

# Metal-poor massive stars

What are they? Why to care? And... how can we find them?

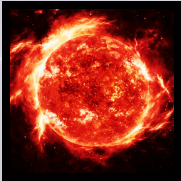
*Dorottya Szécsi*

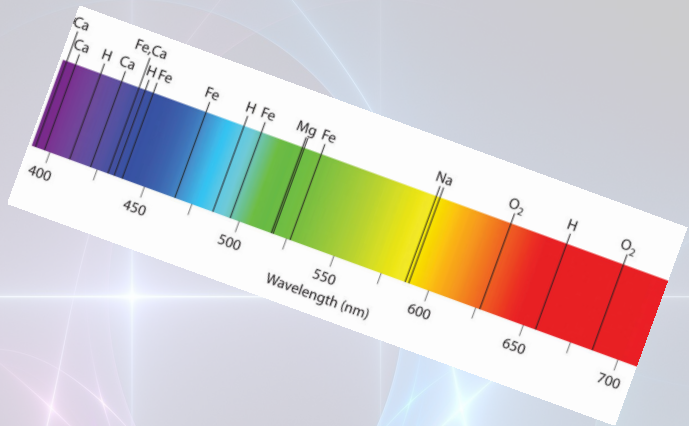
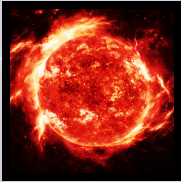
*Humboldt Fellow  
University of Cologne*



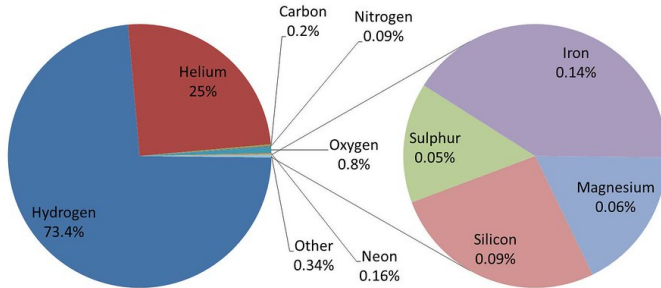
Humboldt Foundation Networking Meeting  
7th November 2019, Hamburg



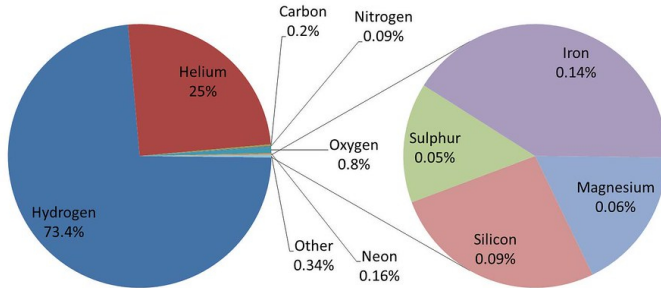




# The Sun's composition



# The Sun's composition

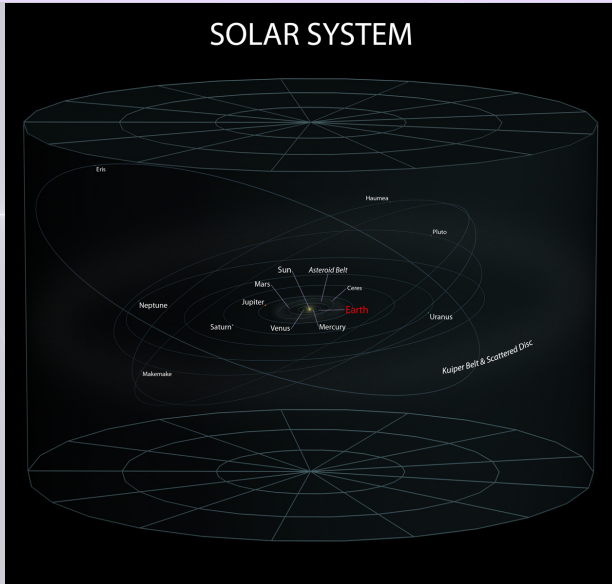


Less than 2% heavy elements,  
i.e. *high* metal content, *metal-rich*

The Universe is pretty large though...



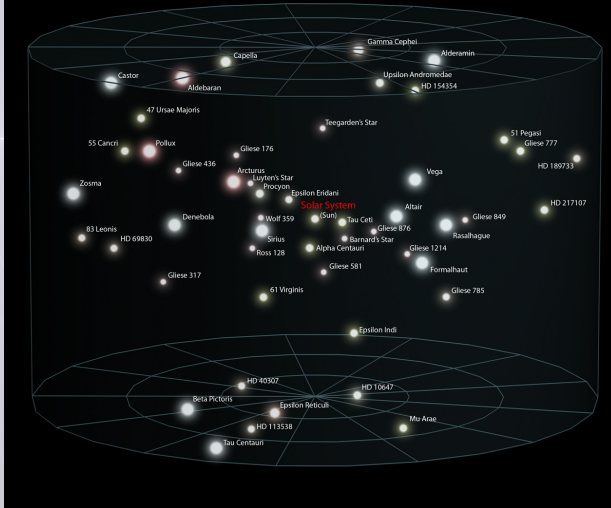
The Universe is pretty large though...



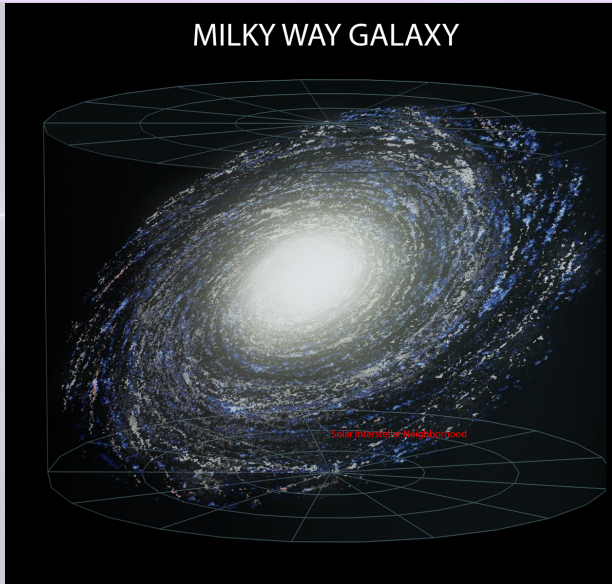


# The Universe is pretty large though...

## INTERSTELLAR NEIGHBORHOOD

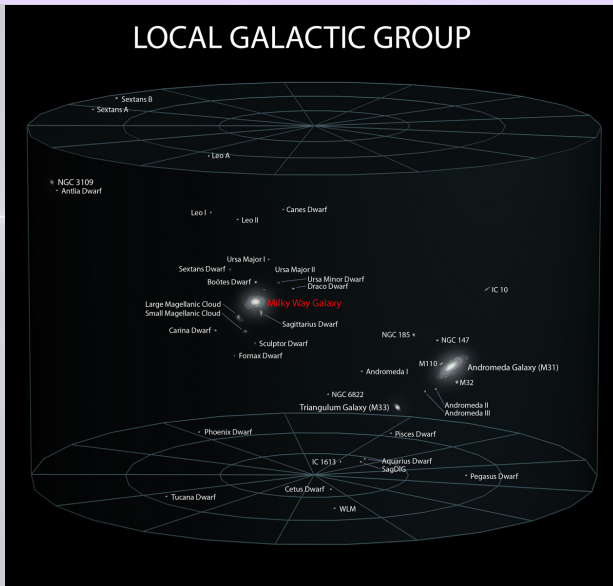


The Universe is pretty large though...

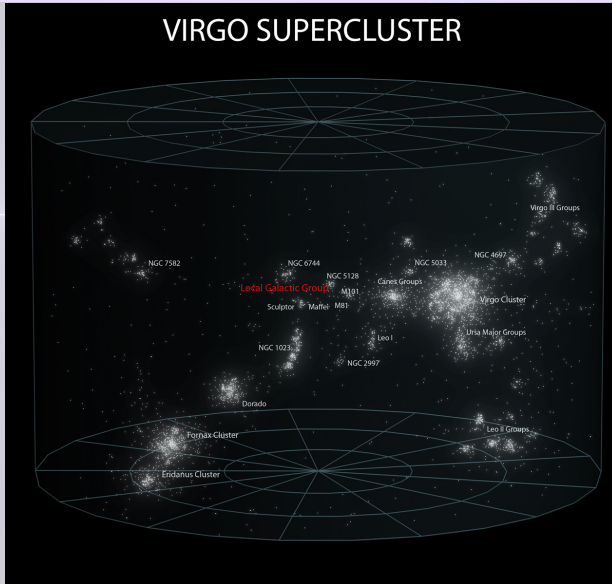


# The Universe is pretty large though...

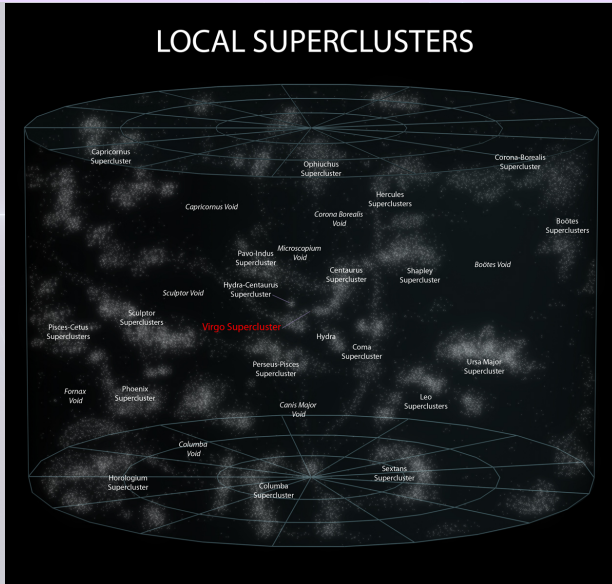
## LOCAL GALACTIC GROUP



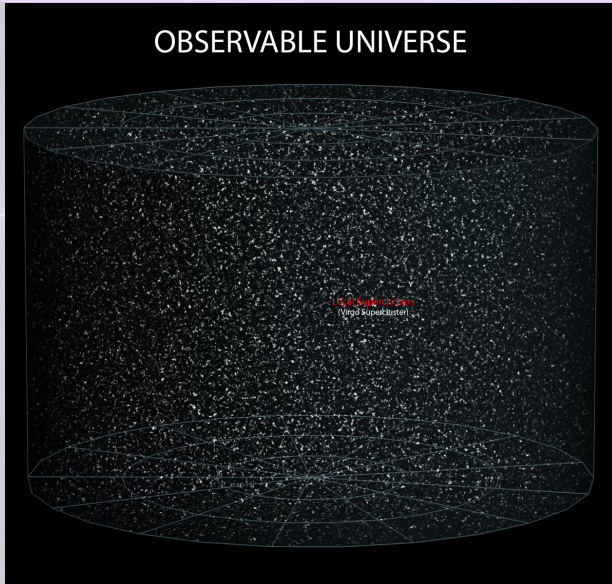
The Universe is pretty large though...



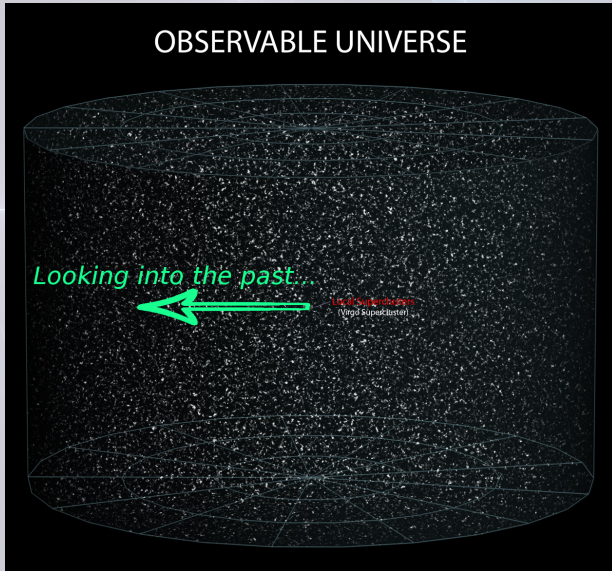
# The Universe is pretty large though...



The Universe is pretty large though...



The Universe is pretty large though...



The Universe is pretty large though...





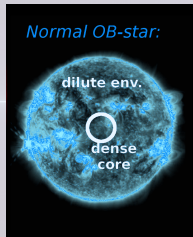
# Metal-poor *massive* stars... theory



# Metal-poor *massive* stars... theory

*massive*: > 8 times the Sun

– rare but influential



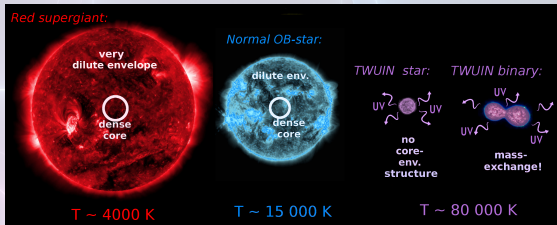
# Metal-poor *massive* stars... theory

*massive*: > 8 times the Sun

– rare but influential



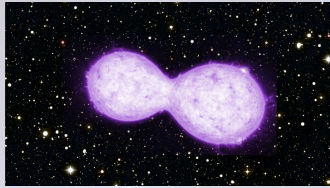
Metal-rich



Metal-poor: new stars predicted!

e.g. [Szécsi+15](#), [Szécsi+18](#), [Szécsi+19](#)

# Gravitational waves... theoretical origin!



e.g. [Szécsi'17a](#)

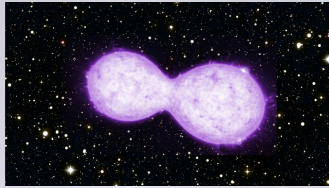
[Szécsi'17b](#)

Bagoly,[Szécsi+16](#)

Marchant+16,17

# Gravitational waves... theoretical origin!

*Life*



Massive binaries

e.g. [Szécsi'17a](#)

[Szécsi'17b](#)

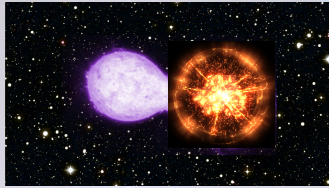
Bagoly,[Szécsi+16](#)

Marchant+16,17

# Gravitational waves... theoretical origin!

*Life*

*Death*



Massive binaries

Explosions

e.g. [Szécsi'17a](#)

[Szécsi'17b](#)

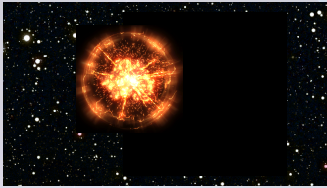
Bagoly,[Szécsi+16](#)

Marchant+16,17

# Gravitational waves... theoretical origin!

*Life*

*Death*



Massive binaries

Explosions

e.g. [Szécsi'17a](#)

[Szécsi'17b](#)

Bagoly,[Szécsi+16](#)

Marchant+16,17

# Gravitational waves... theoretical origin!

*Life*

*Death*

*Afterlife*



Massive binaries

Explosions

2 Black Holes  
(or Neutron Stars)

e.g. [Szécsi'17a](#)

[Szécsi'17b](#)

Bagoly,[Szécsi+16](#)

Marchant+16,17

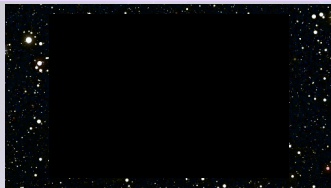


# Gravitational waves... theoretical origin!

Life

Death

Afterlife



Massive binaries

Explosions

2 Black Holes  
(or Neutron Stars)



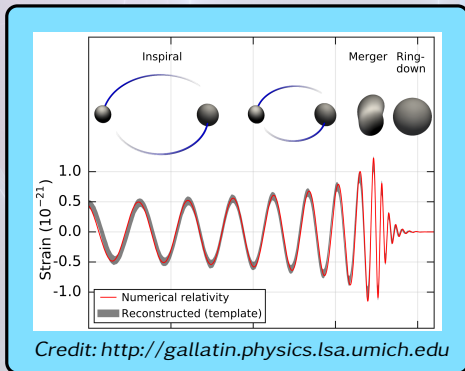
'Second  
death'

e.g. [Szécsi'17a](#)

[Szécsi'17b](#)

[Bagoly, Szécsi+16](#)

[Marchant+16,17](#)



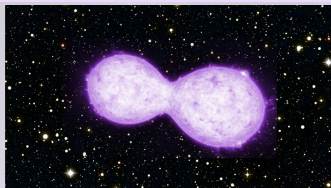
Merger

# Gravitational waves... theoretical origin!

Life

Death

Afterlife



Massive binaries

Explosions

2 Black Holes  
(or Neutron Stars)



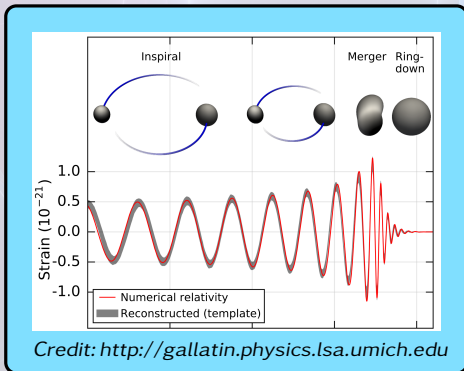
'Second  
death'

e.g. [Szécsi'17a](#)

[Szécsi'17b](#)

[Bagoly, Szécsi+16](#)

[Marchant+16,17](#)



Merger

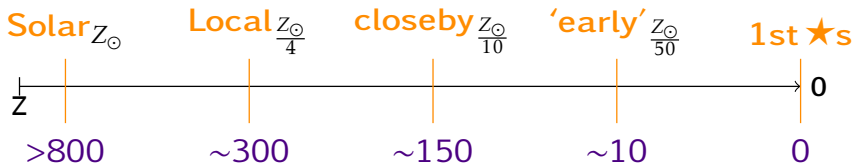
The background features a complex, glowing fractal pattern. It consists of numerous overlapping, semi-transparent lines and curves that form a dense, web-like structure. The colors are primarily light blue and cyan, with some areas of soft pink and pale green. The overall effect is ethereal and futuristic, with a central circular void that frames the text.

*However...*

Metal-poor *massive* stars... observations??



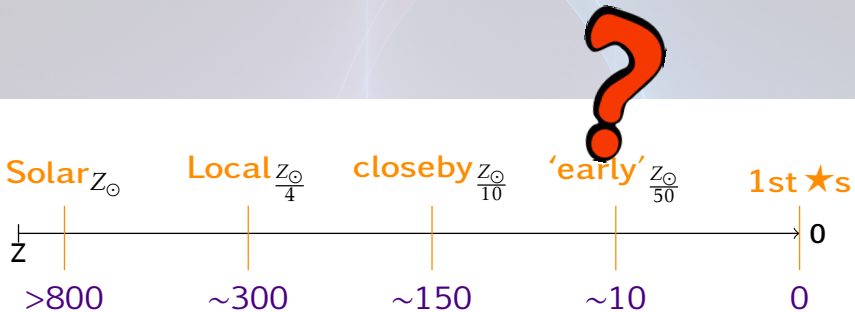
# Metal-poor *massive* stars... observations??



spectroscopy  
(i.e. direct evidence)

e.g. Castro+14,+18, Ramírez-Agudelo+17, Kubátová&[Szécsi](#)+18

# Metal-poor *massive* stars... observations??



spectroscopy  
(i.e. direct evidence)

Gravitational wave theories...

e.g. Castro+14,+18, Ramírez-Agudelo+17, Kubátová&Szécsi+18

The background features a large, semi-transparent white circle in the center. Overlaid on this are several glowing, ethereal lines in shades of blue, cyan, and magenta. These lines form a complex, web-like pattern that resembles a molecular structure or a network diagram. The lines are semi-transparent and have a soft, glowing aura around them. The overall aesthetic is clean, modern, and scientific.

My research

# My research

Dr. Dorottya Szécsi, Uni Köln

