1. Joke (timing!)
2. Want to tell you a story:
    a. There was a time in Canada when we launched rockets
        i. Sounding rockets and the Space Engineering Division - students worked hands-on
        ii. SED Systems, spinoffs
        iii. Saskatoon Mafia: Llewellyn, Wood
            (1) OSIRIS Science Team
    b. Space research in Canada
        i. Alouette, ISIS, Viking
        ii. Sounding rockets from Churchill
        iii. Closure of CRR
    c. CSA: rockets are a good thing after all
        i. AO for Small Payloads
3. Experiment: important science benefitting Canadians
    a. Ozone depletion and ozone monitoring
    b. Visible starlight absorption
    c. Rocket launch from Churchill, parachute descent
    d. Optical imaging detector / spectrum analyser
    e. Position and attitude measurements
        i. GPS receiver gives real-time 3-d position
        ii. Attitude video camera images stars
    f. Atmospheric tomography yields 3-d ozone distribution
    g. Name,. Acronym, logo
4. Submission team
    a. Not a team of ‘old boys’
    b. Faculty from many departments - new faces
    c. Graduate students from many departments
        i. Proposal development experience: important career skill
        ii. ‘Three-month interview’ with industrial partner

d. MBA students to handle **management plan**

e. Senior personnel from **industrial partner**, SCI-TEC Instruments, Inc.

i. Design and manufacturing know-how

ii. Large knowledge base about ground-based ozone monitoring, want to learn more

iii. Well-equipped with ozone monitoring and calibration equipment

f. Graduate course credit **if compliant, on time**

5. Concept development (design project)

a. Principal Investigator (editor, project manager)

b. Working groups (faculty, students)

i. Science

ii. Optics

iii. Mechanical

iv. Electrical / GPS / Firmware

v. Onboard Data Handling

vi. Ground-Based Data Handling

vii. Risk / Reliability

viii. Management Plan

c. What are the important questions?

i. Brainstorming

ii. Talking to 'experts'

d. How do we find the answers?

i. Search the literature - scientific and industrial

ii. Look for someone who knows

iii. Work it out yourself

iv. Make a model

e. Trade-offs

i. Tomography / redundancy / number of launches / cost and complexity

ii. Chute time / battery life / prevailing winds / payload recovery

iii. Sensitivity / field-of-view / detector size

iv. Spectral resolution / data volume / auroral contamination

v. Data precision / data rate / data compression

vi. Payload size and mass / vehicle and launch cost

vii. Star target density / angular resolution / date and time / Sun and Moon

f. External input: vehicle, parachute, payload, telemetry, launch

i. Bristol Aerospace, Akjuit Aerospace

ii. Trip to Winnipeg in a blizzard

6. Proposal development

a. Had to meet AO requirements (abbreviate!)

i. Science, science team, Canadian / international context, support studies and measurements (not fundable), analysis and publication plan

ii. Instrument, other systems, facilities, testing, launch, operations, work breakdown structure and schedule, budget, risks, benefits, management plan

b. Everyone contributed ...

i. Working group meetings (~weekly)

ii. Plenary meetings (irregular)

iii. Password-protected project Web site with latest information

c. But graduate students did the writing ...

i. Individuals responsible for sections of proposal

ii. Weekend writing blitzes last two weekends in November

iii. Course mark based on quality, quantity of contribution (written and otherwise)

d. Until we got to the crunch

i. Students (mostly) off the hook after end of term

ii. Editing team helped PI write, assemble, polish, proofread

iii. Deadline extended by one week (whew!)

iv. PC crashed (argh!)

v. Electronic submission (whew!)

vi. Work breakdown structure and schedule, budget

vii. PostScript figures, last-minute checks

viii. I got so tired my brain locked up

ix. Proofreaders working overtime

x. Signatures gathered and electronically merged

7. Management plan

a. Industrial partner has already made a real contribution

i. Senior personnel attended meetings on company time

ii. Got involved in actual work and helping students

(1) Taught how to use software

b. Graduate students will get hands-on experience with space hardware

i. Electrical Engineering, Mechanical Engineering, Physics, MBA?

ii. 'Part of' preliminary design studies with faculty advisors, science team members, or

iii. 'Part of' time, cost, and resource management team with PI

iv. Build, test, calibrate experiment **as SCI-TEC term employees** (*i.e.*, they get paid!)

c. Experiment to be built by industrial partner - not just business as usual

i. Industrial partner will do project at cost - all profit foregone

ii. Engineers will implement design developed at University

iii. Will hire term employees as needed to finish job on time

iv. Engineers + term employees will build, test, calibrate

d. Innovative support for graduate students

i. University work supported by targeted scholarships funded from contract overhead

ii. Term employee work at SCI-TEC supported directly by (sub)contract to SCI-TEC

8. Future

a. CSA decision expected in mid-May

b. If selected, first stage is Phase A: concept development and design studies

i. Possible opportunities for undergraduates?

ii. Graduate students, advisors, and other science team members carry the ball

iii. Assess results of Phase A at Preliminary Design Review

iv. CSA decide whether to fund project to completion

c. If funded, next step is Phase B: instrument development

i. Carried out at SCI-TEC

ii. Implement design: turn algorithms into code, block diagrams into circuits

iii. Build, test, characterize, calibrate

d. Phase C: payload development at Bristol Aerospace Limited in Winnipeg

i. Design, build, integrate, test

ii. Structural, electrical, RF

iii. Vehicle, despin mechanism, motor separation

iv. Fins

v. Parachute

(1) deploy at 80 km altitude (no air to fill!)

(2) stop swinging early in fall

(3) spin slowly to scan stars (~1 turn per minute)

(4) descend slowly enough to stay below Mach 1 ...

(5) But fast enough to get down before batteries die

e. Phase D: launch at SpacePort Canada, Churchill, Manitoba

i. Vehicle integration and test

ii. Range safety, wind weighting, jet stream, polar bear alert

iii. Launch, radar lock, telemetry reception

iv. Payload recovery off the ice of Hudson Bay

f. Data analysis and publication

i. Spectral analysis to determine amounts of ozone, etc. along lines of sight

ii. Tomographic analysis to get 3-d ozone distribution

iii. Publish results

g. Proceed to microsat experiment

i. Global ozone monitoring using same technique

ii. Generate global ozone maps for public consumption (6 pm news?)

9. Opportunities
    a. Graduate students
        i. Electrical Engineering: power supply, data compression, etc.
        ii. Mechanical Engineering:
            (1) tomography
            (2) parachute dynamics, thermal and stress analysis
        iii. Physics: ozone, optics, spectral inversion
        iv. MBA: project management
    b. Undergraduate students: design projects? (See Profs. Bolton, Wood)
    c. May need graduate students for the microsat!
10. Closing
    a. Thank you for the chance to speak to you tonight
    b. Hope the story I've told has been interesting and informative
    c. Hope some of you will find it useful!
    d. Have extra copies of cover story on NiteOwl for those who are interested
    e. Would be happy to answer any questions you may have.