The size, shape, density and ring of the dwarf planet Haumea from a stellar occultation

J. L. Ortiz, P. Santos-Sanz, B. Sicardy, G. Benedetti-Rossi et al.

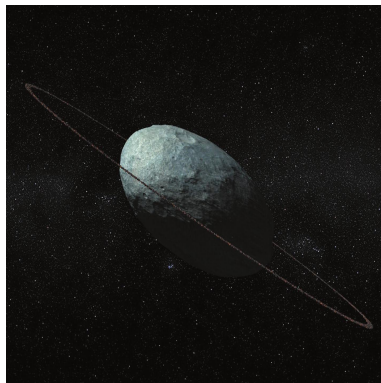Tópicos de Ocultações no Sistema Solar, 2017 B

Haumea is a **very elongated** and **rapidly rotating** body.

Haumea

In contrast to other dwarf planets its:

- Size
- Shape
- Albedo
- Density

are not well constrained.

Haumea

In contrast to other dwarf planets its:

- Size
- Shape
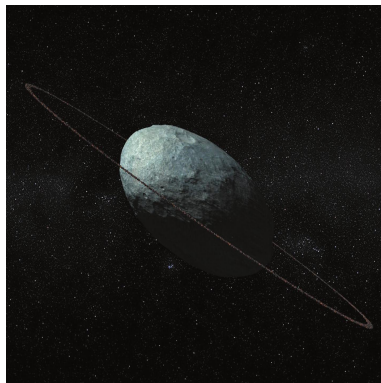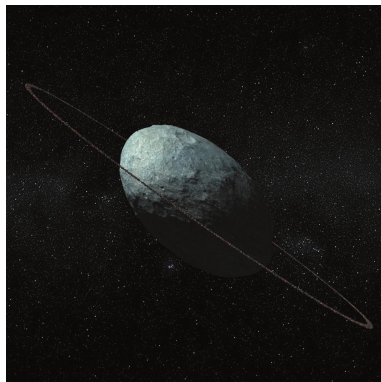- Albedo
- Density

are not well constrained.

Haumea

In contrast to other dwarf planets its:

- Size
- Shape
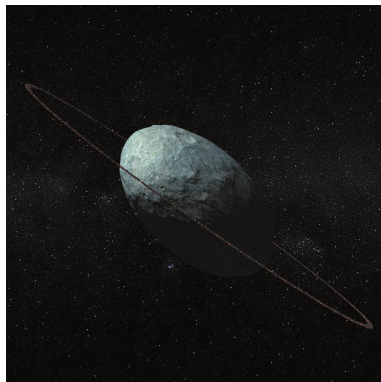- Albedo
- Density

are not well constrained.
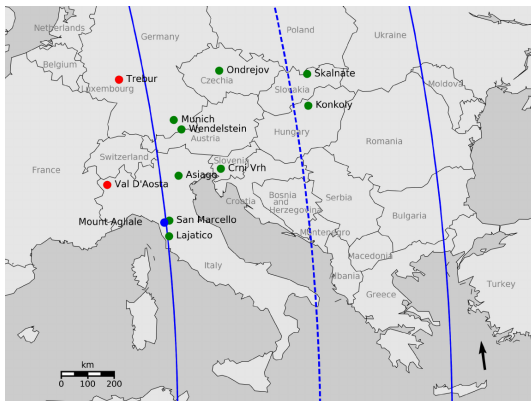
Haumea

In contrast to other dwarf planets its:

- Size
- Shape
- Albedo
- Density
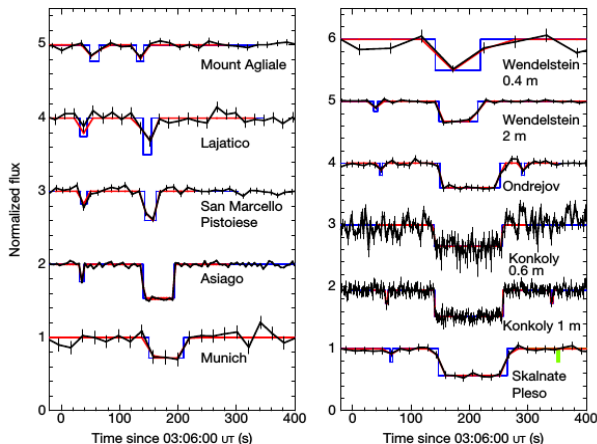
are not well constrained.

Stellar Occultation

Occultation of the star URAT1 533-182543 by the dwarf planet Haumea. Positive occultation detections were obtained on 21 January 2017, predicted time (around 3:09 ut).

Light Curves

Because the drops are abrupt, Haumea must lack a global Pluto-like atmosphere. An upper limit atmosphere is determined to be 15 nbar (N) and 50 nbar (CH4).

Square-well fits to the drops provide the times of star disappearance and reappearance at each site. Those times define an occultation chord for each site, and an elliptical fit to the extremities of the chord provides the instantaneous limb of Haumea.
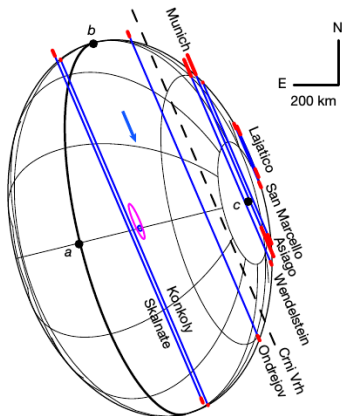
- $a = 1704 \pm 4\,km$
- $b = 1138 \pm 26\,km$
- $PA = -76, 3 \pm 1.2°$

Haumea's Ring

In addition to the main occultation, there are brief dimmings before and after the main event.
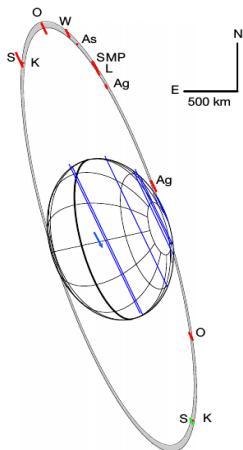
- Opacity $= 0.5$
- $a'_{ring} = 2287$

Columns
Sometimes it's useful to split the screen

Test why is it gray?

Here's a column where I can write a bunch of things.

There are all sorts of things I can do in paragraph form.

- Here's a column
- where I can itemize
- a bunch of things.

Blocks
...work in here too.

Sample Feynman Diagrams

Using `tikzfeynman.sty`, you can draw Feynman diagrams with ease. The default color follows the normal text, so it automatically changes color when you swap from a light to a dark background.
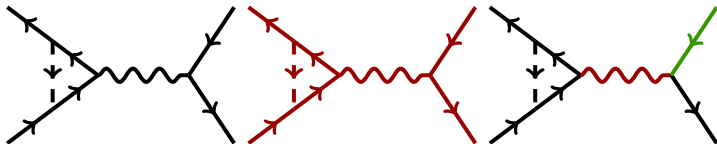
This makes it easy to copy and paste TikZ code from your paper! You can also import diagrams as images. Be sure to use an empty background and pdf/png format to ensure transparency.

More Feynman Diagrams

Note that TikZ code is preferred because it will automatically change colors and its easy to modify.
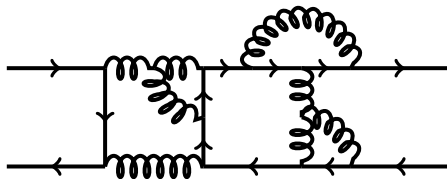
't Hooft operator
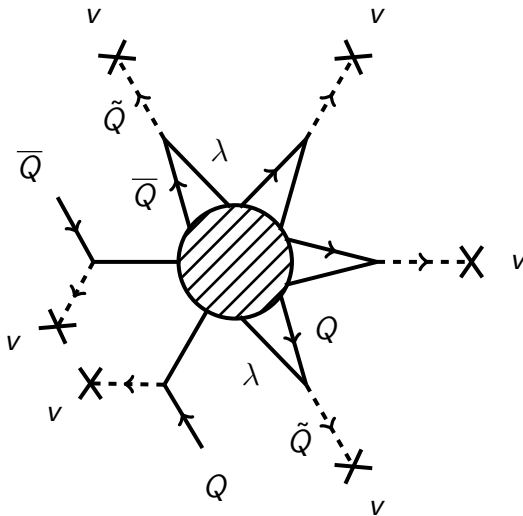
Even more diagrams
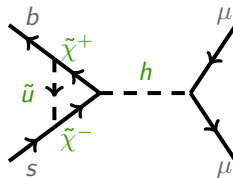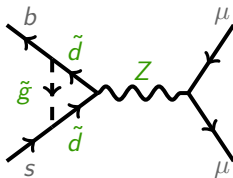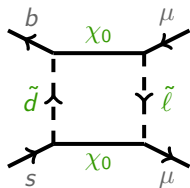
TikZ and Beamer are both built on PGF, so they play together very nicely.

Feynman diagrams and overlays

Penguin diagram
Allows FCNC sub-diagram to occur on-shell.

Here's an example where a sequence of overlays can be used to illustrate some useful physics.

Feynman diagrams and overlays

Penguin diagram
Allows FCNC sub-diagram to occur on-shell.

Here's an example where a sequence of overlays can be used to illustrate some useful physics.

Feynman diagrams and overlays

Penguin diagram
Allows FCNC sub-diagram to occur on-shell.

Here's an example where a sequence of overlays can be used to illustrate some useful physics.

Feynman diagrams and overlays

Penguin diagram
Allows FCNC sub-diagram to occur on-shell.

Here's an example where a sequence of overlays can be used to illustrate some useful physics.

Feynman diagrams and overlays

new physics

$b \rightarrow$ u_i $\rightarrow s$

Penguin diagram
Allows FCNC sub-diagram to occur on-shell.

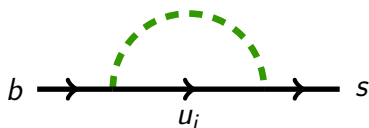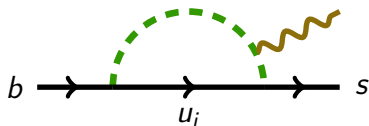Here's an example where a sequence of overlays can be used to illustrate some useful physics.

Other diagrams

Here's a nice picture illustrating Seiberg duality:
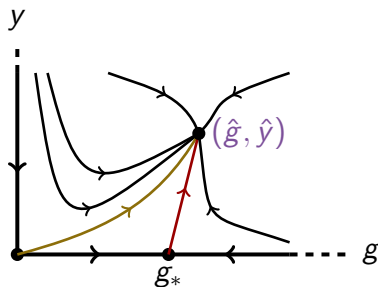
Image based on Strassler's 'unorthodox' review of SUSY gauge theory.

Including a table

Here's how you include a table.

Channel	Expt.	Bound (90% CL)	SM Prediction
$B_s^0 \to \mu^+\mu^-$	CDF II	$< 4.7 \times 10^{-8}$	$(4.8 \pm 1.3) \times 10^{-9}$
$B_d^0 \to \mu^+\mu^-$	CDF II	$< 1.5 \times 10^{-8}$	$(1.4 \pm 0.4) \times 10^{-10}$
$B_s^0 \to \mu^+ e^-$	CDF II	$< 2.0 \times 10^{-7}$	≈ 0
$B_d^0 \to \mu^+ e^-$	CDF II	$< 6.4 \times 10^{-8}$	≈ 0

Some equations

As if you didn't think Beamer could typeset equations...

$$\left(\frac{\Lambda}{m}\right)^b = \left(\frac{\Lambda_L}{m}\right)^{b_L} \quad \Rightarrow \quad \left(\frac{\Lambda_{N,F}}{m}\right)^{3N-F} = \left(\frac{\Lambda_{N,F-1}}{m}\right)^{3N-(F-1)}$$

$$G_k(z, z') = \frac{(R')^2}{R} G_y(x, x') = \frac{(R')^2}{R} \frac{xx'}{y} \frac{T(x, y) T(x', y)}{S(wy, y)}$$

$$f_c = \sqrt{\frac{1 - 2c}{1 - (R/R')^{1-2c}}}$$

Design Notes

- Watermarks need to really be transparent or else the background won't show through, e.g. if your background color is not plain white. Fortunately, PGF respects png transparency so watermark images can be saved as png images. Alternately, if you have a nice vector representation in TikZ, you can use the "opacity" option to make it semi-opaque.

- The second problem with watermarks is that even once you have a transparent image, how do you stick it behind the main text of each slide? This is surprisingly subtle. The solution is to put all watermarks the "sidebar right" region controlled by the outer theme style. Anything placed here will remain behind the main text of the screen.

- At the moment this is not implemented in this theme.

Aesthetic use of arrows and nodes
The WIMP Miracle

Contains factors of M_{Pl}, s_0, $\cdots$

$$\Omega_{\text{DM}} h^2 \approx 0.1 \left(\frac{x_{\text{f}}}{20}\right) \left(\frac{g_*}{80}\right)^{-\frac{1}{2}} \left(\frac{\langle \sigma v \rangle_0}{3 \times 10^{-26} \text{ cm}^3/\text{s}}\right)$$

$$\sim \left\langle \frac{\alpha^2 v}{(100 \text{ GeV})^2} \right\rangle$$

http://www.texample.net/tikz/examples/beamer-arrows/

Node decorations, arrows

The new scalar interactions take the form

$$\mathcal{L} \supset \left[\frac{1}{2}(\partial a)^2 + \frac{1}{2}\bar{\chi}\slashed{\partial}\chi\right]\left(1 + c_h\frac{v}{f}h + \cdots\right)$$

c_h depends on c_i and the Higgs mixing angles.

c_h controls direct detection

Mind Maps

usetikzlibrary{mindmap}
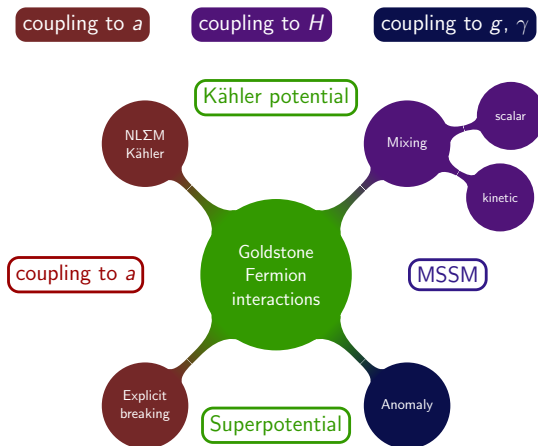
Fonts

Some comments on fonts.

- I use *XeLaTeX* and `fontspec` to specify local fonts. I try to only use readily available fonts on OS X and Adobe, but occasionally I will use a silly font like.

- To mitigate incompatibility with users without these fonts, I include them as user-specified commands in the main file:

Drawing arrows onto a plot

CMSSM

Ruled out

Well tempered neutralino

h^0 resonance

slepton co-annihilations

A^0 resonance

stop co-annihilations

σ_{SI} in cm^2

M_{DM} in GeV
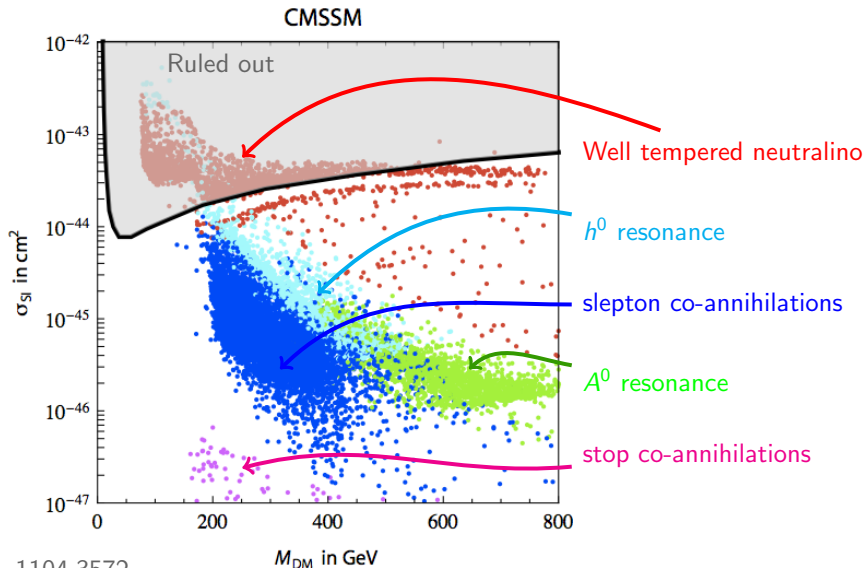
1104.3572

Miscellaneous

- Use `\only<2>` to only show something for one overlay
- Can also use <2->
- For example, can highlight a word
- If you use `\uncover<3->` you get a   ... see?
- Protip: use `\textbackslash` to get a backslash

Miscellaneous

- Use \only<2> to only show something for one overlay
- Can also use <2->
- For example, can highlight highlight a word
- If you use \uncover<3-> you get a   … see?
- Protip: use \textbackslash to get a backslash

Miscellaneous

- Use `\only<2>` to only show something for one overlay
- Can also use <2->
- For example, can highlight highlight a word
- If you use `\uncover<3->` you get a space ... see?
- Protip: use `\textbackslash` to get a backslash

Problems and Kludges
Things to work on

- There seems to be a bug in Beamer where the footnote color (defined using `setbeamercolor{footnote}` and `setbeamercolor{... mark}`) contaminates the normal text color. For now I suggest not using footnotes. They're of questionable use in a talk, anyway.
- Even though comment text is footnote-sized, it still has normal text line spacing. The `setspace` environment can fix this, but it forces a newline and it seems to make footnotes disappear.
- Make color theme more uniform and based on palette colors.

Problems and Kludges
XeLaTeX, LuaLaTeX

XeLaTeX doesn't allow one to use
setbeamertemplate[background canvas] multiple times
(e.g. to have one slide with a different background). A fix is to
include \def \pgfsysdriver{pgfsys-dvipdfmx.def} before
the documentclass, but this ends up breaking the arrows
pointing to nodes.
In principle, LuaLaTeX can solve this, but that also requires some
work since it only looks at Open Type Fonts (e.g. Gill Sans is not
available by default).

http://tex.stackexchange.com/questions/29491/
xelatex-preventing-beamer-from-using-different-backgrounds

Acknowledgements

I have borrowed heavily (and learned much) from Marco Barisione's Torino theme, which can be found one his blog. I have also learned and borrowed from Shawn Lankton's Keynote theme.

These can be found at

- http://blog.barisione.org
- http://www.shawnlankton.com/2008/02/beamer-and-latex-with-keyno

I've tried to maintain lots of comments in the .tex and .sty files to help other template-designers. At the moment it's all a jumbled mess, though!

Extra page: Additional hints
Look, it doesn't add to the total page count!

- Be sure to turn off any auto-notifiers (e.g. GMail)
- Consider using a PDF-to-keynote program; http://www.cs.hmc.edu/~oneill/freesoftware/pdftokeynote.html.
- Don't ever go over time.
- TikZ transparency trick: http://www.texample.net/tikz/examples/transparent-png-overlay/
- Use addtocounter{framenumber}{-1} for extra slides (like this one) to prevent it from screwing up the page numbering.