Sample Payload Mission Targets

Need to begin thinking now!

- Given the constraints, you need to think about and address issues throughout the academic year
- Here we discuss some example payloads
  - Either previously developed and flown or
  - Should be feasible to develop and fly within the limitations of this program
- Your team will have two weeks to develop your Pre-PDR
  - Research and write the scientific background for your payload
  - Determine your mission goal, objectives, and requirements
  - Establish a general schedule for payload development

Considerations for Mission Topic

- Mission should be appropriate to the flight platform
  - Why do you need to fly this payload
  - Should not be an experiment that can be done in a vacuum chamber
- Compatible with mission constraints
  - Low cost, light weight, lower power
  - Needs to be developed in a short amount of time
  - Must meet all LaACES payload requirements

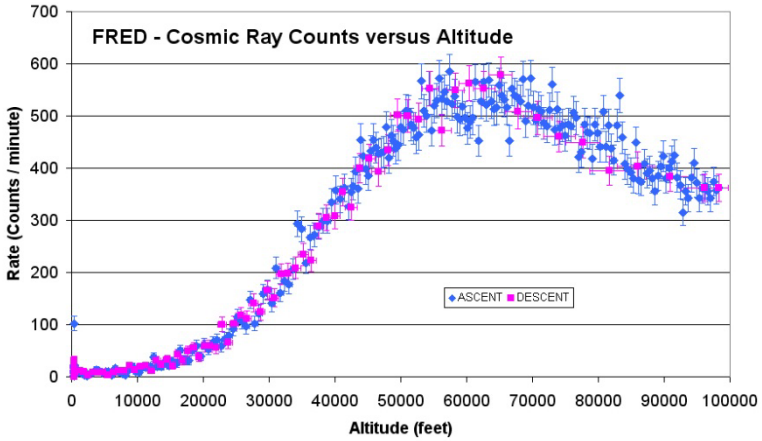
Payload Payload Requirements and Bases

	Requirement	Basis
Weight	Payload mass shall be less than 500 grams	FAA Total Weight Limit/FAA Individual Payload Limit
Density	Smallest payload surface must be larger than 10 in^2	FAA Density Limit
Physical Interface	Payload shall have 2 **vertical penetrations through the entire payload**: -17 cm apart center to center -Inner Diameter 0.7 cm to 1.0 cm (to allow for plastic grommet) - Greater than 1 cm from any payload wall	Flight String integrations
Data	Enough data storage for 4 hours of recording	2.5 Hours of flight + setup time
Power	Enough power capacity for 4 hours	2.5 Hours of flight + setup time

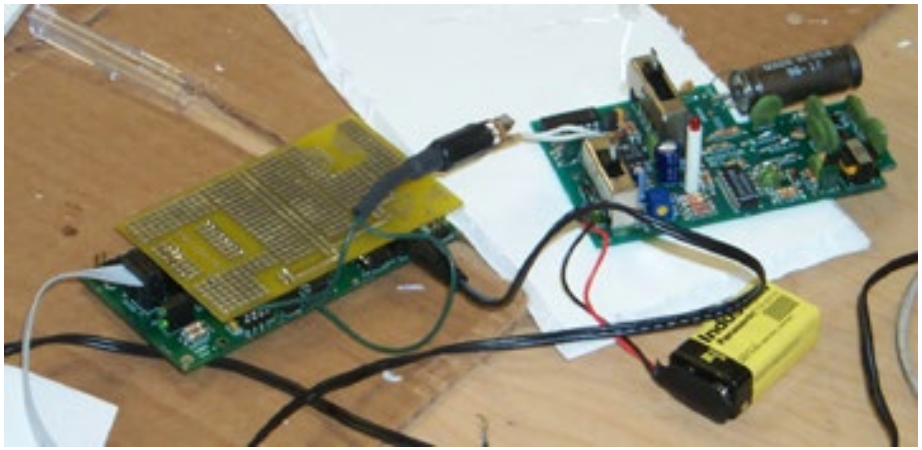
Some possibilities

- Radiation Intensity as a function of altitude
- Measure intensity of UV bands as a function of altitude to deduce properties of the ozone layer
- Directly measure concentration of O3, NOx, COx gases as a function of altitude using solid state sensors
- Develop a system to measure air flow (e.g. hot wire anemometer) at high altitudes (i.e. very low pressure).
- Investigate methods to optimize atmospheric temperature measurements
- Develop an inertial sensing system which will provide sub-minute of arc orientation knowledge
- Downlooking environmental studies like tree or water cover

Radiation Intensity vs Altitude



- This payload would determine the radiation flux as a function of altitude on ascent and descent

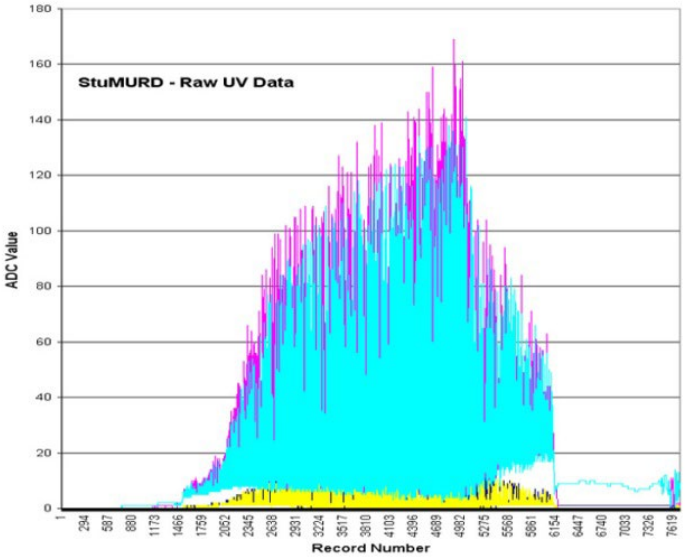


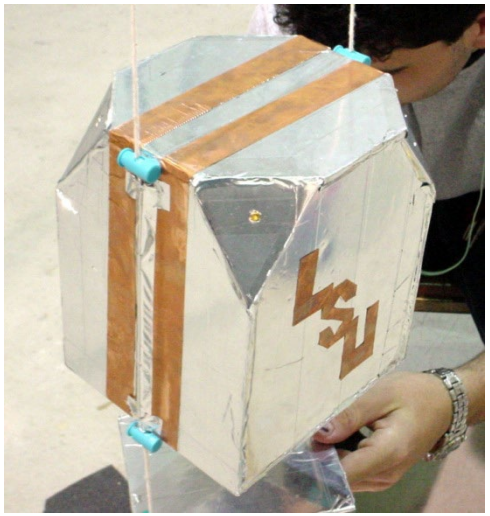
- Cosmic rays are high energy nuclei that originate outside our solar system.
- CR interact in Earth's atmosphere producing a shower of particles
- The intensity of this radiation varies with altitude

- Challenges: Can you measure beyond count rate? How can you determine particle type or energy?

Measurement of Solar Spectrum in versus Altitude

- Many wavelengths are absorbed or scattered by the atmosphere (UV/IR/Visible)
- UV is absorbed by ozone in the upper atmosphere
  - Surprisingly there are few (none?) published measurements of UV intensity in the stratosphere.
  - This effort has the potential of generating a journal publication with the team as authors!
- One or more sensors (or the appropriate wavelength sensitivity) would monitor UV from the Sun.



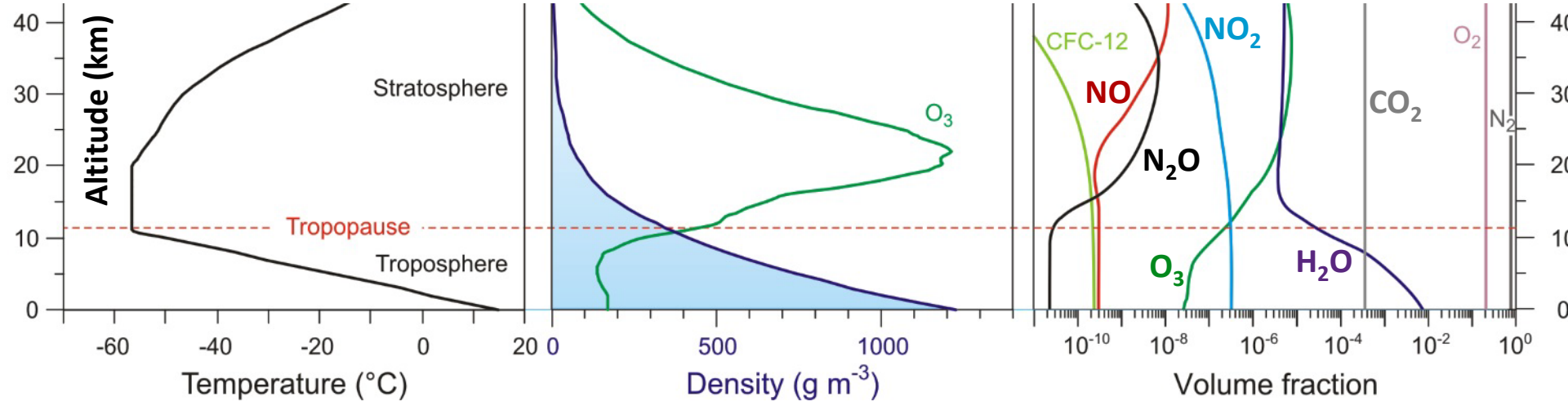


Challenges

- You will need to take into account the rotation of the balloncraft, most sensors will vary depending on where they are pointing
- To calibrate your sensor, you will need an appropriate wavelength source

Measure Atmospheric Components (Gases, Aerosols,

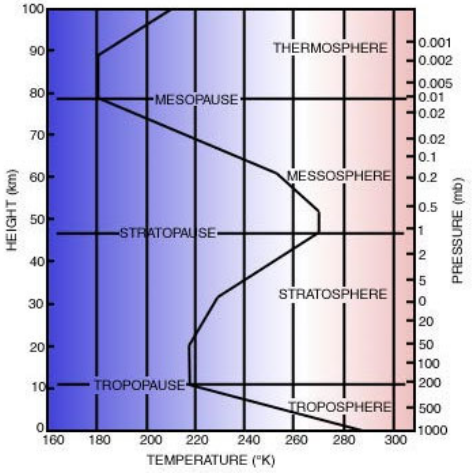
- **Challenge: Most commercial sensors are designed and calibrated for 1 Atm, and will require correction for lower pressure**
- The gas composition of the atmosphere changes as a function of altitude
- The increase in temperature above the Tropopause is related to the ozone layer
- Correlate stratospheric temperature with ozone concentration
- The aerosol particle density also changes as a function of altitude
- Determine how to measure aerosol characteristics (density, size distribution) as a function of altitude



Air Flow Sensing

- Payload would measure the air flow or ‘wind speed’ as a function of altitude
- Investigate various techniques used to build hot-wire anemometers
- Investigate methods to calibrate a hot-wire anemometer sensitive enough to measure small ‘wind speeds’
- Payload can use the upward movement of the payload to generate the wind across the anemometer but will there even be any horizontal flow or will the balloon match the airflow
- **Challenge: How do you calibrate wind speed measurement with changing the air pressure?**

Accurate Atmosphere Temperature and Pressure

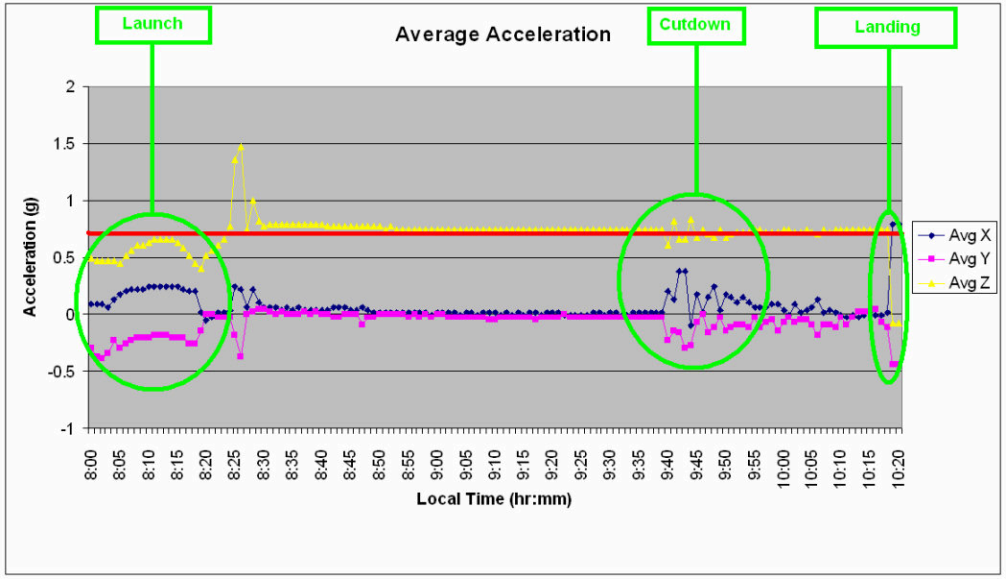


- The temperature and pressure of the atmosphere vary as a function of altitude
- **Challenge: Temperature measurement in the stratosphere is complex because low pressure and high solar radiation**

- Many factors influence the measured temperature
  - Sensor color
  - Airflow around the sensor
  - Where the sensor is placed
  - Periodic shadowing and sunlight exposure
  - Density of the surrounding air

Minute of Arc Inertial System

- Develop an inertial attitude sensing system that would be accurate to less than one minute of arc
- Investigate the rotation and turbulence of the payload during flight
- Use some combination of magnetometer, tilt sensors, gyroscopes, accelerometers, and a sun sensor
  - Develop a system that would determine payload attitude
    - **Payload motion is chaotic and rapid**
  - Conversely, attempt to build a stabilization system to minimize rotations or pendular motion
    - **Challenge: weight and power constraints**



Additional Ideas

- Take 5 minutes to brainstorm possible missions now
- Concentrate on big picture science questions and do not worry about the implementation
  - When doing background research for Pre-PDR you will look at possible implementations and feasibility