

# GNSS Retroreflector Activity

- **Background**

- ◆ Current arrays on GPS-35 and 36, and GIOVE-A based on back-coated corner cubes are inadequate in terms of data yield and daylight tracking
- ◆ Current array “effective cross-section” on GLONASS (about 5 time larger) is adequate but the array is very large and heavy

- **Developments**

- ◆ Chinese Navigation Satellite launched on April 13 carrying an array based on uncoated cubes offer promise of significant increase in efficiency (tests imminent)
- ◆ Arrays with hollow-cube (honeycomb) structure study and testing at GSFC offer promise of significant increase in efficiency and significant reduction in weight
- ◆ New climatic test facility at LNG in Frascati will test and compare difference options (LAGEOS Sector, Array identical to GPS-35 and -36, Hollow cubes)

# GNSS Retroreflector Activity

- **Array Recommendation**
  - ◆ ILRS has approve a “standard” for GNSS “effective cross-section” of 100 million sq. meters (5 times that of GPS-35 and -36)
  - ◆ Next step – request for GGOS approval
- **GPS III Series (2013 timeframe)**
  - ◆ Dialog continues with relevant agencies on the importance of including reflectors on GPS-III satellites

# PASS SEGMENTS for SEP-2005

| Station         | PAD  | WAVE | GPS35 | GPS36 | GLONASS87 | GLONASS89 | GLONASS95 | TOTAL |
|-----------------|------|------|-------|-------|-----------|-----------|-----------|-------|
| Maidanak        | 1864 | 5320 |       |       | 5         | 5         | 3         | 13    |
| Simeiz          | 1873 | 5320 |       |       | 1         | 4         |           | 5     |
| Riga            | 1884 | 5320 |       | 1     |           |           |           | 1     |
| Mcdonald Observ | 7080 | 5320 | 8     | 8     | 12        | 3         | 4         | 35    |
| Yarragadee      | 7090 | 5320 | 44    | 2     | 66        | 35        | 51        | 198   |
| Greenbelt       | 7105 | 5320 | 1     |       | 1         | 10        | 5         | 17    |
| Monument Peak   | 7110 | 5320 | 18    | 11    | 15        | 15        | 22        | 81    |
| Changchun       | 7237 | 5320 |       |       |           | 2         | 1         | 3     |
| Tanegashima     | 7358 | 5320 |       |       | 2         |           |           | 2     |
| Hartebeesthoek  | 7501 | 5320 |       |       | 17        | 41        |           | 58    |
| Zimmerwald      | 7810 | 4230 | 9     | 16    | 17        | 19        | 16        | 77    |
| Zimmerwald      | 7810 | 8460 | 7     | 13    | 16        | 20        | 15        | 71    |
| Mt Stromlo      | 7825 | 5320 | 3     |       | 8         | 11        | 7         | 29    |
| Riyadh          | 7832 | 5320 | 20    | 18    | 10        | 13        |           | 61    |
| Graz            | 7839 | 5320 | 6     | 7     | 13        | 10        | 7         | 43    |
| Herstmonceux    | 7840 | 5320 |       | 6     | 9         | 8         | 8         | 31    |
| Wettzell        | 8834 | 5320 | 4     | 3     | 15        | 11        | 17        | 50    |
|                 |      |      | 120   | 85    | 207       | 207       | 156       | 775   |

# Relative Signal Strength Normalized to LAGEOS

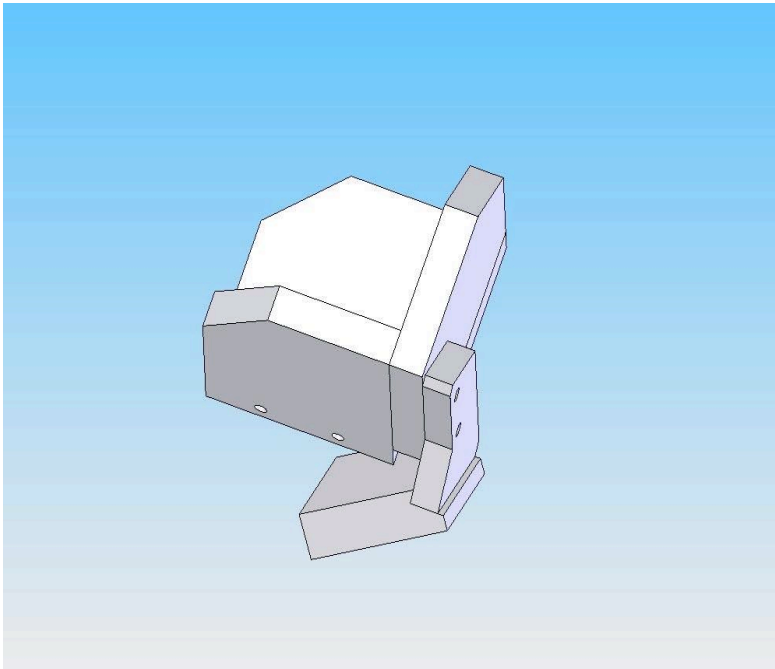
(Effective Cross-Section (ECS) are estimated from the array and cornercube specifications)

| Satellite            | Average Range<br>(in $10^3$ km.) | Eff. Cross<br>Section<br>(in $10^6$ m <sup>2</sup> ) | R**4<br>(in $10^{16}$ m <sup>2</sup> ) | Relative Signal<br>Strength<br>normalized to<br>LAGEOS |
|----------------------|----------------------------------|------------------------------------------------------|----------------------------------------|--------------------------------------------------------|
| LAGEOS               | 6 - 8                            | 7                                                    | 0.24                                   | 1                                                      |
| GLONASS              | 19 - 21                          | 76                                                   | 13.3                                   | 0.1                                                    |
| GPS 35/36            | 20 - 22                          | 19                                                   | 16.0                                   | 0.02                                                   |
| GIOVE-A<br>(Galileo) | 24-26                            | 45                                                   | 31.0                                   | 0.025                                                  |

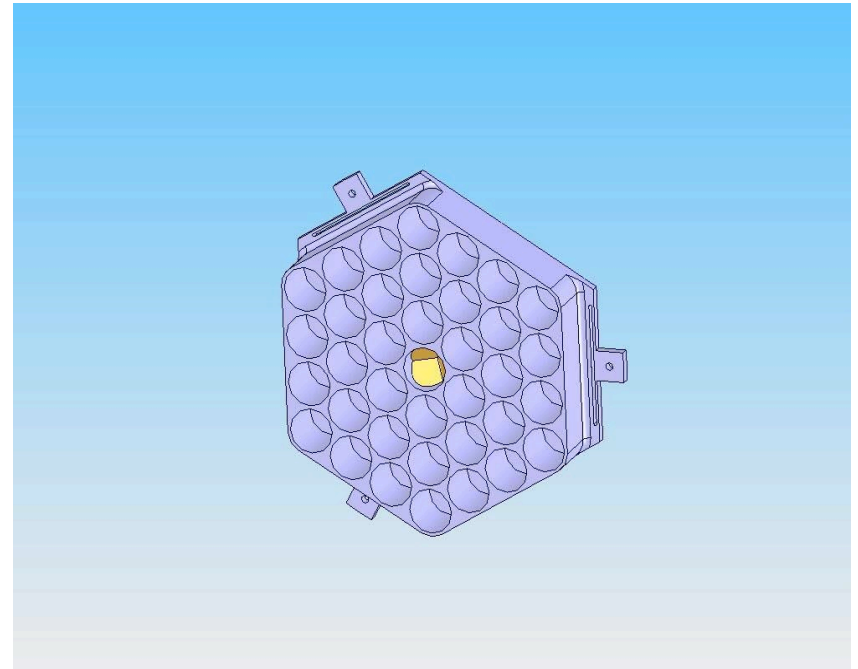
## Array Options for Effective Cross Section of 100 million sq. meters.

| Design                                  | # of cubes | Diameter of cubes (inch) | Approx. Area of the array (sq cm) | Approx. Mass of the arrays (Kg) |
|-----------------------------------------|------------|--------------------------|-----------------------------------|---------------------------------|
| <b>Solid - uncoated</b><br>(scaled ETS) | <b>50</b>  | <b>1.3</b>               | <b>847</b>                        | <b>2.3</b>                      |
| <b>Solid - coated</b><br>(scaled GPS)   | <b>160</b> | <b>1.06</b>              | <b>2300</b>                       | <b>6.4</b>                      |
| <b>Hollow</b><br>(calculation)          | <b>37</b>  | <b>1.4</b>               | <b>730</b>                        | <b>1.2</b>                      |

# Hollow Cube Array



Single hollow cube



Hollow cube array configuration