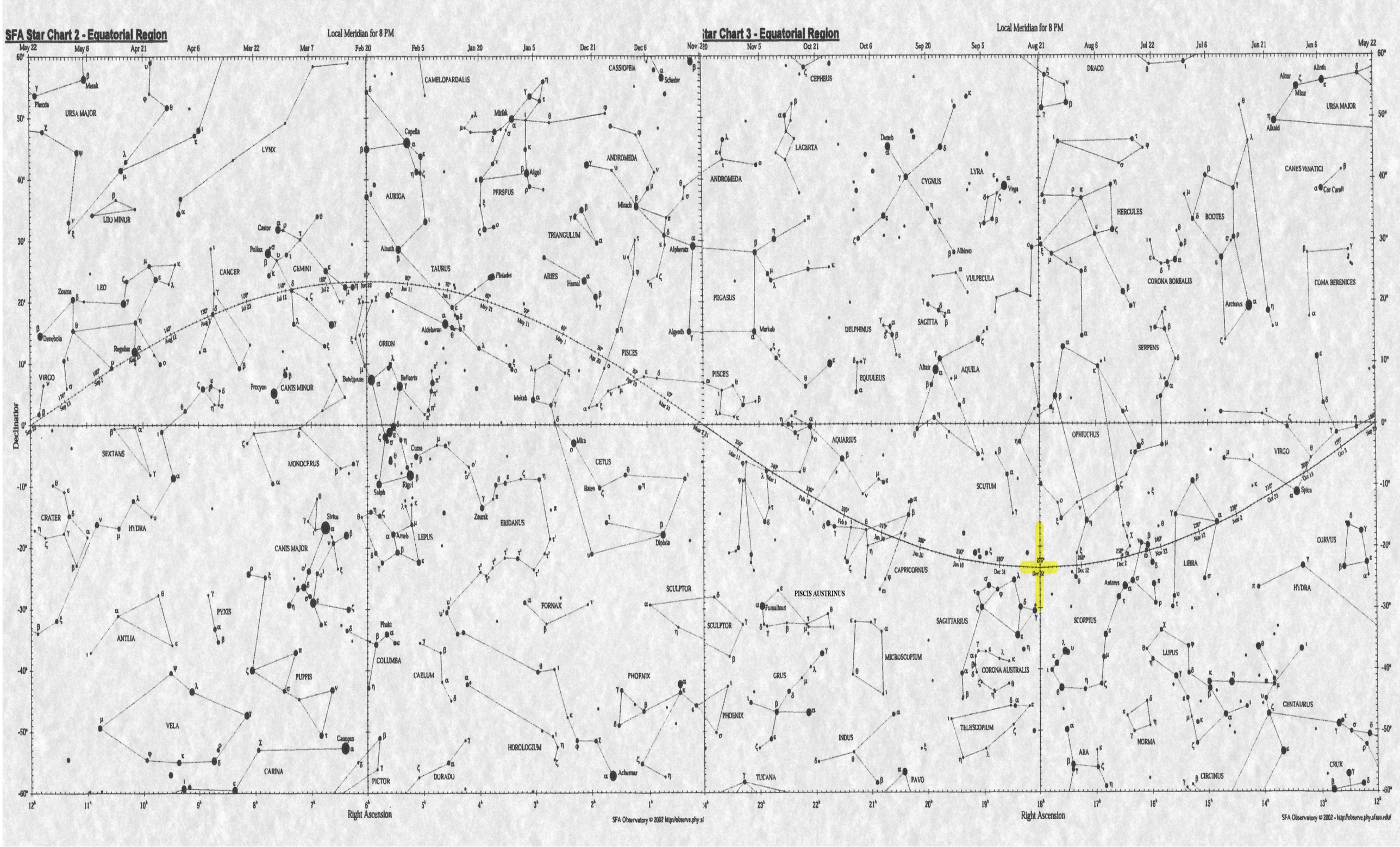
WINTER SOLSTICE

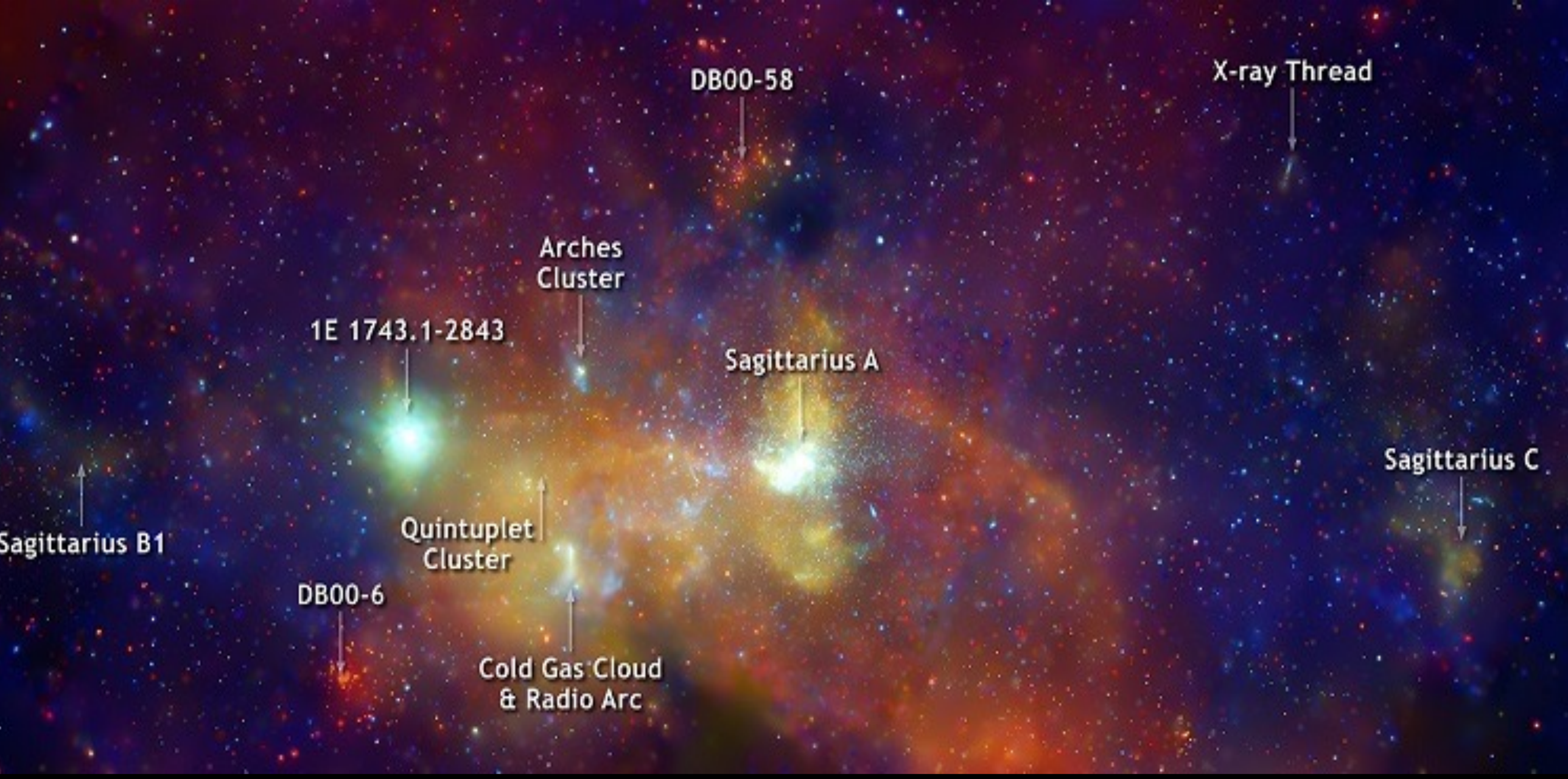


WINTER SOLSTICE


SUMMER
SOLSTICE
WINTER
SOLSTICE

Sunrise

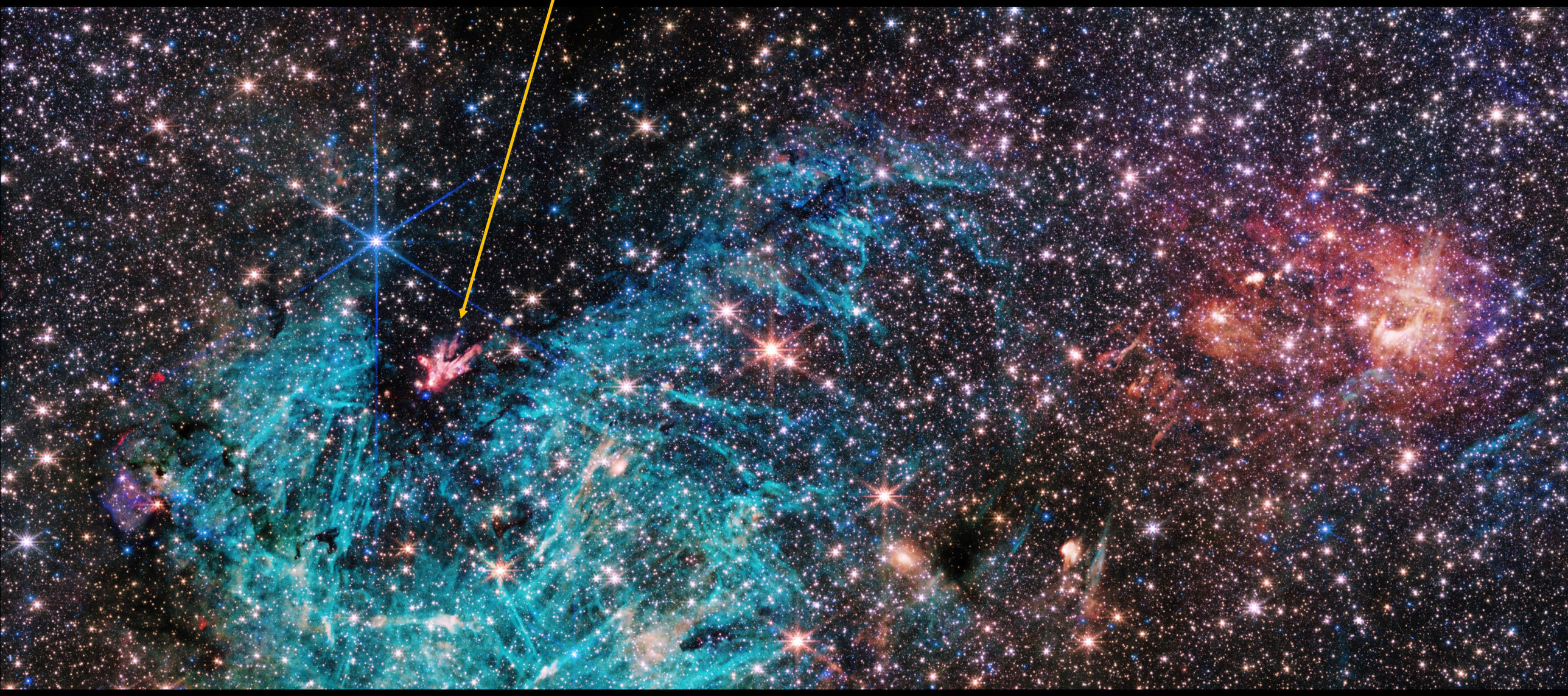

Sunset



Our Milky Way
Galactic Center

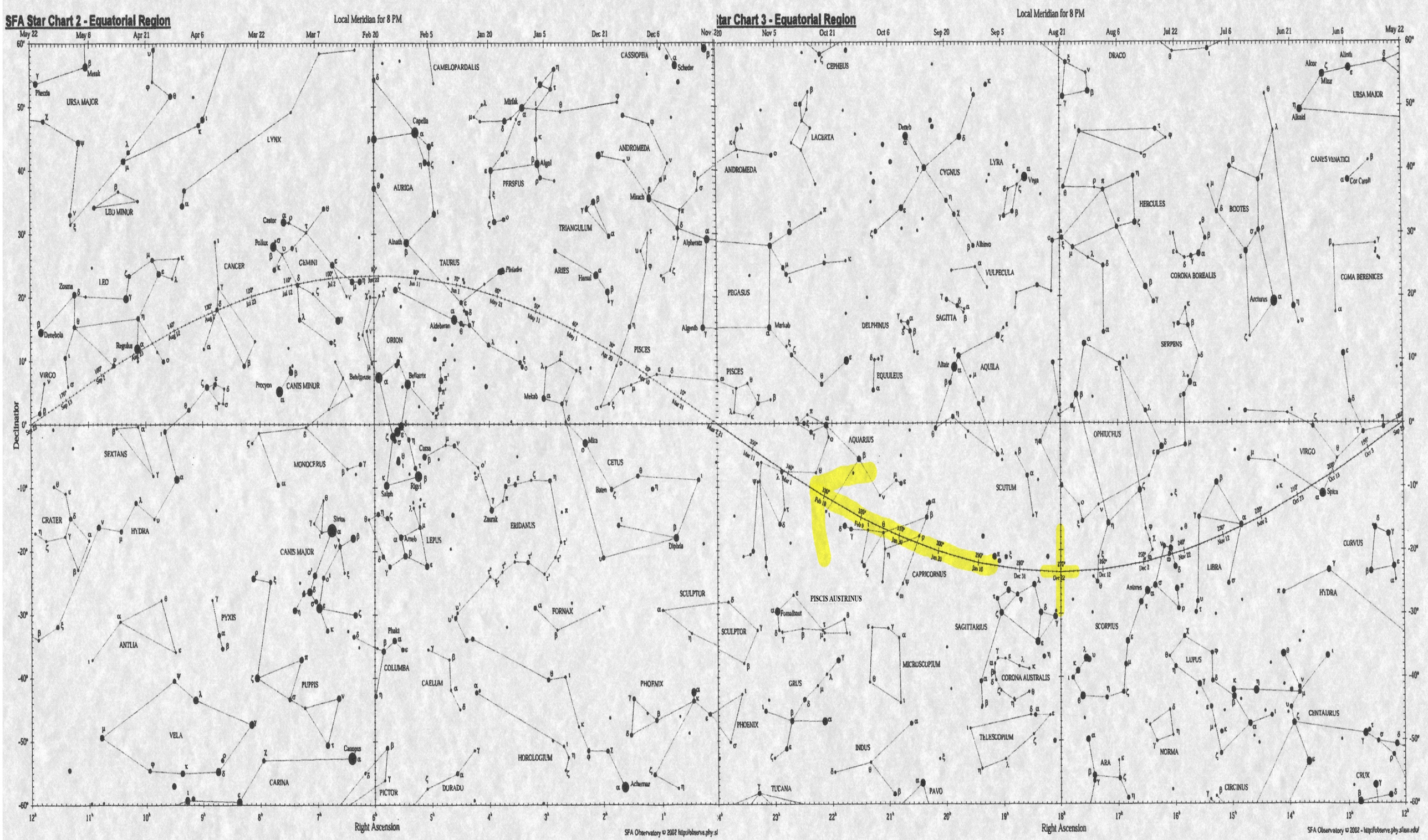
Sagittarius C

Protostar cluster

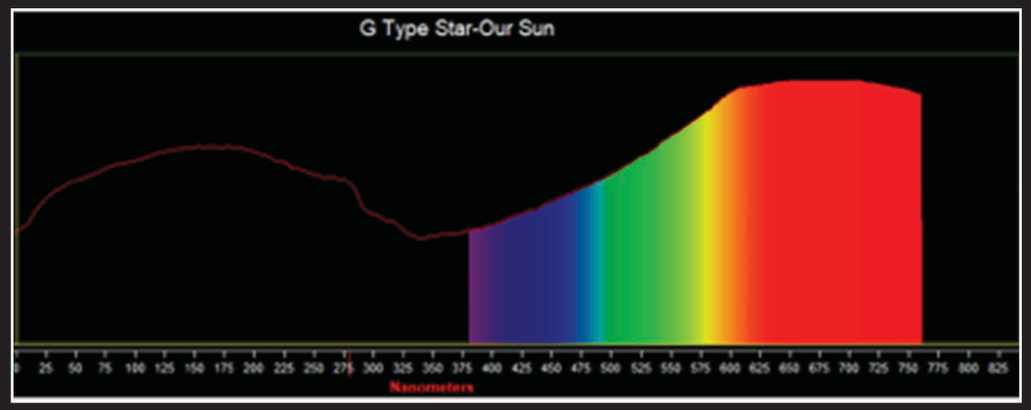


Ionized Hydrogen

JWST:NIRcam



WINTER PRECESSION



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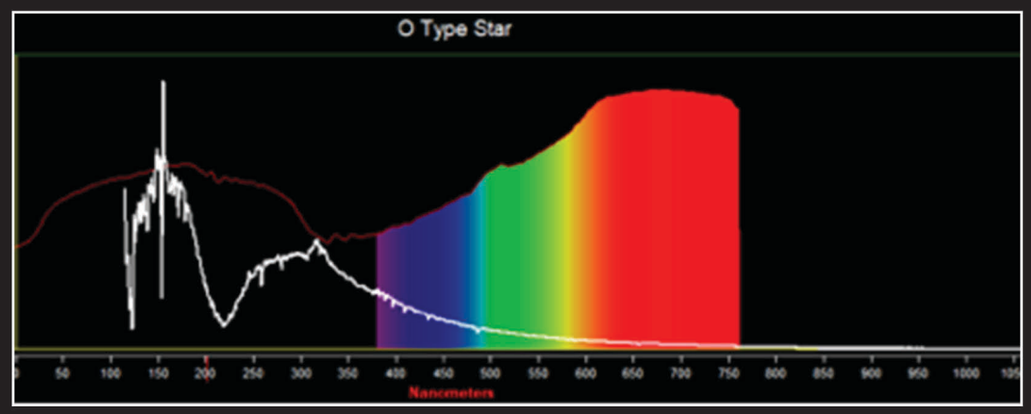

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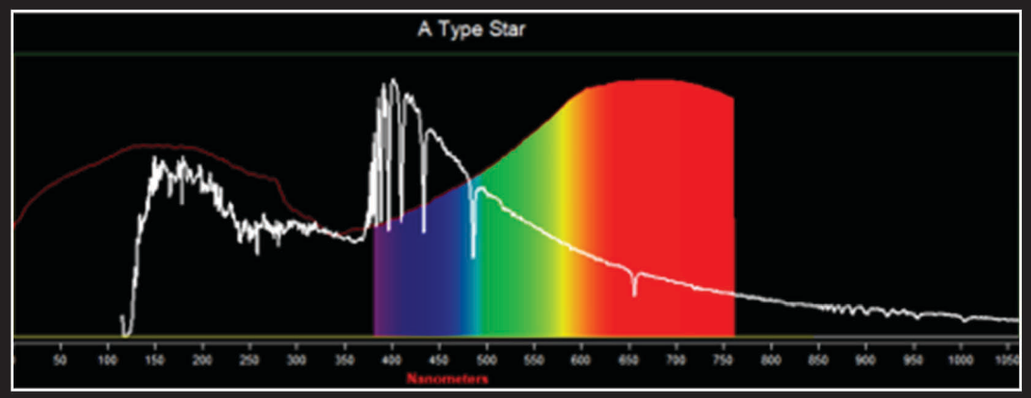

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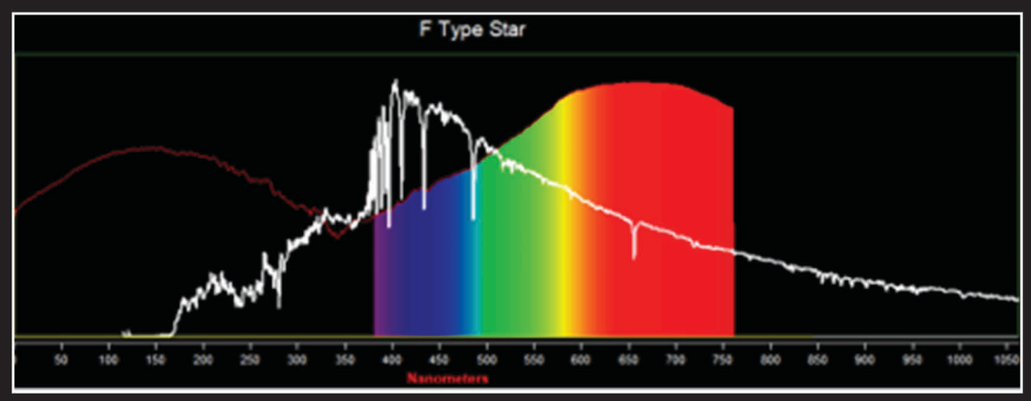

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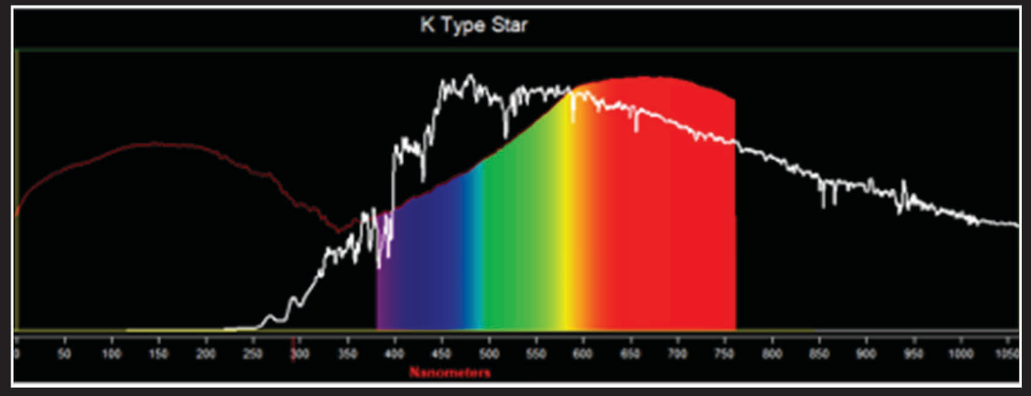

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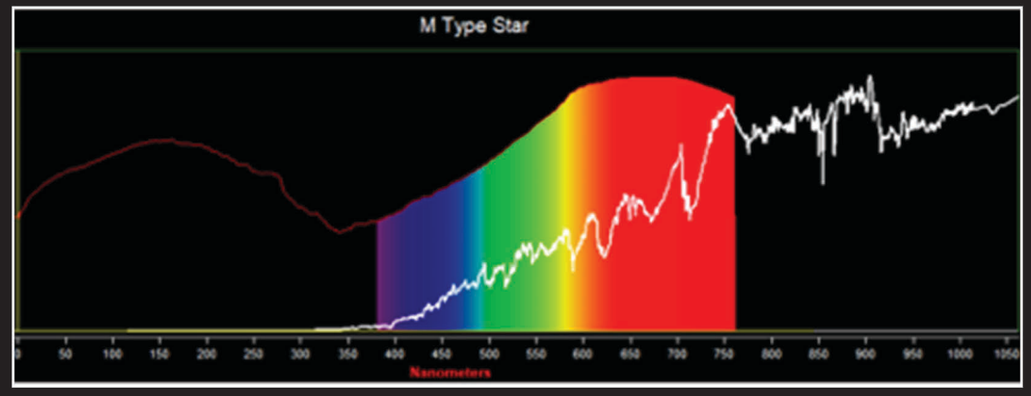
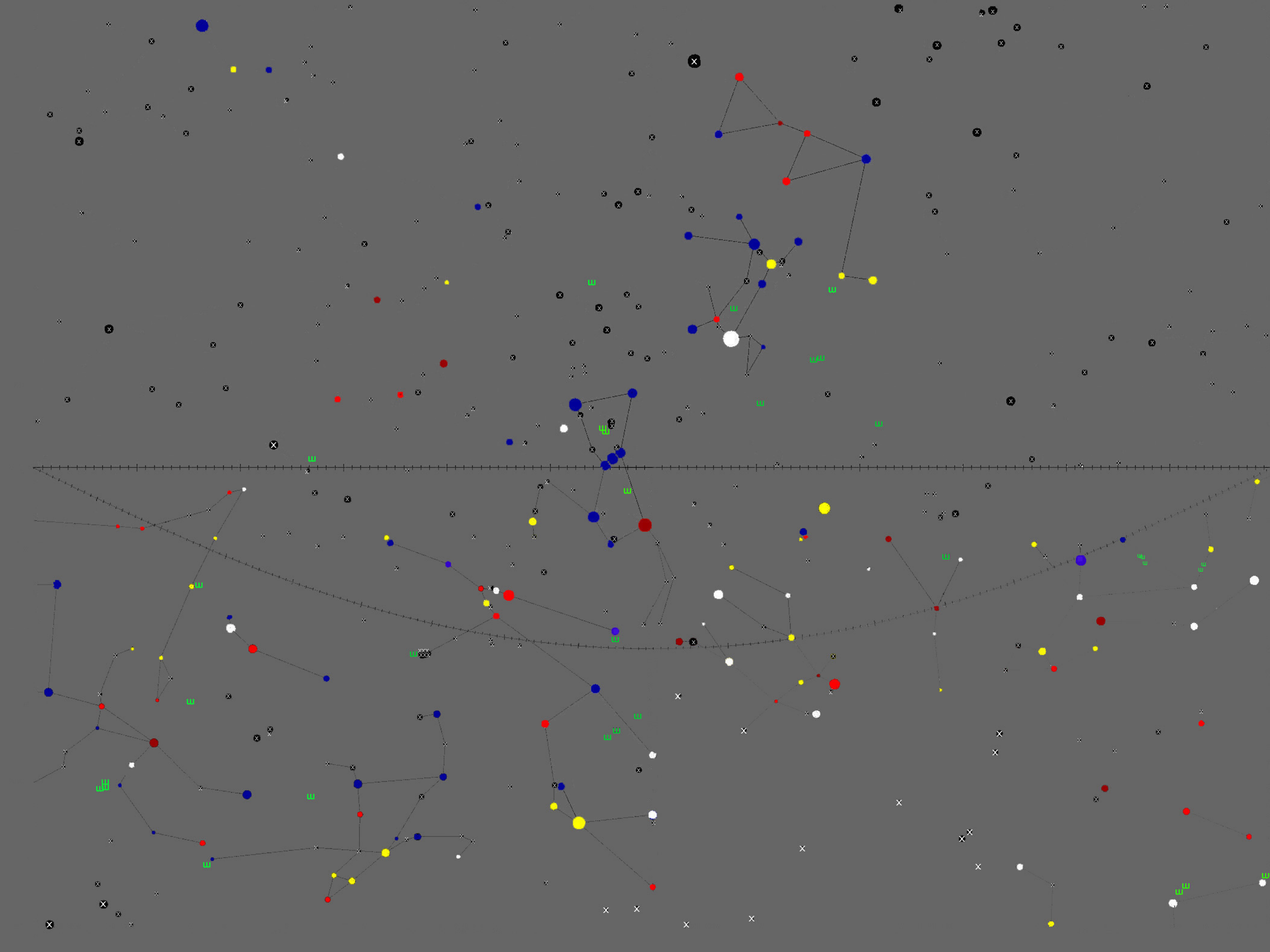


M

Review: Star Classifications By Spectra



SFA Star Chart 2 - Equatorial Region

Local Meridian for 8 PM

May 22 | May 6 | Apr 21 | Apr 6 | Mar 22 | Mar 7 | Feb 20 | Feb 5 | Jan 20 | Jan 5 | Dec 21 | Dec 6 | Nov 20

60° 50° 40° 30° 20° 10° 0° -10° -20° -30° -40° -50° -60°

Declination

URSA MAJOR
Phecda
Merak
LYNX
LEO MINOR
CASSIOPEIA
Schedar
CAMELOPARDALIS
Capella
AURICA
Mirfak
Algol
PERSEUS
ANDROMEDA
Mirach
Alpheratz
TRIANGULUM
Alnath
TAURUS
Hamal
ARIES
Pleiades
Aldebaran
CANCER
GEMINI
Castor
Pollux
LEO
Zosma
Denebola
Regulus
VIRGO
ORION
Betelgeuse
Bellatrix
Procyon
CANIS MINOR
Mekbuda
PISCES
Algenib
Mira
Cusa
Rigel
Saiph
CETUS
Baten
Diphda
Zaurak
ERIDANUS
SEXTANS
MONOCEROS
CRATER
HYDRA
Sirius
CANIS MAJOR
Arneb
LEPUS
ANTLIA
PYXIS
PUPPIS
VELA
Canopus
CARINA
COLUMBA
Phakt
CAELUM
PICTOR
DORADO
FORNAX
SCULPTUR
HOROLOGIUM
Achernar
PHOENIX

12h 11h 10h 9h 8h 7h 6h 5h 4h 3h 2h 1h

Right Ascension

SFA Observatory © 2002 http://observe.phy.sl

Star Chart 3 - Equatorial Region

Local Meridian for 8 PM

Nov 20 | Nov 5 | Oct 21 | Oct 6 | Sep 20 | Sep 5 | Aug 21 | Aug 6 | Jul 22 | Jul 6 | Jun 21 | Jun 6 | May 22

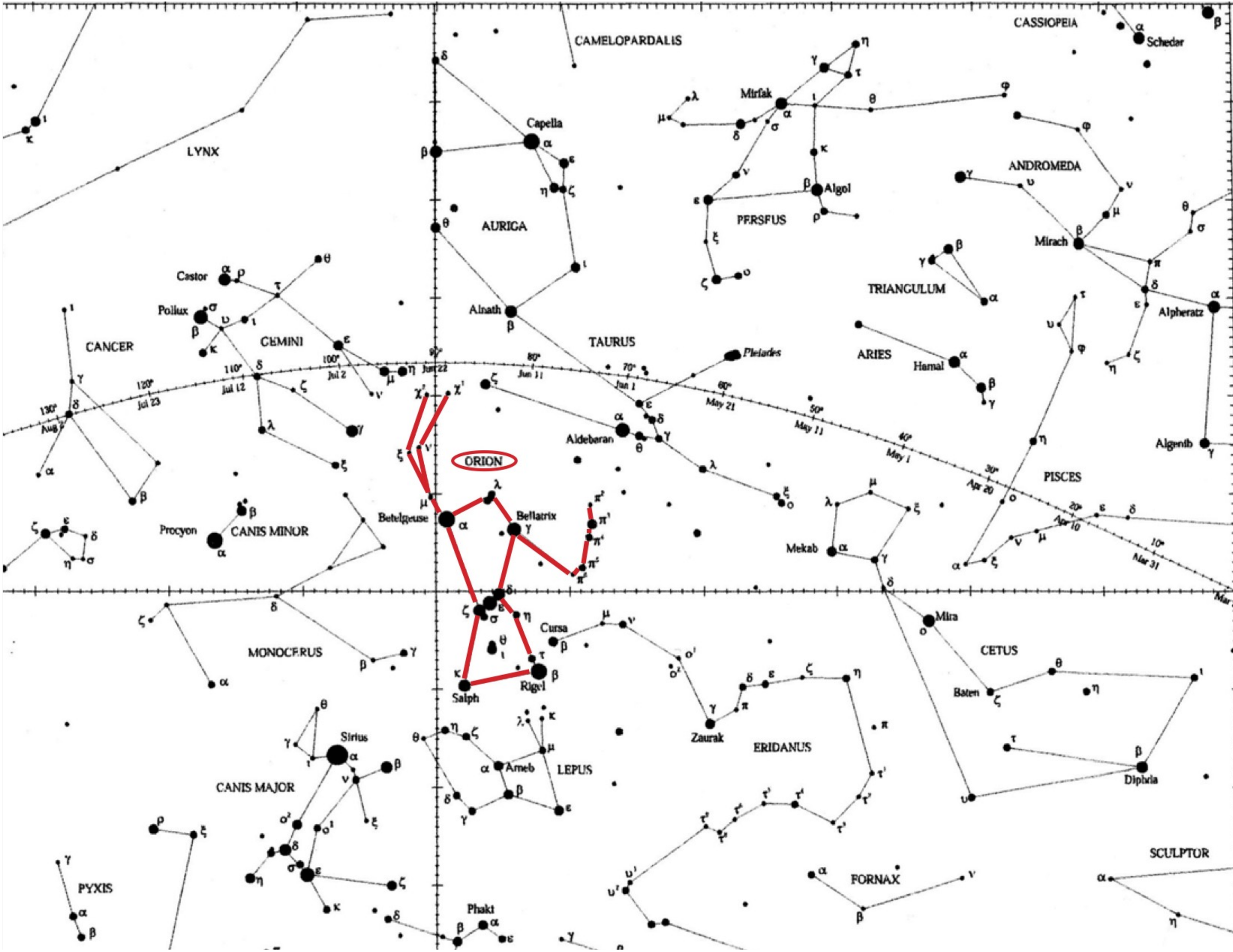
60° 50° 40° 30° 20° 10° 0° -10° -20° -30° -40° -50° -60°

CEPHEUS
DRACO
Alcor
Mizar
Alioth
URSA MAJOR
Alkaid
LACERTA
ANDROMEDA
Deneb
CYGNUS
LYRA
Vega
Albireo
CANES VENATICI
Cor Caroli
HERCULES
BOOTES
CORONA BOREALIS
Arcturus
COMA BERENICES
SERPENS
VULPECULA
SAGITTA
PEGASUS
Markab
DELPHINUS
EQUULEUS
AQUILA
Altair
PISCES
AQUARIUS
OPHIUCHUS
VIRGO
Spica
SCUTUM
CAPRICORNUS
PISCIS AUSTRINUS
Fomalhaut
SAGITTARIUS
SCULPTOR
MICROSCOPIUM
GRUS
CORONA AUSTRALIS
TELESCOPIUM
INDUS
PAVO
TUCANA
SCORPIUS
Antares
LIBRA
LUPUS
CENTAURUS
NORMA
ARA
CIRCINUS
CRUX
CORVUS
HYDRA

18h 17h 16h 15h 14h 13h 12h 11h 10h 9h 8h 7h 6h

Right Ascension

SFA Observatory © 2002 - http://observe.phy.sfasu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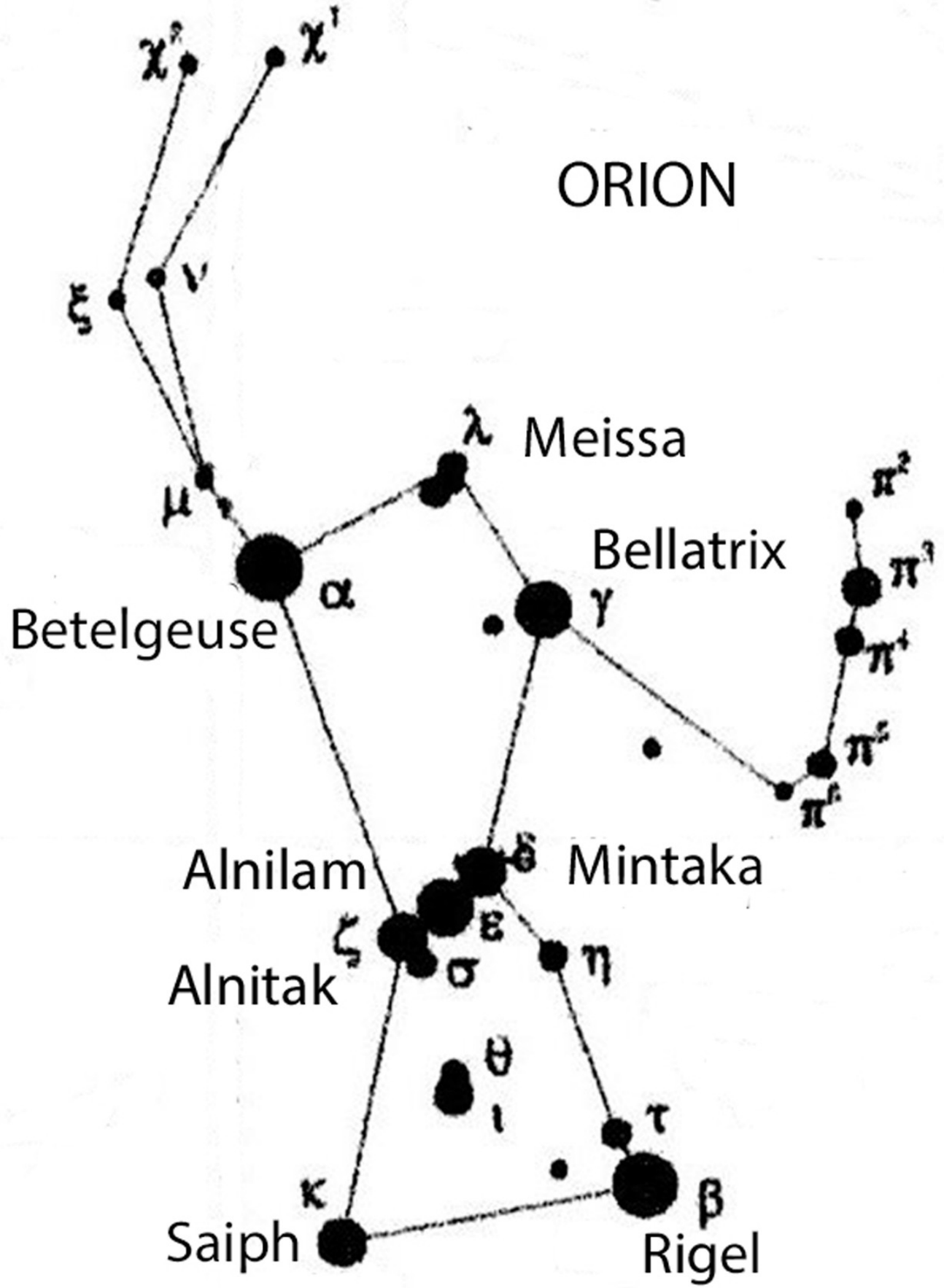
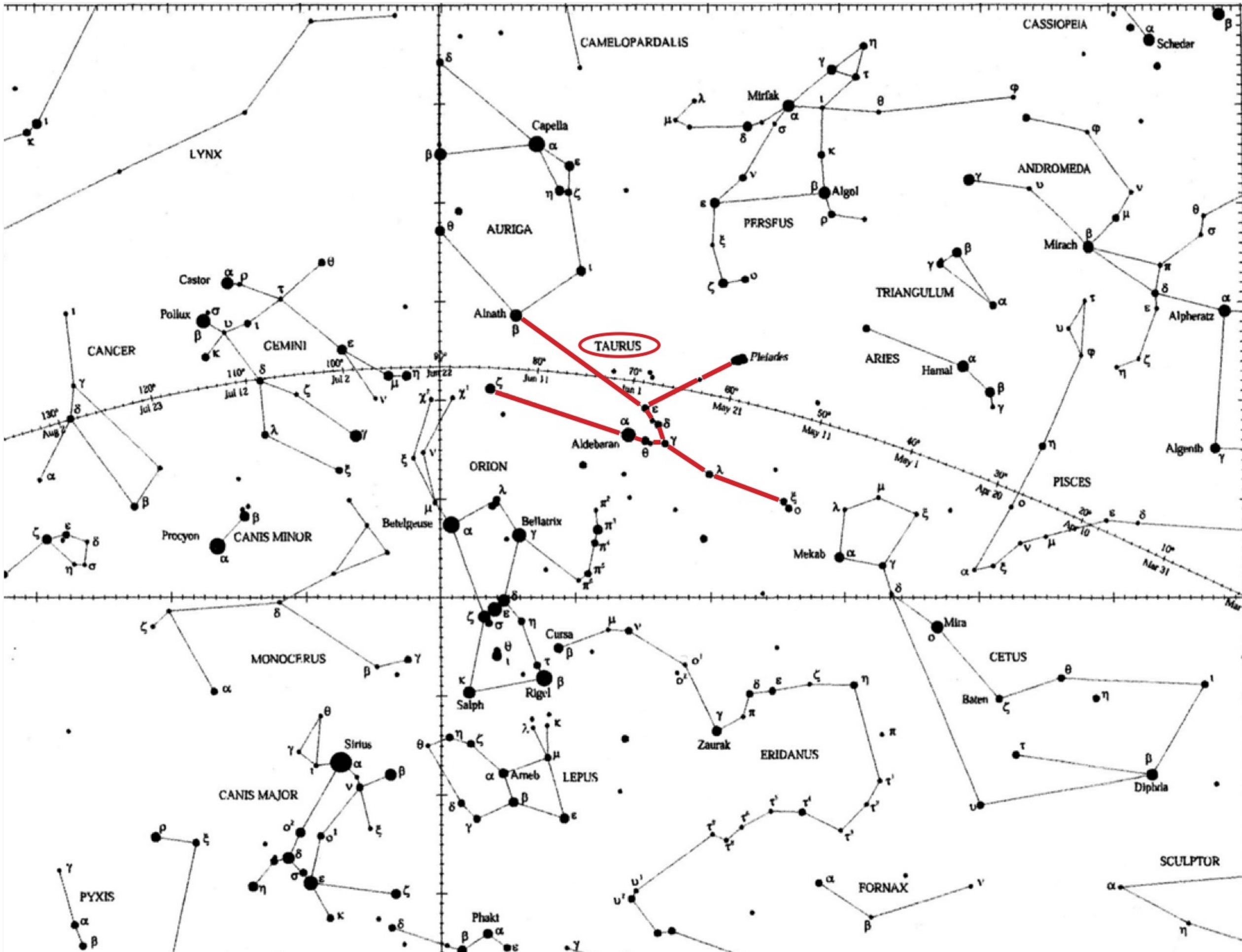
CASSIOPEIA
Schedar
LYNX
Capella
Mirfak
Algol
PERSEUS
ANDROMEDA
Mirach
AURIGA
Alnath
TRIANGULUM
Alpheratz
Castor
Pollux
CANCER
GEMINI
TAURUS
Pleiades
ARIES
Hamal
Aldebaran
ORION
PISCES
Algenib
Betelgeuse
Bellatrix
Procyon
CANIS MINOR
Mekab
Mira
CETUS
MONOCEROS
Cursa
Rigel
Saiph
Baten
Diphda
Zaurak
ERIDANUS
Sirius
CANIS MAJOR
Arneb
LEPUS
Phakt
PYXIS
FORNAX
SCULPTOR

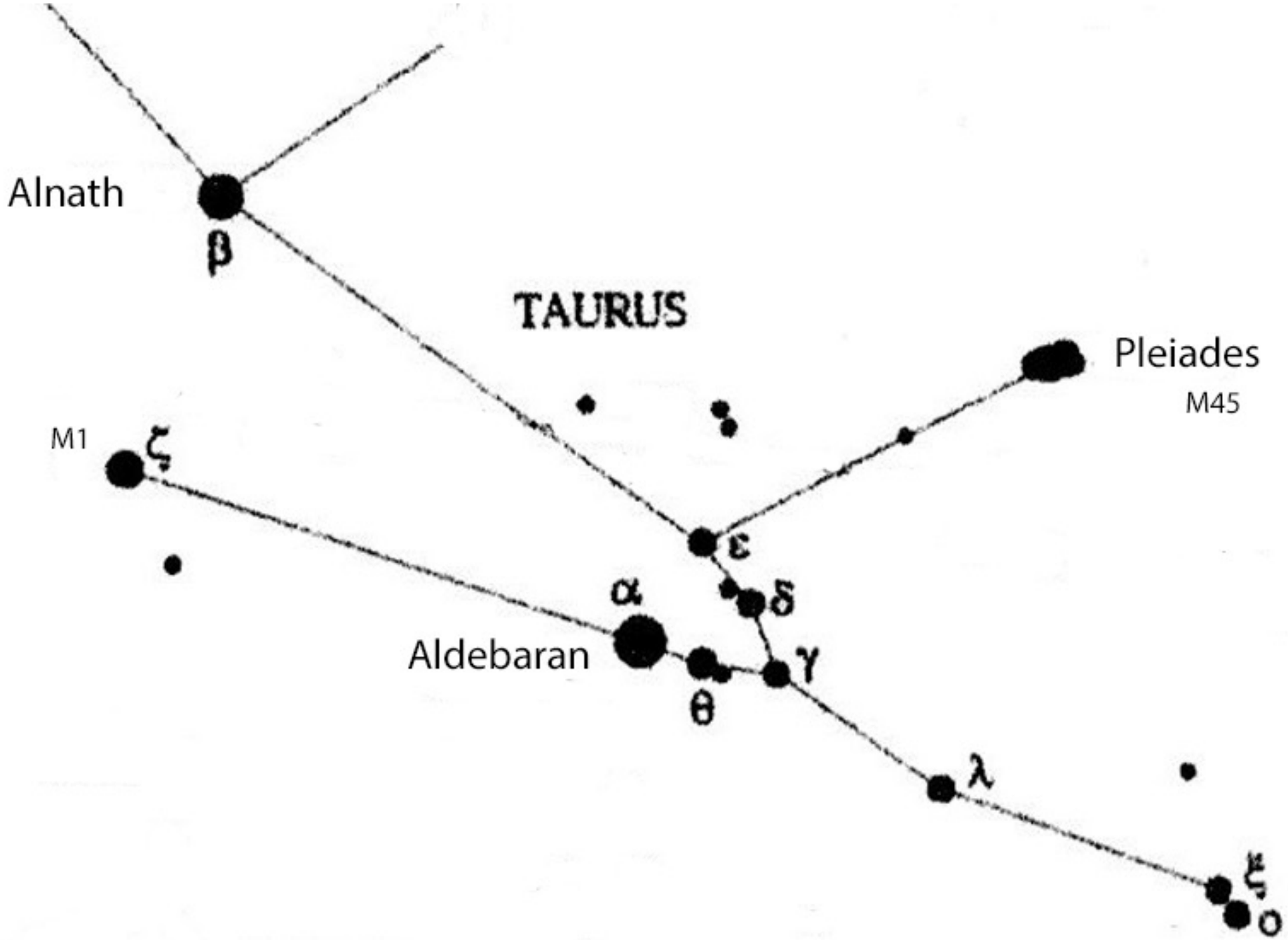

ORION
χ²
χ¹
ξ
ν
λ
Meissa
μ
Bellatrix
α
γ
Betelgeuse
π²
π¹
π⁴
π⁵
π⁶
δ
Alnilam
Mintaka
ζ
ε
η
σ
Alnitak
θ
ι
τ
κ
β
Saiph
Rigel

α Orionis
Betelgeuse
ALMA image

Horse head Nebula

Euclid: First Image


CAMELOPARDALIS
CASSIOPEIA
Schedar
Mirfak
LYNX
Capella
AURIGA
PERSEUS
Algol
ANDROMEDA
Mirach
TRIANGULUM
Alpheratz
Castor
Pollux
CANCER
GEMINI
Alnath
TAURUS
Pleiades
ARIES
Hamal
Aldebaran
ORION
Algenib
PISCES
Procyon
CANIS MINOR
Betelgeuse
Bellatrix
Mekab
Cursa
Rigel
Saiph
Mira
CETUS
Baten
Diphda
Zaurak
ERIDANUS
MONOCEROS
Sirius
CANIS MAJOR
Arneb
LEPUS
Phakt
PYXIS
FORNAX
SCULPTOR


Alnath
β
TAURUS
Pleiades
M45
M1
ζ
ε
δ
α
Aldebaran
θ
γ
λ
ξ
ο

Taurus

Aldebaran
Hyades
Pleiades

Orion

Canis Major
Sirius

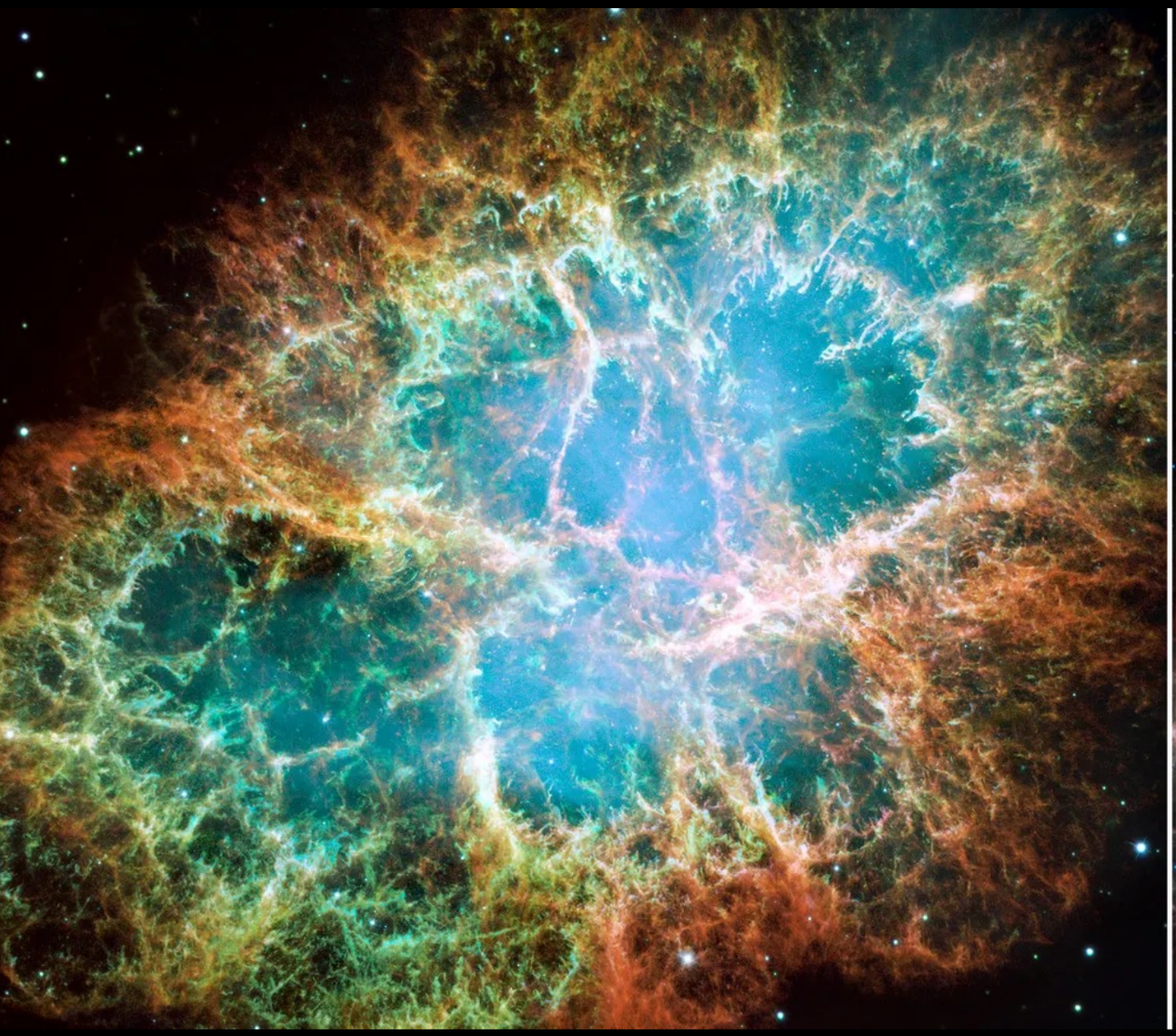

Hyades
Pleiades

Xray
Chandra

IR
Spitzer

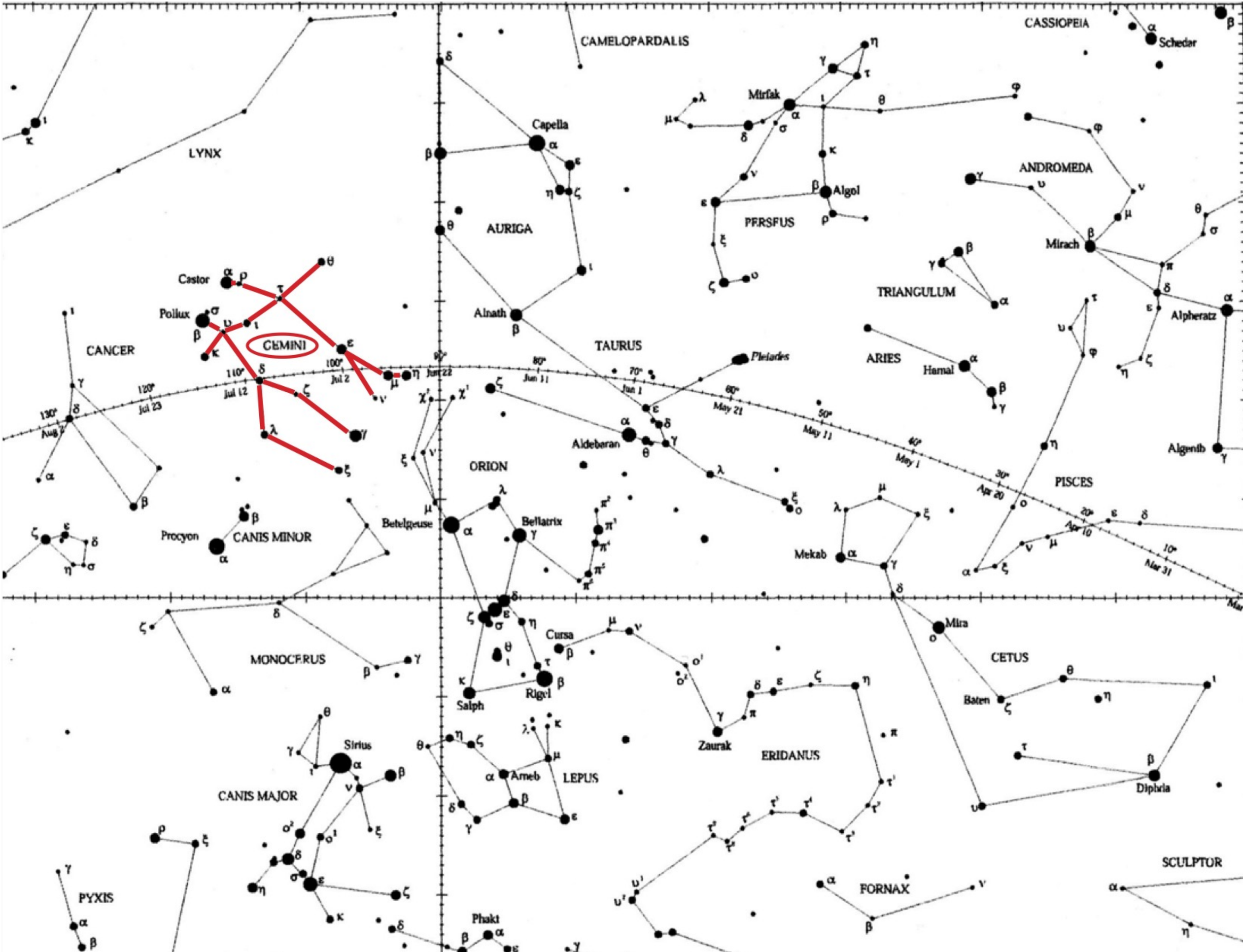
V
Hubble

M1 Crab Nebula SNR 1054



Hubble
M1

JWST
M1


CAMELOPARDALIS
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Mirfak
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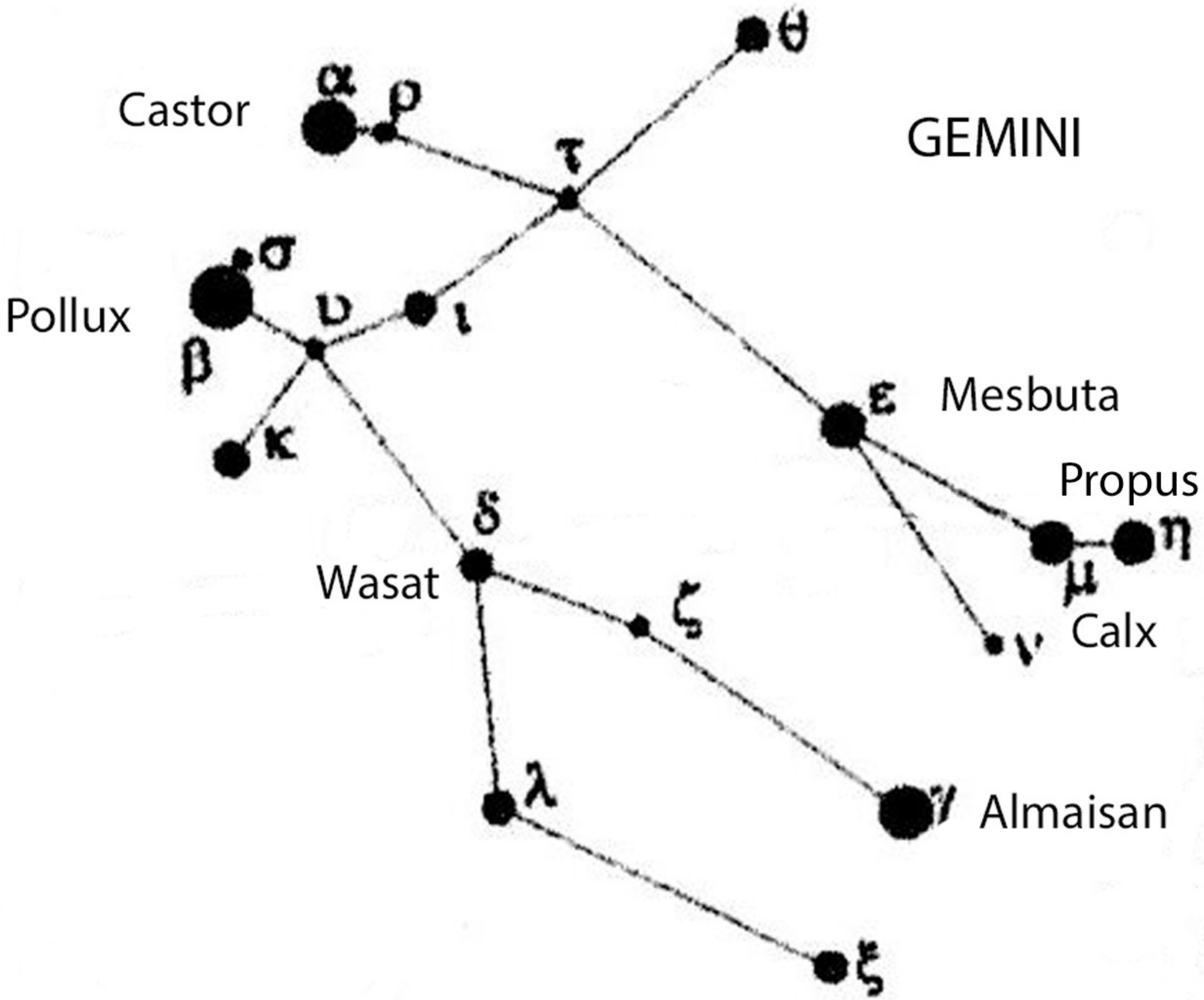
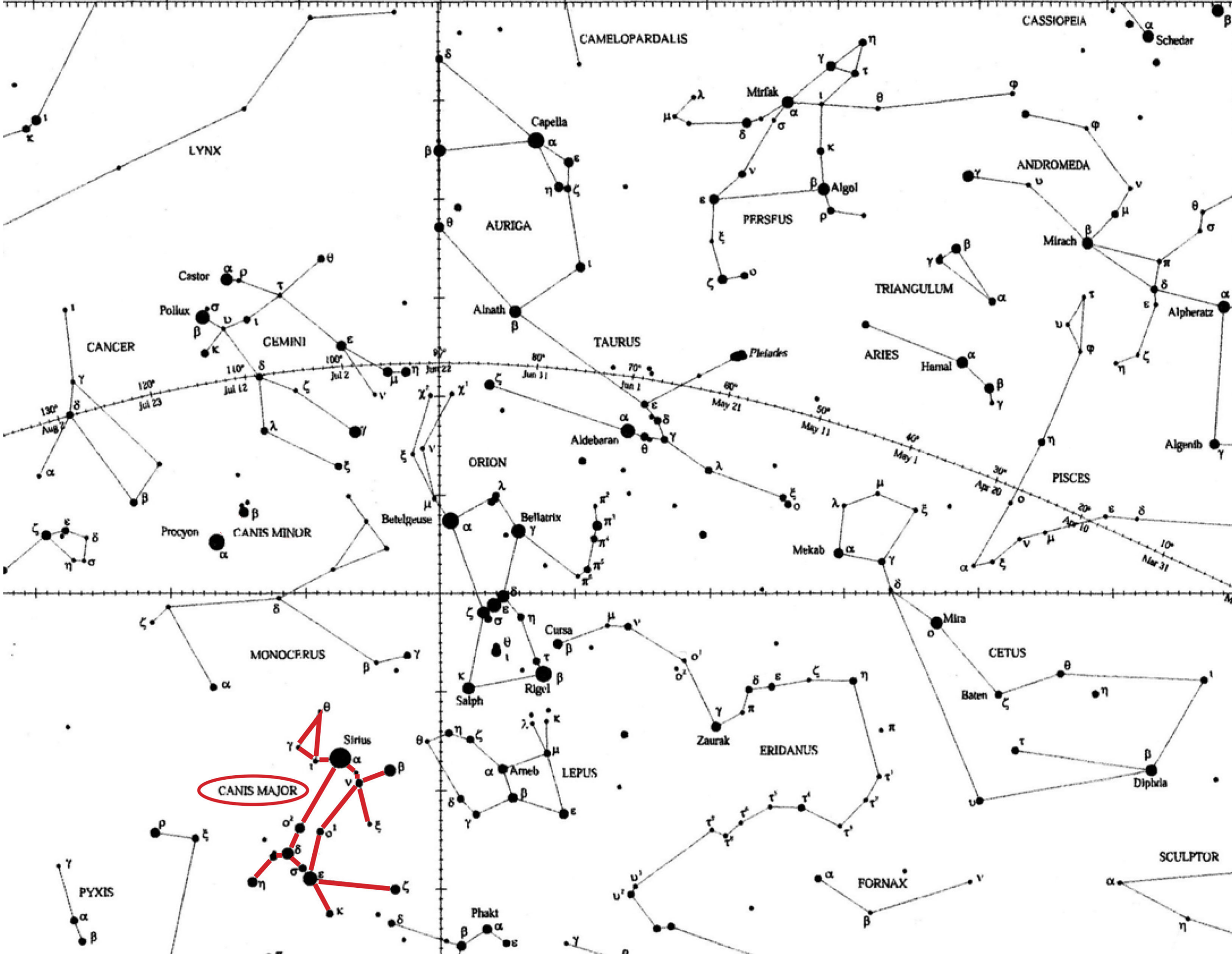
PERSEUS
Algol
ANDROMEDA
Mirach
TRIANGULUM
Alpheratz
Castor
Pollux
GEMINI
CANCER
Alnath
TAURUS
Pleiades
ARIES
Hamal
Aldebaran
ORION
PISCES
Algenib
Betelgeuse
Bellatrix
Mekab
CANIS MINOR
Procyon
Mira
CETUS
Baten
Diphda
MONOCEROS
Cursa
Rigel
Saiph
Zaurak
ERIDANUS
Sirius
CANIS MAJOR
Ameb
LEPUS
Phakt
PYXIS
FORNAX
SCULPTOR
110°
Jul 12
100°
Jul 2
90°
Jun 22
80°
Jun 11
70°
Jun 1
60°
May 21
50°
May 11
40°
May 1
30°
Apr 20
20°
Apr 10
10°
Mar 31
120°
Jul 23
130°
Aug 2


GEMINI
Castor
Pollux
Mesbuta
Propus
Wasat
Calx
Almaisan


CAMELOPARDALIS
CASSIOPEIA
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LYNX
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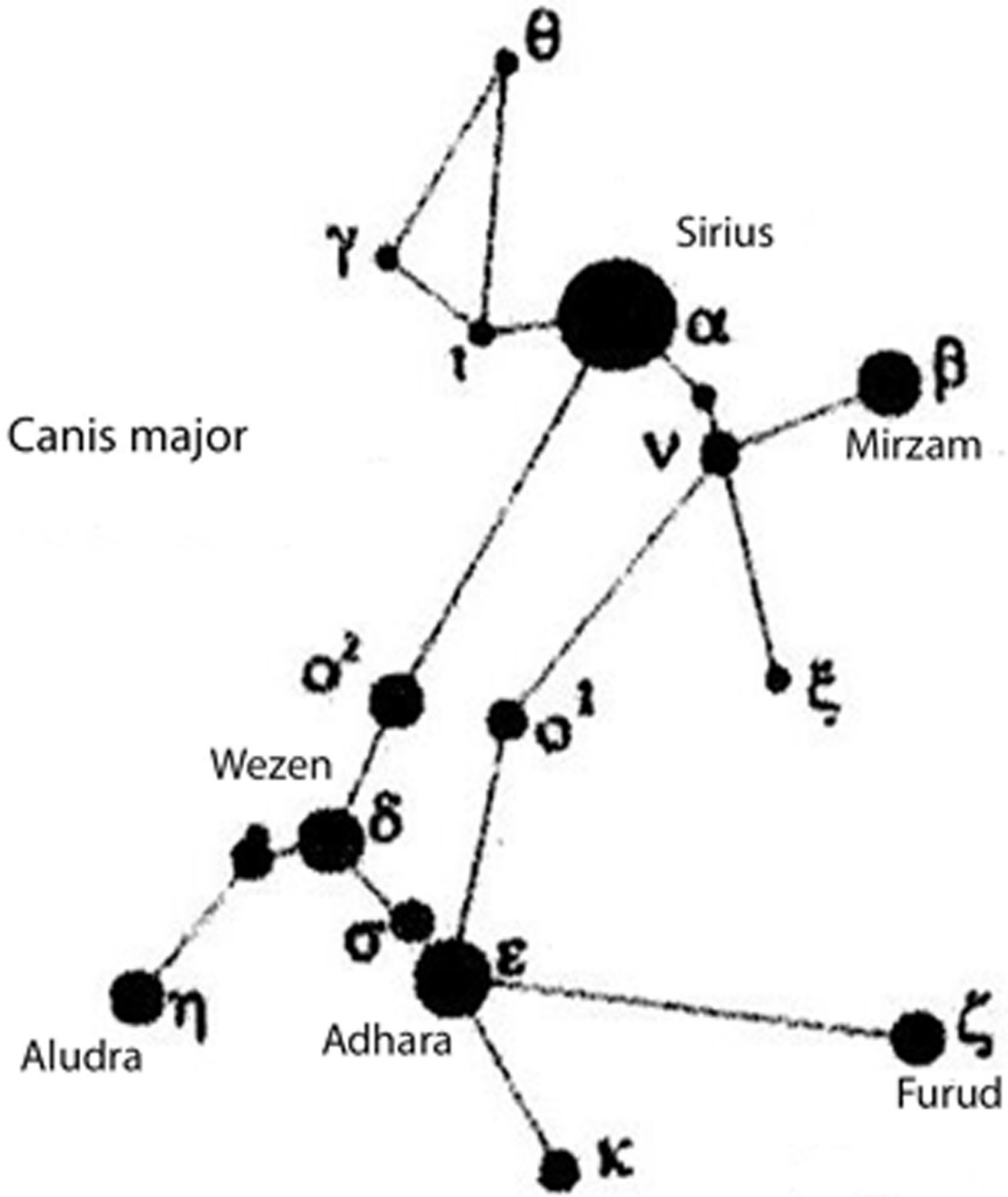
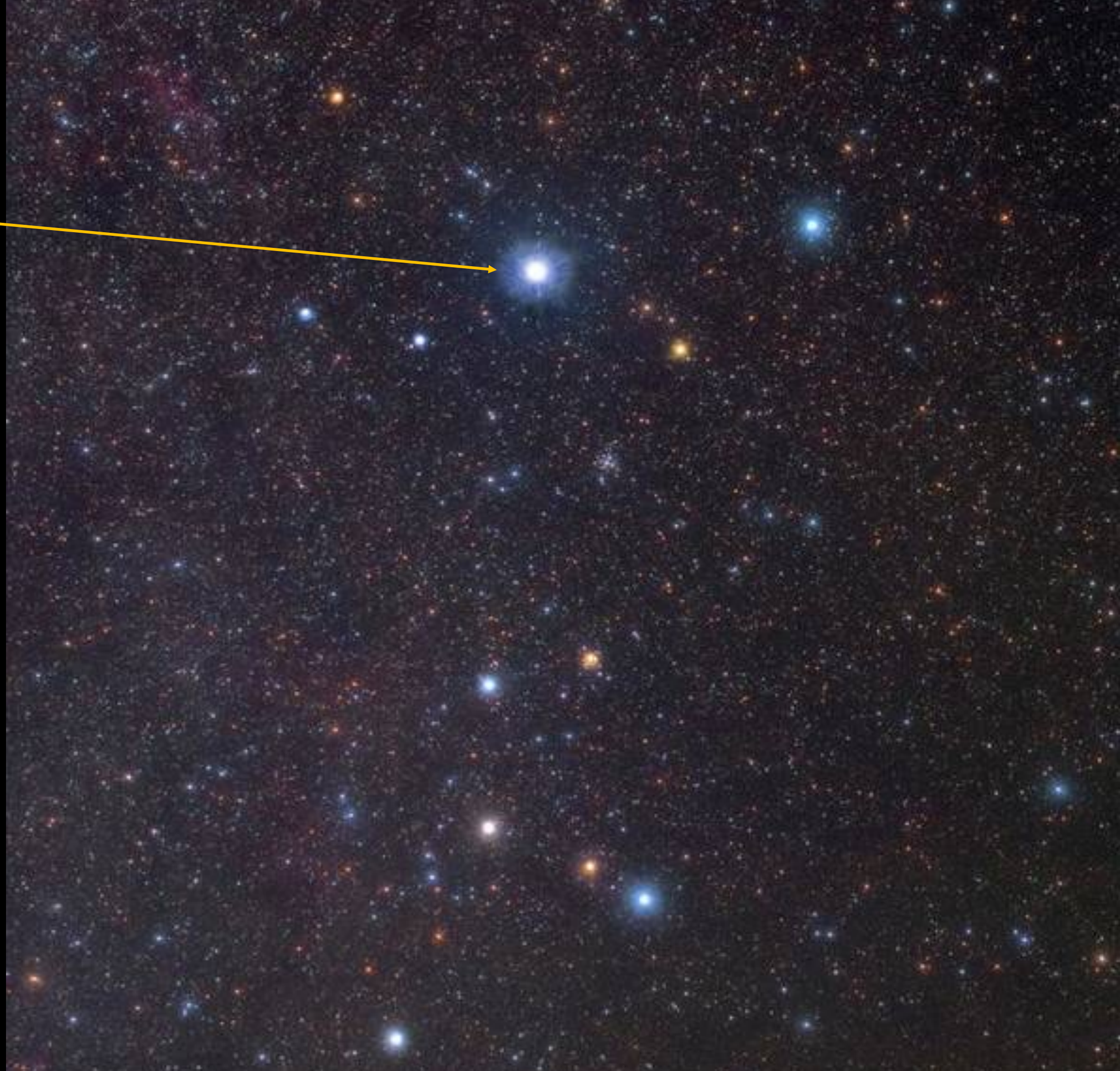
Mirfak
Algol
PERSEUS
ANDROMEDA
Mirach
AURIGA
Alnath
Castor
Pollux
CANCER
GEMINI
TAURUS
Pleiades
TRIANGULUM
ARIES
Hamal
Alpheratz
Aldebaran
ORION
Betelgeuse
Bellatrix
Procyon
CANIS MINOR
Mekab
PISCES
Algenib
Sirius
CANIS MAJOR
MONOCEROS
Cursa
Rigel
Saiph
Zaurak
ERIDANUS
Ameb
LEPUS
Mira
CETUS
Baten
Diphda
PYXIS
Phakt
FORNAX
SCULPTOR
Jun 22
Jun 11
Jun 1
May 21
May 11
May 1
Apr 20
Apr 10
Mar 31
Jul 2
Jul 12
Jul 23
Aug 2


Canis major
θ
γ
Sirius
α
ι
β
Mirzam
ν
ξ
σ²
σ¹
Wezen
δ
σ
ε
η
Aludra
Adhara
ζ
Furud
κ

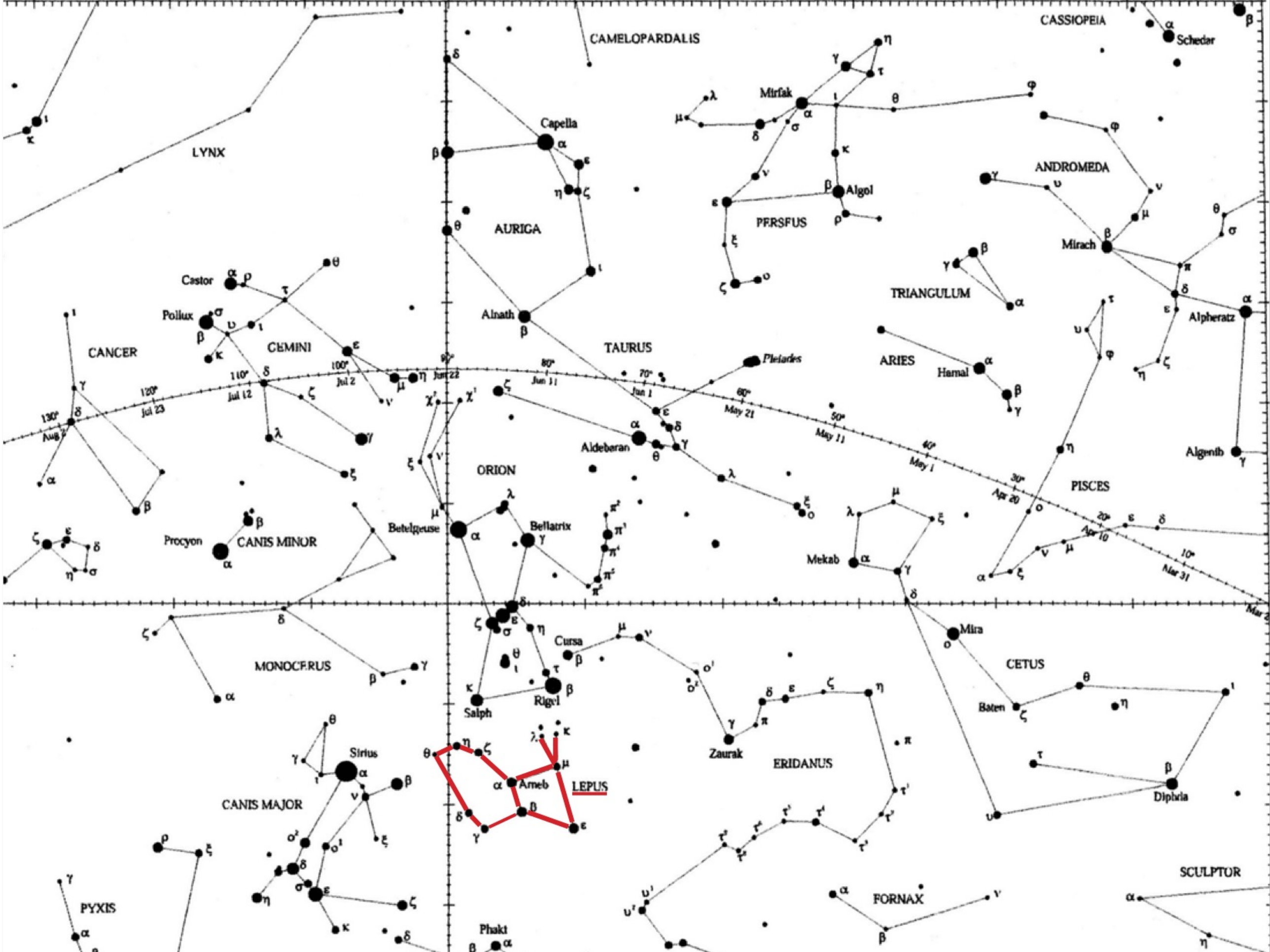
α Canis Major
Sirius

Canis Major



Wolf-Rayet star
EZ Cannis Majoris

SH2-308
Dolphin
Emission Nebula


CAMELOPARDALIS
CASSIOPEIA
Schedar
LYNX
Capella
Mirfak
Algol
PERSEUS
ANDROMEDA
Mirach
AURIGA
Castor
Pollux
Alnath
TRIANGULUM
Alpheratz
CANCER
GEMINI
TAURUS
Pleiades
ARIES
Hamal
Aldebaran
ORION
Algenib
PISCES
Procyon
CANIS MINOR
Betelgeuse
Bellatrix
Mekab
Mira
MONOCEROS
Cursa
Rigel
Saiph
CETUS
Baten
Diphda
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CANIS MAJOR
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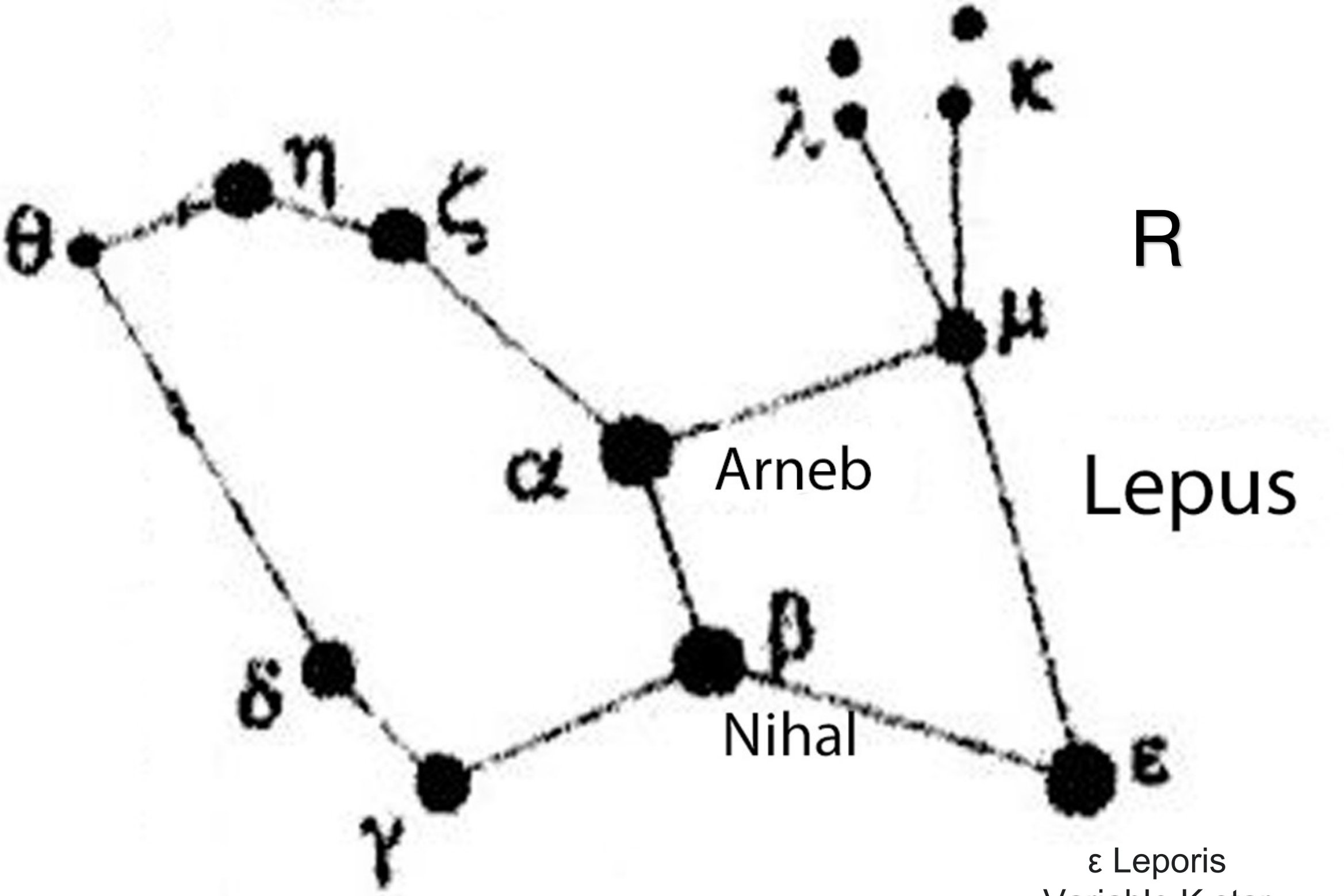
LEPUS
PYXIS
Phakt
FORNAX
SCULPTOR
Jun 22
Jul 2
Jul 12
Jul 23
Aug 2
Jun 11
Jun 1
May 21
May 11
May 1
Apr 20
Apr 10
Mar 31



ε Leporis
Variable K star

R Leporis

ALMA, 5 arcseconds

Star surface

HCN cloud

DSS2, 30 arcminutes
Red, variable, Carbon star

CAMELOPARDALIS
CASSIOPEIA
Schedar
Mirfak
Capella
LYNX
AURIGA
Algol
PERSEUS
ANDROMEDA
Mirach
TRIANGULUM
Castor
Pollux
Alnath
CANCER
GEMINI
TAURUS
Pleiades
ARIES
Hamal
Alpheratz
Aldebaran
ORION
PISCES
Algenib
Procyon
CANIS MINOR
Betelgeuse
Bellatrix
Mekab
MONOCEROS
Cursa
Rigel
Saiph
Mira
CETUS
Baten
Diphda
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Arneb
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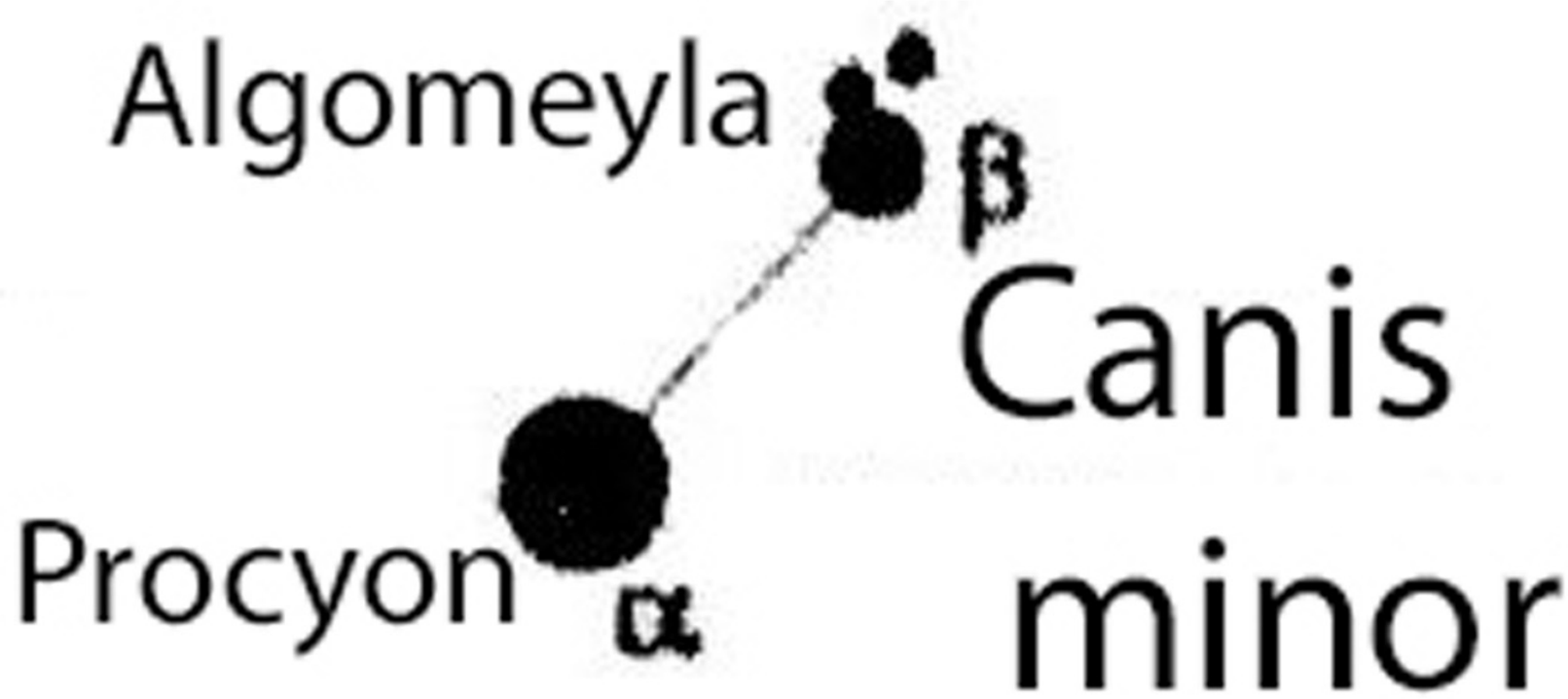
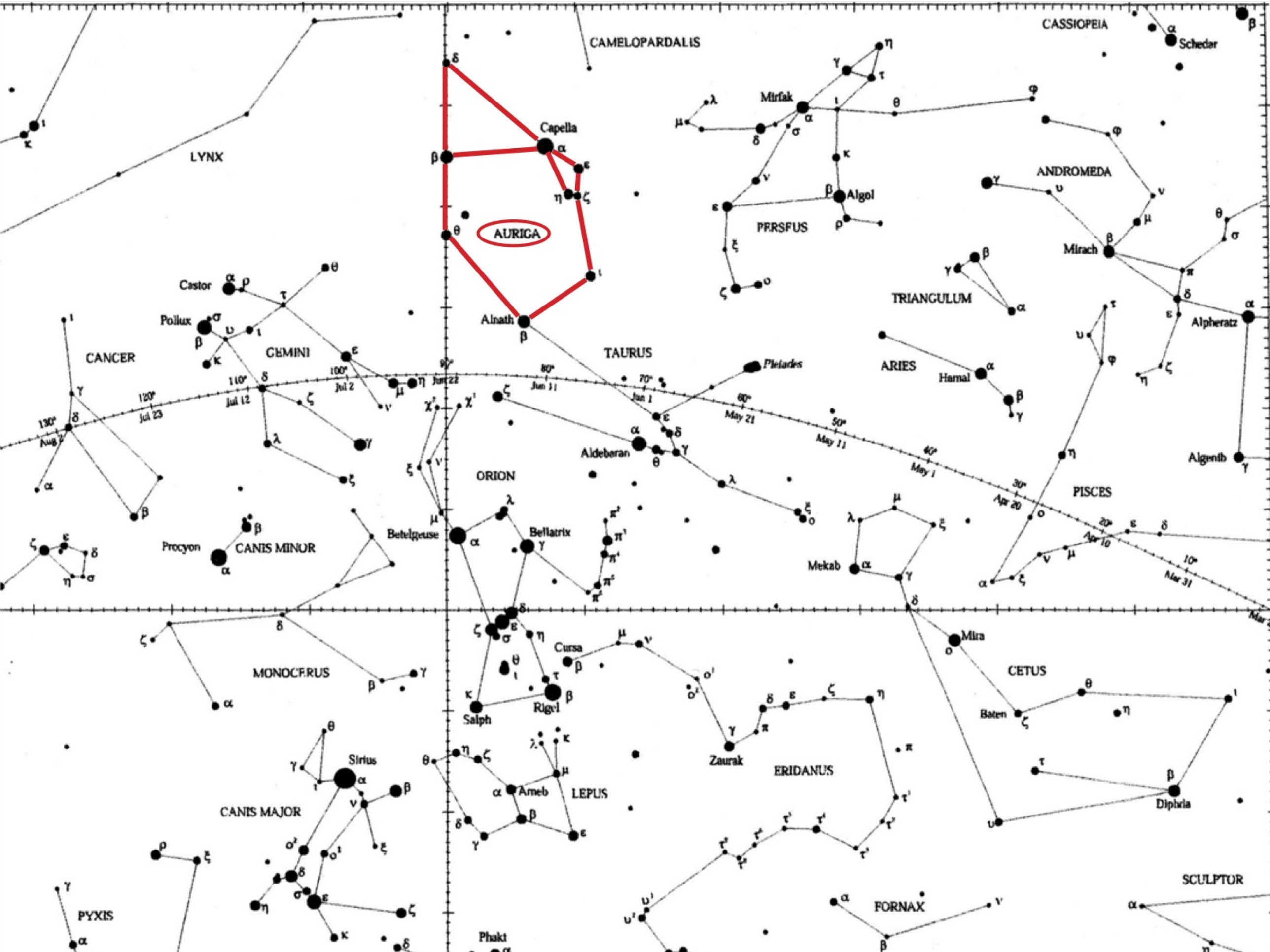
PYXIS
Phakt
FORNAX
SCULPTOR


Algomeyla
β
Canis
minor
Procyon
α

Gomeisa

Procyon

α Canis Minor
Procyon


CAMELOPARDALIS
CASSIOPEIA
Schedar
Mirfak
LYNX
Capella
AURIGA
PERSEUS
Algol
ANDROMEDA
Mirach
TRIANGULUM
Alpheratz
Castor
Pollux
Alnath
CANCER
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Cursa
Rigel
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MONOCEROS
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CETUS
Baten
Zaurak
ERIDANUS
Diphda
Sirius
CANIS MAJOR
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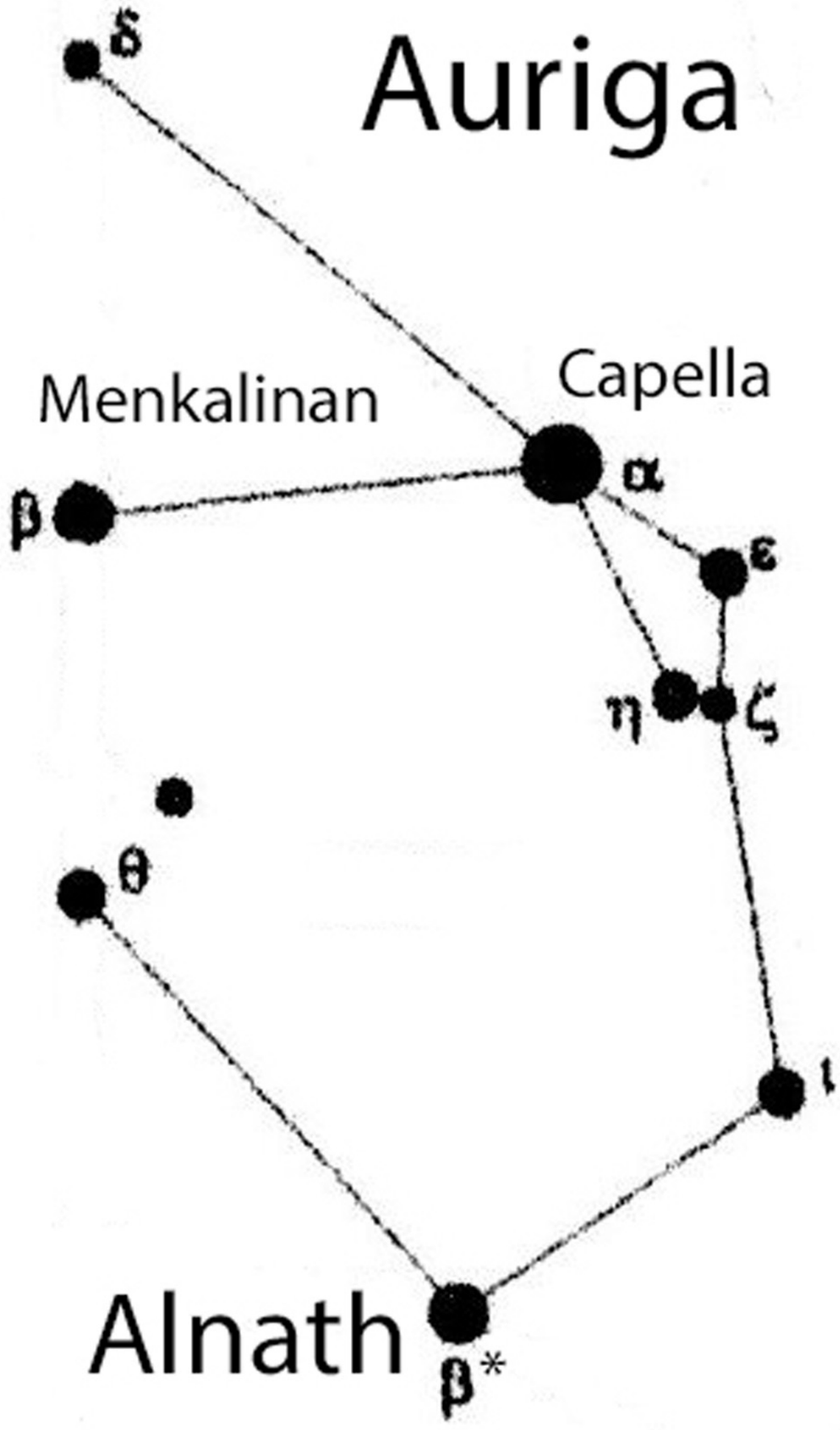
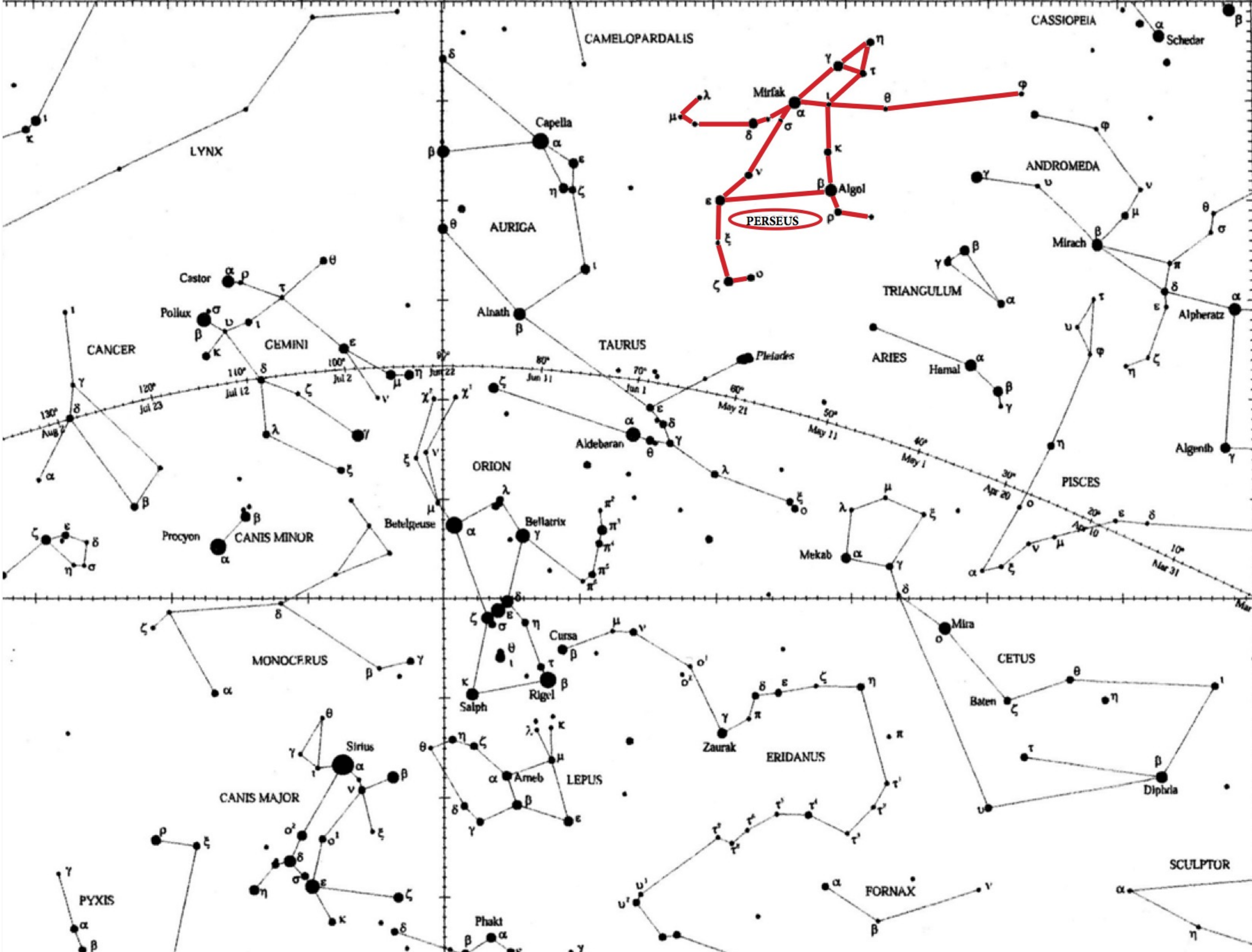
LEPUS
PYXIS
Phakt
FORNAX
SCULPTOR
110°
Jul 12
100°
Jul 2
90°
Jun 22
80°
Jun 11
70°
Jun 1
60°
May 21
50°
May 11
40°
May 1
30°
Apr 20
20°
Apr 10
10°
Mar 31
120°
Jul 23
130°
Aug 2

Auriga




CAMELOPARDALIS
CASSIOPEIA
Schedar
Mirfak
PERSEUS
Algol
LYNX
Capella
AURIGA
ANDROMEDA
Mirach
Alpheratz
TRIANGULUM
Hamal
ARIES
Castor
Pollux
CANCER
GEMINI
Alnath
TAURUS
Pleiades
Aldebaran
ORION
Betelgeuse
Bellatrix
Procyon
CANIS MINOR
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Mekab
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Saiph
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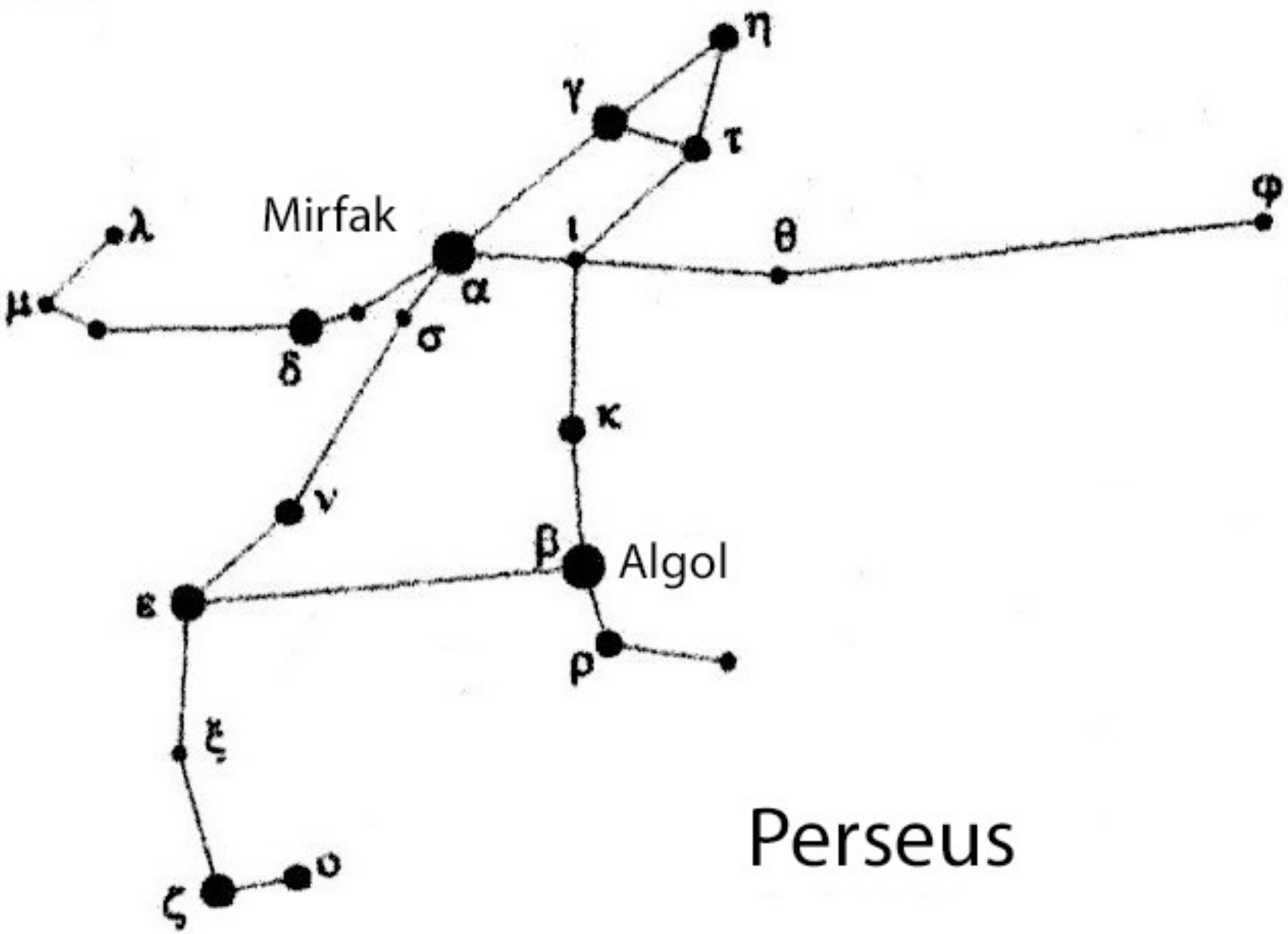
Mira
CETUS
Baten
Diphda
Sirius
CANIS MAJOR
Arneb
LEPUS
MONOCEROS
PYXIS
Phakt
FORNAX
SCULPTOR
May 21
May 11
May 1
Apr 20
Apr 10
Mar 31
Jun 22
Jun 11
Jun 1
Jul 2
Jul 12
Jul 23
Aug 2



Perseus

CAMELOPARDALIS
CASSIOPEIA
Schedar
LYNX
Capella
Mirfak
ANDROMEDA
AURIGA
Algol
PERSEUS
Mirach
Alpheratz
TRIANGULUM
Castor
Pollux
Alnath
CANCER
GEMINI
TAURUS
Pleiades
ARIES
Hamal
Aldebaran
ORION
PISCES
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Procyon
CANIS MINOR
Betelgeuse
Bellatrix
Mekab
MONOCEROS
Cursa
Rigel
Saiph
Mira
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Baten
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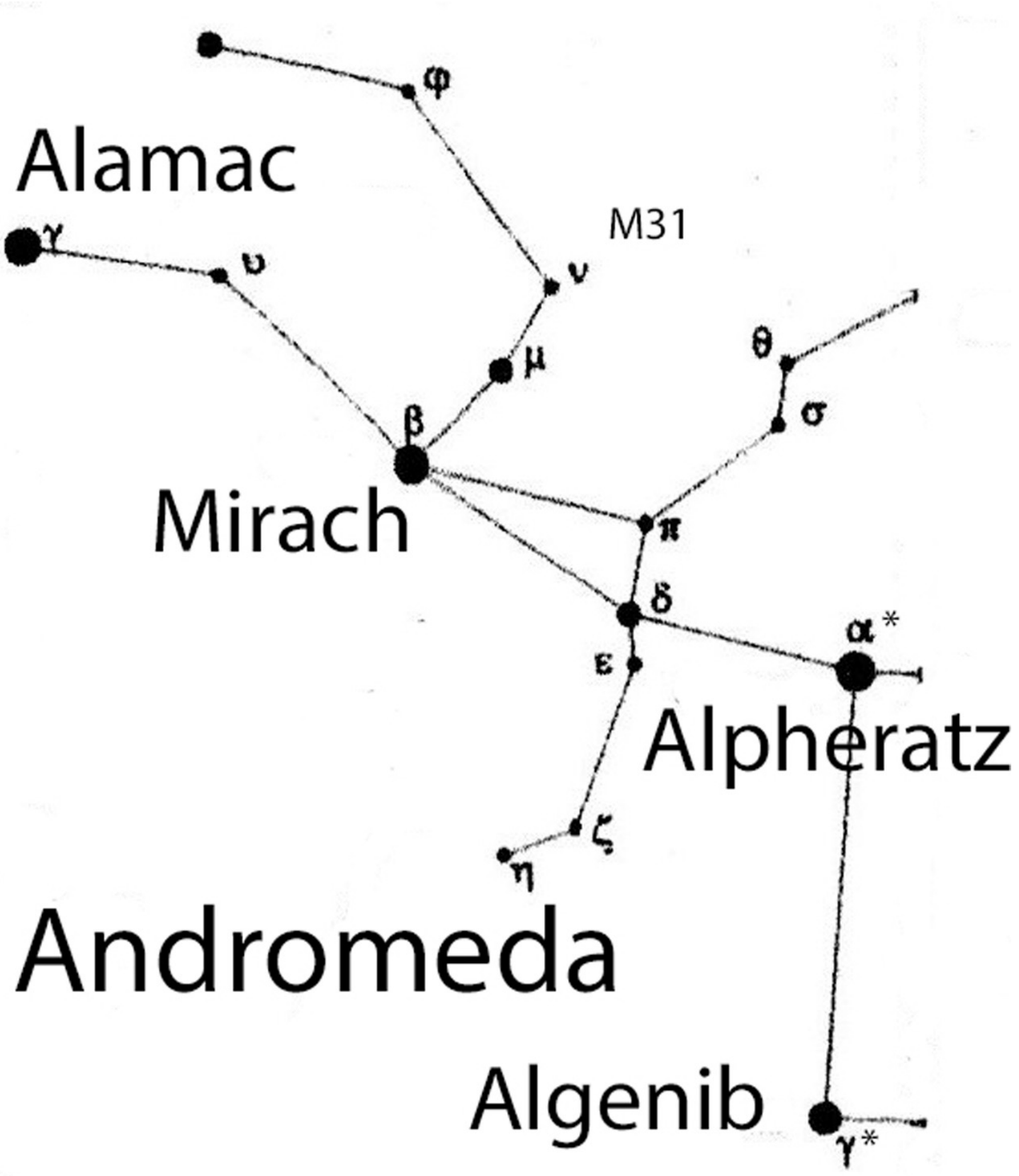
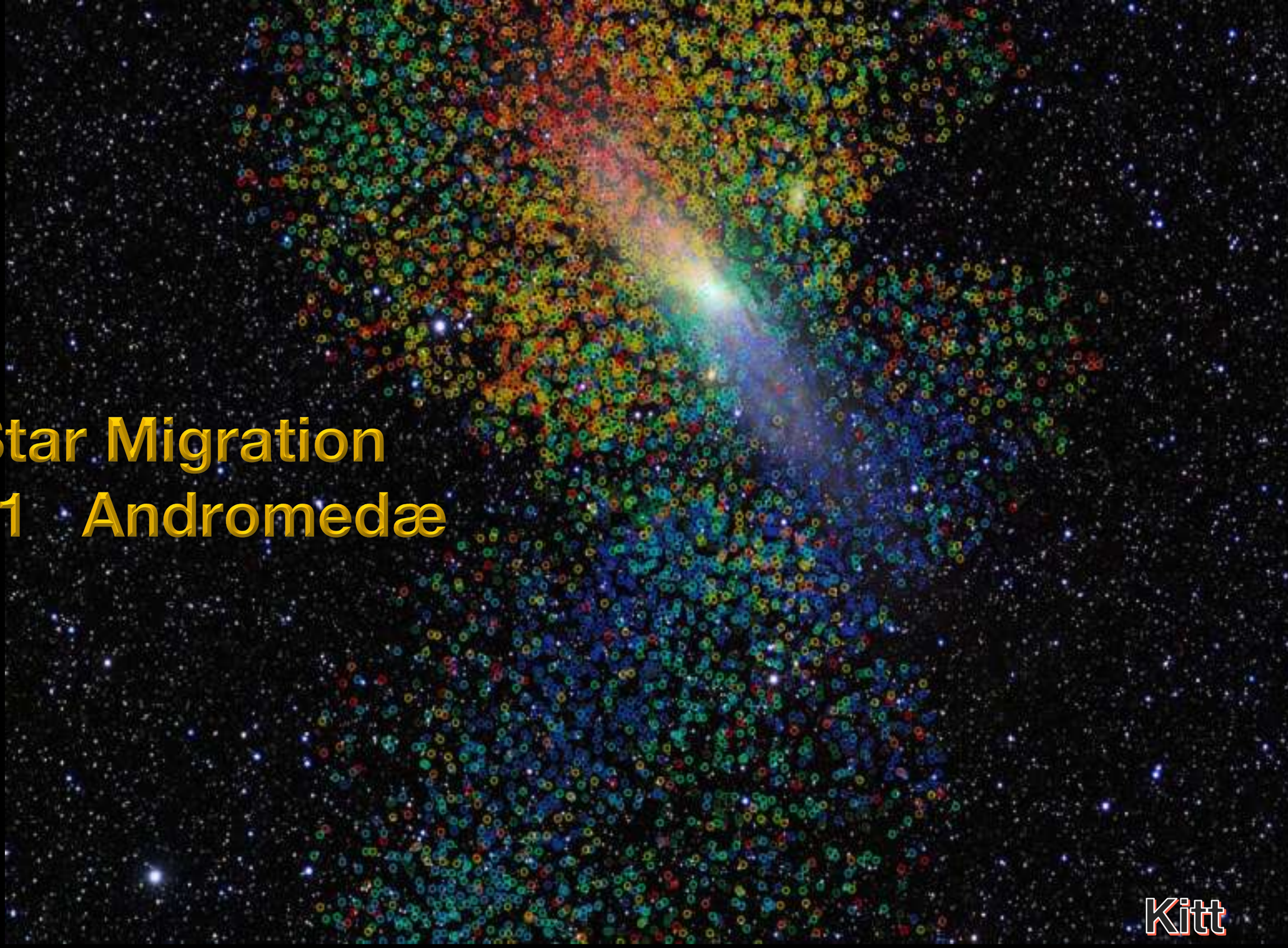
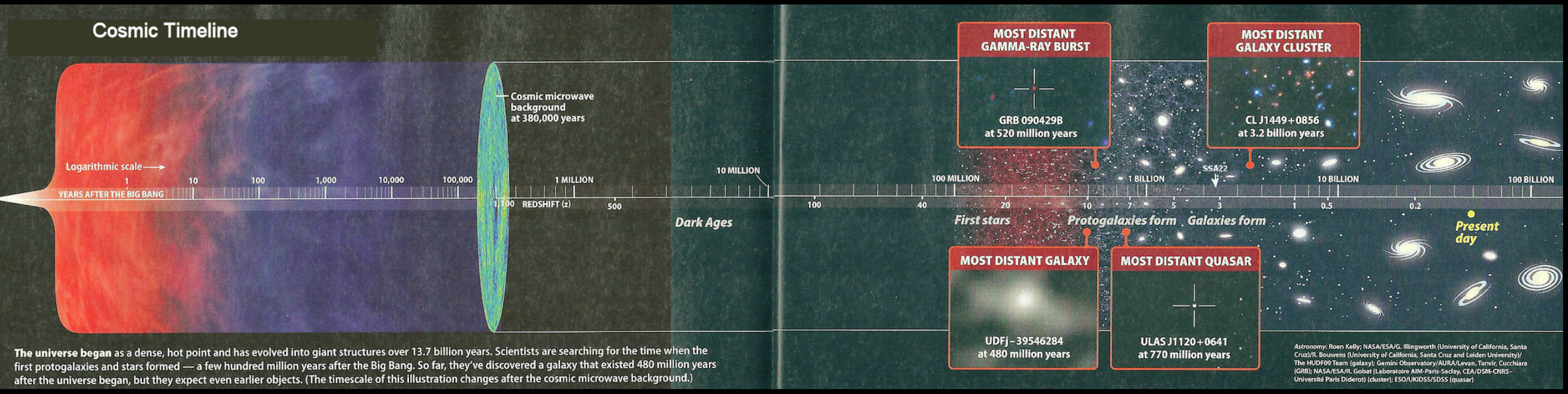
Sirius
CANIS MAJOR
Zaurak
ERIDANUS
Ameb
LEPUS
PYXIS
FORNAX
SCULPTOR


Alamac
φ
M31
γ
υ
ν
μ
θ
β
σ
Mirach
π
δ
α*
ε
Alpheratz
ζ
η
Andromeda
Algenib
γ*


Star Migration
M31 Andromedæ
Kitt
Peak
DESI

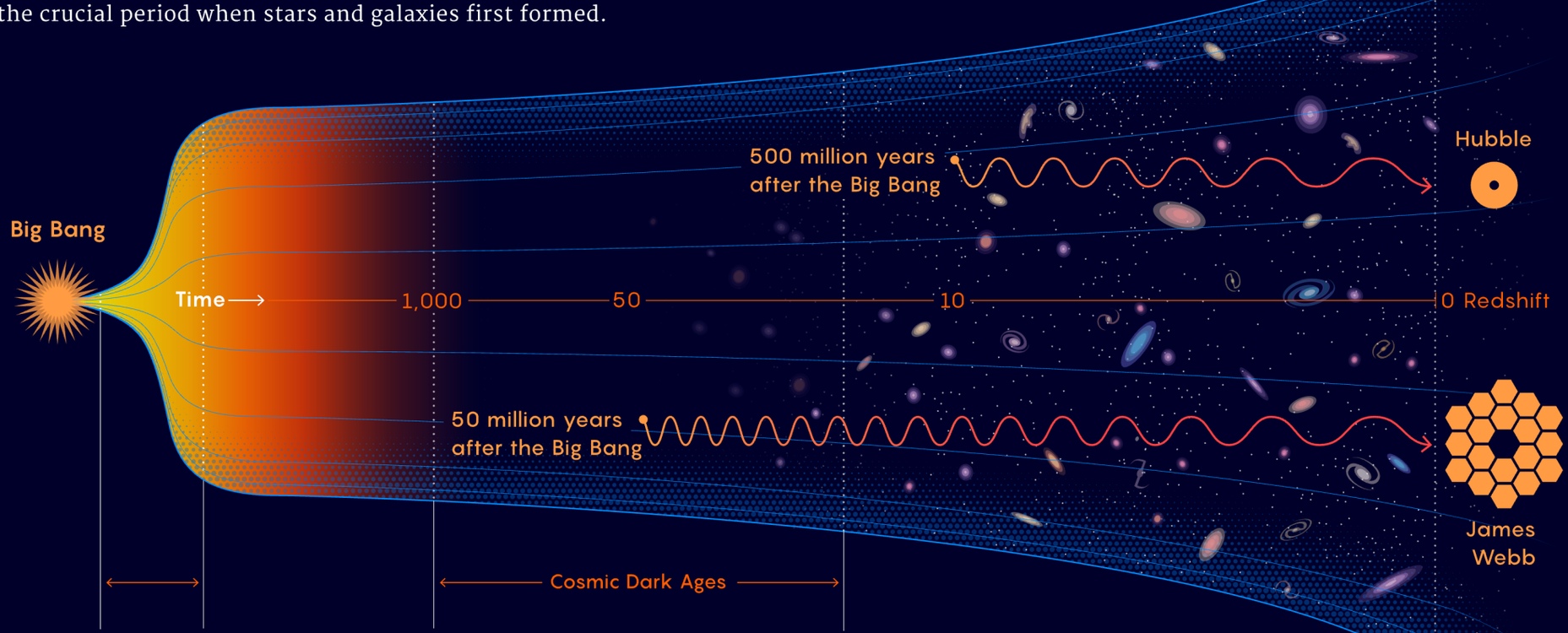
Cassiopeia A
Supernova Remnant



The universe began as a dense, hot point and has evolved into giant structures over 13.7 billion years. Scientists are searching for the time when the first protogalaxies and stars formed — a few hundred million years after the Big Bang. So far, they've discovered a galaxy that existed 480 million years after the universe began, but they expect even earlier objects. (The timescale of this illustration changes after the cosmic microwave background.)

The Growth of Cosmic Structure

Over billions of years, the universe went from smooth to structured. Powerful space telescopes have gradually uncovered much of the story of how this happened. The James Webb Space Telescope aims to reveal the crucial period when stars and galaxies first formed.



10^{-36} to 10^{-33} seconds
Inflation
During this period of exponential expansion, quantum fluctuations created density variations.

380,000 years
Cosmic Dark Ages Begin
After the first atoms formed, the universe was dark and structureless for eons.

100 million years?
Galaxies Form
At some point, dark matter corralled atoms into forming stars and proto-galaxies.

13.8 billion years
Today
Galaxies have become dimmer and more structured, appearing as spirals and ellipses.