Newton Small Space Telescope

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NPC
new production concept

SPACE MIND

Satellite Business Network
- Changing the focus
- Why a amateur space telescope?
- Project componentes
- Project evolution
- Technical risk analyses
Changing the focus

Space to Earth
Traditional focus of small satellite programs

Space to Space
A new frontier for small satellites
A marketing vision of Nano satellites

- Proof of concept
- Space Education
- Deep space missions
- Space to Space
- Late builders
- Business models

Telecom | Remote sensing | Constellations | Etc..
Why an amateur space telescope?

- Thousands of amateur astronomers in the world.
- They use limited tools as small telescopes and binoculars.
- More than 30 amateurs astronomers associations in major countries of the world.
Why an amateur space telescope?

Some exponents amateur astronomers

- George Alcock, discovered several comets and novae.
- Robert Owen Evans: record for visual discoveries of supernovae.
- David H. Levy: Discovered or co-discovered 22 comets.
We are in the Collaborative and sharing times
OSCAR Program, a benchmarking

- A community of engaged users (Radio Amateurs)
- Simple and creative technical solutions.
- Divided project in gradual steps (Phases).

Success, more than 70 OSCAR satellites launched in 54 years.
Newton Spacecraft overview

- 6U CubeSat structure
- COTS Design
- 3 axes, based in reaction wheel and star tracker technology.
- 95mm optical telescope
Newton Spacecraft overview

- Low-gain UHF antenna
- High-gain S band antenna
- 95mm telescope
- 300 mm focal length
- 200X magnification

- Solar panels
  - 900 cm²
  - 22.7 W.h (peak)

- 1.5 kbps up/downlink

- 375 kbps downlink
Project components

Spacecraft

Ground Station

IT Infrastructure

Users

Technological committee

Scientific committee
Program evolution

Phase I
- < 6kg
- Mirror diameter: 95mm

Phase II
- < 25kg
- Mirror diameter: 220mm

Phase III
- < 65kg
- Mirror diameter: 500mm
Program evolution

- The first step will have the duty to perform the mission and rise the interest and the contributors to the project

- Using a standard for the first mission is very important: in this case 6U cubesat

- 6U cubesat it is a good starting solution: lower development costs and increase the possibility of launch.
Program evolution

PRINCIPAL REQUIREMENTS FOR THE FEASIBILITY MISSION

- The system shall provide image from space (100% mission complete)
- The system shall provide information about the pointing attitude in order to determinate what is looking
- The system shall stabilize its attitude
- The system shall transmit image to the ground
- The system shall respect the IADC guidelines on space debris
Newton Spacecraft overview

- HD Camera
- Power Systems
  - Batteries
  - Solar Panels
- On board Computer
- S Band Transceiver
  - Flash Memory
  - Patch Antenna
- Attitude Control Systems
  - Sun Sensor
  - Star tracker
  - GPS Receiver
  - Gyroscopes
- Reaction Wheels

- HD CCD
- Auto focus servo
- Batteries
- Solar Panels
- Flash Memory
- Patch Antenna
Space Segment Description

- 6U Structure
- ADCS (Magnetorquer and momentum wheels, star tracker)
- Power System (solar panel and battery)
- Extension System for the optics (thermal cutter and spring)
- On Board Computer
- Data Link (Down link)
- De-orbiting system
Space Segment Description

Deorbiting System ARTICA:

- Plug and Plat Philosopy
- Stand alone philosophy (not depend from satellite)
- Easy Integration
Telescope:
- 95 mm primary mirror
- 300 mm focal length with 200X highest useful magnification (1.3 arc*sec resolving power)
- CCD servo Aligning system, check by laser
- Image fusion algorithms. This technique a sequence of photos is obtained (as a short movie) and the onboard computer selects the best framework of the photographed object
## Space Segment Description (Rough Budgets calculation)

### SPACECRAFT (launch excluded)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description/Function</th>
<th>Mass (g)</th>
<th>Power</th>
<th>Dimension</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>Aluminum</td>
<td>1000</td>
<td>/</td>
<td>200x100x300</td>
<td>10K</td>
</tr>
<tr>
<td>Telescope</td>
<td>Primary Payload</td>
<td>1500</td>
<td>1.54 W</td>
<td>100x100x300</td>
<td>TBC</td>
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<tr>
<td>ADCS</td>
<td>Air Coil Magnetorquer</td>
<td>2000</td>
<td>&lt;2 W</td>
<td>60x60x50 mm</td>
<td>50K</td>
</tr>
<tr>
<td></td>
<td>Reaction wheels, Star tracker</td>
<td></td>
<td>3 W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TX/RX</td>
<td>VHF /UHF /S-BAND</td>
<td>500</td>
<td>10 W</td>
<td>100x100x100 mm</td>
<td>20K</td>
</tr>
<tr>
<td>Thermal Control</td>
<td>Passive</td>
<td>/</td>
<td>/</td>
<td>-</td>
<td></td>
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<tr>
<td>OBC</td>
<td>Specific design</td>
<td>300</td>
<td>&lt;1 W</td>
<td>-100x100x100</td>
<td>TBC</td>
</tr>
<tr>
<td>Power System</td>
<td>Batteries Solar panels (4 side)</td>
<td>1000</td>
<td>2A@24V Battery 1A@5V</td>
<td>200x200x200 mm 300x300</td>
<td>TBC</td>
</tr>
<tr>
<td>Deorbiting Sys</td>
<td>Deorbiting passive sys</td>
<td>500g</td>
<td>StandAlone 25x200x100</td>
<td>NPC supply</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>&lt; 7 Kg</td>
<td>StandAlone 25x200x100</td>
<td>NPC supply</td>
<td>200k E TBC</td>
</tr>
</tbody>
</table>

### POWER SYSTEM

| Average Power  | < 2 W   |
| Peak Power     | < 12 W (during transmission) |
| Battery Pack   | 2A@24V ca 50W peak available power |
| Solar Panels   | 1A@5V  |
ORBIT:
- One ground station in the north (Kiruna)
- It needs to be almost 70°
- Possible download window: 4 access with average time for each of 200 sec (3.3 min)
- For each access we can expect about 1.5MB (350 kbps) (or many poor quality or less photos)
- More ground station = More photo = More quality
<table>
<thead>
<tr>
<th>RISK</th>
<th>GRADE</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCD Failure</td>
<td>HIGH</td>
<td>Space Heritage material</td>
</tr>
<tr>
<td>Attitude determination System Failure</td>
<td>MEDIUM</td>
<td>Space Heritage material and solar panel information</td>
</tr>
<tr>
<td>Attitude Control System Failure</td>
<td>MEDIUM</td>
<td>Magneto torque Stabilizations (very long)</td>
</tr>
<tr>
<td>Failure transmission Image</td>
<td>MEDIUM</td>
<td>Improve Ground station number</td>
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<tr>
<td>Deorbiting system not deploy</td>
<td>LOW</td>
<td>Locking system have ablative failsafe redundancy</td>
</tr>
</tbody>
</table>
Future steps and conclusion

FIND PARTNERS:
- Commercial Partner (even publicity partner)
- Technical Partner

FIND UTILIZATORS:
- Increase the Hype around the mission
- Increase the number of ground station (even build?)

MORE SATELLITE:
- Increase number of satellites
- Increase the dimension of the telescope

OUTREACH PROGRAMME