12. Royal Astronomical Society Discussion Meeting: *Neutron Stars*, London, Jan 1995
13. UK National Astronomy Week, Cardiff, Apr 1995
14. Inaugural Conference of the Asia-Pacific Centre for Theoretical Physics, Seoul, Sep 1996 [121]
15. WHEPP 96: Fourth Workshop on High Energy Physics Phenomenology, Calcutta, Jan 1996
16. DARK 96: *Dark Matter in Astro- & Particle Physics*, Heidelberg, Sep 1996 [120]
17. WIN 07: XVI Intern. Workshop on Weak Interactions & Neutrinos, Capri, Jun 1997 [122]
18. International Workshop on Synthesis of Nuclei in the Early Universe, Trento, Jun 1997
19. ICTP Workshop: *Highlights in Astroparticle Physics*, Trieste, Nov 1997
20. UK Institute of Physics Annual Conference on High Energy Physics, Manchester, Apr 1998
21. CAPP-98: International Workshop on Cosmology & Particle Physics, Geneva, Jun 1998
22. DARK 98: *Dark Matter in Astro- & Particle Physics*, Heidelberg, Jul 1998
23. NOW 98: EPS Neutrino Oscillation Workshop, Amsterdam, Sep 1998 [438]
24. ICTP Workshop: *The Physics of Relic Neutrinos*, Trieste, Sep 1998
25. DESY Theory Workshop: *Directions Beyond the Standard Model*, Hamburg, Oct 1998
26. JENAM'99: Joint European & National Astronomical Meeting, Toulouse, Sep 1999
27. COSMO-99: *Particle Physics & the Early Universe*, Trieste, Oct 1999 [125]
28. Landelijk Seminarium, NIKHEF, Amsterdam, Dec 1999
29. Annual UK HEP Theory Meeting, Rutherford Appleton Laboratory, Chilton, Dec 1999
30. Nordic Workshop: *Neutrino physics & Cosmology*, Copenhagen, Apr 2000
31. Summer Institute: *Dark Matter & Supersymmetry*, Gran Sasso, Jul 2000
32. XIII Recontres des Blois: *Frontiers of the Universe*, Blois, Jun 2001 [131]

33. International Workshop: *The Physics of Extra Dimensions*, Paris, Jun 2001
34. International Conference: *Deuterium in the Universe*, Meudon, Jun 2001
35. ICHEP 01: Intern. Europhyics Conf. on High Energy Physics, Budapest, Jul 2001 [128]
36. COSMO-01: *ParticlePhysics & the Early Universe*, Rovaniemi, Sep 2001 [129]
37. IUCAA Workshop: *Interface of Gravitational & Quantum Realms*, Pune, Dec 2001 [42]
38. NORDITA Meeting on Astroparticle Physics & Cosmology, Copenhagen, Mar 2002
39. Planck 01: International Conference on Supersymmetry & Brane Worlds, Kazimierz, May 2002
40. Workshop: *Cosmoseismology& Entropy Perturbations*, Portsmouth, Jun 2002
41. International Conference on String/M-theory Phenomenology, Oxford, Jul 2002
42. International Workshop on Branes, Gravity, . . . : New Interfaces, London, Sep 2002
43. HEP 2003: Workshop on High Energy Physics and Cosmology, Athens, Apr 2003
44. Planck 03: *From the Planck Scale to the Electroweak Scale*, Madrid, May 2003
45. CAPP-2003: International Workshop on Cosmology & Particle Physics, Geneva, Jun 2003
46. Claude Itzykson meeting: *Which Model(s) for the Early Universe?*, Saclay, Jun 2003
47. Eötvs̈ Graduate Course and Workshop in Physics, Balatonfüred, Jun 2003 [132]
48. ISMD 03: XXXIII International Symposium on Multiparticle Dynamics, Krakow, Sep 2003 [130]
49. International Workshop on Astroparticle & High Energy Physics, Valencia, Oct 2003
50. 315th WE-Heraeus-Seminar: *Dark Matter and Dark Energy*, Bad Honnef, Dec 2003
51. Institute of Physics UK Particle Physics Conference 2004, Birmingham, Apr 2004
52. Planck 04: *From the Planck Scale to the Electroweak Scale*, Bad Honnef, May 2004
53. International Conference: *The density Perturbation in the Universe*, Athens, Jun 2004 [133]
54. *Terrestrial and Cosmic Neutrinos, leptogenesis and Cosmology*, Benasque, Jul 2004
55. ISVHECRI 04: Intern. Symp. on Very High Energy Cosmic Ray Interactions, Pylos, Sep 2004
56. UK High Energy Physics Forum: *Cosmic Particles*, Abingdon, Feb 2005
57. SNS Pisa-UCLA Workshop: *Cosmic Connections*, La Magia, Apr 2005
58. Montpellier-Toulose meeting: *Dark Energies, Dark matters*, Paris, Apr 2005
59. PASCOS'05: International Conference on Particles, Strings & Cosmology, Gyeongju, Jun 2005
60. COSMO 05: Intern. Workshop on Particle Physics & the Early Universe, Bonn, Sep 2005
61. European Astroparticle Physics Town Meeting, Munich, Nov 2005
62. International Conference: *From Strings to Cosmic Web*, Groningen, Dec 2005
63. Cosmology 2005: *A Reality Check*, Copenhagen, Dec 2005
64. XI IFT-UAM/CSIC Christmas Workshop on Particle Physics, Madrid, Dec 2005
65. Workshop on High Energy Physics Phenomenology, Bhubaneshwar, Jan 2006 [439]

66. Sixth National Astroparticle Symposium, Amsterdam, Feb 2006
67. HEP2006: Recent Developments in High Energy Physics & Cosmology, Ioannina, Apr 2006
68. ToK Workshop on Particle Physics & Cosmology, Warsaw, May 2006
69. Institute of Physics UK, Astroparticle Group meeting, Sheffield, May 2006
70. International Workshop: *The Dark Side of the Universe*, Madrid, Jun 2006
71. International Conference: *Quantum . . . Gravity and Cosmology*, Barcelona, Jul 2006
72. DESY Theory Workshop: *The Dark Universe*, Hamburg, Sep 2006
73. *Outstanding questions for the standard cosmological model*, London, Mar 2007
74. *From IRAS to Herschel/Planck*, London, Jul 2007
75. ASPERA workshop for the Astroparticle Roadmap, Phase II, Paris, Jul 2007
76. COSMO 07: Intern. Workshop on Particle Physics & the Early Universe, Falmer, Aug 2007
77. TRR-33 Workshop: *The Dark Universe*, Bad Honnef, Oct 2007
78. AMT Workshop: *Questions for the Universe*, Toulouse, Nov 2007
79. ICGC 07: International Conference on Gravitation & Cosmology, Pune, Dec 2007
80. Rencontre des Particules, Annecy, Jan 2008
81. Workshop on *Nu Horizons*, Allahabad, Feb 2008
82. International Workshop: *Quarks in astrophysics and cosmology*, Puri, Feb 2008
83. Nordic Workshop: *Field Theoretical Applications in Cosmology*, Copenhagen, Mar 2008
84. UK HEP Forum Meeting: *Neutrino Horizons in the 21st Century*, Abingdon, Apr 2008
85. International Conference: *Progress on Old and New Themes in Cosmology*, Avignon, Apr 2008
86. Neutrino 08: Intern. Conf. on Neutrino Physics & Astrophysics, Christchurch, May 2008 [135]
87. International Conference on Quantum Geometry & Quantum Gravity, Nottingham, Jul 2008
88. International Conference on Dark Energy and Dark Matter, Lyon, Jul 2008 [136]
89. ICTS Workshop: *Cosmology with CMB and LSS*, Pune, Aug 2008
90. ICTS Workshop: *QCD at High Parton Density*, Panjim, Sep 2008
91. ISSI Workshop: *The Nature of Gravity*, Bern, Oct 2008
92. Royal Astronomical Society Discussion Meeting: *Galaxies and the Elements*, London, Nov 2008
93. IoP UK Meeting: *Searching for Dark Matter Underground & at the LHC*, London, Dec 2008
94. WAPP-08: Workshop on Astroparticle Physics, Ootacamund, Dec 2008
95. ToK Workshop on Particle Physics and Cosmology, Warsaw, Feb 2009
96. Eleventh National Astroparticle Symposium, Leiden, March 2009
97. ICTS Workshop: *Neutrinos in Particle Astrophysics & Cosmology*, Mahabalipuram, Apr 2009
98. *Cosmology and astroparticle physics from the LHC to PLANCK*, Copenhagen, Jun 2009

99. CHIPP Workshop: *Astroparticle Physics*, Lausanne, Jun 2009
100. PPAP Meeting: *Neutrino & Non-accelerator Physics*, Birmingham, Jul 2009
101. *Universe in a Box : LHC, Cosmology & Lattice Field Theory*, Leiden, Aug 2009
102. Workshop on *Origin of mass*, Odense, Nov 2009
103. HEAP 2009: *Cosmic Particles, Jets and Accelerator Science*, Tsukuba, Nov 2009
104. WAPP-09: Workshop on Astroparticle Physics, Darjeeling, Dec 2009
105. Workshop on the New, the Rare and the Beautiful, Zurich, Jan 2010
106. DISCOVERY Centre inauguration, Copenhagen, Jan 2010
107. ToK Workshop: *Particle Physics & Cosmology*, Warsaw, Feb 2010
108. *Workshop: Frontiers of Cosmology*, Heraklion, Apr 2010
109. *Cosmology and astroparticle physics from the LHC to PLANCK*, Copenhagen, Jun 2010
110. *NEB14: Recent developments in gravity*, Ioannina, Jun 2010
111. PPC 2010: Workshop on interconnection between particle physics & cosmology, Torino, Jul 2010
112. TeVPA-10: International conf. on TeV Particle Astrophysics, Paris, Jul 2010
113. *Darkness visible*: Workshop on Dark Matter in Astro- & Particle Physics, Cambridge, Aug 2010
114. UniverseNet Workshop: *Confronting Theory with Observations*, Copenhagen, Aug 2010
115. SUSY10: Supersymmetry & Unification of Fundamental Interactions, Bonn, Aug 2010
116. WAPP-10: Workshop on Astroparticle Physics, Ootacamund, Dec 2010
117. Workshop on *Dark Matter in the LHC Era: Direct and Indirect Searches*, Kolkata, Jan 2011
118. XIV International Workshop on Neutrino Telescopes, Venice, Mar 2011
119. IoP Nuclear & Particle Physics Divisional Conf., Glasgow, Apr 2011
120. Workshop on *Cosmology & astroparticle physics from LHC to PLANCK*, Copenhagen, Jun 2011
121. NuSky2011: International Workshop on Cosmic Rays & Cosmic Neutrinos, Trieste, Jun 2011
122. TeVPA-11: Workshop on TeV Particle Astrophysics, Stockholm, Aug 2011
123. ICRC2011: 32$^{\mathrm{nd}}$ International Cosmic Ray Conference, Beijing, Aug 2011
124. XXV International Symposium on Lepton Photon Interactions, Mumbai, Aug 2011
125. RAS Specialist Discussion Meeting, *Exploring the Non-Thermal Universe*, London, Nov 2011
126. HEAP 2011: *Gamma-ray universe: Fermi to CTA*, Tsukuba, Nov 2011
127. *OPERA versus Maxwell and Einstein' event*, King's College London, Nov 2011
128. CTA Consortium Meeting, Univ Complutense Madrid, Nov 2011
129. *Amazing Particles & Light: Horizons in Accelerators and Enabled Sciences*, Bangalore, Dec 2011
130. Advances in Astroparticle Physics & Cosmology, Darjeeling, Mar 2012
131. National Symposium on Particles, Detectors and Instrumentation, Mumbai, Mar 2012

132. HEP2012: *Recent Developments in High Energy Physics and Cosmology*, Ioannina, Apr 2012
133. Planck 2012: *From the Planck Scale to the Electroweak Scale*, Warsaw, May 2012
134. NORDITA Workshop on *Origin of Mass 2012*, Stockholm, Jun 2012
135. *darkattack2012*, Ascona, Jul 2012
136. International Symposium on *Very High Energy Cosmic Ray Interactions*, Berlin, Aug 2012
137. IAU XXVIII General Assembly: *The Highest-Energy Gamma-ray Universe*, Beijing, Aug 2012
138. Workshop on *Physics of De Sitter Space-time*, Hannover, Sep 2012
139. John Ellis Day, *Outlook in Particle Physics*, London, Oct 2012
140. IMAPP Jubilee Colloquium, Nijmegen, Nov 2012
141. *Partikeldagarna*, Stockholm, Nov 2012
142. *ASPERA ad futurum*, Brussels, Nov 2012
143. V F Hess Centenary Symposium, Mumbai, Dec 2012
144. *Time & Matter*, Venice, Mar 2013
145. Nordic CTA Meeting, Stockholm, Mar 2013
146. 47th ESLAB Symposium: *The Universe as seen by PLANCK*, Noordwijk, Apr 2013
147. Latsis Symposium: *Nature at the Energy Frontier*, Zurich, Jun 2013
148. KSETA Plenary Workshop, Bad Herrenalb, Feb 2014
149. *New Frontiers in Theoretical Physics*, Cortona, May 2014
150. Strategy Workshop on Astroparticle in Switzerland, Geneva, Jun 2014
151. *Frontiers of Fundamental Physics*, Marseille, Jul 2014
152. DISCRETE 2014, London, Dec 2014
153. NuPhys2014, London, Dec 2014
154. LahanasFest, Athens, Jan 2015
155. *Measuring B-mode polarization from Greenland*, Copenhagen, Feb 2015
156. AMS Days at CERN: The Future of Cosmic Ray Physics, Geneva, Apr 2015
157. WylerFest, Zurich, May 2015
158. 5th Iberian Gravitational-Wave Meeting, Barcelona, May 2015
159. Workshop on *Alternative matter & alternative gravity*, Heraklion, May 2015
160. TamavakisFest, Ioannina, May 2015
161. Planck 2015, Ioannina, May 2015
162. *2015: The Spacetime Odyssey Continues*, Stockholm, Jun 2015
163. *Current Themes in High Energy Physics & Cosmology*, Copenhagen, Aug 2015
164. European Nuclear Physics Conference, Groningen, Sep 2015

165. Sixth Quantum Universe Symposium, Groningen, Mar 2016
166. APPEC Town Meeting, Paris, April 2016
167. *Axion-like Particles: Theory & Experiment*, Durham, April 2016
168. *CMB Spectral Distortions*, Bangalore, Jul 2016
169. *Relativistic astrophysics & gravitational waves*, Copenhagen, Jul 2016
170. Current Themes in High Energy Physics & Cosmology, Copenhagen, Aug 2016
171. *LHC Days in Split*, Split, Sep 2016
172. Danish Astroparticle Physics Meeting, Odense, Oct 2016
173. *Dark matter from aeV to ZeV*, Lumley Castle, Nov 2016
174. Landelijk Seminarium, NIKHEF, Mar 2017
175. DIS 2017, Birmingham, Apr 2017
176. *The future of WIMP dark matter*, Chicheley Hall, May 2017
177. *Messengers: Astroparticles and Gravitational Waves*, Stockholm, Jul 2017
178. *DAVCo: DArk matter, neutrinos and their Connections*, Odense, Sep 2017
179. Galileo Institute Conference: *Collider Physics & the Cosmos*, Florence, Oct 2017
180. *Probing Fundamental Physics with CMB Spectral Distortions*, Geneva, Mar 2018
181. *New Probes for Physics Beyond the Standard Model*, Santa Barbara, Apr 2018
182. *The small-scale structure of cold(?) dark matter*, Santa Barbara, Apr 2018
183. Symposium on Particle, Astroparticle & Cosmology, Tallin, Jun 2018
184. NORDITA Workshop: *Cosmology & Gravitational Physics with Lambda*, Stockholm, Jul 2018
185. *Current themes in High Energy Physics and Cosmology*, Copenhagen, Aug 2018
186. Workshop on The Standard Model & Beyond, Corfu, Sep 2018
187. Hillas Symposium, Heidelberg, Dec 2018
188. XVIII International Workshop on Neutrino Telescopes, Venice, Mar 2019 [talk]
189. International Conference on High-Energy-Density Physics, Oxford, Apr 2019
190. Ninth Quantum Universe Symposium, Groningen, Apr 2019
191. CTA: 1st Science Symposium, Bologna, May 2019
192. ICTP-AP International Conference on Frontiers of Fundamental Physics, Beijing, May 2019
193. 36th International Cosmic Ray Conference, Madison, Jul 2019
194. International Conf. on Fundamental Physics, Hyderabad, Sep 2019
195. 15$^{\text{th}}$ Central European Seminar on Particle Physics & Quantum Field Theory, Vienna, Nov 2019
196. Multimessengers, compact objects and fundamental physics, Prague, Dec 2019
197. Chitre Memorial Symposium: Frontiers in Astrophysics & Fluid Dynamics, Mumbai, May 2021

198. Cosmological Frontiers in Fundamental Physics, Paris, May 2021
199. 38th Conf. on Recent Developments in HEP & Cosmology, Thessaloniki, Jun 2021
200. MMAP2022: Advances in Astroparticle Physics and Cosmology, Kolkata, May 2022
201. 24th International Conference: From the Planck Scale to the Electroweak Scale, Paris, Jun 2022
202. XV Intern. Conf. on Interconnections between Particle Phys. & Cosmology, St Louis, Jun 2022
203. 39th Conf. on Recent Developments in HEP & Cosmology, Thessaloniki, Jun 2022
204. XXIX Conf. on Supersymmetry & Unification of Fundamental Interactions, Ioannina, Jun 2022
205. Workshop on the Standard Model and Beyond, Corfu, Sep 2022
206. Challenges to $\Lambda$CDM, Thessaloniki, Sep 2022
207. Annual Theory Meeting, Durham, Dec 2022
208. Frontiers in Cosmology, Bangalore, Feb 2023
209. Herbi-Fest, Bonn, Mar 2023
210. Axions across boundaries between Particle Physics, Astrophysics, Cosmology . . . , Florence, Jun 2023
211. XXX Conf. on Supersymmetry & Unification of Fundamental Interactions, Southampton, Jul 2023
212. A.K. Raychaudhuri Centenary Symposium, Kolkata, Aug 2023
213. Cosmology Workshop: A multipolar universe?, Thessaloniki, Sep 2023
214. Forward Physics Facility Theory Workshop, Geneva, Sep 2023
215. The Early Universe: A Window to New Physics, Gainesville, Oct 2023
216. International Symposium on Recent Developments in Relativistic Astrophysics, Gangtok, Dec 2023

**Invited Lectures at Schools:**

1. ICTP Summer School in High Energy Physics & Cosmology, Trieste, Jul 1985 [117]
2. Scuola Internazionale Superiore Studi Avanzati (SISSA) Graduate School, Trieste, Jul 1986
3. GIFT School in Theoretical Physics, Peniscóla, Aug 1986
4. Adriatic School on High Energy Physics, Split, Jun 1987
5. Centro Fundamental Materia Condensada (CFMC) Graduate School, Lisbon, Mar 1992
6. Spring School in High Energy Physics & Cosmology, Tenerife, May 1992
7. Tata Institute of Fundamental Research (TIFR) Graduate School, Bombay, Aug 1993
8. Indian Institute of Astrophysics (IoA) Graduate School, Bangalore, Dec 1994,
9. BCSPIN/ICTP Summer School in Physics, Kathmandu, May 1997
10. Autumn School on Theoretical Physics, Santiago de Compostela, Sep 1997
11. XIX UK Institute for Theoretical High Energy Physicists, Oxford, Aug 1998
12. Graduiertenkolleg on Cosmology & Statistical Physics, Heidelberg, Nov 1998
13. IPM School on Large-scale structure formation, Kish, Jan 1999 [124]

14. Bruno Pontecorvo School on Elementary Particles, Capri, May 1999
15. Finnish Particle Cosmology School, Kiljavanranta, Aug 1999
16. NATO Advanced Study Institute: Particle Physics & Cosmology, Cascais, Jul 2000 [126]
17. British Universities Summer School in Elementary Particle Physics, Oxford, Sep 2000
18. British Universities Summer School in Elementary Particle Physics, Manchester, Sep 2001
19. International Graduate School in Mathematics & Physics, Bonn, Jan 2002
20. ICTP Summer School on Particle Physics & Cosmology, Trieste, Jul 2002
21. Second Crete School on String Theory, Kolymbari, June 2003
22. Second Aegean School on the Physics of the Early Universe, Syros, Sep 2003
23. CERN Summer Student Programme: *Introduction to Cosmology*, Geneva, Aug 2004
24. Third Aegean School on the Physics of the Early Universe, Chios, Sep 2005
25. CERN Summer Student Programme: *Introduction to Cosmology*, Geneva, Jul 2006
26. Nordic Winter School in Particle Physics & Cosmology, Gausdal, Jan 2007
27. CERN Summer Student Programme: *Introduction to Cosmology*, Geneva, Jul 2007
28. CERN Summer Student Programme: *Introduction to Cosmology*, Geneva, Jul 2008
29. ICTS School: *Cosmology with CMB and LSS*, Pune, Aug 2008
30. ICTS School: *QCD at High Parton Density*, Dona Paula, Sep 2008
31. Les Houches School: *Searching for Dark Matter*, Les Houches, Mar 2009
32. Corfu Summer School: *The Standard Model & Beyond*, Corfu, Sep 2009
33. DPG Physics School: *Astroparticle Physics*, Bad Honnef, Sep 2009
34. Winter School in Astroparticle Physics, Darjeeling, Dec 2009
35. YETI School in Astroparticle Physics, Durham, Jan 2009
36. Taller de Altas Energias: *Astroparticle Physics*, Barcelona, Sep 2010
37. CORSIKA Winter School in Astroparticle Physics, Ooty, Dec 2010
38. Corfu Summer Institute: *Unification in the LHC Era*, Corfu, Sep 2011
39. Intern. School of Cosmic Ray Astrophysics: *A new era in particle astrophysics*, Erice, Jul 2012
40. 4th International Summer School on Astroparticle Physics, Nijmegen, Aug 2012
41. Nordic Winter School on Particle Physics and Cosmology, Gausdal, Jan 2013
42. International School for AstroParticle Physics (ISAPP) 2013, Djurönäset, Aug 2013
43. Corfu Summer School: *The Standard Model & Beyond*, Sep 2013
44. Corfu Summer School *The Standard Model & Beyond*, Sep 2014
45. ICTP Summer School on Particle Physics, Jun 2015
46. Taller de Altas Energias, Benasque, Sep 2016

47. Nordic Winter School on Particle Physics and Cosmology, Skeikampen, Jan 2017
48. GIAN School: *Dark Matter: The Astroparticle Connection*, New Delhi, Dec 2017
49. International School of Cosmic Ray Astrophysics, Erice, Aug 2018
50. Cracow School of Theoretical Physics, Zakopane, Jun 2019
51. Summer Research School: *Quantum to Cosmos: Ideas and Applications*, Gebze, Jul 2019

## PhD/D.Phil Theses Supervised:

1. Kevin C. Benson, Wadham College, Oxford, 1991–93
   (Thesis: *'Aspects of the electroweak phase transition & baryogenesis'*)
2. Jennifer A. Adams, Magdalen College, Oxford, 1992–95
   (Thesis: *'Cosmological phase transitions: techniques & applications'*)
3. Sebastian E. Larsson, Christ Church College, Oxford, 1993–98
   (Thesis: *'Topological defects from cosmological phase transitions'*)
4. Michael Birkel, Linacre College, Oxford, 1994–97
   (Thesis: *'Astroparticle physics beyond the Standard Model'*)
5. Fermin Viniegra, Worcester College, Oxford, 1997–2001
   (Thesis: *'Reheating in inflationary cosmology'*) — with B Bassett
6. Mario Santos, Wadham College, Oxford, 1999–2003
   (Thesis: *'Primordial effects in the CMB'*) — with P Ferreira
7. David Skinner, Linacre College, Oxford, 1999–2003
   (Thesis: *'Cosmology of heterotic M-theory'*)
8. Paul Hunt, St John's College, Oxford, 2000–06
   (Thesis: *'The cosmological implications of inflation'*)
9. Andrew Taylor, Linacre College, Oxford, 2003–06
   (Thesis: *'The intergalactic propagation of ultrahigh energy cosmic rays'*)
10. Francesco Riva, Merton College, Oxford, 2004–08
    (Thesis: *'Cosmological consequences of supersymmetric flat directions'*) — with J March-Russell
11. Joao Rosa, Exeter College, 2006–10
    (Thesis: *'Aspects of Beyond the Standard Model String Phenomenology'*) — with J March-Russell
12. Shaun Hotchkiss, Balliol College, Oxford, 2006–10
    (Thesis: *'Inflation: beyond the scalar fluctuation power spectrum'*
13. Philipp Mertsch, Balliol College, Oxford, 2007–10
    (Thesis: *'Cosmic ray backgrounds for dark matter indirect detection'*)
14. Seshadri Nadathur, Merton College, Oxford, 2007–11
    (Thesis: *'Inflation, large-scale structure & inhomogeneous cosmologies'*)
15. Felix Kahlhoefer, St Catherine's College, Oxford, 2011–14
    (Thesis: *'Complementarity of searches for dark matter'*)
16. Kyle Allison, Balliol College, Oxford, 2010–14
    (Thesis: *'The Standard Model to the Planck scale'*) — with G Ross
17. Jim Talbert, Hertford College, Oxford, 2012–16
    (Thesis: *'From the LHC to IceCube, a melange of particle phenomenology'*) — with G Bell

18. David Kraljic, Balliol College, Oxford, 2012–16
    (Thesis: *'Inhomogeneities in Cosmology'*)
19. Jeppe Trøst Nielsen, Niels Bohr Institute, Copenhagen, 2013–17
    (Thesis: *'Testing cosmological models'*)
20. Amel Durakovic, Niels Bohr Institute, Copenhagen, 2014–18
    (Thesis: *'On the likely structure & origin of primordial fluctuations'*)
21. George Johnson, St Cross College, Oxford, 2015–20
    (Thesis: *'?'*) — with J March-Russell
22. Augustinas Malinauskas, St Cross College, Oxford, 2016–20
    (Thesis: *'?'*) — with U Haisch
23. Konstantin Beyer, Merton College, Oxford, 2017–21
    (Thesis: *'Investigating New Physics with High Power Lasers'*) — with G Gregori
24. Giacomo Marocco, New College, Oxford, 2018–22
    (Thesis: *'Looking for New Physics in the Lab, the Sky, and the Future'*) — with J Wheater
25. Rudin Petrossian-Byrne, Balliol College, Oxford, 2017–23
    (Thesis: *'Aspects of the Standard Model Landscape'*) — with J March-Russell
26. Ryan Barouki, Merton College, Oxford, 2021–
    (working on astroparticle physics & 2D quantum gravity) — with J Wheater

## Refereeing

Appointments & Promotions: CERN, Geneva; Demokritos, Athens; DESY Zeuthen; Fermilab Batavia; HRI Allahabad; IISER Bhopal; IMSc Chennai; ICTP Trieste; ICTS Bengaluru; IUCAA Pune; King's College London; LAPTH Annecy; Michigan State University; MPIK Heidelberg; National Technical University Athens; NISER Jatni; NORDITA Stockholm; Penn State University; RRI Bangalore, Royal Holloway, University of London; SINP Kolkata; SISSA Trieste; TIFR Mumbai; Tufts University; Universität Aachen; University of Athens; University of Bath; University of California, Berkeley; University of California, Los Angeles; University of California, Riverside; University of Cambridge; University of Crete; Universität Dortmund; University of Durham; University of Edinburgh; University of Geneva; Universität Göttingen; Universität Hamburg; Universität Karlsruhe; University of Lancaster; University of Lyon; University of Massachusets, Amherst; University of Montpellier 2; University of New Mexico; University of Nottingham; Universität Potsdam; Princeton University; University of Southampton; Universität Wuppertal; Universität Zurich

Grant applications: Academy of Finland; Agence Nationale de la Recherche, France; Alexander von Humboldt Stiftung, Germany; Australian Research Council; Department of Atomic Energy, India; Department of Energy, USA; Department of Science & Technology, India; Deutsche Forshungsgemeinshaft, Germany; Engineering & Physical Sciences Research Council, UK; European Commission; European Research Council; European Space Agency; Fondazione Cariparo, Italy; Fundamenteel Onderzoek der Materie, Netherlands; International Centre for Theoretical Physics, Trieste; Istituto Nazionale di Fisica Nucleare, Italy; Leverhulme Foundation, UK; Ministero dell'Istruzione, Italy; Ministry of Education, Greece; National Research Foundation, South Africa; National Science Foundation, USA; Natural Sciences and Engineering Research Council, Canada; Nederlandse Organisatie voor Wetenschappelijk Onderzoek; Newton Institute, Cambridge; RANNIS Iceland; Royal Society of New Zealand; The Royal Society, UK; Science & Technology Facilities Council, UK; Swiss National Science Foundation; Tata Institute of Fundamental Research, Mumbai

Book proposals: Cambridge University Press, Oxford University Press

Journals: Astronomy & Astrophysics, Astrophysical Journal, Astroparticle Physics, Astrophysics & Space Science, Classical & Quantum Gravity, Computer Physics Communications, European Physical Journal C, Europhysics Letters, Journal of Cosmology & Astroparticle Physics, Journal of High Energy Physics,

International Journal of Modern Physics A, Modern Physics Letters, Monthly Notices of the Royal Astronomical Society, Nature, Nuclear Physics B, Physics Letters B, Physical Review D, Physical Review Letters, Pramana, Reports on Progress in Physics, Science

## Organisation of Conferences, Schools & Workshops:

▷ **Main Organiser:**
- UK Theoretical Cosmology Network meeting, Oxford, 15 May 1996, 26 Mar 1997, 20 May 1998
- EU Research & Training School: *Supersymmetry & the Early Universe*, Oxford, 26–29 Sep 2002
- IceCube collaboration meeting, Oxford, 21–24 Sep 2005
- ASPERA Workshop: *Theory and Astroparticle Physics*, Oxford, 17 Mar 2008
- EU Research & Training School: *Fundamental Physics & Cosmology*, Oxford, 22–26 Sep 2008
- First LINK Workshop: *Probing Physics beyond the SM with CTA*, Abingdon, 12 Nov 2010
- GrahamFest, Oxford, 30 Sep 2011
- IoP/IPPP Workshop: *New paths to particle dark matter*, Oxford, 29–30 Mar 2012
- NBIA PhD School: *Neutrinos underground and in the heavens*, Copenhagen, 23-27 Jun 2014
- 2$^{\rm nd}$ NBIA-APCTP Workshop: *Cosmology & Astroparticle Physics*, Copenhagen, 18-22 Aug 2012
- NBIA-Oxford Colloquium, Copenhagen, 13-15 Apr 2015
- NBIA PhD School: *Neutrinos underground and in the heavens II*, Copenhagen, 1-5 Aug 2016
- NBIA Workshop: *Self-interacting dark matter*, Copenhagen, 1-5 Aug 2017

▷ **Local Organising/Advisory Committee:**
- SUSY 98, Oxford, 11-17 Jul 1998
- Kogan Memorial Meeting: *From Fields to Strings*, Oxford, 8–10 Jan 2004
- First International Conference on String/M-theory Phenomenology, Oxford, 6–11 Jul 2002
- UK Neutrino Network meeting, Oxford, 29 Nov 2006
- Astroparticle Physics UK meeting, Oxford, 18–20 Jun 2008
- Rudolf Peierls Symposium on Theoretical Physics, Oxford, 5-6 Jul 2018
- British Univ. Summer School in Theoretical Elementary Particle Physics, Oxford, 20-31 Aug 2018
- *Higgs Couplings 2019*, Oxford, 30 Sep-4 Oct 2019

▷ **Organising Committee:**
- UK Institute for Theoretical High Energy Physics, Cambridge, 1–7 Sep 1991
- UK HEP Forum: *Cosmology after COBE*, Abingdon, 20–21 Jun 1992
- International Europhysics Conference on High Energy Physics, Brussels, 28 Jul–3 Aug 1995
- 28th International Conference on High Energy Physics, Warsaw, 25–31 Jul 1996
- UK HEP Forum: *New Horizons in Neutrino Physics*, Abingdon, 8–9 May 1999
- EU Network School: *The Early Universe*, CERN, 19–22 Apr 2001
- IPPP Workshop: *Phenomenology of Ultra-high-energy Cosmic Rays*, Durham, 21 June 2002
- UK HEP Forum: *The World according to WMAP*, Abingdon, 7–8 Jun 2003
- Astrophysics/Cosmology Session, SUSY'05, Durham, 18–23 Jul 2005
- Dalitz Memorial Meeting, Oxford, 3 Jun 2006
- EU Network School: *The Origin of the Universe*, Mytilene, 24–29 Sep 2007
- IoP/RAS meeting: *The Search for Dark Matter*, London, 26 Nov 2007
- International Workshop: *Cosmology with the CMB & LSS*, Pune, 18–31 Aug 2008
- PPAP Community Meeting: *Neutrino & Non-accelerator Physics*, Birmingham, 15 July 2009
- 9th Hellenic School of Elementary Particle Physics & Gravity, Corfu, 30 Aug–20 Sep 2009
- EU Network School: *Particle Physics & Cosmology*, Barcelona, 28 Sep–2 Oct 2009
- 10th Hellenic School of Elementary Particle Physics & Gravity, Corfu, 29 Aug–5 Sep 2010
- EU Network School: *Frontiers of Particle Cosmology*, Lecce, 13–18 Sep 2010
- ICATPP Conference: *Cosmic Rays for Particle and Astroparticle Physics*, Como, 7–8 Oct 2010
- Cherenkov Telescope Array Collaboration Meeting, Rutherford Lab, 8–11 Nov 2010
- Astroparticle Physics session: RAS National Astronomy Meeting, Llandudno, 17–21 Apr 2011
- ICTP Workshop: *Looking at the Neutrino Sky*, Trieste, 20-24 Jun 2011
- CERN Theory Institute: *Dark Matter Underground and in the Heavens*, Geneva, 18-29 Jul 2011

- 11th Hellenic School of Elementary Particle Physics & Gravity, Corfu, 4-18 Sep 2011
- XII Workshop on High Energy Physics Phenomenology, Mahabaleshwar, 2-8 Jan 2012
- 12th Hellenic School of Elementary Particle Physics & Gravity, Corfu, 8-27 Sep 2012
- Danish National Astronomy Meeting, Sandbjerg Estate, 18-19 Jun 2013
- 13th Hellenic School of Elementary Particle Physics & Gravity, Corfu, 31 Aug-27 Sep 2013
- 1st APCTP-NBIA joint workshop on Cosmology and Astroparticle Physics, Pohang, 21-25 Oct 2013
- 14th Hellenic School of Elementary Particle Physics & Gravity, Corfu, 3-21 Sep 2014
- *Dark Matter@LHC*, Oxford, 25-27 Sep 2014
- 15th Hellenic School of Elementary Particle Physics & Gravity, Corfu, 1-27 Sep 2015
- 16th Hellenic School of Elementary Particle Physics & Gravity, Corfu, 31 Aug-23 Sep 2016
- Nordic Winter School: *Cosmology and Particle Physics*, Skeikampen, 2-7 Jan 2017
- Corfu Summer Institute, Corfu, 2-28 Sep 2017
- Current themes in high energy physics & cosmology, Copenhagen, 13-17 Aug 2018
- Workshop on the Standard Model and Beyond, Corfu, 31 Aug-9 Sep 2018
- 36th International Cosmic Ray Conference, Madison, 24 Jul-1 Aug 2019
- International Workshop on Laboratory Astrophysics with Intense Lasers (on-line), 7-8 Dec 2020
- 37th International Cosmic Ray Conference (on-line), Berlin, 12-23 Jul 2021
- 21st International Symposium on Very High Energy Cosmic Ray Interactions, Ooty, 23-27 May 2022

▷ **International Scientific/Advisory Committee:**

- *Trends in Astroparticle Physics*, Stockholm, 22–25 Sep 1994
- *Beyond the Desert*, Castle Ringberg, 6–12 June 1999
- COSMO-01, Rovaniemi, 30 Aug–4 Sep 2001
- WIN'02, Canterbury, 21-26 Jan 2002
- COSMO-03, Ambleside, 24–30 Aug 2003
- *Quantum gravity phenomenology*, Ladek Zdroj, 4–14 Feb 2004
- 3rd International workshop on Ultra High Energy Cosmic Rays, Leeds, 22–24 Jul 2004
- WIN'05, Delphi, 6–11 Jun 2005
- WIN'07, Kolkata, 15–20 Jan 2007
- ICGC'07, Pune, 17–21 Dec 2007
- DISCRETE'08, Valencia, 11-16 Dec 2008
- *Radiation Matter Interaction Under Extreme Conditions*, Varanasi, 19–20 Dec 2008
- *Dark Matter in Astrophysics & Particle Physics*, Cambridge, 2–6 Aug 2010
- DISCRETE'10, Rome, 6–11 Dec 2010
- *Primordial Features and Non-Gaussianities*, Allahabad, 14–18 Dec 2010
- TAUP 2011, Munich, 5–9 Sep 2011
- Lepton-Photon Conference, Mumbai, 22–27 Aug 2011
- VLVnT11 – Very Large Volume Neutrino Telescopes, Erlangen, 12–14 Oct 2011
- WHEPP12: Workshop on High Energy Physics Phenomenology, Mahabaleshwar, 2–15 Jan 2012
- COSGRAV12: Modern Perspectives of Cosmology & Gravitation, Kolkata, 7–11 Feb 2012
- ICHEP2012: 36th International Conf. on High Energy Physics, Melbourne, 4–11 Jul, 2012
- *Darkattack2012*, Ascona, 15–20 Jul 2012
- TeVPA 2012, Mumbai, 11–15 Dec 2012
- 33$^{\mathrm{rd}}$ ICRC 2013, Rio de Janeiro, 2-9 Jul 2013
- TeVPA 2013, Irvine, 26–29 Aug 2013
- TeVPA 2014, Amsterdam, 23–28 Jun 2014
- Cosmo Cruise 2015, 2–9 Sep 2015
- VLVnT–2015: Very Large Volume Neutrino Telescopes, Rome, 2–16 Sep 2016
- TeVPA 2016, Geneva, 12–16 Sep 2016
- Winter School on AstroParticle Physics, Ootacamund, 21–29 Dec 2016
- DISCRETE 2016, Warsaw, 28 Nov–3 Dec 2016
- International Neutrino Summer School, Fermilab, 7-18 Aug 2017
- TeVPA 2017, Columbus, 7–11 Aug 2017
- International Neutrino Summer School, Mainz, 21 May–1 Jun 2018

- TeVPA 2018, Berlin, 27–31 Aug 2018
- Workshop on the Standard Model and Beyond, Corfu, 31 Aug-11 Sep 2019
- PPNT19, Uppsala, 7–9 Oct 2019
- TeVPA 2019, Sydney, 2–12 Dec 2019
- Workshop on the Standard Model and Beyond, Corfu, 29 Aug-8 Sep 2021
- XXVIII Epiphany Conference, Cracow, 10–14 Jan, 2022
- Workshop on the Standard Model and Beyond, Corfu, 28 Aug-8 Sep 2022
- Workshop on the Standard Model and Beyond, Corfu, 27 Aug-7 Sep 2023

## Participation in Experiments:

- *Big European Bubble Chamber* WA66 Beam Dump Collaboration (Data analysis 1985)
- *Pierre Auger Observatory* (Institutional Representative, 2003–13; Publications Committee)
- *IceCube* (Collaboration Board Member, 2004–; Editor, Yellow Book ; Publications Committee)
- *Cherenkov telescope Array* (Collaboration Member, 2010–; Requirements Review Committee; Co-editor of Special Issue; Review of Key Science Projects)
- *Laboratory Astroparticle Physics with High Powered Lasers* (Participant, 2016–)
- *Quantum Sensors for the Hidden Sector* (co-I, 2021–)

## Research Grants:

1. SERC AF Starter Research Grant (*'Cosmological Probes of Physics Beyond the SM'*)
   PI, 1993–98 [GR/H90162] – £10,000
2. EU Third Framework Programme (*'Theoretical Astroparticle'* network)
   (Annecy + Barcelona, Copenhagen, Geneva, Gran Sasso, Munich, Oxford, Paris, Stockholm)
   UK Scientist-in-Charge, 1993–97 [CHRX-CT93-0120] — €57,140
3. EU 4th Framework Programme (*'Beyond the Standard Model'* TMR network)
   (Paris + Bonn, Geneva, Lisbon, Madrid, Oxford, Pisa, Thessaloniki, Trieste, Valencia)
   Co-I with G Ross (PI) *et al*, 1996–00 [FMRX-CT96-0090] — €132,000
4. British Council 'Acciones Integradas' Programme (*'Large-scale Structure'* network)
   (Barcelona, Cambridge, Durham, Oxford)
   Co-I with G Efstathiou (PI) *et al*, 1997–98 — £2,900
5. PPARC Rolling Grant (*'Theoretical Studies of Elementary Particles'*)
   Co-I with G Ross (PI) *et al*, 1999–03 [PPA/G/O/2000/00469]; — £360,692
6. PPARC Special Program Grant (*'Neutrino Mass'*)
   Co-I with G Ross (PI), 2000–02 [PPA/G/S/1998/00561] — £87,287
7. EU 5th Framework Programme (Marie Curie training site *'Particle Astrophysics'*)
   Co-I with J Binney and J Silk (PI), 2000–03 — €158,400
8. EU 5th Framework Programme (*'Physics Across the Present Energy Frontier'* TMR network)
   (Paris + Bonn, Geneva, Lisbon, Madrid, Oxford, Pisa, Thessaloniki, Trieste, Valencia)
   Co-I with G Ross (PI) *et al*, 2000–04 [HPRN-CT-2000-00148] — €145,000
9. EU 5th Framework Programme (*'Supersymmetry and the Early Universe'* TMR network)
   Network Coordinator, 2000–04 [HPRN-CT-2000-00152] — €1.49 M
10. Leverhulme Foundation Major Grant (*'Dark Matter'*)
    Co-I with J Binney and J Silk (PI), 2000–05 [F/08776A] — £433,134
11. EU Marie Curie fellowship (*'Cosmic Ray Probe of Physics beyond the SM'*)
    Scientist-in charge (awarded to R Toldra), 2000–02 [MCFI-1999-00465] — €107,072
12. Joint Research Equipment Initiative (*'Beowulf Supercomputer'*)
    Co-I with J Silk (PI) *et al*, 2000–05 — £127,151

13. EU Marie Curie fellowship (*'Non-Baryonic Dark Matter'*)
    Scientist-in charge (awarded to F Ferrer), 2001–03 [MCFI-2001-00645] — €107,072
14. PPARC Rolling Grant (*'Theoretical Studies of Elementary Particles'*)
    Co-I with G Ross (PI) *et al*, 2003–08 [PPA/G/O/2002/00479] — £562,204
15. PPARC Special Program Grant (*'Neutrino Physics'*)
    Co-I with G Ross (PI), 2004–06 [PPA/G/S/2003/00138] — £72,919
16. PPARC Research Grant (*'Operation of the Pierre Auger Observatory . . . '*)
    Co-applicant with A Watson (PI) *et al*, 2004–07 [PPA/G/S/2003/00073] — £475,495.68
17. PPARC Senior Fellowship (*'Auger & IceCube: Probes of the high energy universe'*)
    PI, 2006–09 [PPA/C506205/1] — £118,692
18. EU 6th Framework Programme Marie Curie RTN (*'The Origin of the Universe'*)
    Network Coordinator, 2006–10 [MRTN-CT-2006-035863] — €3.53 M
19. John Fell Fund *Strengthening Oxford-India Research Links in Theoretical Physical Sciences*)
    PI (with J. Cardy *et al*) 2006–12 — £25,313
20. STFC Research Grant (*UHE cosmic ray research with the Pierre Auger Observatory*)
    PI, 2008–11 [PPA/E007007/1] — £42,428
21. PPARC Rolling Grant (*'Theoretical Studies of Elementary Particles'*)
    Co-I with G Ross (PI) *et al*, 2008–11 [ST/G000492/1] — £1,900,748
22. UKIERI grant (*Interdisciplinary Oxford-India Research Network in Theoretical Physics*)
    Co-I (with J. Cardy *et al*), 2008–11 — £67,372
23. STFC Consolidated Grant (*'Theoretical Particle Physics Research'*)
    PI, 2011–14 [ST/J000507/1] — £989,201
24. IPPP Associateship (*'Phenomenology of Dark Matter'*)
    PI, 2011–12 — £4,000
25. DNRF Niels Bohr Professorship (*'Connecting Inner Space & Outer Space'*)
    PI, 2013–18 [506600-50-36547] — DKK 29,000,000
26. STFC Consolidated Grant (*'Theoretical Particle Physics Research'*)
    PI, 2014–17 [ST/L000474/1] — £1,107,542
27. STFC Grant (*'Parton Distributions with Electroweak corrections'*)
    co-PI (with J. Rojo), 2015–18 [ST/M003787/1] — £173,570
28. EPSRC grant (*'Particle acceleration in magnetised shocks'*)
    Co-I (with G. Gregori (PI) & A. Bell), 2016–19 — £566,043
29. SPARC (India-UK partnership in laboratory astro-particle physics)
    Co-I (with G. Gregori *et al*), 2016–20
30. STFC Consolidated Grant (*'Theoretical Studies of Elementary Particles'*)
    PI, 2017–20 [ST/P000770/1] — £721,571
31. STFC Consolidated Grant (*'Theoretical Studies of Particles & Strings'*)
    Co-I (with G. Salam *et al*), 2020–24 [ST/T000864/1] — £1,141,212
32. STFC Grant (*'Quantum Sensing for the Hidden Sector'*)
    Co-I (with P.J. Leek *et al*), 2021–24 [ST/T000864/1] — £838,605
33. EPSRC Grant (*'Probing the quantum vacuum with high power laser and 4th generation light sources'*)
    Co-I (with G. Gregori & I. Shipsey), 2023–26 [EP/X01133X/1] — £622,695

## Participation in Networks:

▷ Scientist-in-Charge @ Oxford, EU network on *'Theoretical Astroparticle Physics'*, 1993–97
(Annecy + Barcelona, Copenhagen, Geneva, Gran Sasso, Munich, Oxford, Paris, Stockholm)

▷ Member, Oxford node of EU network on *'Beyond the Standard Model'*, 1996–00 (Paris + Bonn, Geneva, Lisbon, Madrid, Oxford, Pisa, Thessaloniki, Trieste, Valencia)

▷ Co-ordinator, EU network on *'Supersymmetry and the Early Universe'*, 2000–04 (Oxford/Lancaster/King's College + Bonn, Geneva, Helsinki, Ioannina/Thessaloniki, Madrid/Barcelona/Granada, Orsay/Annecy/Marseilles, Trieste, Warsaw)

▷ Member, Oxford node of European Network of Theoretical Astroparticle Physics, 2004–

▷ Member, UK Neutrino Network, 2004–

▷ Member, Oxford node of EU network on *'Quest for Unification'*, 2004–08 (Paris + Salonicki, Lisbon, Madrid, Bonn, Oxford, Pisa, Trieste, Valencia, Geneva)

▷ Co-ordinator, EU network on *'Origin of the Universe'*, 2006–10 (Oxford + Lancaster, King's College London, Annecy, Barcelona, Bonn, Copenhagen, Geneva, Helsinki, Ioannina, Munich, Padova, Paris, Seoul, Warsaw)

▷ Co-ordinator, Oxford-India network on Theoretical Physical Sciences, 2006–12

▷ Oxford representative, UK-India Education & Research Initiative Network on *'Neutrino & the Fundamental Laws of Nature'*, 2007–10

▷ Member, UKIERI Network on *'Theoretical Physical Sciences'*, 2008–11

▷ Member, Oxford node of EU network on *'Unification in the LHC era'*, 2009–13 (Paris + Salonicki, Lisbon, Madrid, Bonn, Oxford, Pisa, Trieste, Valencia, Geneva)

▷ Associate Member, DFG Research Training Group on *'Models of Gravity'*, 2013–21

## External Appointments:

▷ Maxwell Visiting Fellow, King's College, London, 2000–05

▷ Adjunct Professor, Tata Institute of Fundamental Research, Mumbai, 2006–09

▷ Adjunct Professor, Saha Institute of Nuclear Physics, Kolkata, 2008–13

▷ Scientific Associate, Discovery Center, Niels Bohr Institute, Copenhagen, 2010–20

▷ Scientific Associate, Institute of Particle Physics Phenomenology, Durham, 2011–12

▷ Niels Bohr Professor, Niels Bohr International Academy, Copenhagen, 2013–18

▷ Affiliate Professor, Niels Bohr Institute, Copenhagen, 2018–23

▷ Adjunct Professor, Raman Research Institute, Bangalore, 2019–22

## Public Understanding of Science

I worked (1988-89) with Eklavya, a NGO in Bhopal concerned with science teaching & outreach. My main task was to launch a monthly newsletter on science & technology (*Srote*) for regional vernacular newspapers.We set up the supporting library and publishing facility and wrote a number of articles for the newsletter.

I have engaged in the following science outreach activities in the UK:

▷ Oxford Physics: Publicity Committee (1995–96); Participation in Open Days; Science, Engineering & Technology Weeks; Assessment Panel, Undergraduate Speaking Competition (2001–04)

▷ Continuing Education, Oxford: Summer School: *'Blowing up the universe'*, 15–22 Jul 1995; School: *'Cosmic antimatter'*, 23 Jan 1999; Summer School: *'Constructing the Universe'*, 24–31 Jul 1999

▷ Consultant to BBC science programme makers on several occasions

▷ Radio interviews, e.g. BBC Thames Valley, 12 Jan 2000, LBC, London, 27 Apr 2000

▷ Assisted the Royal Institution, London to organise topical exhibition

▷ Filmed interview for new Space Galleries at Royal Greenwich Observatory (Dec 2007)

▷ Debate: *The fate of the universe: Does dark energy exist?*, Imperial College, London, 21 July 2009

- Debates & discussions: *How the Light Gets in*, Hay-on-Wye, 24-27 May 2019

▷ Popular level talks:

- *'Why do science?'*, Kingsway Camden's College, London, 10 May 1993
- *'A magical mystery tour of the universe'*
  - St Phillip & James Primary School, Oxford, 9 Oct 1997
  - St Barnabas Primary School, Oxford, 14 Jun 2004
- *'Why is the sky dark at night?'*
  - SET'95 Public Lecture, Oxford, 17 Mar 1995
  - Cherwell School, Oxford, 26 Mar 1996
  - SET'97 'Frontier Physics for Teachers', Cosener's House, Abingdon, 15 Mar 1997
  - Oxford Space & Astronomical Society, Oxford, 9 Feb 1998
- *'Seeing the edge of the universe'*
  - Linacre College Seminar, Oxford, 12 Oct 1999
  - 'Oxford Festival of Science' Programme, Peers School, Oxford, 26 Jan 2000
  - Charterhouse School, Godalming, 6 Mar 2001
  - IOP Lecture, Shrewsbury School, 28 Sep 2001
  - New College 'Discovery Evening', Oxford, 15 Nov 2001
  - St Edward's School, Oxford, 13 Mar 2002
  - Taunton School, 10 May 2002
  - Georgia Tech Summer School, Oxford, 17 Jul 2002
  - Linacre Lecture at King's School, Canterbury, 18 Sep 2003
  - National AimHigher Masterclass for Sixth Form students, Oxford, 6 Dec 2004
  - Jadavpur University, Kolkata, 5 Jan 2005
  - British Council, Kolkata, 7 Jan 2005
  - Dudley Residential Masterclass, Oxford, 21 Mar 2005
  - Open Day talk, Department of Physics, Oxford, 30 Jun 2005
  - Headington School, Oxford, 28 Nov 2005
  - Admissions talk, Department of Physics, Oxford, 13 Dec 2005
  - AVM School Bandra, Mumbai, 20 Dec 2006
  - Cherwell School, Oxford, 17 Jan 2007
  - InfoSys lecture, Homi Bhabha Centre for Science Education, Mumbai, 22 Dec 2008
  - International Year of Astronomy lecture, Green Templeton College, Oxford, 3 Mar 2009
  - Chipping Norton Amateur Astronomical Society, 21 Mar 2011
  - Folkeuniversitet i København, 5 & 7 Dec 2017
  - Jawaharlal Nehru University, New Delhi, 19 Dec 2017
  - Manthan, Hyderabad, 3 Sep 2019
  - National Science Day public lecture, Ootacamund, 28 Feb 2023
- *'The road to quantum gravity'*
  - 'Frontier Physics for Teachers' Workshop, Cosener's House, Abingdon, 4 Mar 2000
  - 'Oxford Access Scheme' Summer School, Dept of Physics, Oxford, 23 Aug 2000
  - Georgia Tech Summer School, Oxford, 9 Jul 2001
  - IOP 'Young Physicist's Conference', Dept of Physics, Oxford, 25 Nov 2001
  - Linacre Seminar, Oxford, 12 Feb 2002
  - A K Raychoudhury Symposium, Scottish Church College, Kolkata, 5 Jan 2005
  - Oxford University Physics Society, 26 Apr 2012
- *'Discovering brane-world'*
  - Meeting of Heads of Physics, Rugby Group, Cheltenham College, 24 Feb 2001
  - 'Oxford Access Scheme' Summer School, Dept of Physics, Oxford, 22 Aug 2001
- *'Cosmology in wonderland'*, IOP 'Physics Update' Meeting, Oxford, 10 Dec 2004

- *'Dark matter vs. modified gravity'*
  - Oxford Space & Astronomical Society, 1 Nov 2010
  - Oxford Undergraduate Student Conference, St Catherine's College, 16 Apr 2013
- *'Darkness visible: the search for the missing mass of the universe'*
  - Public talk at Lepton Photon 2011, TIFR, Mumbai, 27 Aug 2011
  - Larsen & Toubro *"GuruSpeak"* Forum, Mumbai, 30 Aug 2011
  - Cambridge University Scientific Society, 11 Oct 2011
  - Folkeuniversitetet, NBI, Copenhagen, 8 Dec 2014
- *'Should scientists be activists?'*, Centre for Society & Policy, Bangalore, 13 Sep 2019

▷ Articles & letters in scientific/academic magazines:
- *'Lifetime significance'*, Physics World, 1987
- *'Shadow of a star: the neutrino story of Supernova 1987a'*, THES, Sep 1997 (book review)
- *'Could the end be in sight for high energy cosmic rays?'*, Physics World, Sep 2002, p.23
- *'The solution to Olbers' paradox'*, Physics World, Oct 2002, p.17
- *'Does dark energy really exist?'*, Physics World, Jul 2004
- *'Lambda marks the spot: the biggest problem in theoretical physics*, Plus Magazine, Jun 2009

▷ My work was reported on in:

- Astronomy: *'Skeptics of dark energy raise concerns, but remain outnumbered'*, Jan 2020
- Astronomy Today: *'Quantum Gravity - revealed by gamma ray bursts?'*, 2001
- BBC Future: *'The giant arcs that may dwarf everything in the cosmos'*, 2023
- Bild der Wissenschaft: *'Ist die dunkle energie eine illusion?'*, Jun 2006, p.54
- Boston Globe: *'Was it just dust?'*, Sep 2014
- CERN Bulletin: *'Astroparticle Physics Gets Organized'*, Dec 2008
- CERN Courier: *'Neutrino Oscillations NOW'*, Nov 1998, p.17; *'Directions beyond the Standard Model'*, Mar 1999, p.23; *'Relic neutrinos, a challenge for the next millennium'*, Mar 1999, p.25; *'UK theorists investigate new trends'*, Mar 2000, p.6; *'Testing models for quantum gravity'*, Sep 2002; *'Hubble tension questioned'*, Sep/Oct 2021
- Daily Express: *'The expansion of the universe is NOT accelerating'*, Oct 2016
- Daily Mail: *'Shedding light on dark matter'*, Sep 2012; *'The universe might NOT be accelerating: Controversial new study claims dark energy theory is 'rather shaky''*, Oct 2016
- De Morgen: *'Zijn de kreukels in de oerknal nu al een illusie?'*, Apr 2014; *'Deze onderzoeken kunnen ons begrip van de werkelijkheid op zn kop zetten (als ze kloppen)'*, Apr 2020
- De Volkskrant: *'Waarnemingen overkoken allervroegste heelal nu al onder vuur'*, Apr 2014; *'Het heelal dijt steeds sneller uit, maar waarom, dat zit theoretici nogal dwars'*, May 2017
- Die Zeit: *'Scotland Dark jagt Mister Wimp'*, Feb 2013; *'Supernova statt Gravitationswellen?'*, Apr 2014
- Discover: *'Some Scientists Are Skeptical Dark Energy Even Exists – But Others Push Back'*, Jan 2020
- Frontline: *Chasing supernovae*, Nov 2011; *'New window to the universe'*, Jun 2014; *The dark side of the universe*, Apr 2017
- Gizmodo: *The Universe Might Be Expanding Like a Lumpy Balloon*, Apr 2020
- Horizon: *'Dark energy is the biggest mystery in cosmology, but it may not exist at all'*, 3 Sep 2018
- Inside Science: *'Dark Energy Skeptics Raise Concerns, But Remain Outnumbered'*, Jan 2020
- Kijk: *'Dijt ons heelal toch niet steeds sneller uit?'*, 27 Oct 2016
- Nature: *'Cosmic rays without end'*, 3 Sep 1998; *'Quantum gravity: Testing time for theories'*,18 Mar 1999; *'Relativity: Special treatment'*,4 Jul 2002; *'Quantum gravity: an astrophysical constraint'*,28 Aug 2003; *'Physicists question model of the universe'*,12 Apr 2007; *'Bursting dark energy's bubble'*, 2 Nov 2007; *'Cosmology: Out of the darkness'*, 10 Oct 2012
- Newsweek: *'There's a huge void in space and we are living inside it, scientists say'*, 7 June 2017; 'Dark energy: Mystery force driving expansion of universe might not exist at all', 9 Sep 2018
- Observer: *'The hunt for neutrinos in the Antarctic'*, 23 Jan 2011

• New Scientist: *"Mystery of gravity wave shakes astronomers"*, 24 Mar 1988, p.24; *'Fourth' neutrino upsets the theories*, 2 Feb 1991; *'Supernova sheds light on cold dark matter'* 18 Feb 1995, p.17; *'Has SUSY shown her shadowy face'*, 30 Mar 1996, p.15; *'In the begining'*, 25 Apr 1998, p.7; *'The crypton factor'*, 27 Jun 1998, p.16; *'Quantum foam'*, 19 Jun 1999, p.28 (also *'Quantum players'*, 24 Jul); *'Is dark energy a mirage?'*, 6 Dec 2003, p.10; *' Particle physicist takes on Newton and Einstein'*, 28 Apr 2007; *'Dark energy may just be a cosmic illusion'*, 7 Mar 2008; *'A MAGIC test for string theory?'*, 8 Sep 2007; *'Moon used as giant particle detector*, 5 Aug 2009; *'Heart of darkness could explain Sun mysteries'*, 14 Jul 2010; *'Dark energy is not an illusion after all'*, 16 Mar 2011; *'Largest structure challenges Einstein's smooth cosmos'*, 16 Jan 2013; *'Hints of lightweight dark matter get even stronger'*, 10 May 2013; *'Star dust casts doubt on recent big bang wave result'*, 15 Apr 2014; *'Bestaat donkere energie toch niet?'*, Dec 2019; *'Kosmologen, koester je ketters!'*, Apr 2020 *'Controversial claim that the universe is skewed could upend cosmology'*, Apr 2022

• Physics Today: Europe sets priorities in astroparticle physics, Feb 2010; *'Remarkable gravitational lensing by the galaxy cluster Abell 3827'*, Jun 2015

• Physics World: *'Gamma-ray bursts could test quantum gravity'*, Jun 1998; *'Particle physics: the next generation'*, Dec 1999, p.43; *'The new universe around the next corner'*, Dec 1999, p.79; *'Quantum gravity's new phenomenon*, Mar 2002, p.9; *'Quantum gravity phenomenology'*, Nov 2003, p.43; *'Asking the big questions in London'*, Jul 2009; *'Dark energy and the balance of blogging'*, Jul 2009; *'Are CDMS and XENON both right about dark matter?'*, Apr 2013; *'PAMELA reasserts positron excess'*, Aug 2013; *'Does the positron 'excess' really exist?'*, Nov 2013; *'Cosmic neutrinos named Physics World 2013 Breakthrough of the Year'*, Dec 2013; *'Have galactic 'radio loops' been mistaken for B-mode polarization?'*, Apr 2014; *'Could pulsars explain the positron excess?'*, Apr 2014; *'A look back at how the dust fell on BICEP2'*, Sep 2014 *'BICEP2 gravitational wave result bites the dust thanks to new Planck data'*, Sep 2014; *'Galactic dust sounds death knell for BICEP2 gravitational wave claim'*, Feb 2015; *'What can cosmic rays tell us about dark matter?'*, Apr 2015; *'Is dark energy becoming marginalized?'*, Jun 2015; *'Supernovae analysis finds scant evidence for dark energy'*, Oct 2016; *'The dark energy deniers'*, Jun 2018; *'Dark energy debate reignited by controversial analysis of supernovae data'*, Oct 2019

• Pour La Science: *'Désintégration de cryptons'*, Oct 1998, p.32

• Quanta: *'No Dark Energy? No Chance, Cosmologists Contend'*, Dec 2019; *'Cosmologists Parry Attacks on the Vaunted Cosmological Principle'*, Dec 2021

• Science: *'Java applet lets readers bite into research'*, 2 Jul 1999, p.34

• Science News: *'A little mass goes a long way'*, Jan 1999, p.76

• Science Week: *'Gamma ray bursts: tests of quantum gravity'*, 24 Jul 1998

• Scientific American: *'String instruments*, 1 Oct 1998; *'Doom & gloom by 2100'*, 1 July 2004; *'Faster-than-light neutrinos show science in action'*, 23 Sep 2011; *'No, Astronomers Haven't Decided Dark Energy Is Nonexistent'*, 26 Oct 2016; *'Dark Matter May Be Missing from This Newfound Galaxy, Astronomers Say'*, 22 Dec 2021

• Shaastra: *'The search continues'*, Sep 2022

• Sky & Telescope: *'Ultrahigh-energy cosmic rays'*, Mar 2003

• Smithsonian Magazine: *'The "Gravitational Wave" finding may have actually just been some dust'*, 17 Apr 2014

• Spektrum: *'Ist die Dunkle Energie ein gigantischer Irrtum?'*, Dec 2019; Zweifel an der Dunklen Energie, Apr 2020

• The Guardian: *'Faster than light particles found'*, 22 Sep 2011; *'New light cast on dark matter'*, 25 May 2013

• The Hindu: *'Gamma-ray telescope takes shape'*, Jul 2013

• The Independent: *'Dark energy: A cosmic mirage?'*, 7 Jan 2004

• The Telegraph: *'Telescope' buried a mile under the Antarctic ice to find source of cosmic rays*, 18 Oct 2010; *Telescope buried in Antarctic ice detects elusive neutrinos*, 21 Nov 2013

• Videnskab: *Gennembrud pa Sydpolen: Nu kan neutrinoer bruges til astronomi*, 30 Aug 2015; *Ny form for astronomi: Fysikere fanger neutrino fra fjern galakse*, 12 Jul 2018

• De Volkskrant: *Waarnemingen overkoken allervroegste heelal nu al onder vuur*, Apr 2014; *Het heelal dijt steeds sneller uit, maar waarom, dat zit theoretici nogal dwars*, May 2017

• The Wire: Is the Universe Different In Different Directions?, Apr 2021

• Wired: *Dark matter may be building up inside the Sun*, 9 Jul 2010, *Does Dark Energy Really Exist? Cosmologists Battle It Out*, Jan 2020

• Zeit: *Scotland Dark jagt Mister Wimp*, 28 Feb 2013; *Supernova statt Gravitationswellen?*, 11 Apr 2014

My papers are classified below as those with a short author list, followed by papers with experimental collaborations: CERN-WA-066, Pierre Auger Observatory, IceCube Neutrino Observatory and the Cherenkov Telescope Array, as well as various laser plasma physics experiments. Publications with the Particle Data Group and other reports are listed separately, as are conference submissions. Note that in (astro)particle physics the author list is always alphabetical.

## Short authorlist papers

[1] *Detection of relativistic iron nuclei in the plastic track detector CR-39*
Nuclear Instruments & Methods 163 (1979) 183–187
(with S. Biswas, N. Durgaprasad, P.J. Kajarekar & V.S. Venkatavaradan)

[2] *A lower limit to the magnetic Field in Cassiopeia-A*
Monthly Notices of the Royal Astronomical Society 191 (1980) 855–861
(with R. Cowsik)

[3] *Does the galactic synchrotron background originate in old supernova remnants?*
Monthly Notices of the Royal Astronomical Society 199 (1982) 97–108

[4] *The evolution of supernova remnants as radio sources* ⋆ ADS[1]: 50+ CITES
Monthly Notices of the Royal Astronomical Society 207 (1984) 745–775; erratum 209, 719
(with R. Cowsik)

[5] *Astrophysical consequences of $n - \bar{n}$ oscillations*
Nature 309 (1984) 727

[6] *Cosmological & experimental constraints on the tau neutrino* ⋆ INSPIRE[2]: TOPCITE 100+
Physics Letters 148B (1984) 347–354
(with A.M. Cooper)

[7] *The cosmology of decaying gravitinos* ⋆ TOPCITE 250+
Nuclear Physics B259 (1985) 175–188
(with J. Ellis & D.V. Nanopoulos)

[8] *Primordial nucleosynthesis, additional neutrinos & neutral currents from the superstring*
Physics Letters 167B (1986) 457–463 TOPCITE 100+
(with J. Ellis, K. Enqvist & D.V. Nanopoulos)

[9] *Neutron oscillations & the primordial magnetic field*
Astrophysics Letters & Communications 27 (1989) 293–297

[10] *Low mass photinos & supernova 1987A*
Physics Letters 215B (1988) 404–410
(with J. Ellis, K.A. Olive & D.W. Sciama)

[11] *Astrophysical constraints on massive, unstable neutral relic particles* TOPCITE 250+
Nuclear Physics B373 (1992) 399–437
(with J. Ellis, G.B. Gelmini, J. Lopez & D.V. Nanopoulos)

[12] *On the implications of a 17-keV neutrino*
Physics Letters 260B (1991) 381–388
(with A. Hime, R.J.N. Phillips & G.G. Ross)

[13] *Bound on the tau neutrino magnetic moment from the BEBC beam dump experiment*
Physics Letters B280 (1992) 153–158 TOPCITE 50+
(with A.M. Cooper-Sarkar, J. Guy, W. Venus, P.O. Hulth & K. Hultqvist)

[14] *Cosmic neutrinos from unstable relic particles* TOPCITE 100+
Nuclear Physics B392 (1993) 111–133 [hep-ph/9209236]
(with P. Gondolo & G.B. Gelmini)

[15] *Neutralino dark matter in a class of unified theories*
Nuclear Physics B392 (1993) 83–110 [hep-ph/9209292] TOPCITE 50+
(with S.A. Abel & I.B. Whittingham)

[16] *Cosmological constraints on perturbative supersymmetry breaking*
Physics Letters B342 (1995) 40–46 [hep-ph/9409350]
(with S.A. Abel)

[17] *Remarks on the KARMEN anomaly* TOPCITE 100+
Physics Letters B352 (1995) 365–371; erratum B356, 617 [hep-ph/9503295]
(with V. Barger & R.J.N Phillips)

[18] *Successful supersymmetric inflation* TOPCITE 100+
Nuclear Physics B461 (1996) 597–623 [hep-ph/9506283]
(with G.G. Ross)

[19] *On the cosmological domain wall problem for the minimally extended supersymmetric standard model*
* Nuclear Physics B454 (1995) 663–681 [hep-ph/9506359] TOPCITE 100+
(with S.A. Abel & P.L. White)

[20] *A supersymmetric resolution of the KARMEN anomaly*
Physics Letters B374 (1996) 87–92 [hep-ph/9511357]
(with D. Choudhury)

[21] *Big bang nucleosynthesis & physics beyond the standard model* TOPCITE 500+
Reports on Progress in Physics 59 (1996) 1493–1610 [hep-ph/9602260]

[22] *No crisis for big bang nucleosynthesis* TOPCITE 50+
Physical Review D54 (1996) R3681–R3685 [astro-ph/9603045]
(with P.J. Kernan)

[23] *Nucleosynthesis bounds on a time–varying cosmological "constant"* TOPCITE 50+
Astroparticle Physics 6 (1997) 197–203 [astro-ph/9605055]
(with M. Birkel

[24] *Evading the cosmological domain wall problem* TOPCITE 100+
Physical Review D55 (1997) 5129–5135 [hep-ph/9608319]
(with S. Larsson & P.L. White)

[25] *Natural supergravity inflation* TOPCITE 50+
Physics Letters B391(1997) 271–280 [hep-ph/9608336]
(with J.A. Adams & G.G. Ross)

[26] *Multiple inflation* * TOPCITE 100+
Nuclear Physics B503 (1997) 405–425 [hep-ph/9704286]
(with J.A. Adams & G.G. Ross)

[27] *Ruling out a critical density baryonic universe*
Physics Letters B408 (1997) 59–68 [hep-ph/9705331]
(with M. Birkel)

[28] *Tests of quantum gravity from observations of $\gamma$-ray bursts* * TOPCITE 1000+
Nature 393 (1998) 763–765 [astro-ph/9712103]
(with G. Amelino-Camelia, J. Ellis, N.E. Mavromatos & D.V. Nanopoulos)

[29] *Quantifying uncertainties in primordial nucleosynthesis without Monte Carlo simulations*
Physical Review D 58 (1998) 063506 [astro-ph/9803177] TOPCITE 100+
(with G. Fiorentini, E. Lisi & F.L. Villante)

[30] *Extremely high energy cosmic rays from relic particle decays* ⋆ TOPCITE 250+
Astroparticle Physics 9 (1998) 297–309 [hep-ph/9804285]
(with M. Birkel)

[31] *CMB anisotropy in the decaying neutrino cosmology* ⋆ TOPCITE 50+
Monthly Notices of the Royal Astronomical Society 301 (1998) 210–214 [astro-ph/9805108]
(with J.A. Adams & D.W. Sciama)

[32] *Scale of $SU(2)_{\rm R}$ symmetry breaking & leptogenesis*
Physics Letters B 458 (1999) 73–78 [hep-ph/9812276]
(with E. Ma & U. Sarkar)

[33] *Big bang nucleosynthesis limit on $N_\nu$* TOPCITE 100+
Physical Review D 59 (1999) 123520 [hep-ph/9901404]
(with E. Lisi & F. Villante)

[34] *Implementing quadratic supergravity inflation*
Physics Letters B 469 (1999) 46–54 [hep-ph/9908380]
(with G. German & G.G. Ross)

[35] *A supersymmetric solution to the KARMEN anomaly* TOPCITE 50+
Physical Review D61 (2000) 095009 [hep-ph/9911365]
(with D. Choudhury, H. Dreiner & P. Richardson)

[36] *Thermalisation after inflation* TOPCITE 100+
Journal of High Energy Physics 11 (2000) 012 [hep-ph/0009078]
(with S. Davidson)

[37] *On the APM power spectrum & CMB anisotropy: Evidence for a phase transition during inflation* TOPCITE 50+
Monthly Notices of the Royal Astronomical Society 324 (2001) 977–987 [astro-ph/0011398]
(with J. Barriga, E. Gaztañaga & M. Santos)

[38] *The anisotropy of the ultra-high energy cosmic rays* TOPCITE 50+
Astroparticle Physics 17 (2002) 319–340 [astro-ph/0103085]
(with N.W. Evans & F. Ferrer)

[39] *Low-scale inflation* TOPCITE 100+
Nuclear Physics B608 (2001) 423–450 [hep-ph/0103243]
(with G. German & G.G. Ross)

[40] *No cosmological domain wall problem for weakly coupled fields*
Physical Review D65 (2002) 025002 [hep-ph/0106272]
(with H. Casini)

[41] *The high energy cosmic ray spectrum from relic particle decay* TOPCITE 100+
Nuclear Physics B621 (2002) 495–520 [hep-ph/0108098]
(with R. Toldra)

[42] *Possible astrophysical tests of quantum gravity* TOPCITE 50+
Modern Physics Letters A17 (2002) 1025–1035 [gr-qc/0204092]

[43] *The clustering of ultra-high energy cosmic rays and their sources* TOPCITE 50+
Physical Review D67 (2003) 103005 [astro-ph/0212533]
(with N.W. Evans & F. Ferrer)

[44] *An alternative to the cosmological 'concordance model'* TOPCITE 100+
Astronomy & Astrophysics 412 (2003) 35–44 [astro-ph/0304237]
(with A. Blanchard, M. Douspis & M. Rowan-Robinson)

[45] *A 'baedeker' for the dark matter annihilation signal* * TOPCITE 100+
Physical Review D69 (2004) 123501 [astro-ph/0311145]
(with N.W. Evans & F. Ferrer)

[46] *Reply to 'Comment on "The clustering of ultra-high energy cosmic rays and their sources"'*
Physical Review D 69 (2004) 128302 [astro-ph/0403527]
(with N.W. Evans & F. Ferrer)

[47] *Have atmospheric Cerenkov telescopes observed dark matter?* TOPCITE 50+
Journal of Cosmology & Astroparticle Physics 09 (2004) 002 [astro-ph/0404205]
(with D Hooper, I Calle Perez, J Silk and F Ferrer)

[48] *The impact of heavy nuclei on the cosmogenic neutrino flux* TOPCITE 100+
Astroparticle Physics 23 (2005) 11–17 [astro-ph/0407618]
(with D. Hooper and A. Taylor)

[49] *Multiple inflation and the WMAP 'glitches'* * TOPCITE 100+
Physical Review D70 (2004) 103518 [astro-ph/0408138]
(with P. Hunt)

[50] *Probing Planck scale physics with IceCube* TOPCITE 100+
Physical Review D 72 (2005) 065019 [hep-ph/0506168]
(with L. Anchordoqui, H. Goldberg, M. Gonzalez-Garcia, F. Halzen & D. Hooper)

[51] *Exotic neutrino interactions at the Pierre Auger Observatory* TOPCITE 50+
Astroparticle Physics 25 (2006) 14-32 [hep-ph/0508312]
(with L. Anchordoqui, T. Han & D. Hooper)

[52] *Large-scale galaxy correlations as a test for dark energy*
Astronomy & Astrophysics 449 (2006) 925–928 [astro-ph/0512085]
(with A. Blanchard, M. Douspis & M. Rowan-Robinson)

[53] *Probing low-x QCD with ultra-high energy cosmic neutrinos at Auger* TOPCITE 50+
Physical Review D 74 (2006) 043008 [hep-ph/0605086]
(with L. Anchordoqui, A.M. Cooper-Sarkar & D. Hooper)

[54] *Racetrack inflation and assisted moduli stabilisation* TOPCITE 50+
Nuclear Physics B 766 (2007) 1–20 [hep-th/0503178]
(with Z. Lalak & G.G. Ross)

[55] *The intergalactic propagation of ultra-high energy cosmic ray nuclei* TOPCITE 50+
Astroparticle Physics 27 (2007) 199–212 [astro-ph/0608085]
(with D. Hooper & A. Taylor)

[56] *High-energy neutrinos from astrophysical accelerators of cosmic ray nuclei* TOPCITE 50+
Astroparticle Physics 29 (2008) 1–13 [astro-ph/0703001]
(with L. Anchordoqui, D. Hooper & A. Taylor)

[57] *Multiple inflation & the WMAP 'glitches' II. Data analysis & parameter extraction*
Physical Review D76 (2007) 123504 [arXiv:0706.2443] TOPCITE 50+
(with P. Hunt)

[58] *Predictions for the cosmogenic neutrino flux in light of new data from the Pierre Auger Observatory*
Physical Review D76 (2007) 123008 [arXiv:0709.0734] TOPCITE 100+
(with L. Anchordoqui, D. Hooper & A. Taylor)

[59] *Predictions for high energy neutrino cross-sections from the ZEUS global PDF fits*
Journal of High Energy Physics 01 (2008) 075 [arXiv:0710.5303] TOPCITE 100+
(with A.M. Cooper-Sarkar)

[60] *Is the evidence for dark energy secure?* TOPCITE 50+
General Relativity & Gravitation 40 (2008) 269–284 [arXiv:0710.5307]

[61] *The intergalactic propagation of ultra-high energy cosmic ray nuclei: an analytic approach*
Physical Review D77 (2008) 103007 [arXiv:0802.1538]
(with D. Hooper & A. Taylor)

[62] *Fine tuning and the ratio of tensor to scalar density fluctuations from cosmological inflation*
Journal of Cosmology & Astroparticle Physics 10 (2008) 015 [arXiv:0804.2634]
(with S. Hotchkiss, G. German and G.G. Ross)

[63] *Constraints on large-scale inhomogeneities from WMAP-5 and SDSS* TOPCITE 50+
Monthly Notices of the Royal Astronomical Society 401 (2010) 547–558 [arXiv:0807.4508]
(with P. Hunt)

[64] *Neutrino diagnostics of ultra-high energy cosmic ray protons* TOPCITE 50+
Physical Review D 79 (2009) 083009 [arXiv:0902.3993]
(with M. Ahlers & L. Anchordoqui)

[65] *Testing astrophysical models for the PAMELA positron excess with cosmic ray nuclei*
Physical Review Letters 103 (2009) 081104 [arXiv:0905.3152] TOPCITE 100+
(with P. Mertsch)

[66] *On cosmic ray acceleration in supernova remnants and the FERMI/PAMELA data* ⋆
Physical Review D80 (2009) 123017 [arXiv:0909.4060] TOPCITE 100+
(with M. Ahlers and P. Mertsch)

[67] *Non-gaussianity from violation of slow-roll in multiple inflation*
Journal of Cosmology & Astroparticle Physics 05 (2010) 024 [arXiv:0910.3373]
(with S. Hotchkiss)

[68] *Asymmetric dark matter and the Sun* ⋆ TOPCITE 100+
Physical review Letters 105 (2010) 011301 [arXiv:1003.4505]
(with M.T. Frandsen)

[69] *Systematic effects in the extraction of the 'WMAP haze'*
Journal of Cosmology & Astroparticle Physics 10 (2010) 019 [arXiv:1004.3056]
(with P. Mertsch)

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[73] *Mixed dark matter from technicolour* TOPCITE 50+
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[76] *Light asymmetric dark matter from new strong dynamics* TOPCITE 100+
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(with M.T. Frandsen & K. Schmidt-Hoberg)

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[82] *Resolving astrophysical uncertainties in dark matter direct detection* TOPCITE 100+
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[88] *Colliding clusters and dark matter self-interactions* TOPCITE 100+
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[90] *Fingerprints of Galactic Loop I on the cosmic microwave background* ⋆ TOPCITE 50+
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[106] *Is there really a 'Hubble tension'?* TOPCITE 50+
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[109] *Explaining cosmic ray antimatter with secondaries from old supernova remnants*
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[144] *An upper limit to the photon fraction in cosmic rays above $10^{19}$ eV from the Pierre Auger Observatory* Astroparticle Physics 27 (2007) 155–168 [astro-ph/0606619] TOPCITE 100+

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