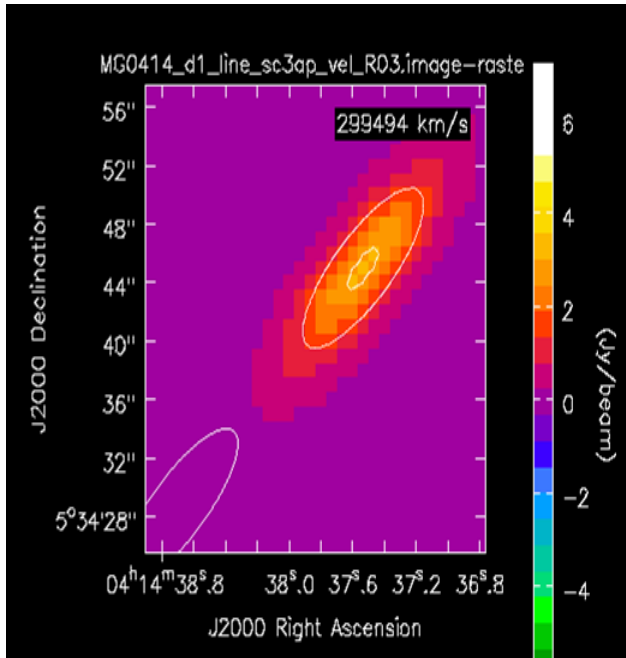


Deep Space Exploration Society Science Meeting



April 27, 2020

Dr. Richard Russel

DrRichRussel@netscape.net

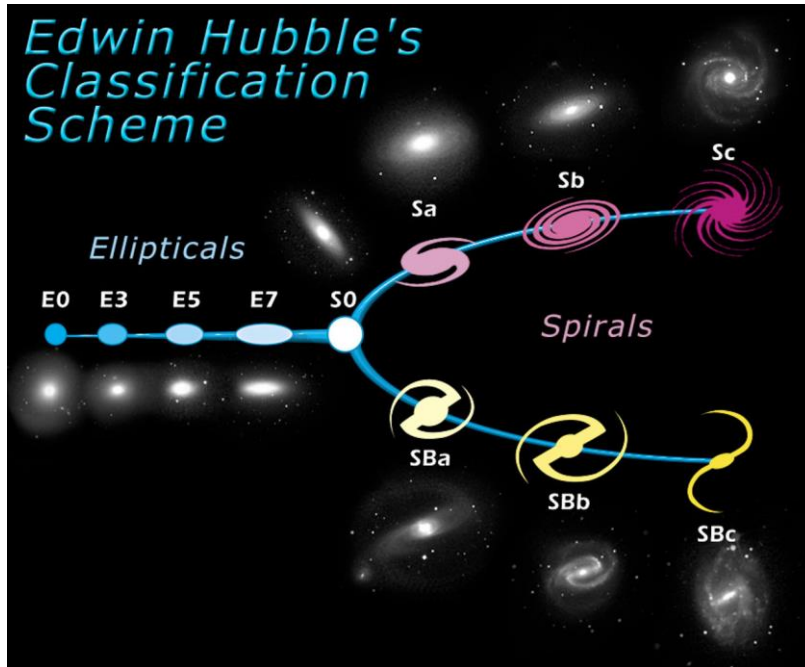
MG0414+0534
Gravitational Lens

Information

- 9 ft Dish – taking 2-3 day measurements at 5 degree Declination intervals
- SuperSID – still taking data – low flare activity
- Radio Jupiter – still need to get a new receiver and setup at site (new member project?)
- Pulsar – coordinating a time to take equipment to site for measurements
- SARA East Conference – recommend everyone virtually attend: August 2-5
- New DSES publications tab on website – posted papers that have been published in journals

Science Training

Galaxy Classifications



TYPES OF GALAXIES

ASTRONOMERS SORT GALAXIES using the "tuning fork" classification scheme developed by American astronomer Edwin Hubble in the 1920s. According to this system, galaxies come in three basic types: elliptical (represented by the handle of the fork), spiral (the prongs) and irregular (shown separately). The smallest galaxies, known as dwarfs, have their own uncertain taxonomy.

Within each of the types are subtypes that depend on the details of the galaxy's shape. Going from the top of the tuning fork to the bottom, the galactic disk becomes more prominent in optical images and the central bulge less so. The different Hubble types may represent various stages of development. Galaxies start off as spirals without bulges, undergo a collision during which they appear irregular, and end up as ellipticals or as spirals with bulges.

G.K. and F.v.d.B

IRREGULARS



DWARF TYPES



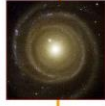
ELLIPTICALS



BARRED SPIRALS



NORMAL SPIRALS



N. A. SHARP/INGO/IAURA/NSF [M82], B. KEEL/HALL TELESCOPE/DWELL OBSERVATORY [M32], R. SCHULTE-LADBECK/V. HOPPM. CRONE/ASTROPHYSICAL JOURNAL [blue compact dwarf], INGO/IAURA/NSF [Small Magellanic Cloud], DAVID MALIN, G. ANGLO-AMERICAN OBSERVATORY [Leo I], INGO/IAURA/NSF [M89, M49, M110, M84], R. BRANCO/IN. WILNER/A. BLUCK/INGO/IAURA/NSF [NGC 660], A. BLUCK/INGO/IAURA/NSF [NGC 7479], F. CESLAK/A. BLUCK/INGO/IAURA/NSF [M58], R. KEEL/R. BUTA/S. FUNNELL/CENRO TOLU/INTER-AMERICAN OBSERVATORY, CHILE [NGC 7217], J. FERGUSON/UT/AT/FTO/INGO/IAURA/NSF [M51]

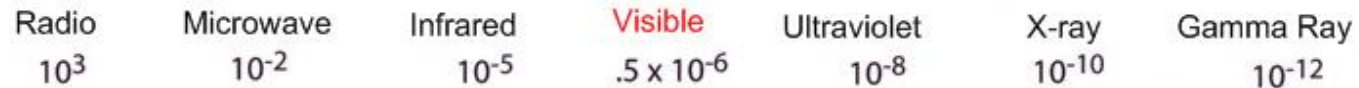
<http://www.universe-review.ca/I05-01-galaxytypes.jpg>

The Electromagnetic Spectrum

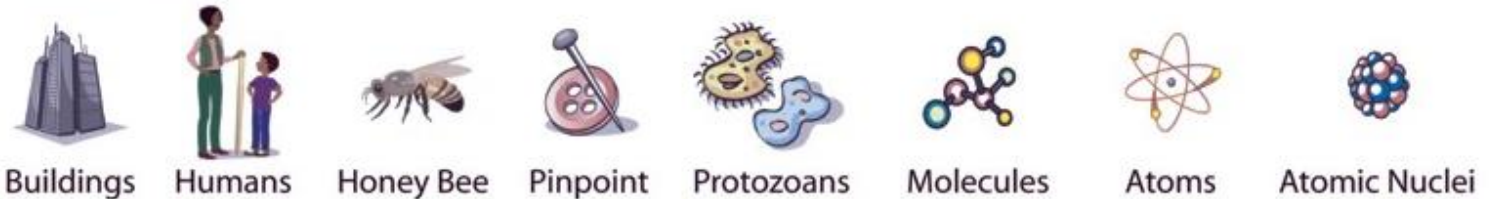
Penetrates Earth Atmosphere?



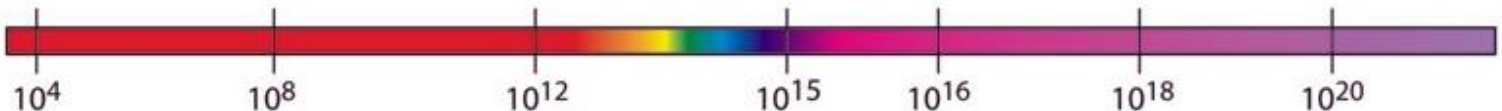
Wavelength (meters)



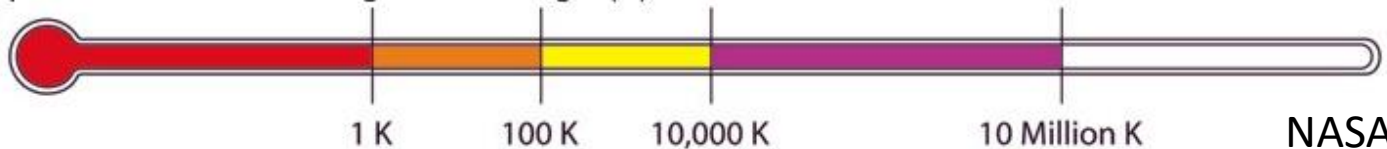
About the size of...



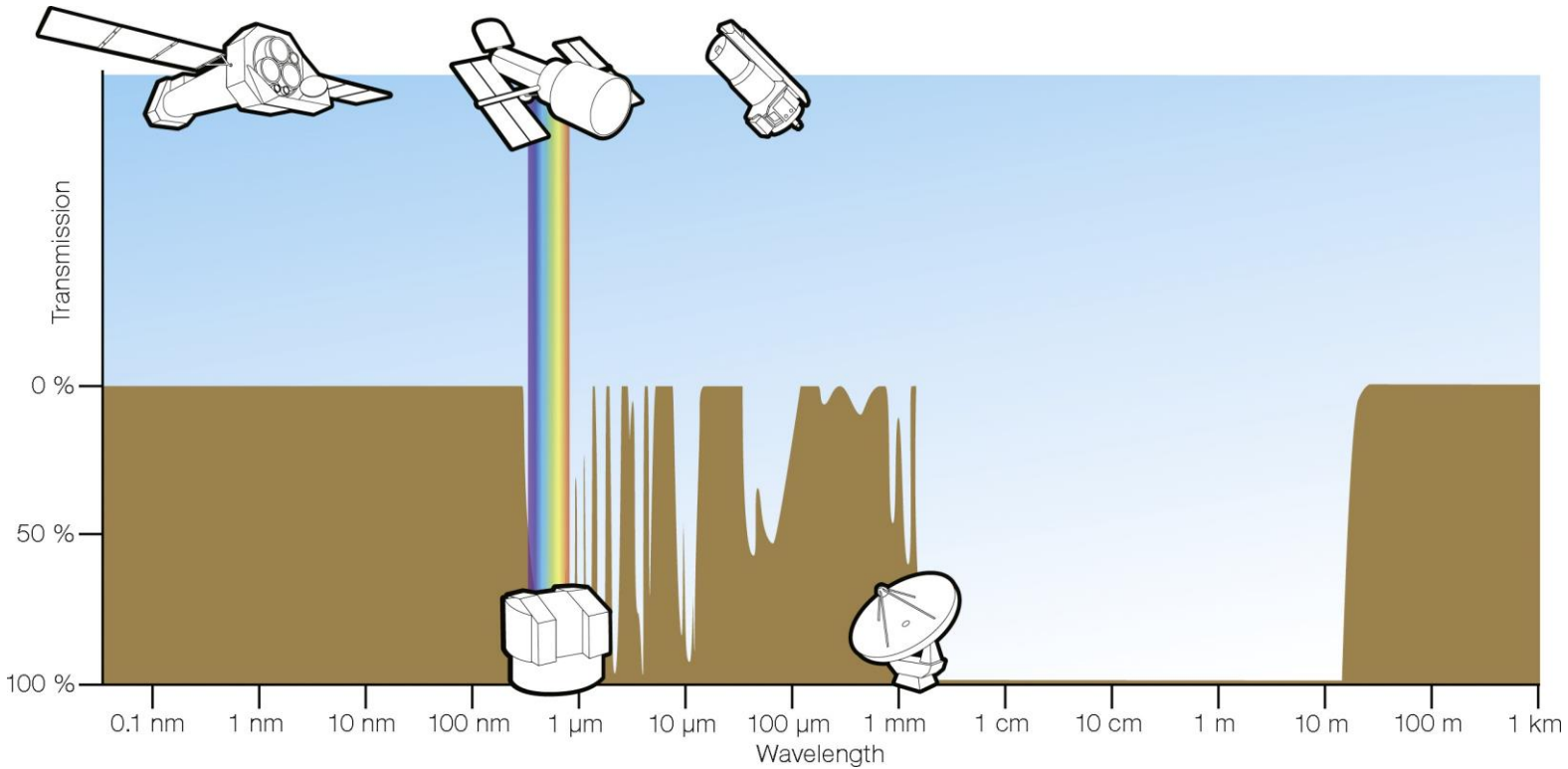
Frequency (Hz)



Temperature of bodies emitting the wavelength (K)



Atmospheric Window



ALMA Opacity Chart

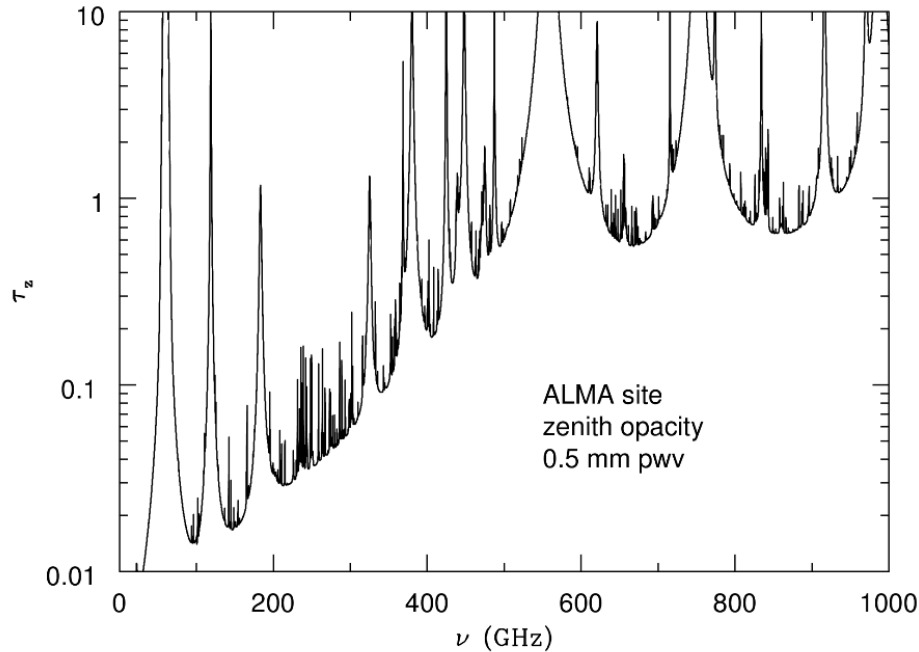
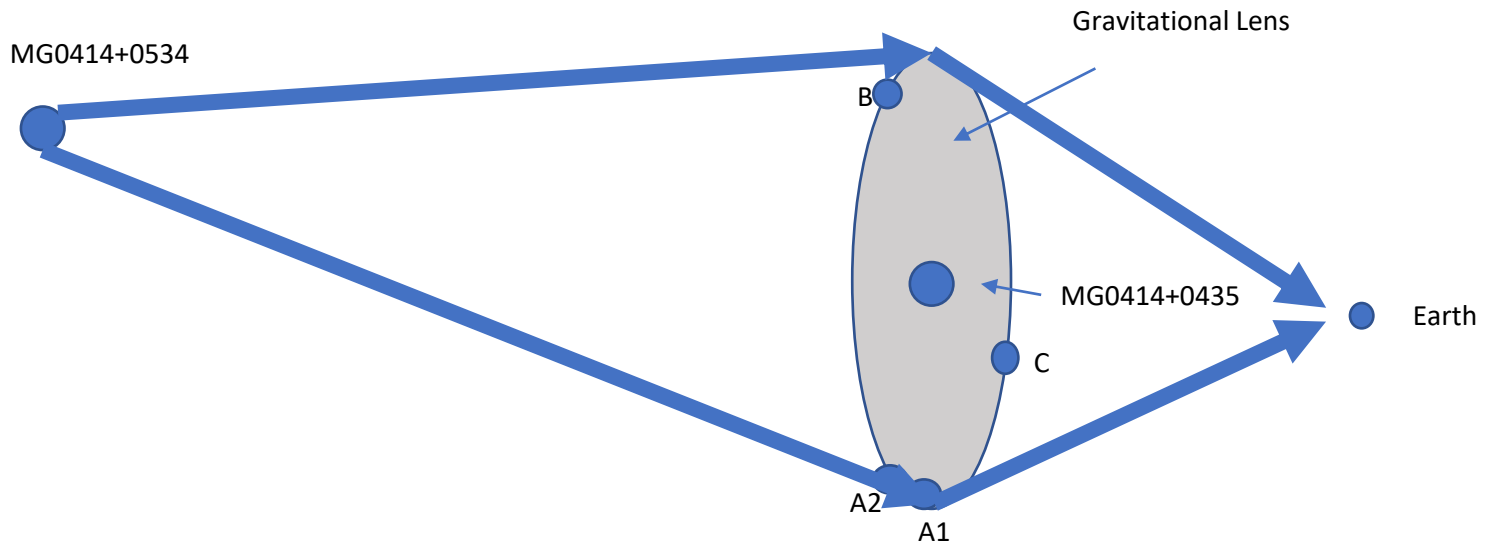


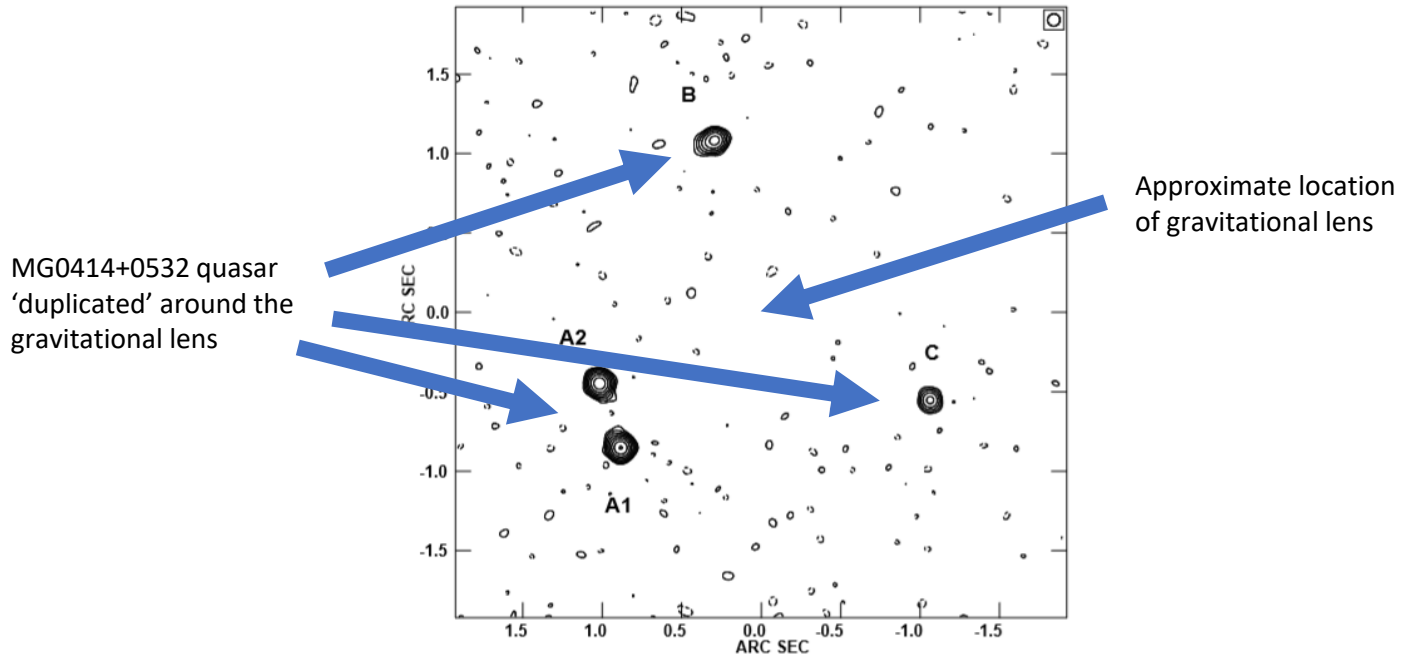
Figure 1.3: Zenith atmospheric opacity τ_z for 0.5 mm pwv at the Atacama Large Millimeter Array (ALMA) site. Water-vapor absorption is responsible for the broad opaque bands centered on 557 GHz, 752 GHz, and 970 GHz. The plotted data are from <https://almascience.eso.org/about-almalweather/atmosphere-model>.

How Gravitational Lenses Work

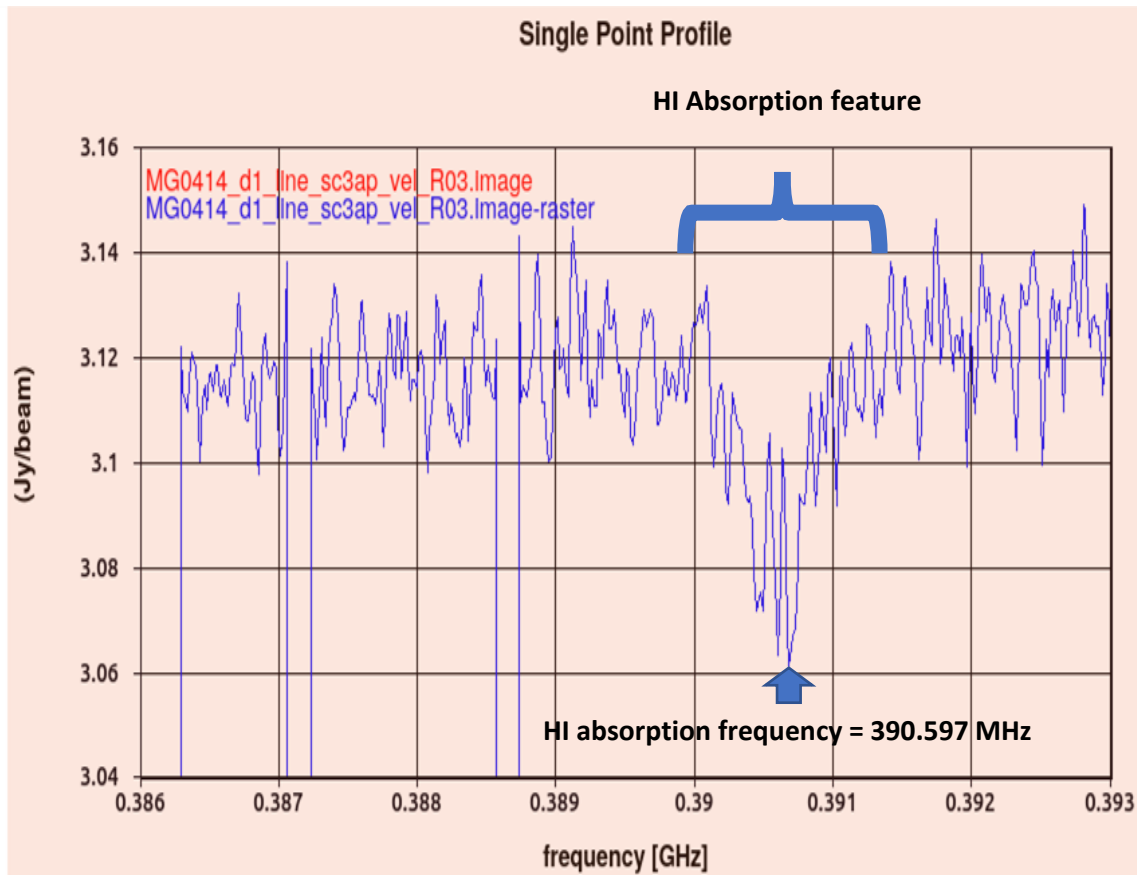
Gravitational Lens Theory



MG0414+0532 Observation

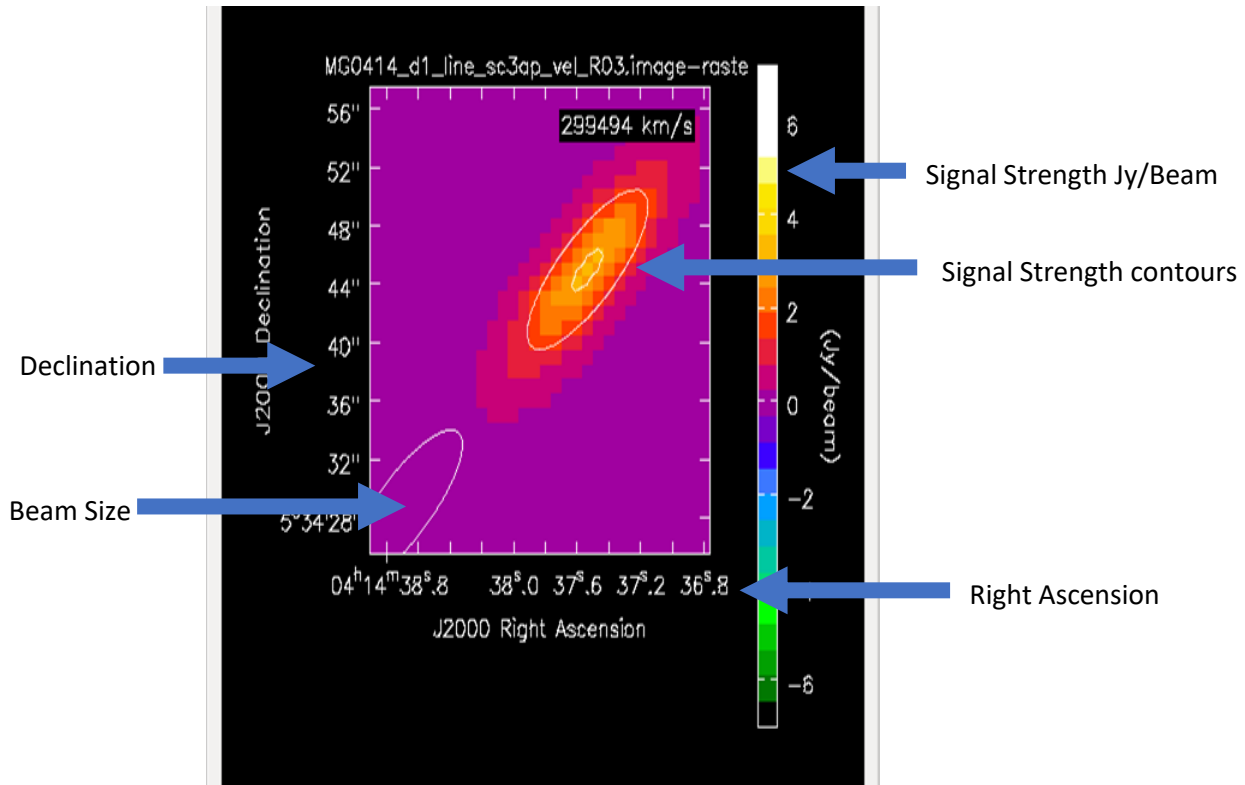


HI Absorption Line Reveals Age of MG0414+0532



MG0414+0532

Archive Data Reduction – Dr. Russel



Using COSMOS to determine Redshift Data

MG0414+0435
Gravitational Lens

iCosmos

Enter Cosmological Parameters

Redshift:

Ω_m :

Ω_Λ :

Ω_r :

w_0 :

w_a :

H_0 :

Reference: ☐

Submit Query

$z_0 = 0.9584$

$\Omega_m = 0.3$

$\Omega_\Lambda = 0.7$

$\Omega_k = 0$

$\Omega_r = 0.0$

$w_0 = -1.0$

$w_a = 0.0$

$H_0 = 70$

Results

Comoving Distance at Redshift 0.9584 = 3201.4048 Mpc or 10.4416 Gly

Angular Diameter Distance at Redshift 0.9584 = 1634.7042 Mpc or 5.3317 Gly

Luminosity Distance at Redshift 0.9584 = 6269.6311 Mpc or 20.4488 Gly

Comoving Volume at Redshift 0.9584 = 137.4391 Gpc³

Age of The Universe Today = 13.4694 Gyr

Age of The Universe at Redshift 0.9584 = 5.9215 Gyr

Perturbation Growth Factor at Redshift 0.9584 = 0.4853

Gravitational lens
observed age

Distance between source and lens
= 5982 - 3201 = 2781 MPc

MG0414+0532
Quasar Source

iCosmos

Enter Cosmological Parameters

Redshift:

Ω_m :

Ω_Λ :

Ω_r :

w_0 :

w_a :

H_0 :

Reference: ☐

Submit Query

$z_0 = 2.6365$

$\Omega_m = 0.3$

$\Omega_\Lambda = 0.7$

$\Omega_k = 0$

$\Omega_r = 0.0$

$w_0 = -1.0$

$w_a = 0.0$

$H_0 = 70$

Results

Comoving Distance at Redshift 2.6365 = 5982.0074 Mpc or 19.5107 Gly

Angular Diameter Distance at Redshift 2.6365 = 1644.9904 Mpc or 5.3652 Gly

Luminosity Distance at Redshift 2.6365 = 21753.57 Mpc or 70.9507 Gly

Comoving Volume at Redshift 2.6365 = 896.6634 Gpc³

Age of The Universe Today = 13.4694 Gyr

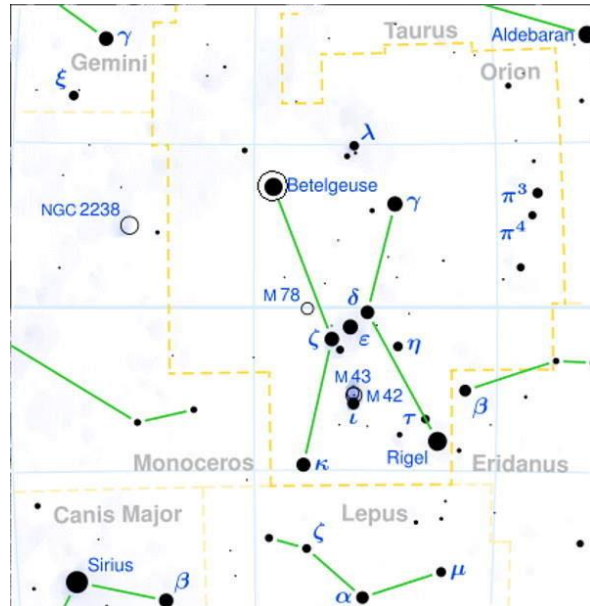
Age of The Universe at Redshift 2.6365 = 2.4328 Gyr

Perturbation Growth Factor at Redshift 2.6365 = 0.2726

Source
observed age

Betelgeuse Update

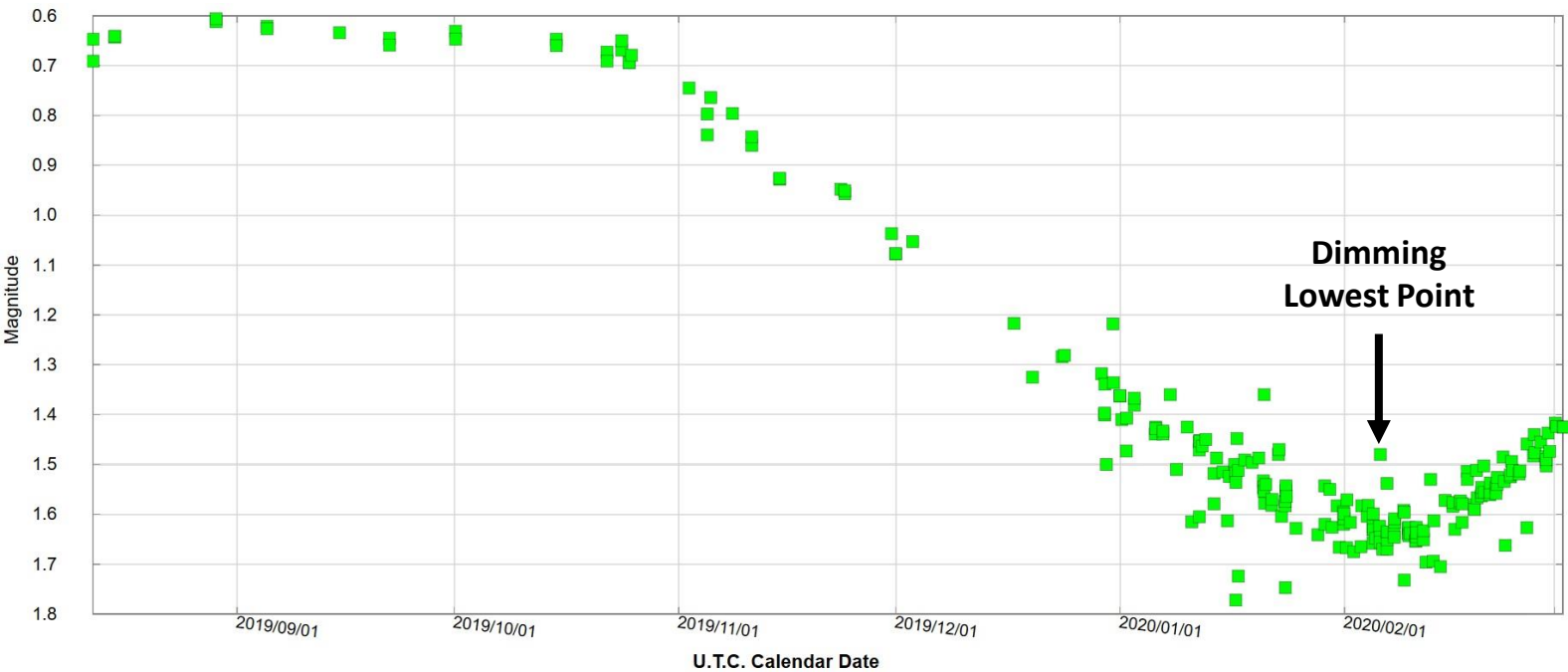
Betelgeuse (Orion Constellation)



- Red super giant
- Distance 700 light years
- RA: 05h55m10.3s
- DEC: +07° 24' 25.4''

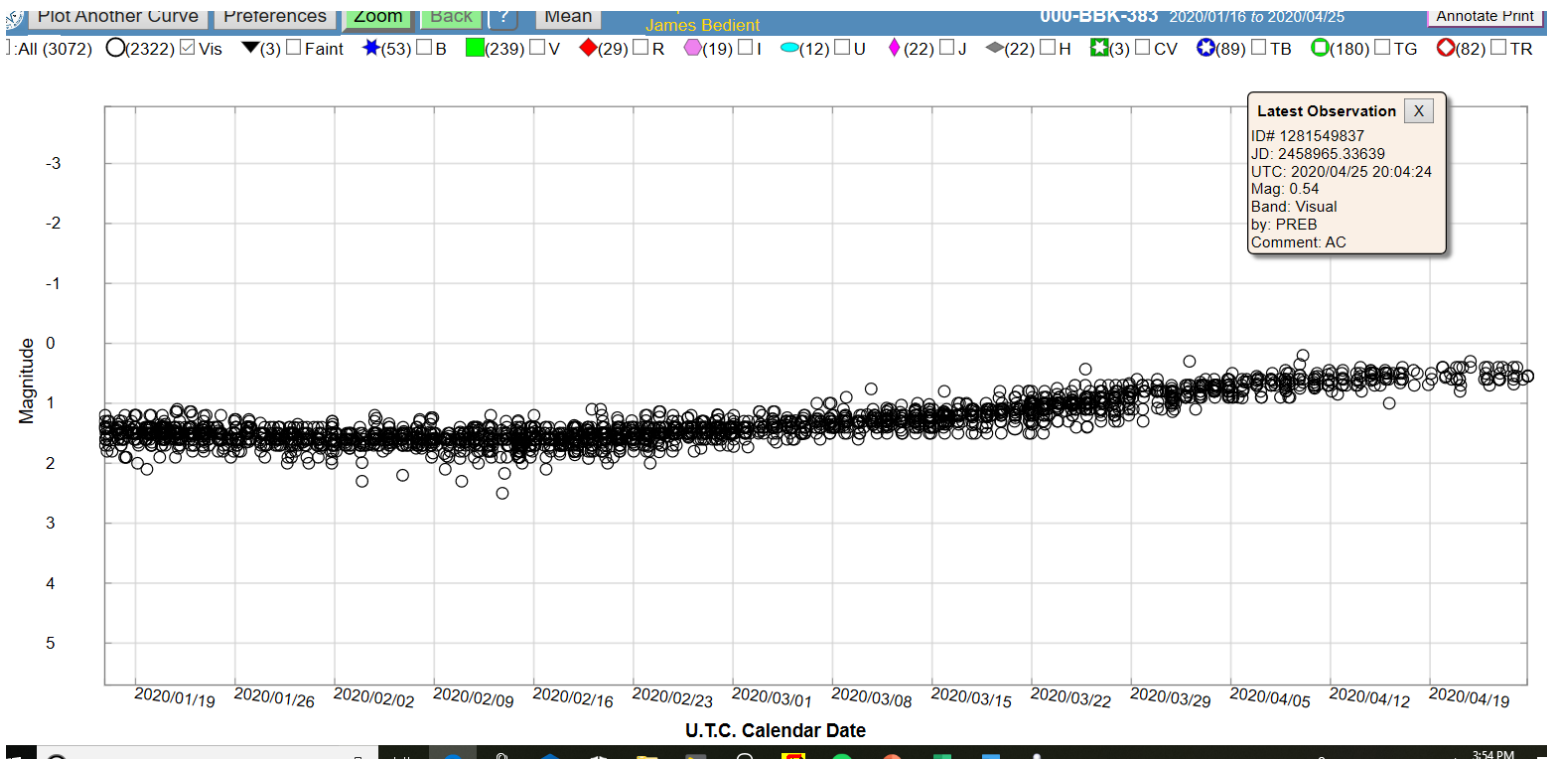
Source: Wikipedia

Betelgeuse Magnitude History



<https://www.aavso.org>

Latest Betelgeuse Light Curve



Black Hole or Neutron Star?

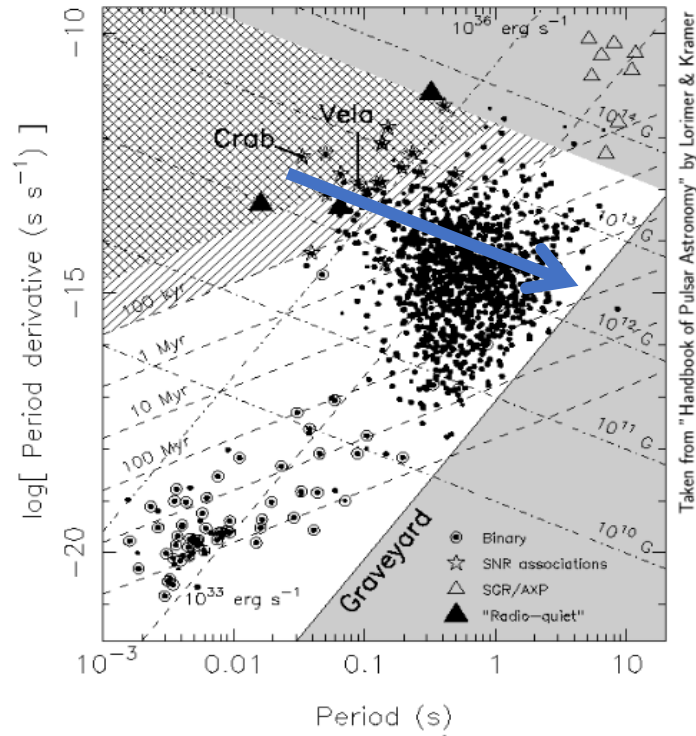
Parameter	Black Hole Requirement	Neutron Star Requirement	Betelgeuse
Mass	2.17Msun	1.4 Msun	1.5 Msun from a 5-30 Msun star

Opinion is that Betelgeuse will turn into neutron star / pulsar

It depends on how much mass is lost during supernova

Source: https://en.wikipedia.org/wiki/Black_hole

Betelgeuse Pulsar Life Prediction



Note: Since there is no binary star – the neutron star will wind down and will not end up as a millisecond pulsar

Source: www.Wikipedia.org

Supernova Early Warning System

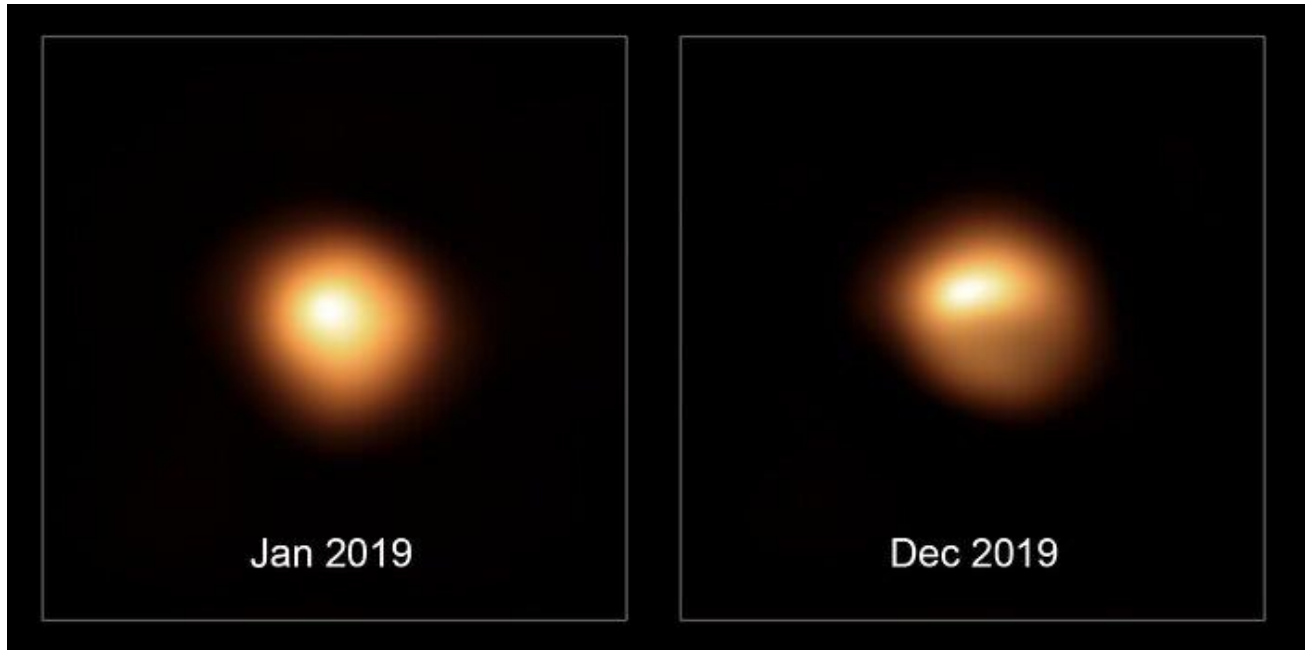
(Supernova Early Warning System) network [<https://snews.bnl.gov/>], which would send an alert if indicator neutrinos were detected.

The gravitational collapse supernova releases most of its binding energy in the form of 10-30 MeV neutrinos.

A photon may take hours to days to pass through the solar envelope, but a neutrino will pass through immediately. This will provide an early warning to optical observers.

<http://hep.bu.edu/~superk/gc.html>

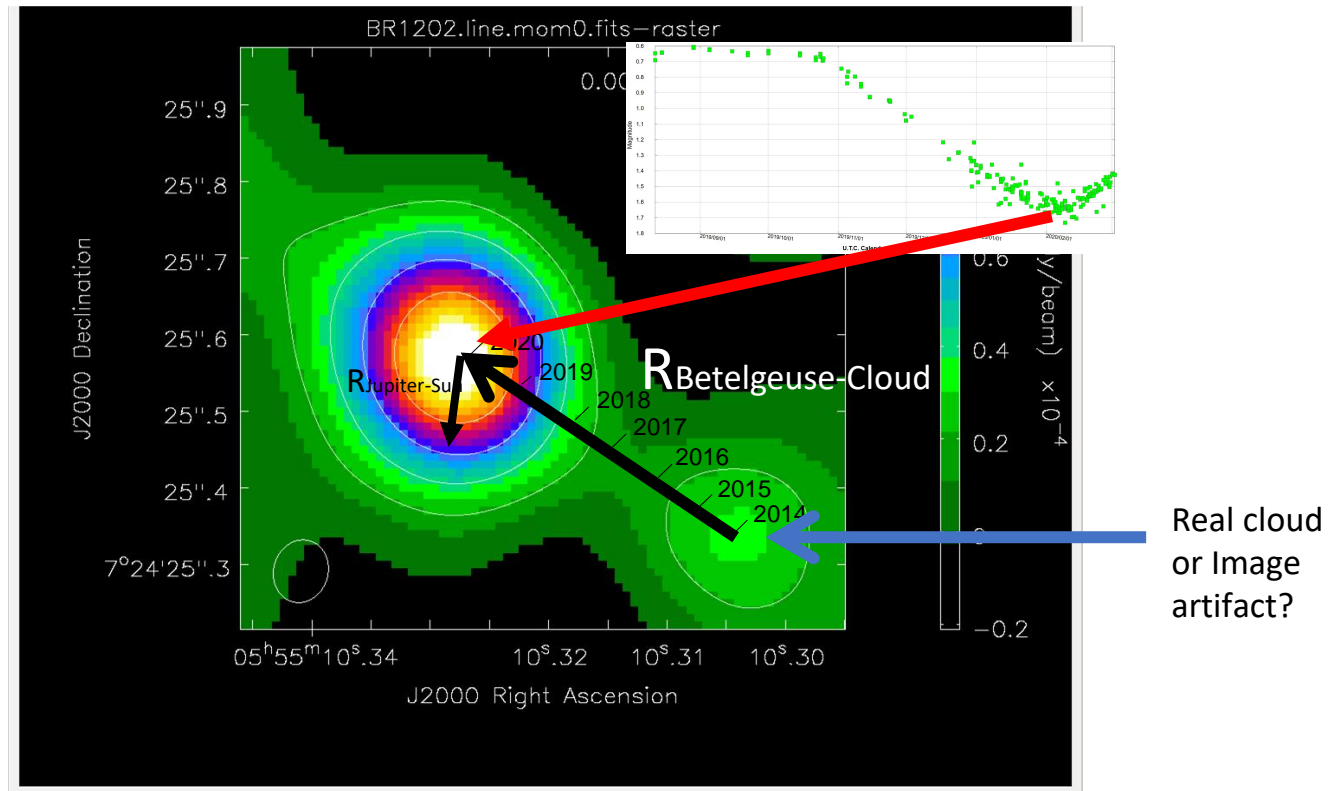
Betelgeuse Images



Source: <https://media.breitbart.com>

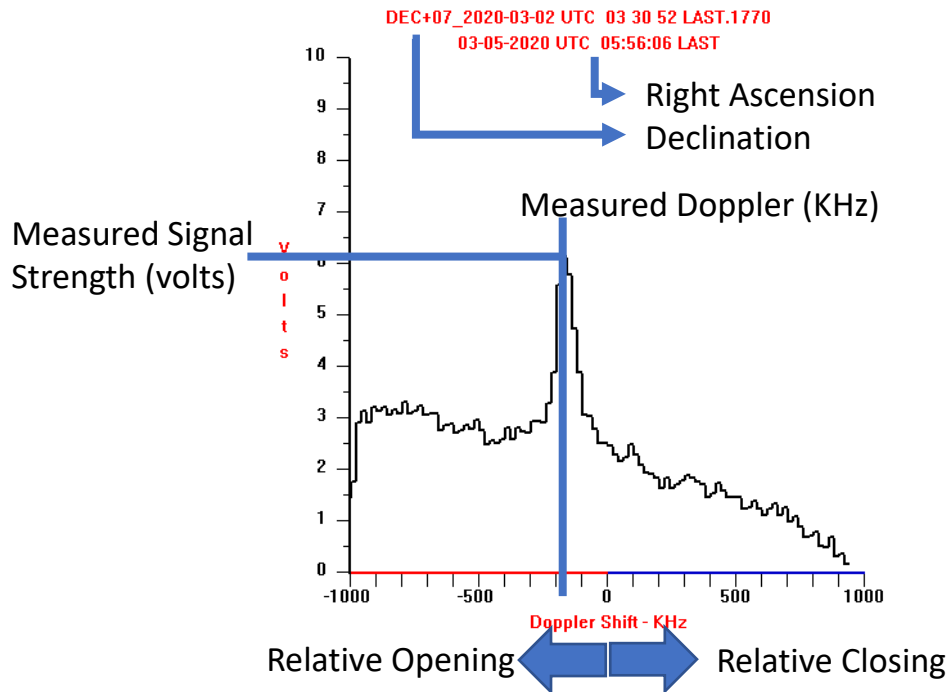
What if the image artifact was a real cloud?

Would it be able to move at the right velocity to dim the brightness per the plot?



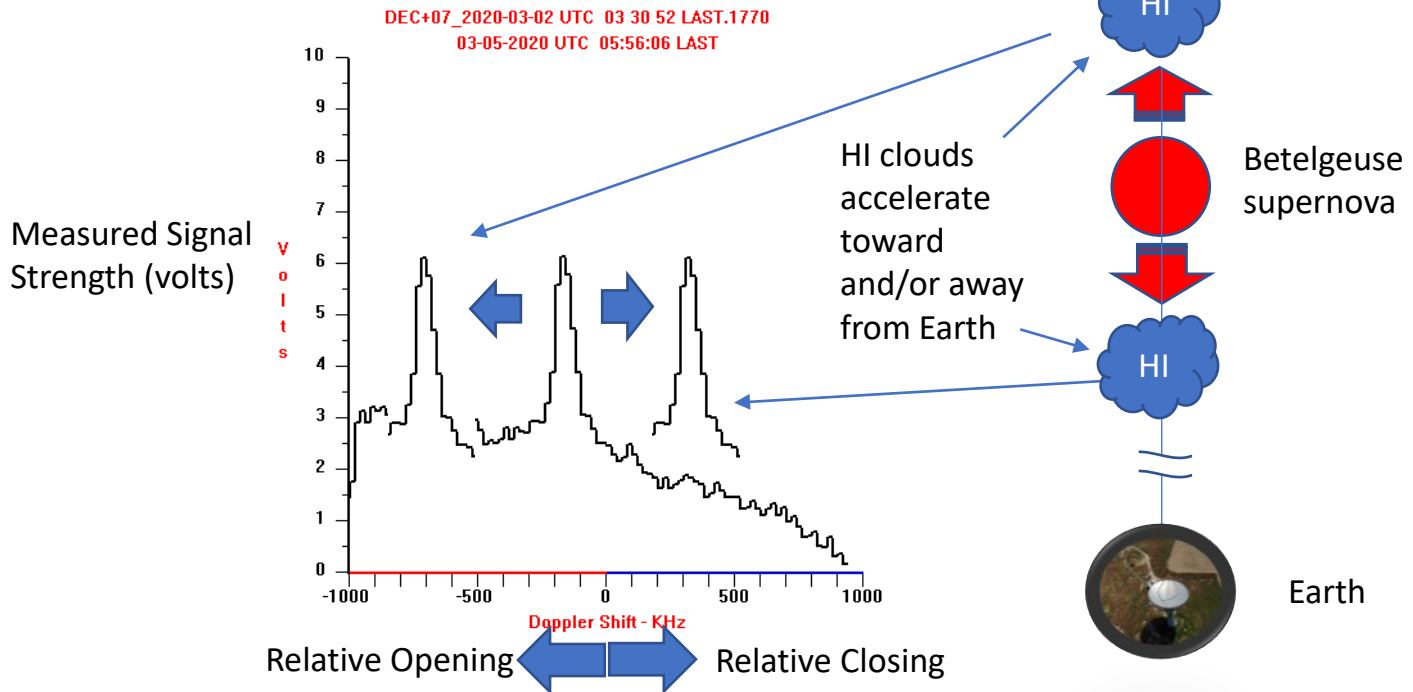
Betelgeuse HI Measurement

March 5, 2020



ONLINE STATUS	
Mode	= SPEC
Autosave	= On
Noise Signal	= Off
ReScan	= On
Scan Rate	= 4x
Que	= Off
Spec Gain	= 10
Cont Gain	= 01
Rest Corr	= 00
IF BW KHz	= 30
Upper KHz	= + 1000
Lower KHz	= - 1000
Spec Int	= 001.00
Cont Int	= 000.30
Spec Offset V	= 002.50
Cont Offset V	= 000.00
IF Gain dB	= 025.00
Time/Step	= 001.00
KHz = 935 Vdc = 0.161	

Betelgeuse Possible HI Measurement After Supernova



Questions?