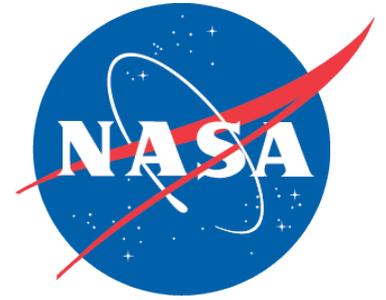


First Planetary Balloon Mission in 50 Years*

Andrew Cheng
Karl Hibbitts
Eliot Young
Pietro Bernasconi



BRRISON
Balloon Rapid Response for ISON

*The Stratoscope II balloon mission first flew in 1963 to observe planets, stars and galaxies



Comet ISON



- Comet ISON discovered September, 2012
 - An Oort Cloud comet believed to be making its first apparition
- ISON perihelion in November, 2013
 - A sun-grazer which may not survive perihelion passage intact
 - Observe the comet before perihelion
- An important target of opportunity
 - To study volatile-rich material from the epoch of planet formation
 - To learn how comets work

Oort Cloud Comets

- Clues to the origins of the Solar System
- Samples of pristine, icy material that was never heated in the inner solar system



Comet Ikeya-Seki in 1965

Comet McNaught in 2007

In late 2013 ISON may become the brightest Oort Cloud comet in decades



BRRISON Objectives



- Provide high-value science from Comet ISON
 - Measure CO₂ and H₂O and determine their ratio
- Develop and demonstrate gondola and payload systems for a balloon-borne platform designed to achieve planetary science objectives
 - Payload systems: IR imaging; NUV/Vis imaging and operation of Fine Steering Mirror for obtaining sub-arcsec pointing stability
 - Gondola systems for platform capable of lifting a >1m aperture telescope to 120,000 feet



Stratospheric Terahertz Observatory



Planetary Science Questions Addressed by BRRISON



- ❑ How does the composition of Oort Cloud comets compare to Kuiper Belt comets?
- ❑ What are the chemical routes leading to complex organic molecules in regions of star and planet formation?
- ❑ Were there systematic chemical or isotopic gradients in the early solar nebula?
- ❑ How did Earth get its water and other volatiles?





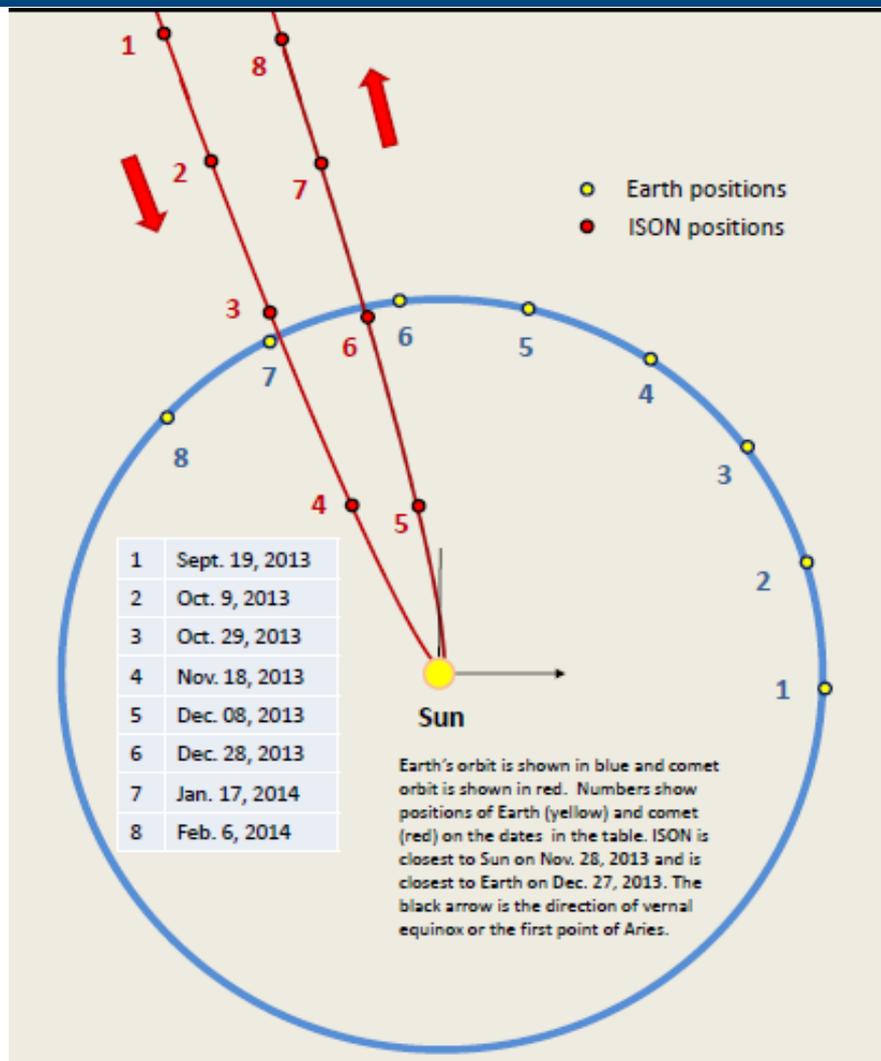
Comet ISON Observability



- Comet ISON is observable from the Northern Hemisphere, with solar elongation $>40^\circ$, from September 15, 2013 through Nov 12, 2013
- ISON becomes steadily brighter through this period
- ISON may remain spectacularly bright after December, 2013



*Vitali Nevski
and Artyom
Novichonok,
discoverers
(space.com)*

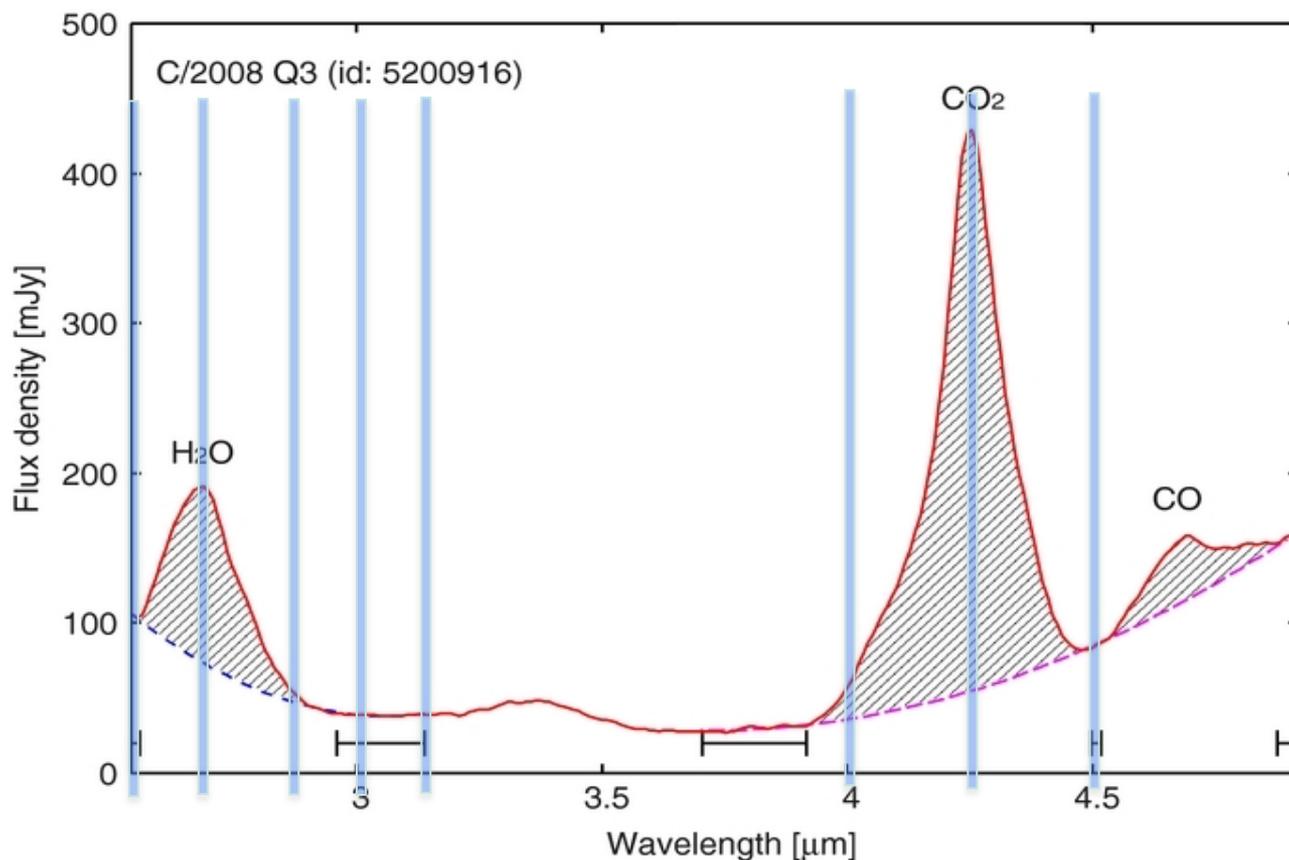




Cometary CO₂ and H₂O



- CO₂ and H₂O are primary cometary volatiles
- Found as ices in the nucleus
- They drive cometary activity
- Are these abundances related to where comets formed, what they formed from, or how they evolved?



Comet Spectrum C/2008Q3 Garradd, with eight spectral filters



Near-IR Science



- Small Bodies and Icy Satellites
 - Asteroids, comets, irregular satellites, Centaurs, Kuiper Belt Objects
 - Survey distributions of organics and volatiles
 - Surface composition: ices, hydrated minerals, mafic minerals
 - Atmospheres and activity of Titan, Io, Enceladus
- Terrestrial Planets
 - Atmospheric characterization
 - Surface composition
- Giant Planet atmospheres and aurorae

Spectrally rich 2.5 - 5 μm region: H_2O and OH (2.7 - 3 μm), NH_3 (2.7 μm), CH_4 etc. (3.2 - 3.6 μm), S=O (4 μm), CO_2 (4.3 μm), CO and xCN (4.6 - 4.8 μm)

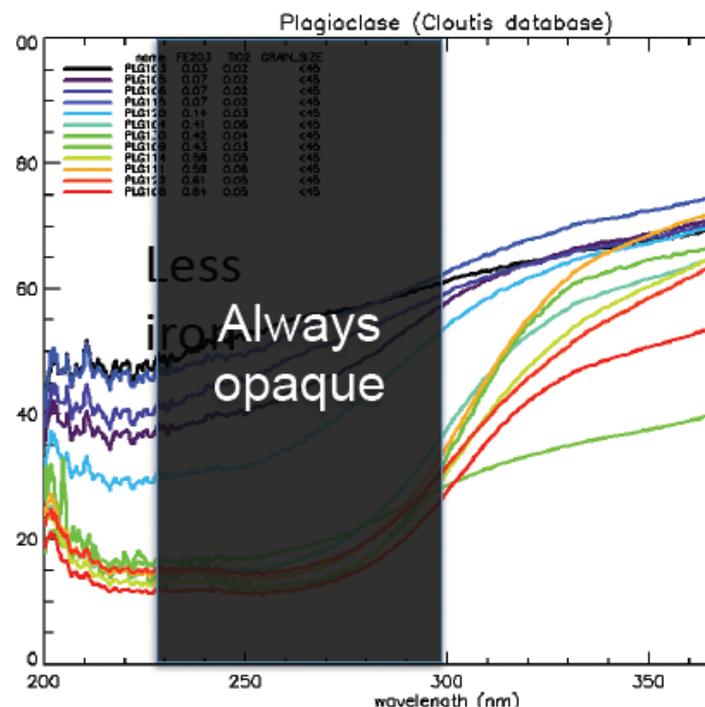




NUV/Visible Science



- Near Ultraviolet (composition)
- Space weathering of airless silicate bodes
 - NUV slope and mineral composition (figure shows oxygen-metal charge transfer)
- Planetary aurora, atmospheric compositions of comets, Io, Venus, Mars, gas giants
 - aurora and atmospheres: OH @ 308.5 nm, O @ 297nm, CN @ 385 nm





High Resolution Imaging

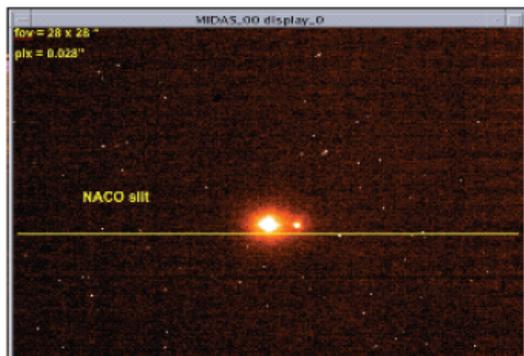


Fig 1. Spatially resolved spectroscopy of Pluto & Charon from the VLT/NACO. Protopapa et al. 2010

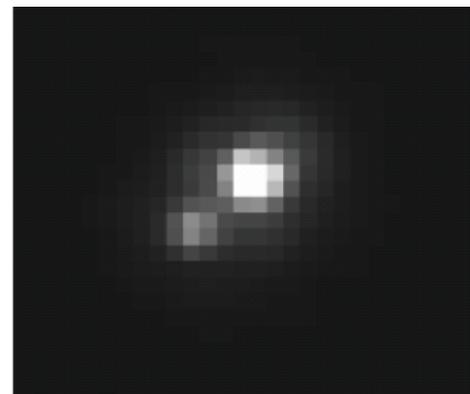


Fig 3. HST/HRC discovery of the binary centaur (42355) 2002 CR₄₆ with 300 sec of on-target integration. Noll et al. 2006.

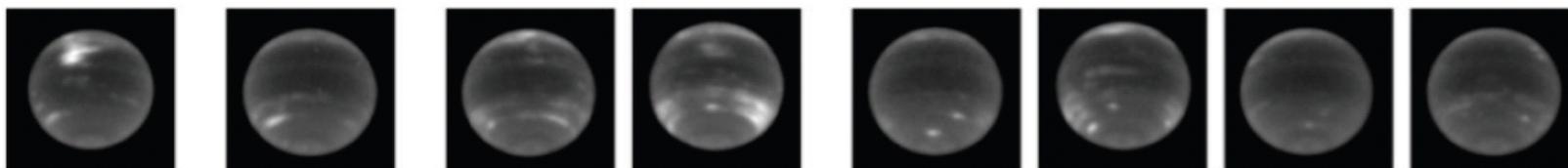


Fig. 2 Neptune (HST) in the 0.619 μm filter of WFPC2 in 1994, 1997, 2001-2002 and 2004-2007 (left to right).

Broad Science Goals:

- Understanding basic weather on giant planets: long-term monitoring of the giant planets at wavelengths shortward of 1.0 μm .
- Clean PSFs: finding & observing faint objects, often next to bright objects. Goals include the understanding of formation scenarios (asteroids, centaurs, TNOs, satellites and comets), ring/satellite systems, separate spectroscopy of close binaries, and discovery of faint NEOs.
- Astrometry without the atmosphere: vastly improved occultation predictions (e.g., for TNOs).



BRRISON and decadal science



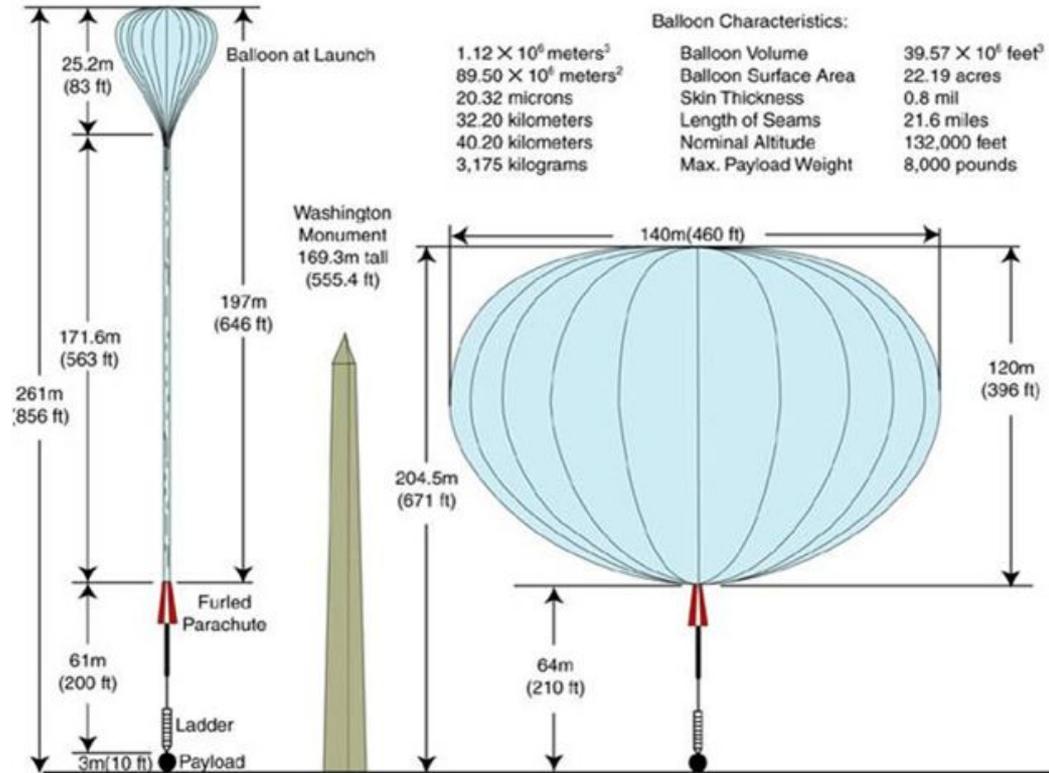
- BRRISON is a demonstration that important planetary science questions can be addressed with a balloon platform
 - Rapid response for unique target of opportunity
- BRRISON gondola designed to protect payload during nominal recovery
 - Enables re-use
- BRRISON gondola designed to accommodate >1 m telescope for decadal science balloon platform



Stratospheric Scientific Balloons



- Large He-filled balloon
- 150 ft to 400 ft in diameter
- 12 to 60 M feet³
- Carry up to 8000 lbs of payload
- Fly at 110,000 to 140,000 feet altitude





Launch from Fort Sumner, NM

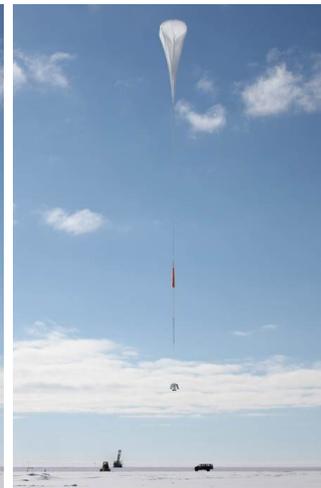
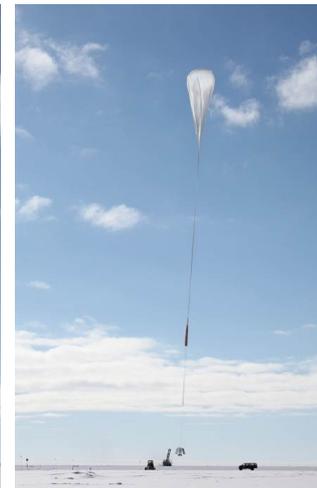
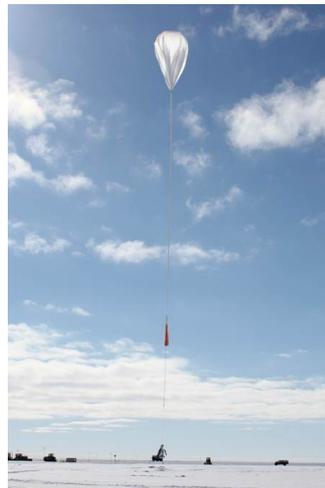


- BRRISON launch from Fort Sumner
- Launch in September-October 2013
 - One day flight
- Columbia Scientific Balloon Facility at Fort Sumner
 - Balloon launch and recovery support
 - Range safety
 - Can accommodate 3 – 4 payloads
- Payload recovered typically within 3 or 4 days after landing





Stratospheric Balloon Launch





BRRISON Flight Timeline

