



PLANETARY DEFENSE AIAA MINI CONFERENCE

REDONDO BEACH, CALIFORNIA

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2013 USC Eden Shield

<https://sites.google.com/a/usc.edu/aste527/home/eden-shield---concept-and-strategies-for-planetary-defense>

QBOLT

2015

ISU READI Project

Roadmap for Earth Defense Initiatives

https://isulibrary.isunet.edu/doc_num.php?explnum_id=722

2015

USC LunaRevolution

<https://sites.google.com/a/usc.edu/aste527/home/lunarevolution-role-of-the-moon-in-the-future-of-human-space-activity-2015>

Lunar Sentinel

Running Theme

- ▣ Emergency Response Strategies
- ▣ Short Period Warning
- ▣ Conventional Campaigns Need Long Term Planning
- ▣ PD Impacts Global Policy and International Relations
- ▣ Nuclear Option is Thorny – **No Unilateral Action**
- ▣ Look for new and maturing technologies
- ▣ Advances in Directed Energy offer promise
- ▣ Close Proximity Engagement @ Speed of Light



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Chronology

- ▣ 2013 - ASTE 527 Team Project - Eden Shield
- ▣ <https://sites.google.com/a/usc.edu/aste527/home>
- ▣ 2015 - IAA Planetary Defense Conference, Italy
- ▣ 2015 - NASA Ames International PD Workshop
- ▣ 2015 - ISU SSP Team Project – READI Project
- ▣ https://isulibrary.isunet.edu/doc_num.php?explnum_id=722
- ▣ 2015 - ASTE 527 Lunar Sentinel
- ▣ 2016 - NASA Ames SSERVI Conference – Lunar Sentinel
- ▣ 2016 - AIAA Space Expo – Lunar Sentinel paper
- ▣ 2017 - IAA Planetary Defense Conference, Japan
- ▣ 2018 -

Current Philosophy

- ▣ Dictated by Policy
- ▣ Observation of NEOs
- ▣ Improved Observation & Detection(IAWN)
- ▣ Mainly Asteroids and Fragments
- ▣ Collision probability based on extrapolating orbits
- ▣ Long term strategy – 30 -100 years
- ▣ Probability is not Reality !

Sorely Lacking

- ▣ Short Warning Period Mitigation Strategies
- ▣ Bolide detected on terminal trajectory
- ▣ Few weeks or Days to Impact
- ▣ Long Period Comets
- ▣ Oort Cloud objects in very high energy hyperbolic orbits
- ▣ Extrasolar objects
- ▣ Single pass hit miss
- ▣ Oumoumou type



Evolution of Awareness

▣ Space Situational Awareness

To

▣ Solar System Situational
Awareness

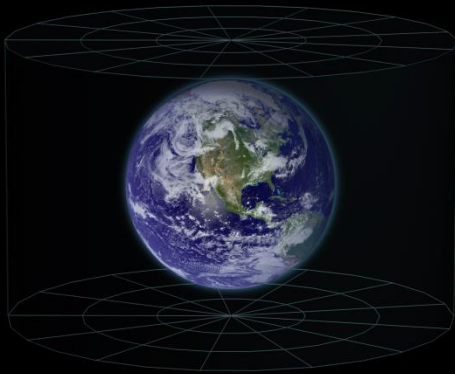
To

▣ Galactic Situational Awareness

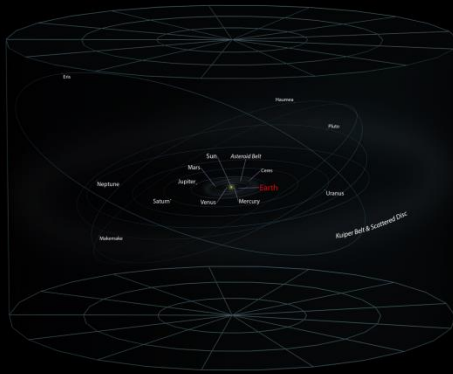
Dynamic Universe

- ▣ Cosmic Velocities and Energies
- ▣ Milky Way Rotation
- ▣ Anisotropic medium ?
- ▣ Fate of Stellar Systems
- ▣ Orphan planets and wandering bodies
- ▣ Radial Migration ?

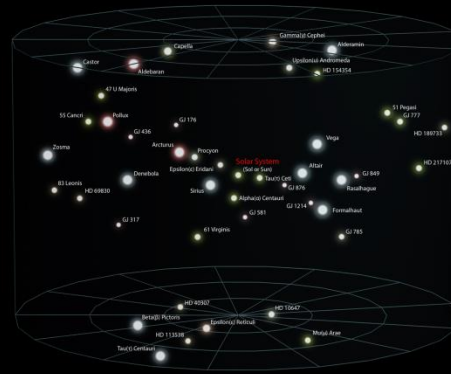
Earth



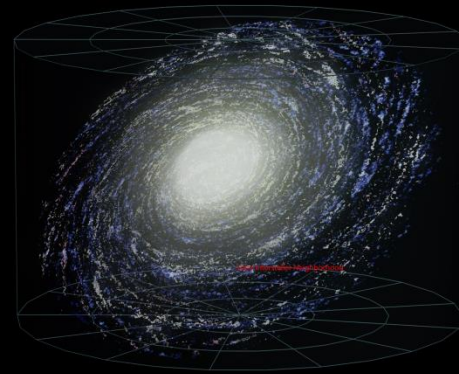
Solar System



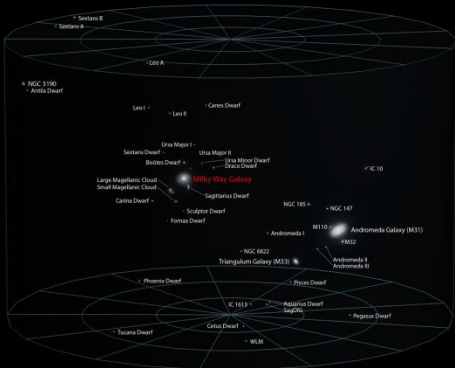
Solar Interstellar Neighborhood



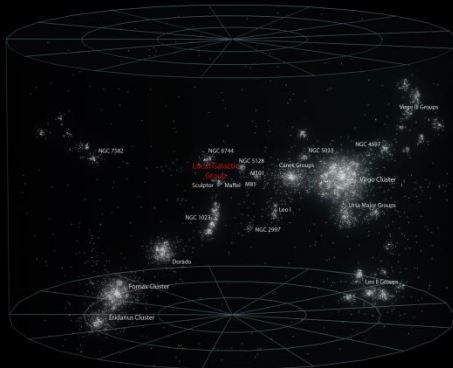
Milky Way Galaxy



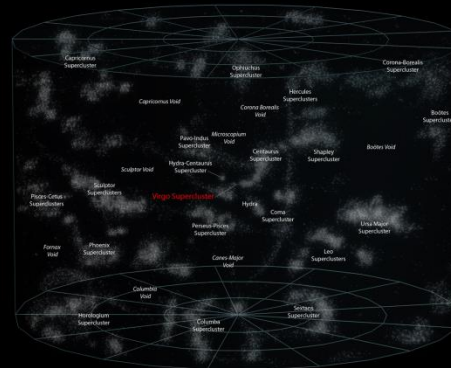
Local Galactic Group



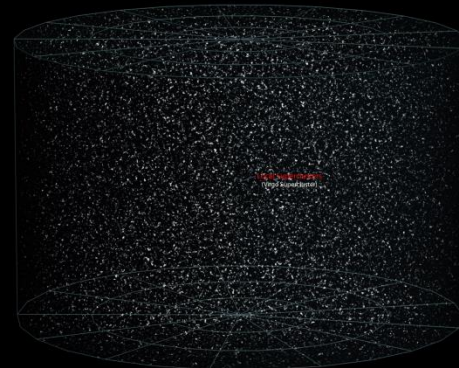
Virgo Supercluster



Local Superclusters



Observable Universe



Evolution of Capabilities

From

- ▣ Observation and Early Detection

To

- ▣ Mitigation – Deflection, Neutralization

And

- ▣ Last Resort Contingency Plans

- ▣ FEMA

- ▣ Develop Strategies in Parallel, not in Series

Essential for PD Capability

- ▣ End to End System Functionality
- ▣ End to End System Demonstration
- ▣ End to End System Readiness Verification
- ▣ Simulations
- ▣ Regular Readiness Exercises
- ▣ Global Warning and Mitigation Capability

Potential Credible Sequence

- ▣ Evolutionary
- ▣ Observation
- ▣ Detection
- ▣ Orbital Debris Mitigation
- ▣ Global Policy Friendly - TCBM
- ▣ Planetary Defense

Awareness

- ▣ Education
- ▣ Global in Scope
- ▣ Collective Sensitivity
- ▣ Collective Action
- ▣ Transcends Nation State Security
- ▣ E.g., Climate Change, Pandemic Prevention

Architect's View

- ▣ In case of PD Emergency :
- ▣ Civilian or Military Response ?
- ▣ Kinetic Kill ?
- ▣ Nuclear Option ?
- ▣ Directed Energy ?
- ▣ Other ?
- ▣ All of above
- ▣ But Globally Coordinated Response

A Global, Cosmopolitan Planetary Defense Capability

- ▣ Impacts whole world
- ▣ Global Awareness
- ▣ Global Coordination
- ▣ Global Action
- ▣ Humanitarian Pursuit
- ▣ Cosmopolitan World View
- ▣ Peaceful and Progressive
- ▣ Leads to other global Earth stewardship projects too !

