



PROPOSED JOINT U.S.-ITALIAN SPACE MISSIONS

UNISat 5 and UNISat 6



On March 10, 2011, the Space Science group at Morehead State University, the Sapienza group at the University of Rome, the Italian Space Agency and the European Space Agency met to discuss potential collaboration on two European-led microsatellite missions. The Europeans have graciously offered and we have agreed to collaborate on two large-scale and very exciting European-US missions-- UNISat 5 and UNISat 6. Each is briefly described below.

UNISat 5

UNISat 5 is a microsatellite (12 kg) that is manifested to fly on a Russian Dnepr in 2012. The launch vehicle and flight has been contracted and funded by the Italians (est. \$1,000,000 USD). The purpose of the meeting on March 10 was to identify a scientific payload and the primary mission for UNISat 5. I proposed a mission to measure the polarization of Gamma Ray Bursts, using the CZT array system we proposed (with UC Berkely) for the NASA PoIOSat mission. The detector is an advanced version of the X-Ray detector we will be flying in 2012 on the NASA Cosmic X-Ray Background NanoSatellite. The proposal was accepted. The primary payload on UNISat 5 will be the Morehead-UC Berkeley Gamma Ray experiment. Additionally we will fly 4 MRFODS (Morehead-Rome Femtosatellite deployers) that will launch Eagle-1 and Eagle-2, QubScout (Taksha University), and MRSat (Morehead-Rome Satellite) on this mission. In addition, the Europeans have asked us to collaborate on the spacecraft itself. We will design and build all of the communications systems while the Italians will build the attitude determination and control (ADCS), mechanical and bus systems. We will build the power systems together. To accomplish the design and fabrication efforts in this collaborative manner, the Italians will send more graduate students here and we will arrange an exchange program to send Space Science majors to the University of Rome for a semester or two to work on the ADCS systems.

UNISat 5 represents an incredible opportunity for us to collaborate on a new class of satellites (microsatellites rather than our typical picosatellites we have built). The science payload will likely cost \$200-300 K to develop. We will capitalize by developing NASA and NSF grants to fund the development. Kevin Brown will serve as the lead design engineer while I will serve as the US PI. Bob Twiggs, Jeff Kruth, Michael Combs, Bob Kroll, and Chantal Cappaletti will round out the engineering team on our end. UNISat 5 will launch in mid-2012 and will represent a next step in the evolution of our R&D program.

UNISat 6

UNISat 6 is an even more exciting and ambitious space mission. In early 2000, Filippo Graziani (Dean of the Sapienza Aerospace Engineering School University of Rome and astrodynamics expert) published a paper outlining the potential use of a Dnepr launch vehicle to place microsatellites in geostationary orbit (GEO) by sending them on a lunar fly-by trajectory, extracting energy from the Moon's gravity well and returning the payloads to GEO. At the meeting on March 10, it was agreed that UNISat 6 would attempt

this (pending approval by the Kosmotras Russian Space Corporation which has granted tentative approval). Estimated value of this mission contract (funded by the Italians) is ca. \$2,250,000 USD). Two microsattellites (20 kg each) would be built (as Morehead-Rome collaborations) one of which would be deployed during lunar apogee (to study aspects of the lunar system) and the second would be parked in GEO (and serve as an Earth observing satellite measuring global climate change, i.e. total integrated Earth albedo measurements based on our proposed Danjon satellite platform). While the specific science missions are TBD, the likely scenario is that both satellites would primarily be technology demonstrators. This mission, while high risk, would be extremely high profile. It would represent numerous benchmark achievements in space for universities (Morehead and Rome together), including:

- 1.) The first university space mission to achieve escape velocity for planet Earth\
- 2.) The first university space mission to reach the moon
- 3.) The first university satellite to reach GEO

A similar approach would be taken to manage UNISat 6 as implemented with UNISat 5, in terms of the engineering responsibilities of both groups and in terms of the Space Science Center management and design team. UNISat 6 will fly in late 2014.

Ground operations for UNISat 5 and UNISat would be shared between University of Rome and Morehead State University (utilizing the 21 M Space Tracking Antenna and the Italian Space Agency ground assets).

Summary

While UNISat 5 and UNISat 6 are ambitious missions, we believe we have the collaboration (given University of Rome's extensive experience in microsattellite design and operation) and the expertise of our team (given the team members' experience prior to coming to MSU and our rapidly expanding experience at MSU) necessary to accomplish these missions.

ITAR and Export controls and protocols are already in place to allow this international collaboration. The technical assistance agreement (TAA) that was approved by the US Department of State runs until 2021 and was written generically enough to account for these collaborative microsattellite programs.

While we plan to sign specific MOAs for each of the two missions, our partners at the University of Rome have asked us to embargo release of information regarding these projects outside of our team or administration until the final launch agreements are in place with the Russians.