

Job Opportunities in Energy: Comment to an Energy Group

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From: Tom Bearden
Sent: Friday, August 20, 2010 5:30 PM
To: 'reply-109595@mail.accessintelemail.com '
Subject: Re: Job opportunities in energy

Dear Energy Job Center:

I notice the severe absences of some essential and highly critical jobs! The present jobs you offer, and the type persons sought, and their lack of vital background knowledge, doom us to continue the deliberately muzzled and crippled old 1892 electrical engineering model. That sad old model, still used today by all our electrical power engineers, was *deliberately mutilated and limited in 1892* so that all electrical engineers would always build only EM systems that destroy the free-energy action of their source dipoles (their action of freely extracting EM energy from the seething vacuum that is due to their proven broken symmetry). Thus to continue using only that crippled old model is directly responsible for the world energy crisis today, and it always has been, since the very beginning of electrical engineering itself.

1. There's no job whose applicant will be rigorously examining Lorentz's direct symmetrization of the Heaviside equations in 1892, at the direct elicitation of J. P. Morgan. As a result of that little move, the just-being-born electrical engineering model was deliberately crippled so that it would only design and build SYMMETRICAL EM power systems -- those which always have COP<1.0. Hence every electrical engineer ever educated -- from the very birth of EE itself -- has only been taught to think, plan, and build the extraordinarily limited type of Maxwellian EM system that *deliberately self-enforces symmetry*. I.e., the EE can only design and build a system that deliberately uses half its collected EM energy -- collected freely from the seething virtual state vacuum via the proven (since 1957) broken symmetry of the source dipole -- to *destroy its own source dipole* and thus *continually destroy the free flow of EM energy extracted from the vacuum by the asymmetry of the source dipole*. The remaining half of the symmetrical EE system's collected EM energy-from-the-vacuum (EFTV) is used to power the loads and losses in the external circuit. Since there are always some losses in that external circuit, that horribly stupid self-symmetrizing EE system will always use more power to destroy its free supply of EFTV faster than it powers its load.

2. There's no job whose applicant will be rigorously studying the *12 total falsities included in the modern electrical engineering model*, much less then correcting them. Instead, all the jobs are still using that horribly mangled and mutilated old 1892 Heaviside-Lorentz symmetrical model. Gad! The spirit of that supremely ruthless J. P. Morgan is undoubtedly looking down at you and is very, very proud of you for your superb dedication to continuing to enforce what he brutally implemented and inflicted on all electrical engineers that the world has produced since EE itself was born.

3. There's no job whose applicant will be studying and correcting the extraordinarily serious electrical engineering error that teaches that cranking the shaft of the generator is what inputs the energy that eventually powers the system load. What a piece of utter

junk! Our EE's are still not taught what actually powers an electrical system. Let us explain: (a) Cranking the shaft of the generator inputs MECHANICAL ENERGY to the system. Thanks to Nikola Tesla's invention of using the rotating magnetic field, that input MECHANICAL energy is then transduced into ROTATING MAGNETIC FIELD energy inside the generator. Well, something else not taught to EEs -- and apparently still unknown to you -- is that "work" is rigorously the CHANGE OF FORM OF ENERGY. And when its form is changed from Form 1 to Form 2, that constitutes work -- and if one then does not allow the energy in the new form to be DISSIPATED FROM THE SYSTEM, one still has all the same amount of energy in the system that he started with before he did that work! So one can input 100 joules of mechanical energy and have it changed to 100 joules of energy in rotating magnetic field energy form -- thus doing 100 joules of work -- and one will STILL HAVE 100 joules of EM energy (in the form of rotating magnetic field energy) available for use in the system while also having just done 100 joules of work! There is absolutely no "conservation of work" law, but this is not taught to EEs. (2) Once the rotating magnetic field energy is formed and available, it is then utilized to force internal opposite charges apart and thus to reconstitute the source dipole that the silly symmetrical circuit is continually destroying! And ALL the input energy then escapes (is dissipated from) the system itself, and so that is the end of it system-wise (it is still there, but out of the system and no longer available). (3) So the EE always builds a very inane symmetrical system that continually requires him to input mechanical energy to the shaft of the generator -- not to power the system load, but to RESTORE THE INTERNAL DIPOLE INSIDE THE GENERATOR that the stupid "energized" system itself keeps destroying faster than it powers the load!

4. There's no job whose applicant will be examining the fact that much higher AND MUCH BETTER higher group symmetry electrodynamics models are already present in physics, and that are ASYMMETRICAL rather than symmetrical. This includes Maxwell's original theory of 20 quaternion-like equations in 20 unknowns -- which is not studied by our electrical engineers, most of whom have never even read and examined Maxwell's actual theory. Yet all our EEs believe -- and are taught -- that they study and apply "Maxwell's theory" when they study and apply the Lorentz-mutilated Heaviside vector model. Incidentally, Lorentz was a great scientist, but he was also fond of taking other scientists' work and publishing it as his own, and taking credit for it. He did that with his "correction" of the Heaviside model. He actually took previous work of Lorenz (without the "t") that had already symmetrized the Heaviside equations, and published it as his own, taking credit for it. For some "whistle-blowing" on this sort of thing, see J. D. Jackson and L. B. Okun, "Historical roots of gauge invariance," Reviews of Modern Physics, Vol. 73, July 2001, p. 663-680. Discusses roots and history of gauge invariance, verifies that Ludwig Lorenz (without the "t") first symmetrically regauged Maxwell's equations, although it has been misattributed to H. A. Lorentz (with the "t") as being first. This is an excellent coverage of the history of who did what and when, and who got credit for it.

5. There's no job whose applicant will be re-examining symmetrical COP>1.0 EM circuits already known and discovered by Tesla as early as 1890, when Tesla -- the genius PHYSICIST who gave us AC power, the rotating magnetic field usage that makes modern motors and generators possible, and radio -- was already briefing technical societies that one need not consume fuel at all in order to get all the electrical power one wishes, right from the "active medium" itself. Was Tesla thus an absolute fool? The answer is a resounding "No!" E.g., the desired job applicant would be re-examining Tesla's actual patented circuits circa 1890, and he would be discovering that Tesla

already had exactly what that type of asymmetric COP>1.0 systems invented. For the rigorous proof, this applicant would be reading said rigorous proof by the world-known T. W. Barrett. E.g., see T. W. Barrett, , "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," Annales de la Fondation Louis de Broglie, 16(1), 1991, p. 23-41. Barrett -- one of the co-founders of ultrawideband radar -- shows that EM expressed in quaternions (which is thus very close to Maxwell's original theory) allows shuttling and storage of potentials in circuits, and also allows additional EM functioning of a circuit that a conventional EM analysis cannot reveal. He shows that Tesla's patented circuits did exactly this. [Paper is carried on the cheniere.org website at internet link <http://www.cheniere.org/references/TeslaOSC.pdf> .].

6. So it is very sad, but you are not seeking any job applicants that would UNDO and CORRECT the terrible mutilation and crippling of the electrical engineering model just before it was born and adopted in our universities to teach the new "electrical engineering". So you are not seeking any job applicants who would be immediately examining and discovering the single and real reason for the world energy crisis! Instead, sadly you are only seeking job applicants who will be saying "What errors in our EE model? Why, our EE model is perfect -- your TV set works, doesn't it?" And yes, my TV set works, as long as I stupidly have to keep paying for the power company to keep inputting EM energy to dissipate in my TV set as work accomplished to RESTORE THE INTERNAL SOURCE DIPOLES that the stupid set itself keeps deliberately destroying!

7. And also, there's no job whose applicant will be re-examining how much EM energy actually already flows from a standard EE circuit or system. That is, he will continue to consider (and look at and be taught and teach) only the very tiny linear Poynting EM energy flow out of the generator terminals and along the external circuit's conduction lines, to be diverged into the wires to interact with the electrons and "power up the circuit". That interaction forms the on-going force fields. These "force fields" DO NOT exist in empty space like the EE is erroneously taught! Instead, only the potentials and their changes exist in "empty" space free of mass. Mass is a COMPONENT of force, via the little equation $F = d/dt(mv)$. Simply substitute $m = 0$, as it is in mass-free space, and you will see that $F = 0$. The force fields are **ONGOING** interactions between changes in spatial potentials and the charged masses of the circuit -- the electrons in specific. As the eminent Nobelist Feynman pointed out:

"...in dealing with force the tacit assumption is always made that the force is equal to zero unless some physical body is present... One of the most important characteristics of force is that it has a material origin..." [Richard P. Feynman, Robert B. Leighton, and Matthew Sands, The Feynman Lectures on Physics, Addison-Wesley, Reading, MA, Vol. 1, 1964, p. 12-2].

Feynman also stated:

"One of the most important characteristics of force is that it has a material origin, and this is not just a definition. ... If you insist upon a precise definition of force, you will never get it!" [Richard P. Feynman, Robert B. Leighton, and Matthew Sands, The Feynman Lectures on Physics, Addison-Wesley, Reading, MA, Vol. 1, 1964, p. 12-2].

And as even the eminent classical electrodynamicist Jackson admitted in summing up the situation:

"Most classical electrodynamicists continue to adhere to the notion that the EM force field exists as such in the vacuum, but do admit that physically measurable quantities such as force somehow involve the product of charge and field." [J. D. Jackson, Classical Electrodynamics, Second Edition, Wiley, 1975, p. 249].

See also Oliver Heaviside, Electrical Papers, Vol. 2, 1887, p. 94. Quoting:

"It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire.... Prof. Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. The[ir] departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire." [Note that Heaviside emphasizes the very slight amount of the flowing energy that gets converged into the wire (by the slight departure from perpendicularity). He also corrects Poynting's assumption that the entire energy flow outside the wire is nearly vertical – the assumption is wrong by a factor of almost 90 degrees, but this is very gently pointed out by Heaviside.]

To see how Lorentz arbitrarily discarded the Heaviside giant curled EM energy flow from all our books, see H. A. Lorentz, Vorlesungen über Theoretische Physik an der Universität Leiden, Vol. V, Die Maxwellsche Theorie (1900-1902), Akademische Verlagsgesellschaft M.B.H., Leipzig, 1931, "Die Energie im elektromagnetischen Feld," p. 179-186. Figure 25 on p. 185 shows the Lorentz concept of integrating the energy flow vector around a closed cylindrical surface surrounding a volumetric element. This is the procedure which arbitrarily selects only a small diverged component of the energy flow associated with a circuit—specifically, the small Poynting component being diverged into the circuit to power it—and then treats that tiny component as the "entire" energy flow. Thereby Lorentz arbitrarily discarded all the extra Heaviside circuitual energy transport component which is usually not diverged into the circuit conductors at all, does not interact with anything locally, and is just wasted.

8. Sadly, there is no job whose applicant will be examining some of the TOTALLY NEGLECTED aspects in EM energy flow that have been rather totally suppressed from electrical engineering. E.g., consider the question of how much EM energy is actually poured out of the terminals of the dipolar generator: The Poynting DIVERGED component (that we are taught and use) is only a very tiny fraction of the EM energy that is actually outpouring and that is extracted from the seething virtual vacuum by the asymmetry of the source dipoles. Astoundingly, more than a trillion times as much energy as is in the little Poynting DIVERGED energy flow is pouring from the terminals in the form of the gigantic Heaviside EM energy flow in CURLED form. Again, in 1900 the same nefarious J. P. Morgan had the same nefarious Lorentz teach all our electrical engineers a cute little trick to just get rid of that bothersome giant curled Heaviside EM energy flow component. He reached up in the air and originated the idea that one must first integrate the energy flow vector (containing both the small diverged Poynting

component and the huge nondiverged Heaviside curled component) around a closed surface that one just ASSUMES around any volume element of interest. That neatly AND ARBITRARILY discards the nondiverged giant curled Heaviside EM energy flow component, while retaining the relatively tiny linear and thus diverged Poynting energy flow component.

So no electrical engineer has been taught -- or even knows or believes -- that his generators already pour out trillions of times more EM energy than he measures or catches and uses.

9. And sadly, there is no job whose applicant will re-examine that Lorentz closed surface integration in the presence of a GENERAL RELATIVISTIC (GR) situation. In a GR situation, the divergence of the curl is not necessarily zero! Hence some of that freely available giant Heaviside curled EM energy flow component CAN BE DIVERGED AFTER ALL, AND USED TO HELP POWER OUR LOADS! The proof has been in optical physics since 1967, and it is severely hidden in the "negative resonance absorption of the medium" situation. There the COP (of the standard circuits used to do the lab tests in our large universities every year) is not mentioned nor is it allowed to be mentioned, since COP = 18. Neither is the term "excess emission" allowed, but instead the physicists are forced to use the term NEGATIVE ABSORPTION. Hence none of our EEs are even aware of that situation, and none is aware that it could be used to SET UP SELF-POWERING STEAM BOILERS IN OUR PRESENT ELECTRICAL POWER GRID AND DISTRIBUTION SYSTEM. In short, we could be actively getting rid of most all the coal burning, oil burning, gas burning, etc. electrical power plants, and power everything off self-powering steam boilers. But sadly, none of our EEs are aware of it, and you are also unaware of it and thus you have no one even studying the real energy crisis with a methodology capable of solving it.

10. Finally, there is no job whose applicant has to realize that the law of conservation of energy and momentum holds only in a SPECIAL RELATIVITY (single frame) situation. In a general relativity situation with multiple frames, that law can be modified and violated at will! E.g., shortly after the publication of Einstein's general relativity, this was rigorously noted by the great mathematician Hilbert. Quoting:

"I assert... that for the general theory of relativity, i.e., in the case of general invariance of the Hamiltonian function, energy equations... corresponding to the energy equations in orthogonally invariant theories do not exist at all. I could even take this circumstance as the characteristic feature of the general theory of relativity." [D. Hilbert, Gottingen Nachrichten, Vol. 4, 1917, p. 21.].

Quoting Logunov and Loskutov:

"In formulating the equivalence principle, Einstein actually abandoned the idea of the gravitational field as a Faraday-Maxwell field, and this is reflected in the pseudotensorial characterization of the gravitational field that he introduced. Hilbert was the first to draw attention to the consequences of this. ... Unfortunately, ... Hilbert was evidently not understood by his contemporaries, since neither Einstein himself nor other physicists recognized the fact that in general relativity conservation laws for energy, momentum, and angular momentum are in principle impossible." [A. A. Logunov and Yu. M.

Loskutov, "Nonuniqueness of the predictions of the general theory of relativity," Sov. J. Part. Nucl., 18(3), May-June 1987, p. 179].

In the West, however, eminent scientists DO understand that conservation of energy is not an iron-clad law that must always hold. E.g., quoting Sir Roger Penrose:

"We seem to have lost those most crucial conservation laws of physics, the laws of conservation of energy and momentum!" [Penrose then adds the Killing symmetry arbitrarily, to get conservation again, when the Killing vector applies and gravity is separated.]. *"These conservation laws hold only in a spacetime for which there is the appropriate symmetry, given by the Killing vector κ [These consider at ions] do not really help us in understanding what the fate of the conservation laws will be when gravity itself becomes an active player. We still have not regained our missing conservation laws of energy and momentum, when gravity enters the picture. ... This awkward-seeming fact has, since the early days of general relativity, evoked some of the strongest objections to that theory, and reasons for unease with it, as expressed by numerous physicists over the years. ... in fact Einstein's theory takes account of energy-momentum conservation in a rather sophisticated way – at least in those circumstances where such a conservation law is most needed. ...Whatever energy there is in the gravitational field itself is to be excluded from having any representation..."* [Roger Penrose, The Road to Reality, Alfred A. Knopf, New York, 2005, p. 457-458.]

Comment: This "solution" accepted by many general relativists is to just arbitrarily toss out the gravity and gravitational energy density of spacetime in a given troublesome case, and the problem of nonconservation of energy and momentum then vanishes. In short, separate the spacetime itself from the fields, and there is no problem! However, **simply avoiding the problem itself is not solving the problem!** Considering the neglected and unaccounted giant Heaviside energy flow always accompanying every Poynting EM energy flow, the gravity effect is always at least of importance, and this "solution" itself is in general nearly always untenable.

The optical physics work referred to (i.e., negative resonance absorption of the medium) already uses a GR situation and multiple rotating and synchronized frames to violate the special relativity law of conservation of energy, hence those optical experiments output some 18 times as much energy as we input.

To see the optical experiments etc. that indeed accomplish this GR violation of the conservation of EM energy, see the following:

Craig F. Bohren, "How can a particle absorb more than the light incident on it?" American Journal of Physics, 51(4), Apr. 1983, p. 323-327. Under nonlinear conditions, a particle can absorb more energy than is in the light incident on it. Metallic particles at ultraviolet frequencies are one class of such particles and insulating particles at infrared frequencies are another.

See also H. Paul and R. Fischer, {Comment on "How can a particle absorb more than the light incident on it?}," Am. J. Phys., 51(4), Apr. 1983, p. 327. The Bohren experiment is repeatable and produces COP = 18.

V. S. Letokhov, "Laser Maxwell's Demon," Contemporary Physics, 36(4), 1995, p. 235-243. Considers a Maxwell's demon based on the use of selective interaction

between laser light and atomic particles, including two versions (destructive and nondestructive) of the demon. The destructive version is based on the velocity- and particle-selective resonant ionization of particles in the near field of laser radiation. The non-destructive version is based on the dipole (gradient) light pressure force in near-field radiation effects.

V. S. Letokhov, "Generation of light by a scattering medium with negative resonance absorption," Zh. Eksp. Teor. Fiz., Vol. 53, 1967, p. 1442.

V.S. Letokhov, "Generation of light by a scattering medium with negative resonance absorption," Sov. Phys. JETP, 26(4), Apr. 1968, p. 835-839.

V. S. Letokhov, "Stimulated emission of an ensemble of scattering particles with negative absorption," ZhETF Plasma, 5(8), Apr. 15, 1967, p. 262-265.

V. S. Letokhov, "Double g and optical resonance," Physics Letters A, Vol. 43, 1973, p. 179-180.

Alekseev, A. V.; Zinin, Yu. A.; Sushilov, N. V. "Effect of negative resonance absorption in a weak polychromatic field," Optics and Spectroscopy, Volume 69, Issue 6, December 1990, pp.736-739. (To be obtained and digested, with quotes and abstract).

Mandel, P. Contemporary Physics, Vol. 34, 1993, p. 327. On negative absorption (to be obtained and digested, with quotes and abstracts.)

Kocharovskaya, O. Phys. Reports, Vol. 219, 1992, p. 175. On negative absorption (to be obtained and digested, with quotes and abstracts).

Anyway, gentlemen, I hope you will indeed read this letter to you, and bring in some highly qualified physicists to see the truth of what is presented.

The world energy crisis can be completely solved -- cheaply, cleanly, and quickly -- whenever we will recognize it as a true PHYSICS problem, and not an ELECTRICAL ENGINEERING problem.

First you have to recognize that electrical engineering -- from its very birth -- has been deliberately mutilated and crippled so that our struggling electrical engineers WOULD BE RESPONSIBLE for the world energy crisis and FOR MAINTAINING IT. We have presented something diabolical that has been DONE TO them! It is not the fault of the engineers themselves, but it is the fault of the entire energy and scientific apparatus that continues to sustain such a horribly crippled old 1892 EM model.

Indeed, you can power an electric car, e.g., from a relatively small battery that only furnishes "static voltage" (correction: electrostatic scalar potential, which is a steady flow of real EM energy photons from the vacuum, and is no more static than a "static" waterfall formed by the steady flow of water molecules through that form. Tesla's 1930s electric car was powered in this fashion. If you wish to know how to do it, I will be happy to communicate the process to you.

And finally, the fact that one can build real EM systems that take excess energy directly from the seething virtual state vacuum has been resoundingly proven -- including experimentally -- by Klimov et al. It has also been rigorously validated by two great national laboratories, the Los Alamos National Laboratory and the National Renewable Energy Laboratory. It is published in leading physics journals and nanocrystalline journals, and has been rigorously and scientifically proven forever. Klimov's work produces systems having COP = 2.0 to 7.0 in the published literature.

A microscopic solar cell, when struck by a proper photon, emits an electron which immediately dives into the virtual vacuum sea, takes on additional energy, and emerges as a highly excited entity which decays to produce from two to seven electrons. Thus the special nanocrystalline solar cell emits 200% to 700% more electron energy than the normal solar cell's photoelectric effect. This effect, validated at both Los Alamos National Laboratory and the National Renewable Energy Laboratory, rigorously proves and demonstrates that real physical systems can be built which directly extract and use excess EM energy from their surrounding active virtual state vacuum.

Here are some references:

Victor Klimov in Los Alamos National Laboratory in New Mexico has constructed a solar cell which can absorb the light of a specific wave length in such a way, that one photon can energize more than one electron. As soon as the electron absorbs a photon, it disappears for a very short moment into the quantum field. Being in the virtual state the electron can borrow energy from the vacuum and thereafter appears again in our reality. Now the electron can energize up to 7 other electrons. This leads to a theoretical coefficient of performance (COP) of 700%. A COP = 200% can be readily achieved and it has been. The experiment has also been replicated successfully by the National Renewable Energy Laboratory in Golden Colorado. [Herb Brody, "Solar Power - Seriously Souped Up." New Scientist, May 27, 2006, p 45].

Quoting: "*Make solar cells as small as a molecule; and you get more than you bargained for. Could this be the route to limitless clean power?*".

Comment by T.E.B.: Note that the super-excited electron, after emerging from the seething virtual state vacuum immersion, actually splits into two or more electrons! So the output current of the solar cell process is *freely* amplified by excess energy from the local virtual state vacuum. Note that at about COP = 3.0, one could conceivably add clamped positive feedback of one of those output electrons back to the "dive back into the seething virtual state vacuum" input, replacing the original electron input, and the unit would be "self-powering" (powered by energy from the vacuum) while putting out the other two electrons as output.

Or by using some of the output current in a radiation-producing process, one could have the positive feedback input as a radiation photon, to replace the initial solar input entirely. In this fashion, once "jump started" by some source of solar radiation, the resulting "solar panel" system would become totally self-powering, taking all its input and output energy directly from the seething vacuum itself

Additional references; Richard D. Schaller, Vladimir M. Agranovich and Victor I. Klimov; "High-efficiency carrier multiplication through direct photogeneration of multi-excitons via virtual single-exciton states." Nature Physics Vol. 1, 2005, pp. 189-194.

Richard D. Schaller, Melissa A. Petruska, and Victor I. Klimov; "Effect of electronic structure on carrier multiplication efficiency: Comparative study of PbSe and CdSe nanocrystals"; Appl. Phys. Lett. Vol. 87, 2005, 253102.

Richard D. Schaller, Milan Sykora, Jeffrey M. Pietryga, and Victor I. Klimov, "Seven Excitons at a Cost of One: Redefining the Limits for Conversion Efficiency of Photons into Charge Carriers," Nano Lett. Vol. 6, 2006, p. 424.

Victor I. Klimov, "Spectral and Dynamical Properties of Multiexcitons in Semiconductor Nanocrystals," Annual Review of Physical Chemistry, Vol. 58, No. 1, 2007, p. 635.

M. C. Hanna, A. J. Nozik. "Solar conversion efficiency of photovoltaic and photoelectrolysis cells with carrier multiplication absorbers," Journal of Applied Physics, vol. 100, No. 7, 2006, p. 07450.

Sung Jin Kim, Won Jin Kim, Yudhisthira Sahoo, Alexander N. Cartwright, Paras N. Prasad, "Multiple exciton generation and electrical extraction from a PbSe quantum dot photoconductor," Applied Physics Letters, Vol. 92, No. 3, 2008, p. 031107.

Alberto Franceschetti, Yong Zhang, "Multiexciton Absorption and Multiple Exciton Generation in CdSe Quantum Dots," Physical Review Letters, Vol. 100, No. 13, 2008, p. 136805.

G. Allan, C. Delerue, "Role of impact ionization in multiple exciton generation in PbSe nanocrystals," Physical Review B, Vol. 73 (20), 2006, p. 205423.

Hsiang-Yu Chen, Michael K. F. Lo, Guanwen Yang, Harold G. Monbouquette, Yang Yang, "Nanoparticle-assisted high photoconductive gain in composites of polymer and fullerene," Nature Nanotechnology, Vol. 3 (9), 2008, p. 543.

M.C. Beard, R.J. Ellingson, "Multiple exciton generation in semiconductor nanocrystals: Toward efficient solar energy conversion," Laser & Photonics Review, Vol. 2, No. 5, 2008, p. 377.

Quoting: "Now Victor Klimov and colleagues at the Alamos National Laboratory have designed nanocrystals with cores and shells made from different semiconductor materials in such a way that electrons and holes are physically isolated from each other. The scientists said in such engineered nanocrystals, only one exciton per nanocrystal is required for optical amplification. That, they said, opens the door to practical use in laser applications." ["Scientists Create New Type of Nanocrystal," PHYSORG.COM, Nanotechnology, May 24, 2007.

Seo, Hye-won; Tu, Li-wei; Ho, Cheng-ying; Wang, Chang-kong; Lin, Yuan-ting. "Multi-Junction Solar Cell," United States Patent 20080178931, July 31, 2008. A photovoltaic device having multi-junction nanostructures deposited as a multi-layered thin film on a substrate. Preferably, the device is grown as $\text{In}_x\text{Ga}_{1-x}\text{N}$ multi-layered junctions with the gradient x , where x is any value in the range from zero to one. The nanostructures are preferably 5-500 nanometers and more preferably 10-20 nanometers in diameter. The values of x are selected so that the bandgap of each layer is varied from 0.7 eV to 3.4 eV to match as nearly as possible the solar energy spectrum of 0.4 eV-4 eV.

J. R. Minkel, "Brighter Prospects for Cheap Lasers in Rainbow Colors," Scientific American (website), May 25, 2007.

Quoting Klimov, Victor" "Carrier multiplication actually relies upon very strong interactions between electrons squeezed within the tiny volume of a nanoscale semiconductor particle. That is why it is the particle size, not its composition that mostly determines the efficiency of the effect. In nanosize crystals, strong electron-electron

interactions make a high-energy electron unstable. This electron only exists in its so-called 'virtual state' for an instant before rapidly transforming into a more stable state comprising two or more electrons." [Lead project scientist Victor Klimov, quoted in "Nanocrystals May Provide Boost for Solar Cells, Solar Hydrogen Production," Green Car Congress, 4 Oct., 2008.]

Very best wishes,

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