2012-2013 EUSpEC
Devin Jacobson

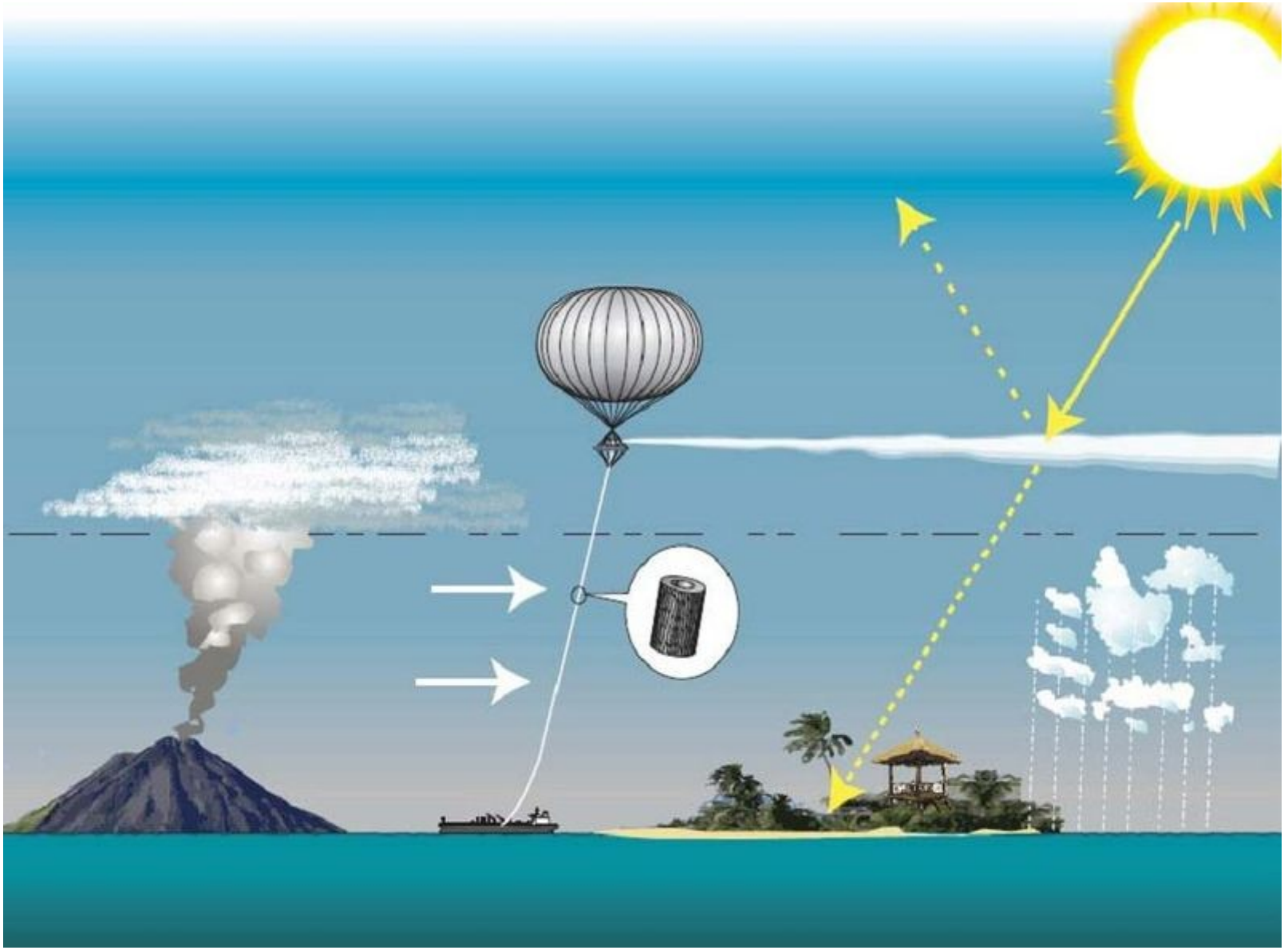
- JSETEC International participation
- EUSpEC competition
- EUSpEC Presentations
- International Competition Status

JSETEC International participation

- SPICE introduction

  Delivery Systems: Engineers from the University of Cambridge and Marshall Aerospace will test the feasibility and design of using a tethered-balloon to inject particles into the stratosphere. They will be using the data obtained from the test-bed project in computer models to examine how a full-scale system might work at an altitude of 20km.

SPICE Project



JSETEC International participation

- Cambridge University SPICE research project
  - 2 members of the experimental tether design team participated
  - Studying and verifying system vibration models for tethered balloon
  - Used master thesis image analysis software to verify models
  - Shared detailed weather data for the competition site for 2 days

JSETEC International participation

- No international climber teams in 2012
- Hopefully we will be able to get some more international team participation (also from Asia) in 2013/2014

EUSpEC Competition details

- Scoring:
  - Potential Energy vs Consumed Energy
    mass * gravity * height / (Energy used)
  - Payload ratio:
    Mass Payload / Mass total
  - These are both Primary reasons for considering Space Elevator over Rockets


WARP
SPACE ELEVATOR
TEAM
HFT

EUSpEC Competition details

- Participant Handbook (Pg 7-9)
- Considerations and Results Ein_Bericht.pdf

  (Pg 4 specs, Pg 5 formula calcs, Results Pg 11)

EUSpEC Competition Highlights
OOPS

EUSpEC Competition Highlights

- **The energy efficiency of several climbers was above 90%.**
- Regarding the load factor still much room for improvement.
  On average the climbers carried 10% of their own weight as payload.

Prizes

- Technology Award 2012 - Aoki Lab B
- Innovation Award 2012 - Irie Lab
  - Noted Innovative Structural body design

- 2011 Innovation Award – Egami Laboratory
  - Noted dynamic adjustment based on slip feedback

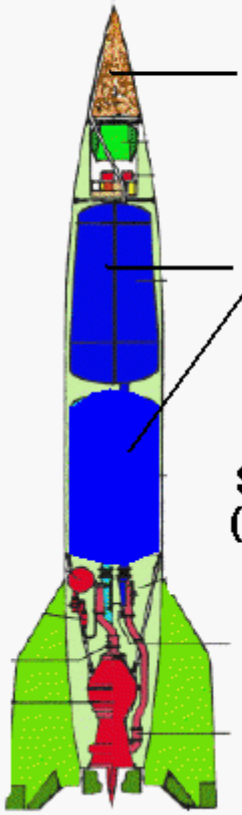

Project Paper

Energy Efficiency
(*random sources/studies found on web)

- Rockets – Mostly propellant so even if 0% loss still effectively only 20% or less efficient.
  - Obviously there is Engine loss
- Space Elevator? Too Many unknowns
  - with/without Laser Delivery system?
- Cars (Combustion Engine) – 15-30% *
  - Currently > 50% Engine loss
- Current High-speed Trains/Rail system – 80% *
- Electric Car drive train - 90% *
- Electric Transformers – 98% *

Payload Ratios

Mass Ratios



Empty Mass = me = md + ms

Full Mass = mf = md + ms + mp

mf = me + mp

Propellant Mass Ratio = $MR = \frac{mf}{me}$

$MR = 1 + \frac{mp}{me}$

Payload Ratio = $\lambda = \frac{md}{mf - md}$

$\lambda = \frac{md}{mp + ms}$

Structural Coefficient = $\varepsilon = \frac{ms}{mp + ms}$

$MR = \frac{1 + \lambda}{\varepsilon + \lambda}$

Payload Ratios
Rocket Technologies

- Assume an exhaust velocity of 4.5 km/s and a \ Delta v of 9.7 km/s for LEO
- Of Initial mass what percent must be propellant
  1 – e ^(-9.7/4.5) = 88.4%
- Liquid Propellant not feasible, but other methodologies may be. Unfortunately I need to study more
  VASIMR or Ion Thruster could look like this (50km/s exhaust velocity):
  1 – e ^(-9.7/50) = 18.3%
  In far future maybe this allows for a payload ratio of around 50% to LEO

Payload Ratios
Current Status

- Space Shuttle:
- fueled weight at liftoff: 1,708,500 kg
- dry weight at liftoff: 342,100 kg
- Given these numbers, the propellant mass fraction is \displaystyle 1-(342,100/1,708,500) = 0.7998. (80% propellant to LEO)
- Effective Payload ratio of Space Shuttle to only LEO:
  22,700 kg payload / 1,708,500 kg
  = 1.3% Payload Ratio

Payload Ratios
Current Status

- Ariane 5
  - fueled weight at liftoff: 777,000 kg
  - Payload to LEO: 16,000 kg
- Effective Payload ratio of Ariane 5 to only LEO:
  16,000 kg payload / 777,000 kg
  = 2.1% Payload Ratio

EUSpEC Notable presentations

- Andreas Hein Space Elevator Feasibility
  - Original Space Elevator baseline not realistic.
  - Only option is INSITU (Near Earth Object) tether production


JAHRE
RITTER
SPORT
GRUNDIG
DB Information
Coffee to go
Brioche Dorée

Upcoming Competitions and conferences

- Seattle, WA Tether competition and conference in US August 23-25 2013
  - Continue NASA Tether competition

    Zylon (PBO) 1340 kg/m^3, 5 GPa
  - Focus on Tether Climbers (perhaps benefit from some participation from JSEA)
- EUSpEC Muenchen Europe 2013
  - Dates unknown
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