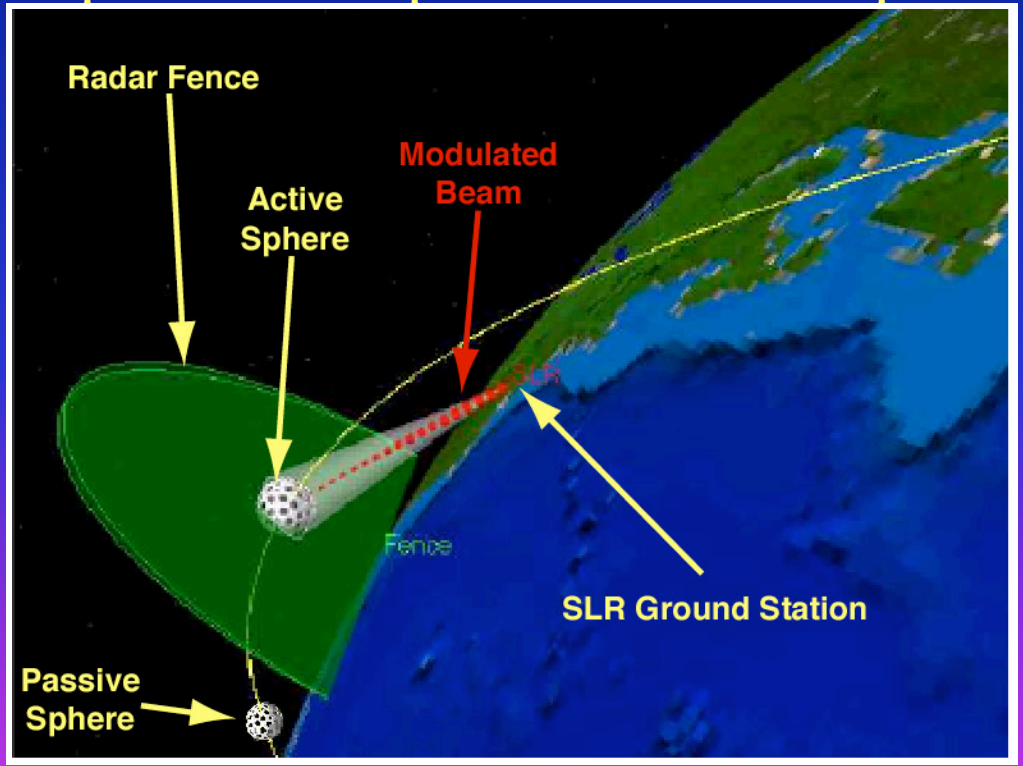
Atmospheric Neutral Density Experiment

ANDE Concept

Objectives:

1. Provide Total Atmospheric Density for Orbit Determination and Collision Avoidance
2. Validate Fundamental Theories on the Calculation of the Drag Coefficient
3. Provide Calibration Objects for SSN
4. Establish a Method to Validate Neutral/Ion Density & Composition Derived from DMSP Sensors.
5. Space to Ground Optical Communication Experiment



- Description:
- Fly two 19” spheres in lead-trail orbit
  - 400 km orbit
  - 51 Degree inclination
- Passive Sphere (~25 kg)
  - Observed with SSN and SLR; variation in observed position used to determine in-track total density
- Active Sphere (~50kg)
  - Determine position wrt to passive sphere
    - Compute total density
    - Validate C_D models
  - Use on-board instrumentation to calculate density and composition
  - Launch via Shuttle in CY 2009
  - RR deployed 21 Dec 2006
- Point of Contact
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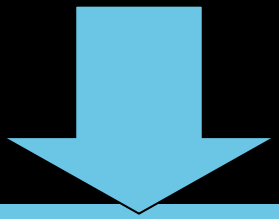
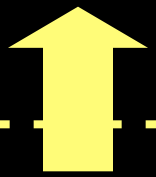
Neutral Atmospheric Specification Evolution

Neutral Atmospheric Specification Evolution

Hydrostatic	Climatology	Data Driven Models	Real-Time (Requires Prediction) "Now Cast"
STD ATM	J70	HASDM (Drag Data, ANDE)	Sapphire Dragon (AF SSN)
Exponential	MSIS	NRL MSIS Data-Driven (ANDE, UV Limb Data)	NRL MSIS
	DTM	GAIM/NADIR MURI (UV Limb/NADIR, ANDE, Need neutral density to initiate model)	GAIM (AFWA) NADIR MURI (AFOSR)
	NRLMSISE-00	HWM Data Enhanced Wind Models (ANDE)	



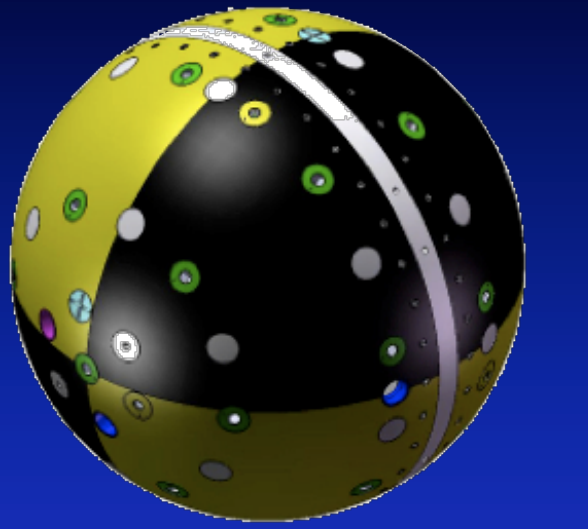
Assimilate All Data (New Data ATM Model)



ANDE Missions

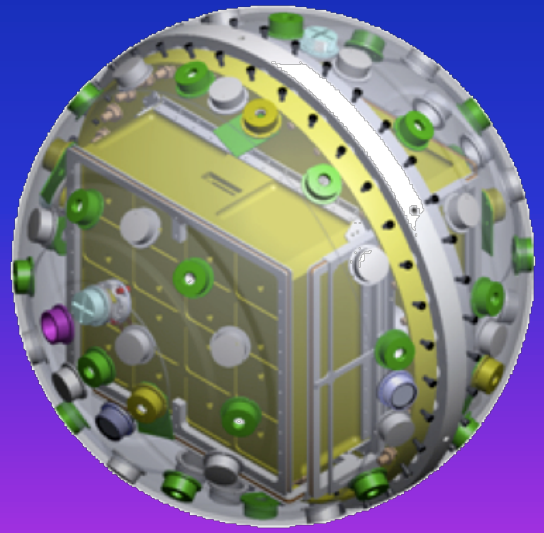
ANDE Timeline

- **ANDERR Re-entry:**
  - ICU Cyl 2 (2/9/07)
  - ICU Cyl 1 (4/18/07)
  - ICU Avionics Deck (4/24/07)
  - ANDERR MAA (12/25/07)
  - ANDE RR FCal (5/25/08)



$$A_{Drag} = -1/2 \rho B (V_{s/c} - V_m)^2$$

- **ANDE: Launch in NET May 2009 via Space Shuttle STS-127**
- **Goal:**
  1. Measure $V_{s/c}$ (ground based sensing: radar, SLR, GPS)
  2. Measure V_m (in-situ: WATS)
  3. Measure ρ (in-situ: WATS)



ANDE Instrument Payload

Instrument	Measurement	Description	Developer
GPS	Position	single frequency GPS receiver	Univ. Texas, Austin
WATS	Ion & neutral winds and temperatures	in-situ wind and temperature spectrometer	Naval Research Lab
iMESA	Electron density & temperature	miniature electrostatic analyzer	US Air Force Academy
Gyroscopes and accelerometers	Spin rate and orientation	3 gyros and 3 MEMS accelerometers in each spacecraft	Local High Schools: Marchall Academy, Chantilly Academy, Westfields High School
Thermal Monitoring	Temperature of spacecraft	Array of thermistors for internal and skin temperature	Naval Research Lab