Antenna array (~10 x 6U cubesat) in space for space debris surveillance

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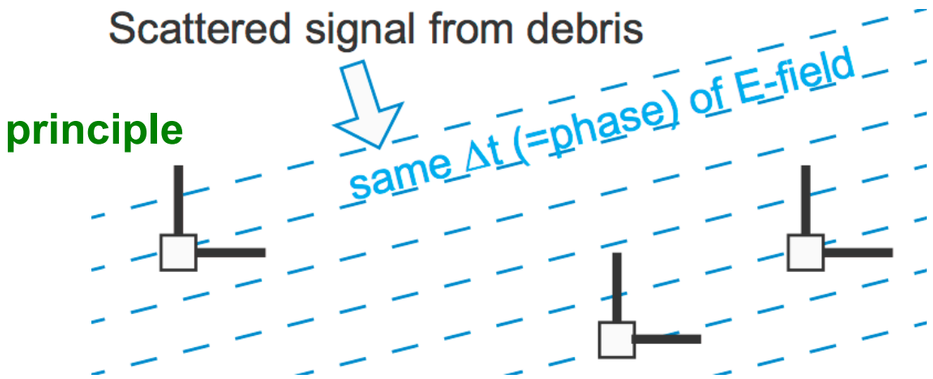
Space debris distribution is expanding to higher altitudes every year, making ground-based monitoring more difficult

⇒ Why not monitoring from the space? : We seek low cost method using **Swedish heritage**

⇒ **Making antenna arrays in space!**



- **Distance** is obtained **from Δt (transmission–receive)**
- **Direction** is obtained **from triangulation (intensity/timing difference *d(Δt)*** between spacecraft)

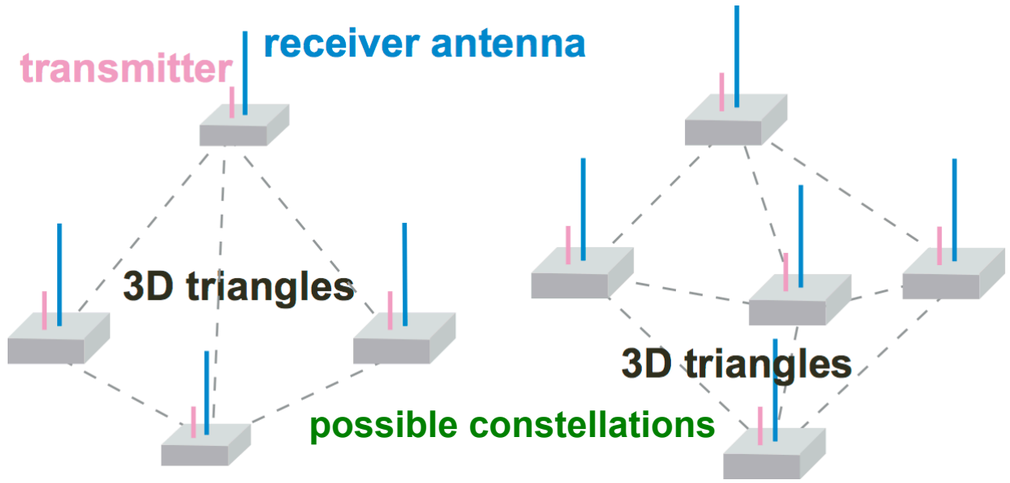
Idea: Construct an array of **antenna–equipped cubesats** at LEO (~ 1000 km altitude circular orbiting) by placing them ideal for triangulation even when the constellation is deformed by orbiting. With triangulation, the "space antenna array" can detect objects close to the satellites efficiently for sizes comparable to the radar wavelength (mm size).

Antennas: Each cubesat has **a receiver antenna**. For the **transmitter antenna**, we will compare (a) parabola method on one cubesat and (b) phase array method on all cubesats.

Constraint: To have enough transmission power with cubesat antenna, frequency must be **>100 GHz** (corresponds to <3 mm). For such a high frequency, we cannot use the phase array method for receiving signal (as is used for EISCAT_3D).

IRF: Expert of detecting "object" using multiple antenna.
KTH: Expert of making antenna and positioning parts of the cubesats,
LTU: Expert of building cubesats.
OHB-Sweden: Very fine inter-spacecraft control experience with PRISMA mission.

Test with one spacecraft (phase-1): We need to know how far we can detect objects with the transmission power on board.



Task after the test (phase-2) :
Make 4-10 identical cubesats with efficient antenna, sufficient transmission power, and high-precision positioning.
Keep the formation such that 3D triangulation is possible.
Develop the triangle analyses program for time-developing formation.

Cost/time: **15-30 MSEK/2-3 years** for one-spacecraft test (phase-1) + **25-60 MSEK/2-3 years** for array (phase 2) including cubesat, payload, launch, and analyses software.

Other merits: The result gives first-time estimation of the amount of mm size objects in the world, including the meteorite origin.

Note: Since the raw data contains defence-sensitive data, level-0 data should be stored at defence facility.