

# NASA and LENR

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## “Preliminaries”

- Over 2 decades with over 100 experiments worldwide indicate LENR is real, much greater than Chemical, Transmutations, Minimal radiation
- Theories since '06 indicate is probably weak interactions/ beta decay, NOT “Fusion”
- The many Rossi demonstrations in '11 suggest LENR may produce “useful” quantities of heat [up to 15KWs ?]..... 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 SOA

- 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 and in space propulsion weights/ costs
- Solves EDL for large payloads to Mars via ingestion, heating and retro injection of atmospheric CO<sub>2</sub>

# 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 in GTE’s or via Sterling or T-E’s to generate electricity for electric propulsors

## Aeronautical Applications Continued

- 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

## Aeronautical Applications Continued

- Makes SST's affordable via huge gross weight reductions, reduces sonic boom, enables emission compliance
- "Solves" emissions except for NO<sub>x</sub>, 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.

## Aeronautical Applications Continued

- 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..]

## Aeronautical Applications Continued

- 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

## Aeronautical Applications Continued

- Possibly obviates THE issue with hypervelocity air-breathing, the decreasing value-added from burning H<sub>2</sub> 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].

## Comments Continued.....

- 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.....