

Space Flight Associated Neuro-ocular Syndrome (SANS)

• Andrew G. Lee, MD

- Chair Ophthalmology, Houston Methodist Hospital, Professor of Ophthalmology, Weill Cornell Medical College; Adjunct Professor of Ophthalmology, University of Iowa, Clinical Professor of Ophthalmology, UTMB Galveston, UT MD Anderson Cancer Center





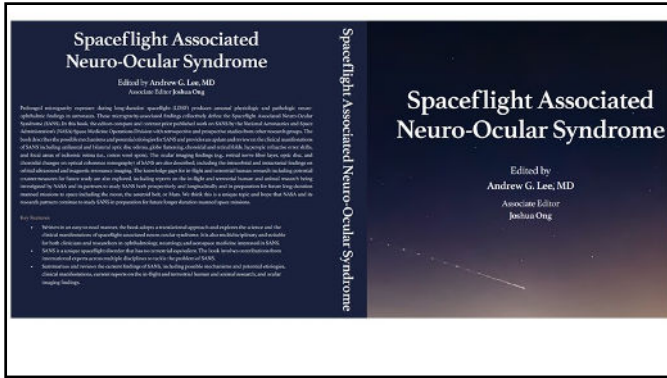
•Dr. Lee (Houston Methodist Hospital) works as a consultant for the **United States Department of Justice (DOJ)**, the **National Aeronautics and Space Administration (NASA)**, and the **National Football League (NFL)** but the views expressed here are his own and do not represent those of these organizations or the United States government.

Other disclosures: Horizon therapeutics

Even though I have no other financial disclosures for this talk...



I am a consultant for NASA but the views expressed here are my own and do not necessarily represent those of the Space Agency or the United States government.

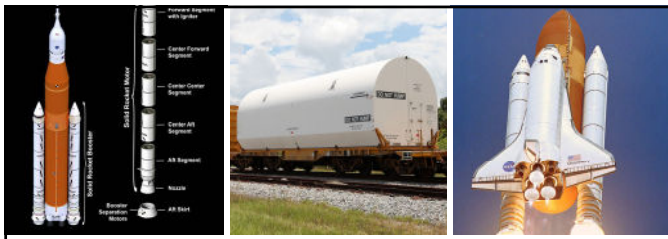


Disclosure: We are going to be discussing a disease that has no terrestrial equivalent (but I did write a book about a disorder that literally has never been diagnosed on Earth).

Roman war chariot roads: 4 ft 8 and 1/2"



Wagon width to standard railroad gauge



Solid rocket boosters travel on rail and through rail tunnels (granted not exactly 4 feet 8 1/2 inches but close)

My grandfather: Yu Pin (age 95) and his 13 children (including my dad, Alberto Lee)



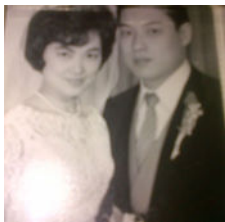
Yu Pin (Lee Sy Do)

- Born in the Empire of China April 29, 1903 (During reign of the last emperor of China in the Qing dynasty)
- Moved to Manila, Philippines age 36 years
- Worked as janitor in Lee Ching Chuan lumbar company
- Was not literate in Filipino language
- Spent 50% of his salary to learn how to read at night
- Taught himself to learn English by reading newspapers that he collected from trash (because on one side was Mandarin and on the other side was....English)

Yu Pin had 12 children including Alberto



Alberto & Rose immigrated from Manila to the United States in 1963 to complete internal medicine residency training in New York City, NY

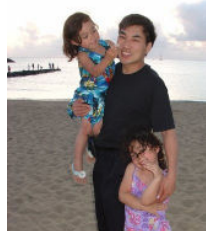


Invented during Yu Pin's lifetime (1903-2006)

- 1903 Yu Pin born in China
- 1903 Wright Brothers first flight
- 1906 Radio broadcasting
- 1909 First model T Ford
- 1925 Television
- 1945 Atomic bomb
- 1969 Man on the moon
- 1973 Motorola mobile phone
- 1975 Personal computers
- 1985 Worldwide web
- 2000- iPhones, apps, wifi, Wii, Facebook, Google, Netflix.....



Yu Pin's son Alberto Lee had three children in the United States (two also became doctors)



On July 20, 1969, I was 5 years old, the moon landing was on tv....



“Houston” was the first word spoken from the moon



July 1978: I wanted to be a doctor;
2nd choice NASA; 3rd Jedi knight



Optic Disc Edema, Globe Flattening, Choroidal Folds, and Hyperopic Shifts Observed in Astronauts after Long-duration Space Flight

Trevino H. Mako, MD,¹ C. Ryan Olson, OD,² Anissa F. Pao, OD, JE,³ Larry A. Egan, MD,⁴
Andrew C. Lee, MD,⁵ Joseph Egan, PhD,⁶ William S. Teras, MD,⁷ Joseph P. Barone, MD,⁸
Erikka R. Hamilton, MD, PhD,⁹ Anne Sorenson, MD,¹⁰ John L. Pawley, PhD,¹¹ Don Fair, DSc,¹²
William Szabo, MD,¹³ Jung-Chul, OD,¹⁴ Claudia Stern, MD, PhD,¹⁵ Rolf Koenigsmann, MD,¹⁶
James G. Bok, DSc¹⁷



Co-investigators
for astronaut
optic disc edema
on International
Space Station

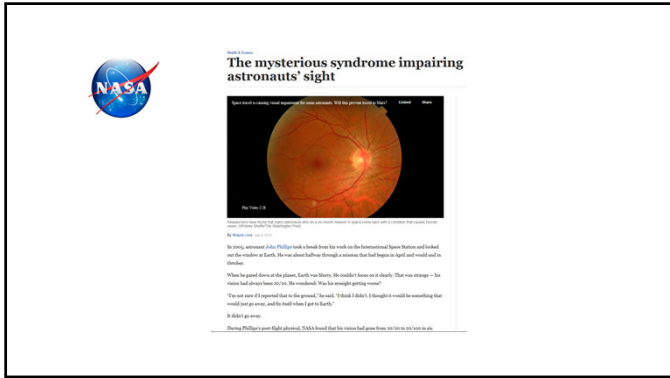
You can read more about SANS at....



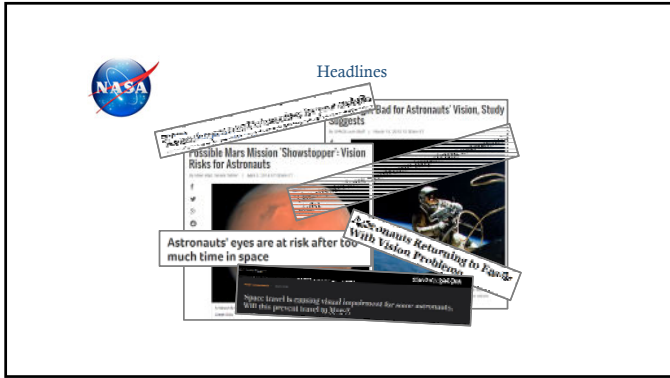
20 year Timeline: SANS in astronauts

- 2003: **Choroidal folds** in astronaut on return
- 2005: Optic **disc edema** & cotton wool spot
- 2007: **Cotton wool spot**
- 2008: Optic disc edema OU
- ISS flyers: 50% **hyperopic shift**
- 2011 Mader et al SANS findings published in *Ophthalmology*
- 2013 **Recurrent findings** in repeat flyer (JNO)
- 2022: PED, CSR, intraretinal cyst (pachychoroid)







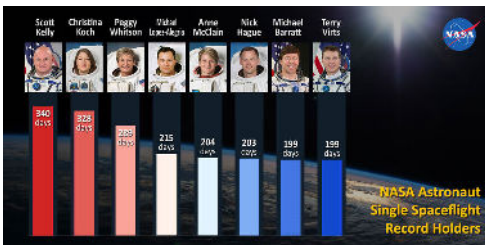


Longitudinal Medical Surveillance:
We need to see, why they cannot see

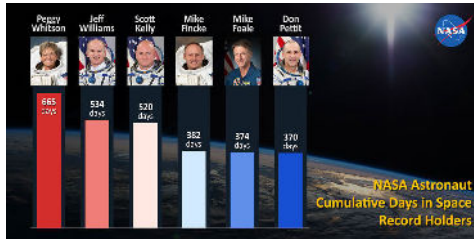




Longer & longer duration missions

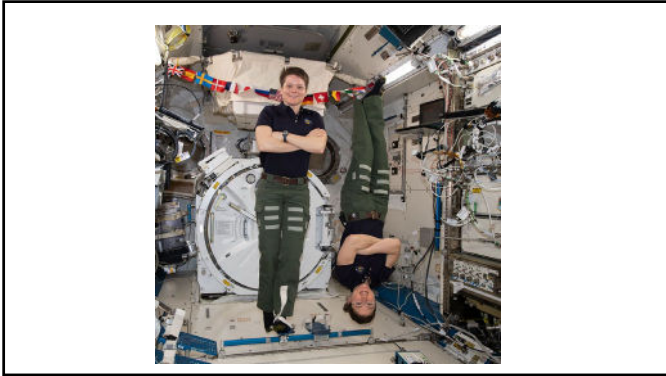


Cumulative days in space records

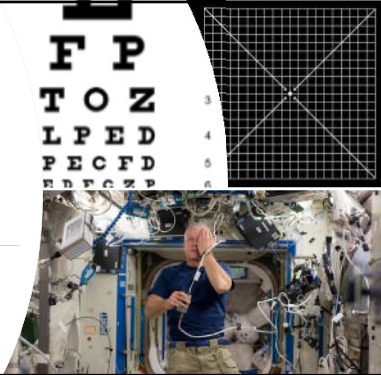




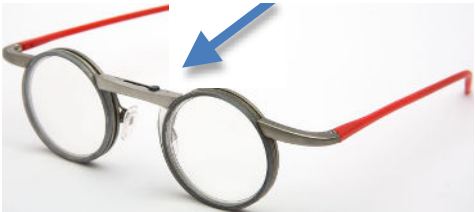




Visual Acuity & Amsler Grid

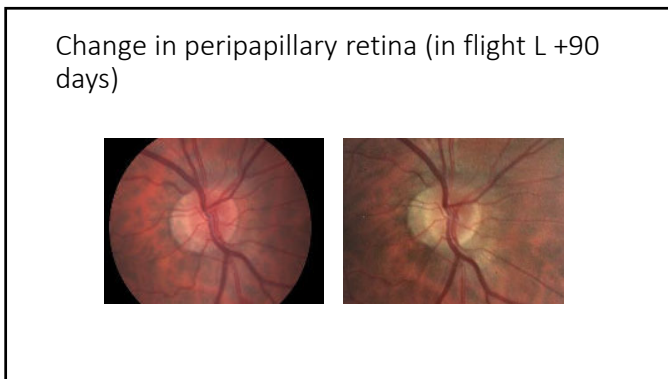


Space Anticipation Glasses









OCT in SANS

Invited Commentary

February 2018

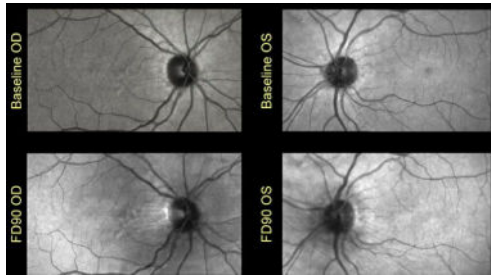
Optical Coherence Tomographic Analysis of the Optic Nerve Head and Surrounding Structures in Space Flight-Associated Neuro-ocular Syndrome

Andrew G. Lee, MD^{1,2}

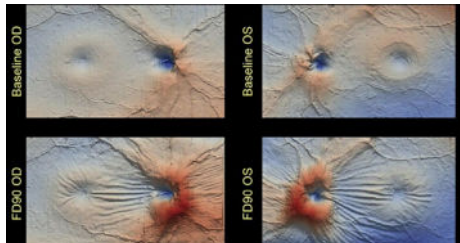
> Author Affiliations

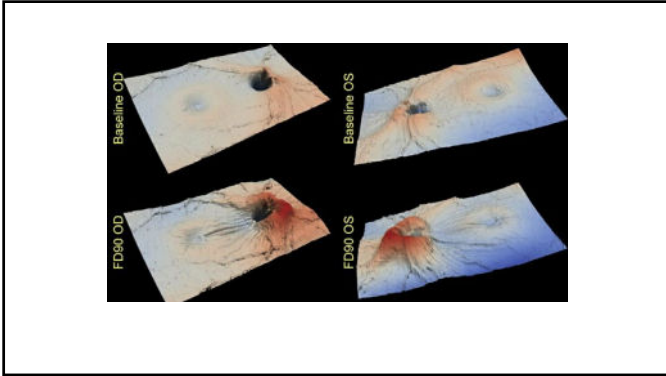
JAMA Ophthalmol. 2018;136(2):200-201. doi:10.1001/jamaophth.2017.5496

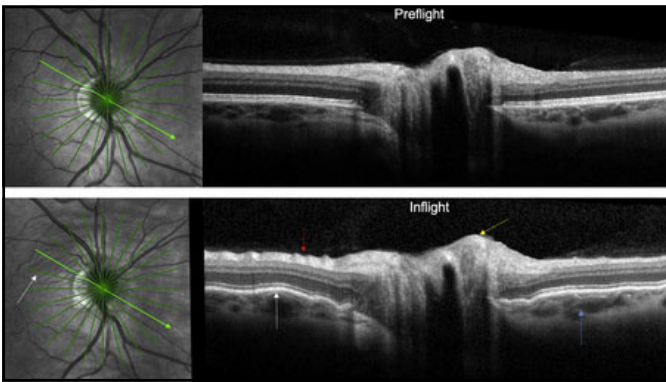
Choroidal folds develop Flight Day (FD) 90

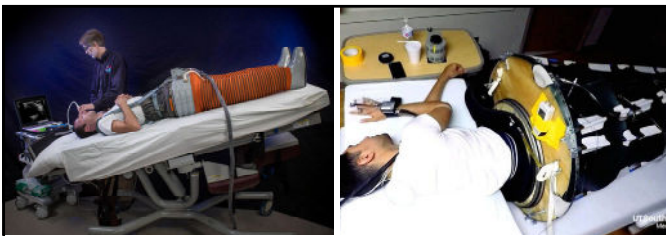


Frisen grade 1 optic disc edema with choroidal folds (FD 90) OU









Space "sleeping bag" negative pressure device

• Head-Down Bed Rest & Eye

RESEARCH ARTICLE

Ocular Outcomes Evaluation in a 14-Day Head-Down Bed Rest Study

GIOWANMI TUBBI, ROSITA L. CROMBELL, SUSANA B. ZANELLO, PATRICE U. VAKROVIC, ROBERT J. FLOTT-SINVERO, BERNARD F. GOBLEY, AND GIAMMARIO VIZZINI

Aviation, Space, and Environmental Medicine • Vol. 85, No. 10 • October 2014



• Head-Down Bed Rest & Eye

CASE REPORT

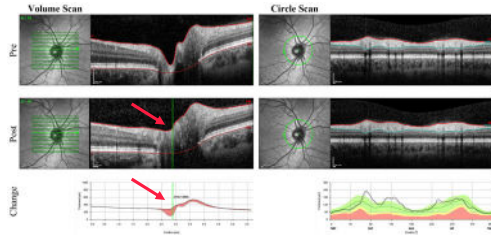
Effects of 30-Day Head-Down Bed Rest on Ocular Structures and Visual Function in a Healthy Subject

GIOWANMI TUBBI, KEVIN KAPLOWITZ, ROSITA L. CROMBELL, BERNARD F. GOBLEY, SUSANA B. ZANELLO, AND GIAMMARIO VIZZINI

Aviation, Space, and Environmental Medicine • Vol. 84, No. 2 • February 2013

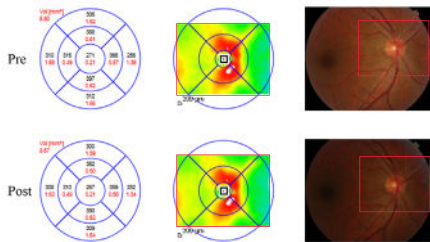
OCT RNFL head down study

- Spectralis OCT



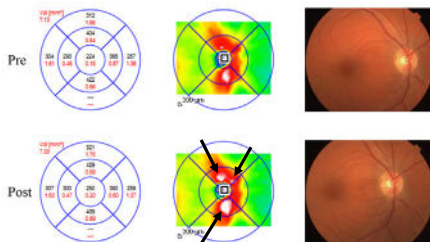
Results: RNFL increase

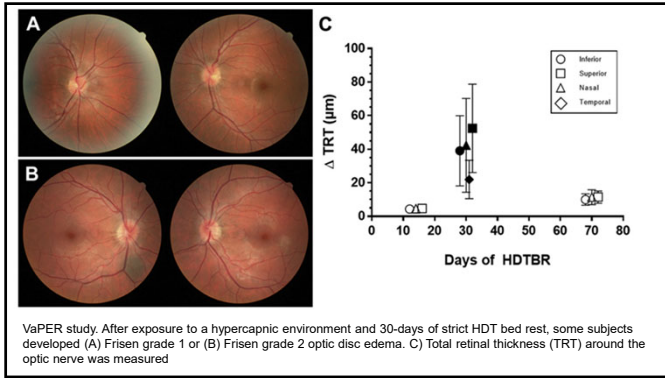
- Case Example, 14-d Bed Rest

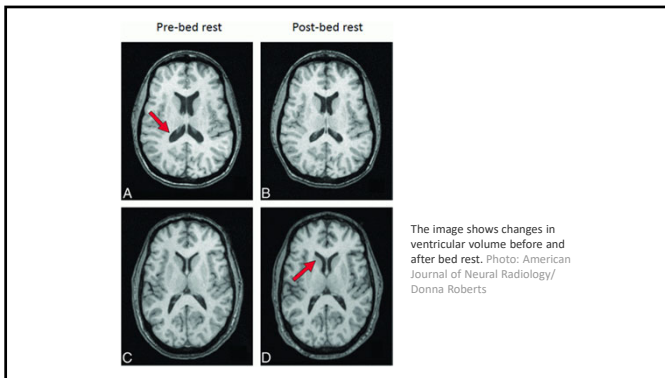


Results: increased RNFL

- Case Example, 70-d Bed Rest







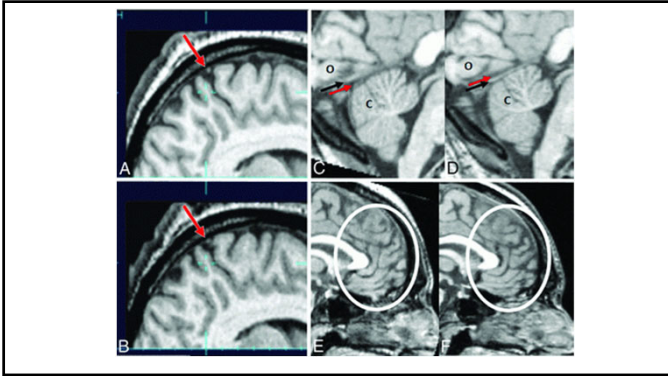
Effects of Spaceflight on Astronaut Brain Structure as Indicated on MRI

Devika R. Bokem, M.D., Manoj H. Alivisatos, M.D., Heather R. Collins, Ph.D., David Aizenstein, Ph.D., A. Rana Chatterjee, M.D., M. Victoria Spampinato, M.D., Yun Zhu, Ph.D., Marc I. Chimowitz, M.B., Ch.B., and Michael U. Anderson, M.D.

November 2, 2017
 N Engl J Med 2017; 377:1764-1770
 DOI: 10.1056/NEJMoa1705126

Abstract

- Narrowing of central sulcus
- Upward shift of brain
- Narrowing of CSF spaces at vertex
- Occurred frequently and predominantly in astronauts after long-duration flights





Kazakhstan return from ISS

3 astronauts from International Space Station land in Kazakhstan







Space X return to Earth

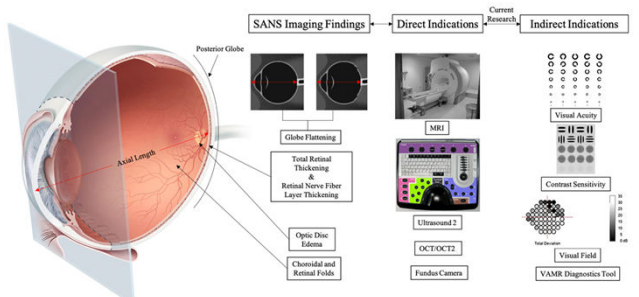




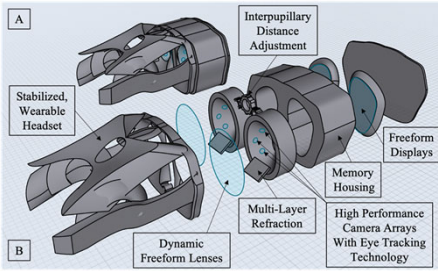
**IN-FLIGHT
VISION TESTER**
GFAE EC 34999
GEMINI EXPERIMENT
S-8/D-13/M-9
VISUAL ACUITY

ASTRONAUT USING INSTRUMENT

Multimodal imaging Direct and Indirect measures



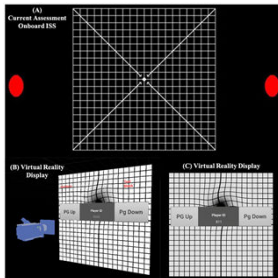
Head mounted, wearable, light weight, segmented, stabilized, portable, high performance, dynamic, freeform display, integrated device

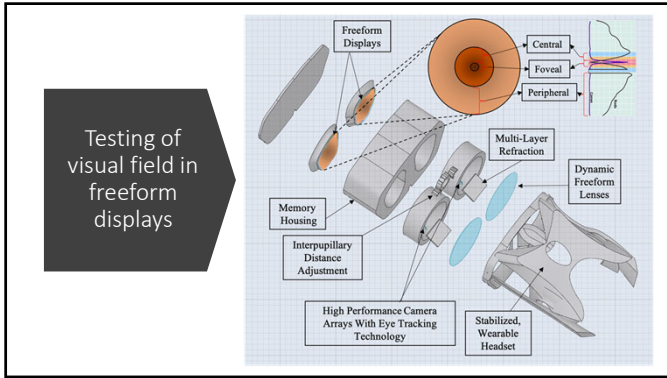


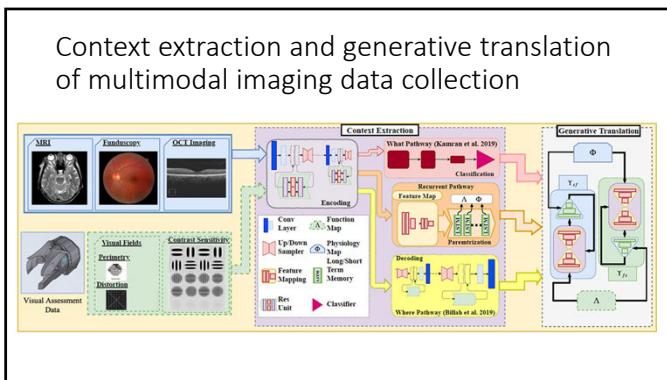


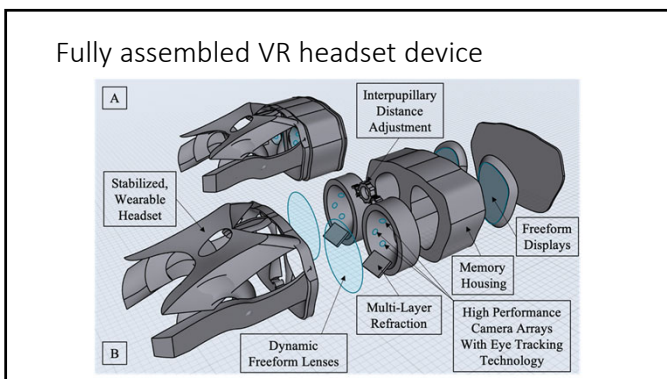
Virtual reality of simulated optotypes in the eye lane (complete with VR houseplants)

Head mounted display for Amsler grid

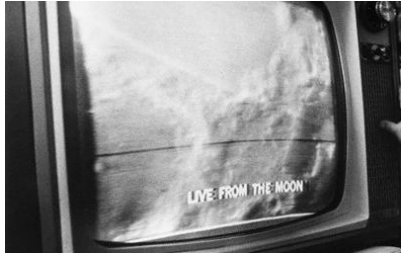








On July 20, 1969, I was 5 years old,
the moon landing was on tv....

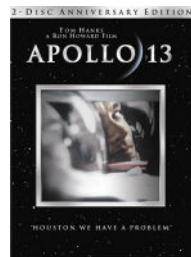
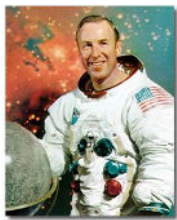


Jim Lovell: April 1970



Houston, we have
a problem

April 1970: "Houston, we've had a
problem" —Jim Lovell



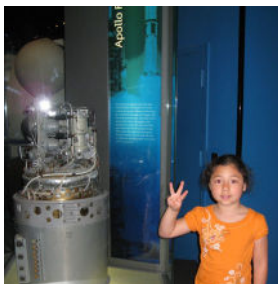
Half the spacecraft panel lost



Jim Lovell



Apollo fuel cell



Most of the computing power was human brains at NASA







1978: I wanted to be a doctor...
2nd choice NASA; 3rd Jedi knight. It
turns out that I get to do all three!



Today, I get to work with real rocket scientists at JSC at NASA in Houston

Lee family reunion Manila 2006:
Yu Pin died age 103:



Lee family reunion:
Hundreds of descendants of Yu Pin



I don't think that Yu Pin could ever have imagined what the lives of his grandson (me) or his great-grand children (my kids) would be like in America



On December 17, 1903, Orville and Wilbur Wright flew over Kitty Hawk, NC. 118 years later, a small piece of their Wright Flyer is soaring over the plains of Mars on NASA's Ingenuity helicopter







