

The electron shapes up

Knowing its exact form would set the course for much else, says s ananthanarayanan

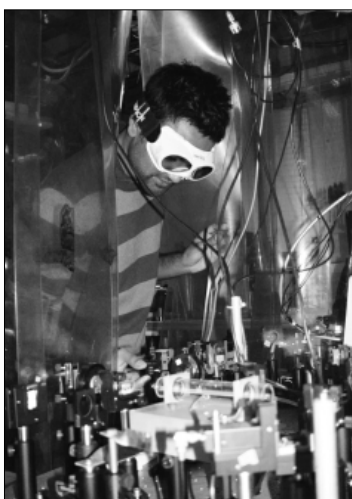
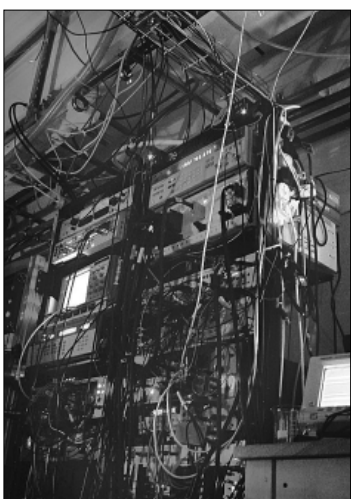
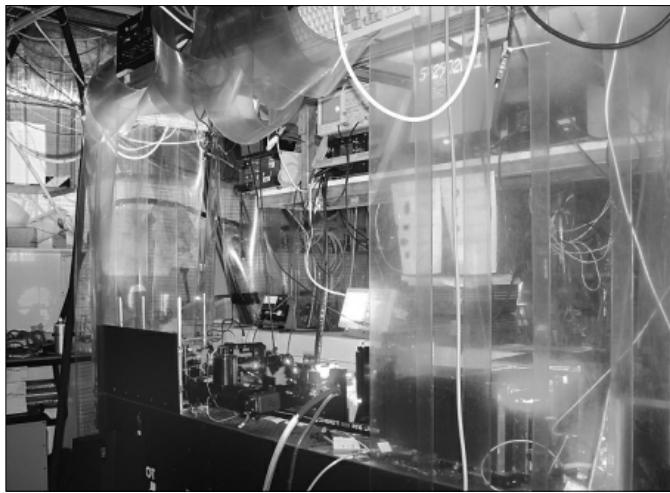
THE electron is the tiniest of atomic particles and it acts like a mass and charge located at a point. Finding its actual shape has been neither feasible nor of any consequence in the normal course, but crises in physics in explaining all of nature now place the importance on whether the electron is even the teeniest bit different from a perfect sphere. Jay Hudson and colleagues at the Centre for Cold Matter, Blackett Laboratory, Imperial College London, report that the best measurement to date still says the electron is round in every way!

The nature of very small particles – atoms – nuclei and the interactions between them has been understood down to a very great degree of certainty with the help of the quantum theory and the Special Theory of Relativity. Quantum electrodynamics, as this field of study is called, has been verified to the precision of one part in 100 billion, 10^{10} , or an uncertainty of just one millimetre in a distance of 100 km. At the same time, the General Theory of Relativity, which deals with gravitation and the structure of the cosmos, has also been verified in every experiment and there is no reason whatever to question its validity on the grounds of facts or principle. And yet the two theories are limited to the fields of very small dimensions and sort range forces or large masses and distances and long-range forces, like gravity, respectively. We can see that short-range forces, which act between nuclear particles, are irrelevant at the cosmic scale and gravity hardly matters for atomic particles, which have low mass and a huge electric charge, for their size.

An important question, perhaps the only one, in physics has been to discover a "unified" theory, which acts both for short distances as well as for astronomical distances, a set of principles that works for all manifestations of nature. The most promising in this line is the *String Theory*, developed by the celebrated Stephen Hawking, which seeks to describe nature with not only the variables of space and time but introduces many other dimensions that display themselves in high energy interactions between elementary particles. With these postulated extra dimensions, the theory seeks to explain, at once, all the phenomena at the atomic scale and also the nature of mass and gravity.

Verification

The proof of this complex structure would depend on verification of some of its predictions, apart from the known physics that it must



explain. One of these new results is the existence of heavy particles, the "supersymmetric" counterparts of all particles. An objective of the *Large Hadron Collider* at Cern is to create reactions of such high energy that these heavy particles could get generated, which would act as a verification of supersymmetry. One more consequence of the theory is that the electron should show "ovality" so that it may align itself along the direction of electric fields. The electron is already known to possess a magnetic axis known as "spin", which can get flipped in magnetic fields. But the current theory does not call for an electric "axis", so that the electron

would feel a turning force in an electric field. At least the current theory, to the extent verified, does imply that any such "ovality" of the electron is less than one part in 10^{28} . But supersymmetry puts this limit at only one part in 10^{14} to 10^{19} . Measurement of the electric directionality of the electron to that accuracy could thus act as a check of the validity of the theory.

Electric dipole moment

An objective of research has thus been to detect the force that turns the electron around when it is placed in an electric field. On one hand, it is clear that the force is very small

because theory predicts very minute non-spherical distribution of charge in the electron. As the force is much too small, there are two ways of making it larger so that it can be detected – one is to increase the electric field, the other is to let the field act for a long time so that the effect of the field adds up.

But because the electron has a negative electrical charge, these methods cannot work – in even a moderate electric field the whole electron, if it is free, is swiftly whisked away by the field and the more the strength of the field the faster the electron moves out of it. The way around this difficulty has been to work not on "free" electrons but electrons that are bound, in atoms. When an atom is placed in an electric field, it is, being neutral, not affected. But as the parts of the atom, the nucleus and the electrons are charged, they get drawn in opposite directions and the atom gets "polarized". If the kind of atom and the strength of the field are well chosen, the field on the outer electrons can be quite high, to more readily display any effects of the electron being different from spherical.

Hudson and Co

It is by refining this idea that the Imperial College group made measurements of great precision. Molecules, which consist of a group of atoms that have "lent or borrowed" electrons to create forces that hold them together, are even more readily "polarised" by an electric field than atoms. And the effective field experienced by individual, outer electrons can be made to be even higher. Hudson and colleagues worked with molecules of *ytterbium monofluoride* (YbF) and improved on the earlier best results that had come from atoms of *thallium*.

The results of the experiments were still that no ovality is detected. But the merit of the experiment is that we are able to say with confidence that if there is any ovality, it has to be less than one in 10^{18} , which is how accurate the experiments were. This limit of ovality is now very near, just a factor of 10, from the limit set by supersymmetry. The group is working on improving the experiment so that it gets more accurate and is able to answer the question: Is there ovality at the limit set by supersymmetry, or is there not?

In either case, the result has great value – either it validates supersymmetry and spurs on the effort to discover other high-energy manifestations, or it turns the course to work on alternative theories. The ovality of the electron has direct implications, not just the theories of interactions but also whether there could be some effect that breaks the symmetry between particles and antiparticles – leading to the observed universe, which has chosen to consist of only particles, for no good reason for why it made a choice!

The writer can be contacted at simplescience@gmail.com

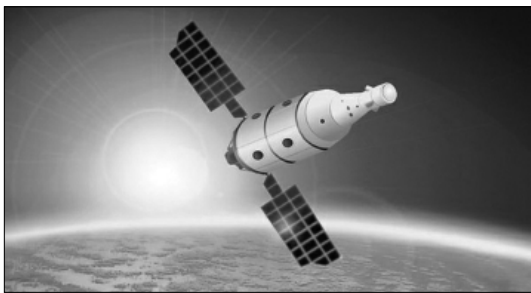
Ascent of Manx

Forget Houston, the Isle of Man is the location for the world's latest space hub, says jonathan brown

THE wind from the Irish Sea whips across the former airfield at Jurby on the north-western tip of the Isle of Man. It was from this bracing spot during World War II that the Royal Air Force flew missions to protect the cities of Liverpool and Belfast from Luftwaffe bombs. The hangars still stand today, although the armed forces left nearly four decades ago. The structures provide a startling symbol of this small island's soaring ambition to one day slip the shackles of the earth and head for the stars. This June, international journalists, potential investors and local schoolchildren will be invited to Jurby to view two Almaz space stations it houses.

The island-based company, Excalibur Almaz, bought them from the Russian government earlier this year – for what it describes as a "good price". The spacecraft were once part of a top-secret Cold War project for spying on the West. After they have been refurbished, the forerunners of the pioneering Salyut and Mir projects will, at some point during the current decade, provide accommodation for space tourists willing to pay up to £20 million to realise the dream of civilian space travel.

It may seem puzzling to outsiders, but this small, self-governing outcrop of rock and lush grass perched between the coasts of Cumbria and County Down has become a major player in the modern space race. Best known for its offshore banks and treacherous motorcycle race, the island was recently ranked the fifth most likely "nation" to lead a manned mission back to the moon after the USA, Russia, China and India. Despite a population measuring just 83,000, the territory is on its way to securing



The Excalibur Almaz space station.

its reputation as the Celtic Houston. A recent report by the Economic Policy Centre underlined this by urging the UK government to learn lessons from its tiny dependent's "conspicuously successful" approach. The architect of much of this success is Chris Stott, founder of space company ManSat. Although he now lives in Texas with wife Nicole, an astronaut who recently returned from the space shuttle Discovery's final mission, Stott can trace his ancestors on the island back 2,000 years. It was in the late 1990s that the former political speechwriter got the call to put his skills as a policy expert into action on behalf of his native land. "I was asked by chief minister Don Gelling to go off and build an industry," he says. "We had a plan on paper how we would do that, what people we wanted here who could put employment and real assets on the island. His actual words were, 'I want Manx children on Mars'. When the chief minister of the country asks you to do something like that, you go and do it."

For inspiration, Stott delved back

further than Kennedy-era America and its spirit of idealism, finding common cause with the pragmatism of the 14th-century Italian city states. "We looked to see where in the past policies had really worked well financially in

work side by side with each other on the island and are all right with that." At the core of the Manx offer to a collection of 17 companies that is already on the way towards earning its first \$1 billion here is the extraordinarily generous offshore tax rate. Corporate tax – with the exception of banking, land and property earnings – stands at zero.

Income tax is just 20 per cent and there is nothing to pay on salaries over £115,000 a year. Former National Aeronautics and Space Administration commander Leroy Chiao, now director of Excalibur Almaz, says the tax advantages are instrumental in persuading his company to store the two stations on the island. "We are mostly incorporated there for tax reasons," he says. But the islanders insist that it is not just the prospect of a benevolent exchequer that has lured big hitters such as CVI Technical Optics – which provided the lenses that discovered snow on Mars – and leading satellite operators SES, Telesat, Avanti and Inmarsat. They point to the financial, legal and insurance expertise that has gathered around the capital, Douglas – services that are at the heart of the new private sector-led space industry, which relies on cash and international agreement to boldly go where few men and women have gone before.



International Space University graduate Carla Sharpe (left) and Excalibur Almaz director Leroy Chiao.

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The Isle of Man has a population of just 83,000.

The Manx leaders, who have jealously guarded their autonomy since founding the world's longest continuously serving parliament at the Tynwald in 979, chose their moment to turn to the heavens judiciously. The last decade has witnessed a rapid switch from the military dominance of space to its commercialisation and the island is riding the booming demand for satellites from data, television and Internet companies hungry for high definition, 3D and cloud computing. It already boasted an aeronautical tradition first established 60 years back when the Ronaldsway Aircraft Company pioneered production of the ejector seat. Crime is low, unemployment virtually unknown and the island has just notched up its 25th year of successive growth. Compared with other offshore tax havens, it is cheap and uncrowded.

The island's celestial ambitions rest with Odyssey Moon. It was the first company to throw its hat in the ring for the \$18 million Google Lunar X Prize and last year the island hosted 14 of the 23 teams competing for the lucrative purse available to a private company capable of putting a spacecraft on the moon and relaying pictures back to earth. Dr Robert Richards, a founder of the International Space University, which has just opened its first outpost on the Isle of Man created Odyssey Moon and he believes the world is poised for a new era of "moonrush". Announcing the company's entry into the race, he described the quest as "a Rosetta Stone of science and knowledge waiting to be unlocked by the explorers of our age".

The Independent, London

TENDER

WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED
(A Govt. of West Bengal Enterprise)

NOTICE INVITING TENDER
Tender No. : CE/TR (O&M)/TR-II/Civil/08/2011 Dated : 31.05.2011
WBSETCL invites sealed bids from eligible bidders for "Construction of foundations of equipment and structures for two 33 KV line bays at Raghunathpur 132/33 KV sub-station, Dist : Purulia." Bid documents shall be on sale from 06.06.2011 to 14.06.2011 on all working days except Saturdays between 11 A.M. and 3 P.M. Bids shall be received up to 3 P.M. on 16.06.2011 and shall be opened on 16.06.2011 at 4 P.M. Interested bidders shall obtain detailed N.I.T and bidding documents from the Additional Chief Engineer, Transmission-II (O&M), Vidyut Bhavan, 10th floor, Block-D, Salt Lake City, Kolkata-91, Tele Fax : 033 2359-1901. Detailed NIT is available on the Company's website (www.wbsetcl.in) and can be downloaded from 03.06.2011 for bidder's information. Addl. C.E., Trans.-II (O&M)

OFFICE OF THE DIRECTOR GENERAL OF POLICE

ANDAMAN & NICOBAR ISLANDS
Port Blair, Dated 30th May, 2011
TENDER NOTICE

Sealed tenders are invited for supply of 02 (two) Nos. Aluminium Out Board Dinghy and 02 (two) Nos. Petrol Driven 25 HP Out Board Motor (OBM) as per the specifications, terms and conditions mentioned in the tender notice for the use of the Police Marine Force of A & N Police. Interested firms can log on to www.andaman.nic.in and www.police.and.nic.in for details.

S.B.S. Tyagi, IPS
Superintendent of Police (D) SA
for Director General of Police
Andaman & Nicobar Islands

KOLKATA MUNICIPAL CORPORATION - TENDER

D.G. (Civil) invites separate sealed tenders in duplicate from the P.I./reputed & resourceful contractor, super-scribing the name of the work on the envelope, enclosing current STCC/ITCC/PAN/CE/Experience Certificate in similar kinds of jobs for "Construction of one passenger shed on or near Park Circus 7 point crossing, Christ the King Church", upto 12.00 noon on 06.06.11 & will be opened on the same day. Details & permission may be had from D.G. (Civil) / Dy.C.E. (Civil/H.O./E.E.(c), H.Q. on production of requisite papers (ST/PAN/CE) upto 03.06.11. KMC reserves the right to accept/reject any/all tenders without showing any reason. Estd. Cost, Earnest Money, Time of completion & Price of tender form are as follows : Rs. 14,56,295/- Rs. 22,300/-, 60 days & Rs. 200/-.

D.G. (Civil) invites tenders for "Development work at the christian Burial Board at 184, A.J.C. Bose Road in ward no.-61" upto 12.00 noon on 16.06.11 & will be opened on the same day at 12.30 p.m. Details & permission may be had from D.G. (Civil) / Dy.C.E. (C), Central/E.E. Br.-VI upto 14.06.11. KMC reserves the right to accept/reject any/all tenders without showing any reason. Estd. Cost, Earnest Money, Time of completion & Price of tender form are as follows : Rs. 7,61,393/-, Rs. 15,240/-, 60 days & Rs. 200/- each. 37/11-12

AUCTION SALE

Under instruction from
BIRLA TYRES
Prop. **KESORAM INDUSTRIES LIMITED**
Factory : P.O. : Chhanpur, Balasore - 756056 Orissa,
Ph: (06782) 254167/780
M/s Tirupati & Company (Auctioneers)
28/D, Harish Mukherjee Road, Kolkata - 700 025,
Phone : (033) 24551069, Fax : (033) 24550102,
Website: www.tirupatiauctioneer.co.in

Will sell the following scrap materials by Public Auction on Thursday, 9th June, 2011 at Kala Kunj, 48, Shakespeare Sarani, Kolkata - 700017 commencing at sharp 10.30 A.M.

- a) Process Scrap like Rubber Compound, Rubbed & Radial Fabric, Cut Bead, Cut Tyres, Cut Bladder, Tubes, Flaps, Trimmings, Green Tyres, etc.
- b) M.S./I.G./I.G.M/A1, Hoop Iron, Plastic Jar of different sizes, M.S. Drums, Conveyor Belt, Rubber Scrap, Rubber Sludge, HDPE Bags, Scissors, Packing Wood, 1/1.5 Ton Capacity 5 No. A.C. Machines in working condition, Lubricating Oil, Scrap Tubral - 46, Pneumatic Controller Recorder, etc.
- c) 7242 nos. rejected Tubes (to be buffed), Excise Duty applicable.
- d) i) Two cars Logan GLE 2007 in good running condition.
ii) One car Inova 2007 in good running condition.
iii) One car Maruti sx4vxi 2009 in good running condition.

Inspection at Factory on 6th & 7th June, 2011 from 9.30 A.M. to 12.30 P.M. and from 2.00 P.M. to 4 P.M.

For Catalogue, Entry Permit and other details, interested purchasers may contact Auctioneer's office or Mr. J. K. Ghosh in Birla Building at 9/1, R. N. Mukherjee Road, 8th floor, Kolkata - 700001 on any working day.

EAST COAST RAILWAY

NOTICE INVITING TENDER FOR ENGINEERING WORKS

Tender Notice No. : DR/Engg/KUR/06/11-12 Dated : 24.05.2011

DESCRIPTION	Tender Value (₹)	EMD (₹)	Cost of Tender Document (₹)
1. Repairs & replacement of existing deteriorated, corroded, perforated & damaged corrosion guards of cross girders on Br. No. 550(DN) (10x15'3") between Chhatrapur-Ganjam and provision of corrosion guards of cross girders on Br. No. 544 (UP) (32'x20'0") (New Mahanadi Bridge) between Kendrapara Road & Cuttack under jurisdiction of ADEN (B) JKR in Khurda Road Division.	14,44,600/-	28,890/-	2000/-
2. Manufacturing, supplying & transportation of new pre-cast PSC bridge slabs for Br. No. 430(DN) (1x6.57m span) & Br. No. 452(DN) (1x6.12m span) with lining of precast RCC bed blocks & pedestal between stations Jajpur Keonjhar Road & Jenapur in Khurda Road Division.	16,91,700/-	33,830/-	2000/-
3. Miscellaneous maintenance works of mechanized cleaning and sanitation (Up keeping) of East Coast Railway Headquarters building at Chandrasekharpur, Bhubaneswar.	25,33,100/-	53,860/-	3000/-
4. Fabrication, supply and fixation of new M.S. checkered plates for pathway on girder bridges on Br. Nos. 992 (UP&DN), 1004 (UP &DN), 1048 (UP &DN), 1055 UP, 1052 UP & 1122 (UP&DN) under jurisdiction of ADEN (B) Brahmapur in Khurda Road Division.	30,66,900/-	61,340/-	3000/-
5. Miscellaneous P.Way works such as casual renewal of rails and sleepers, welding of rails joints, filling of track, through packing & other enabling works under the jurisdiction of SEE (P.Way) Cuttack of Khurda Road Division.	32,06,400/-	64,130/-	3000/-
6. Repairs to minor bridges, such as repair to ballast walls, toe walls, abutments & inspection steps, epoxy grouting, bed flooring, stone pitching, boulder filling to approaches and sides, desilting of waterway etc., in Cuttack-Paradeep section under the jurisdiction of ADEN/Cuttack in Khurda Road Division.	46,03,500/-	92,070/-	3000/-
7. Proposed repairs to boundary wall and development of land near ECoR SADAN at encroached area by the outsiders and nearby railway area at Chandrasekharpur, Bhubaneswar.	53,39,200/-	1,06,780/-	5000/-
8. Miscellaneous P.Way works such as casual renewal of rails and sleepers, welding of rails joints, filling of track, through packing & other enabling works under the jurisdiction of SEE (P.Way) Jajpur/Konjhar in Khurda Road Division.	54,36,600/-	1,08,730/-	5000/-
9. Provision of gate gnomies, hand operated tube wells improvement to road surface & other related works in connection with manning of 10 Nos. of level crossing under Sr. DEN (HQ)'s jurisdiction of Khurda Road Division.	61,38,700/-	1,22,770/-	5000/-
10. Execution of pre and post operation and other enabling works with SCM working along with manual deep screening of isolated locations from Km. 410.38 to 423.00, Km. 477.00 to 485.00 on UP line, Km. 435.00 to 444.00 and Km. 470.00 to 477.50 on DN line in Charbatia-Rajathagah-Budapanik section and Km. 155.50 to 188.85 on SL between junction cabin-Angul Section of Khurda Road Division.	80,76,800/-	1,61,540/-	5000/-
11. Formation Treatment for a length of 2.00 Km. between Km. 327/22 to 329/22 on DN line between Bailaram Road - Jajpur Keonjhar Road station of Khurda Road Division.	92,19,000/-	1,84,380/-	5000/-
12. Proposed conversion of stone slab bridges of Br. Nos. 458/48 into RCC Box along with provision of approach road in Khurda Road - Puri section of Khurda Road Division.	83,39,700/-	1,66,790/-	5000/-

The last date and time of issue of tender form : Upto 12.00 hrs of 04.07.2011
The last date and time of receipt of tenders : Upto 15.00 hrs of 04.07.2011
The date and time of opening of tenders : At 15.00 hrs. of 06.07.2011

Tender forms available at : Office of the Assistant Divisional Engineers (a) Jajpur Keonjhar Road, (b) Cuttack, (c) Brahmapur (d) Bhubaneswar and (e) Div. Rly. Manager (Engg)/Khurda Road on any working day. The tender documents also available in the website at www.eastcoastrail.indianrailways.gov.in or <http://tenders.gov.in> during the period from 26.06.2011 to 04.07.2011.

Complete details available at : Website www.eastcoastrail.indianrailways.gov.in or <http://tenders.gov.in> in case of any discrepancy between the tender documents downloaded from internet and the master copy of the same is available in the office. The later shall prevail and will be binding on the Tenderers (s). No claim on the account will be entertained.
Divisional Railway Manager (Engg.), Khurda Road

PR-765-D SERVING CUSTOMERS WITH A SMILE