from one version of the Olympics .



from one version of the Olympics ...



from one version of the Olympics ...













Olympic flame I seek to light





Cross-country skiing on Mars









Own the podium (humbly)!

HOW TO TELL CANADIANS HAVE WON THE MOST GOLD MEDALS:



Own the Assignment podium!

Albert

My pencil floated away

111

I gave 110% but my mark was only 99.99% because I wasn't allowed to move my pencil faster than the speed of light!

Pencil?!?

The 2010 CAP lecture (Canadian Association of Physicists)



Trapped atoms could be a "Rosetta Stone" for many aspects of modern physics. Theorists can now dream of using ultracold matter (left) to model physical systems ranging from black holes to globular star clusters (middle). With the help of a few lasers, a cloud of ultracold atoms could even be made to simulate gravity.



Here's visual proof of the <u>Pauli Exclusion</u> <u>Principle</u>

Two stable isotopes of lithium (Li ⁷, a boson, and Li ⁶, a fermion) are trapped in the same cloud at temperatures approaching absolute zero



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The fermions are kept from getting any closer together since they can't occupy the same quantum states

A long time ago in a galaxy far, far away ... Two and a half weeks ago A long time ago in a galaxy far, far away ...



in a classroom, um, right here

Opening our eyes to new perspectives



Planetary astrophysics is finally becoming a statistical science with a sample larger than one

There are "selection effects" in our current sample of exoplanets, biased towards giant planets in small orbits

But there are hints that our Solar System may not be as "typical" as astronomers had assumed for many decades

Alien worlds artist's conception

Alien worlds like Pandora Cameron's conception



Alien worlds like Pandora Cameron's conception



Alien worlds

Alien real estate





HD 80606

Star: HD 80606 Distance from Earth: 58.38 ly

Magnitude: 8.93 Mass: 0.9 (Sun = 1) Coordinates: RA = 09 22 37.5679 DEC = +50 36 13.397

Exoplanet HD 80606 b



The radial velocity variations of the star reveal reflex motions due to the unseen exoplanet

The saw-toothed RV curve means very high orbital eccentricity

residuals to orbital solution

 $P \approx 112 \text{ days}$



The radial velocity variations of the star reveal reflex motions due to the unseen exoplanet

The saw-toothed RV curve means <u>very high orbital</u> <u>eccentricity</u>

 $e_{HD80606} = 0.93$ $e_{Mercury} \sim 0.2$



The planet moves fastest when closest to the star

Its distance from the star changes dramatically in only a few days

To Earth HD 80606 b Orbit of Mercury (for scale) Planet shown at intervals of 24 hr. Small dots are spaced by 2.4 hr. Rotation period of planet is 36.83 hr. ° ° ° ° Periastron

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The extreme change in flux of sunlight will change the atmospheric conditions and the planet's weather on timescales of hours

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> Climate change? A few °C in a century?

The planet moves fastest when closest to the star

Its distance from the star changes dramatically in only a few days

The change in intensity of sunlight will change the atmospheric conditions and the planet's weather on timescales of hours

> Climate change? A few °C in a century? Try <u>400°C in a week</u>! A climate rollercoaster









nature

Vol 457 29 January 2009 doi:10.1038/nature07649



Rapid heating of the atmosphere of an extrasolar planet

Gregory Laughlin¹, Drake Deming², Jonathan Langton¹, Daniel Kasen¹, Steve Vogt¹, Paul Butler³, Eugenio Rivera¹ & Stefano Meschiari¹



Spitzer space observatory http://www.spitzer.caltech.edu

0.85-m infrared telescope $3 \mu < \lambda < 180 \mu$







models of atmospheric flow patterns after closest passage to the star

Alien worlds like Pandora Cameron's conception

Back to our regular programming





Search techniques

1)	RADIAL VELOCITY	Gravitational tug of war causes star to "wobble"			
,		<u>Radial Velocity</u> : Motion toward and away detected by Doppler shifts in stellar spectra			
2)	ASTROMETRY	<u>Astrometry</u> : Motion side to side (in plane of sky) detected in images of stars compared to background			
3)	TRANSIT	Eclipses by planets dim the star's light (very slightly)			
		Detected by temporary brightness decrease in light curve			
4)	MICROLENSING	Stars sometimes gravitationally lens background stars and the planet can contribute (very slightly)			
_		Detection of planet is small blip in lens light curve			
5)_	IMAGING	Detection of planet is small blip in lens light curve Planets reflect the starlight and this can be imaged			

<u>Search techniques</u> sensitivity to planet <u>mass</u>

Radial Velocity	Radial Velocities			
Astrometry	Astrometry: One 10-m Telescope Palomar Testbed Interferometer New Interferometer	- -		
Lensing	Microlensing			
Imaging	AO/Balloon/HST ^a			
	Space IR Interferometer ^a		1	
	Ven	1 us Earth	10 4 Uranus Neptund Sa Planet Mass (Earth M	100 1000 e Jupiter aturn ass Units)
	^a The direct im aging methods	are sensitive f	o planet size, albedo and t	temp erature, rather than mass.

Search techniques sensitivity to orbital radius

Radial Velocity	Radial Velocities			I		I
Astrometry	Astrometry: One 10-m Telescope					
	Palomar Testbed Interferometer		—			_
	New Interferom eter					
Lensing	Microlensing	-				_
Imaging	AO/Balloon/HST			_		
	Space IR Interferom eter		_			_
	Ven		∳ Jupiter	∮10 Saturn ∮	Å Neptune	100
		Earth Uranus		us		
		Orbital Radius (AU)				



Deming & Seager Nature (19 Nov 2009)