
• **LENR Presentation by Dennis Bushnell, Chief Scientist, NASA, Langley**

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Slide presentations from the LENR workshop at NASA Glenn Research Center reveal the growing interest at NASA on LENR technology. Dennis talks about the current state of LENR research, where NASA has a role, and how it can positively impact aeronautics across the board.

(This ecatplanet.net exclusive is part 1 of a series. The original ppt files can be downloaded here by registered users.)

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Dennis Bushnell, Chief Scientist, NASA, Langley.

Preliminaries

- Over 2 decades with over 100 experiments worldwide indicate LENR is real, much greater than Chemical, Transmutations, Minimal radiation
- Theories since 2006 indicate is probably weak interactions/ beta decay, NOT "Fusion"
- The many Rossi demonstrations in 2011 suggest LENR may produce "useful" quantities of heat [up to 15KW's ?]. Watts-to-Kilowatts also produced in Piantelli and Patterson Experiments

NASA Interest[s] in LENR

- Between Chemical and strong force Nuc Energy Densities with minimal radiation safety/ protection requirements/ issues, probably "inexpensive"
- Direct and potentially massively/ truly "game-changing" Applications across the board to NASA Mission Areas:
 - Science
 - Exploration
 - Aeronautics

Current LENR State of the Art

- 2 decades of experiments without theoretical guidance producing very low levels of energy
- The Rossi device, possibly producing useful energy but wholly "Edisonian", not "scalable" and not "Optimized"
- Zawodny et al work, first effort to utilize theory to optimize energy output
- Huge number of "knobs"/ approaches appear to "work", issue is how good can it be? Requires experiments guided by theory and major "creative" efforts/ inputs along with CAREFUL Experiments, YEARS of effort required. Rossi is just the merest beginnings of the research/ engineering optimization required.

NASA Science LENR Applications

- Superb light weight power/ energy sources for space probes/ instruments and hoppers/ rovers, far less expensive than solar and better than radiologics for beyond Mars where solar does not "work"
- Reduced LEO (Low Earth Orbit) and in space propulsion weights/ costs
- Solves EDL (Entry, Descent, and Landing) for large payloads to Mars via ingestion, heating and retro injection of atmospheric CO₂

NASA Exploration LENR Applications

- Preliminary systems studies indicate LEO access rockets with Nuc Thermal Isp [~ 800 Seconds] sans the Nuc radiation protection weights/ safety issues
- On Planet Nuc power/ Energy without usual Nuc Radiation protection/ safety issues
- Potentially obviates order of 80% of the 1000 metric ton LEO up-mass for Humans Mars which is in-space fuel, Propulsive mass from far outer region atmosphere or regolith
- Source for energy beaming, energy to terraform Mars, Enables Active Space Radiation Protection

NASA Aeronautical LENR Applications

- Overall, enables what we have never had - "Energy Rich" design space[s]
- Fuel fraction becomes negligible, huge impacts upon vehicle gross weights, especially for SST's which are some 55% fuel fraction
- Use to replace combustors inn GTE's (Gas Turbine Engine's) or via Sterling or T-E's to generate electricity for electric propulsors
- Huge range increases
- Enables VTOL and PAVE both economical and QUIET
- Enables design for ultra low noise via degrading propulsor performance
- Mitigates sonic boom via focused energy projected far forward to reduce shock strength, "lengthen" vehicle virtually
- Makes SST's affordable via huge gross weight reductions, reduces sonic boom, enables emission compliance
- "Solves" emissions except for NO_x, which can be mitigated via "design" or obviated if go electric
- Enables huge loiter capability for "sensor craft" [military, climate/ science, law enforcement, HALE Sat substitutes, etc.]
- Reduces both acquisition and operational costs
- Enables envelope-less flight via active flow control, "Bird Like Flight", ALL-WEATHER
- Provides huge margins to enable superb safety [Armored engine surrounds, triply redundant Faraday caged Electronics, Etc..]
- Allows direct control of wake vortices to obviate wake vortex hazard
- Super STOL performance via circulation/ flow control to increase runway productivity by a factor of 3

- Overall, For Aero "" far lower gross weights, higher speeds, lower noise, greater range, emissions solved, envelope-less/all weather superb ride quality flight, lower costs, greater safety
- Possibly obviates THE issue with hypervelocity air-breathing, the decreasing value-added from burning H2 fuel as a function of increasing vehicle kinetic energy
- For the military– EMP on steroids, VTOL obviates air bases/ runways/ carrier decks, enables loitering combined sensor/ weapon devices [instead of getting there in time ARE THERE, always]

In Short, LENR , depending upon the TBD performance, appears to be capable of Revolutionizing Aerospace across the board. No other single technology even comes close to the potential impacts of LENR upon Agency Missions.

Comments on LENR Going Forward

- Test/ determine the performance of the Rossi and Piantelli devices
- Experimentally validate the weak interaction theories
- Utilize theory to design/ create and experimentally optimize performance, including surface morphology considerations/ opportunities and bootstrapping
- Summarize/ rackup the myriad approaches throughout the entire system/ sequence that appear to work [e.g. the 5 or so methods of adding energy].
- The 2 decades of experiments and the weak interaction theories have removed the existential risk, what is remaining is to ENGINEER for improved performance. Also obviously all the safety issues, labs have blown up studying this arena
- SO - Invent/ create optimized/ improved LENR "Devices", testing "Rossi" is merely a small first step, do the systems and propulsive/other application R&D
- BTW LENR [also] solves Global Climate and Energy

We went directly from Chemical to strong force Nuc and in the process bought huge energetics improvements and radiation protection/ safety issues that precluded fission nuc application[s], We leapt over the weak interaction energetics landscape except for radiologics. It is time to back-track.