

Visible and Infrared Survey Telescope  
for Astronomy

**New horizons in survey astronomy**

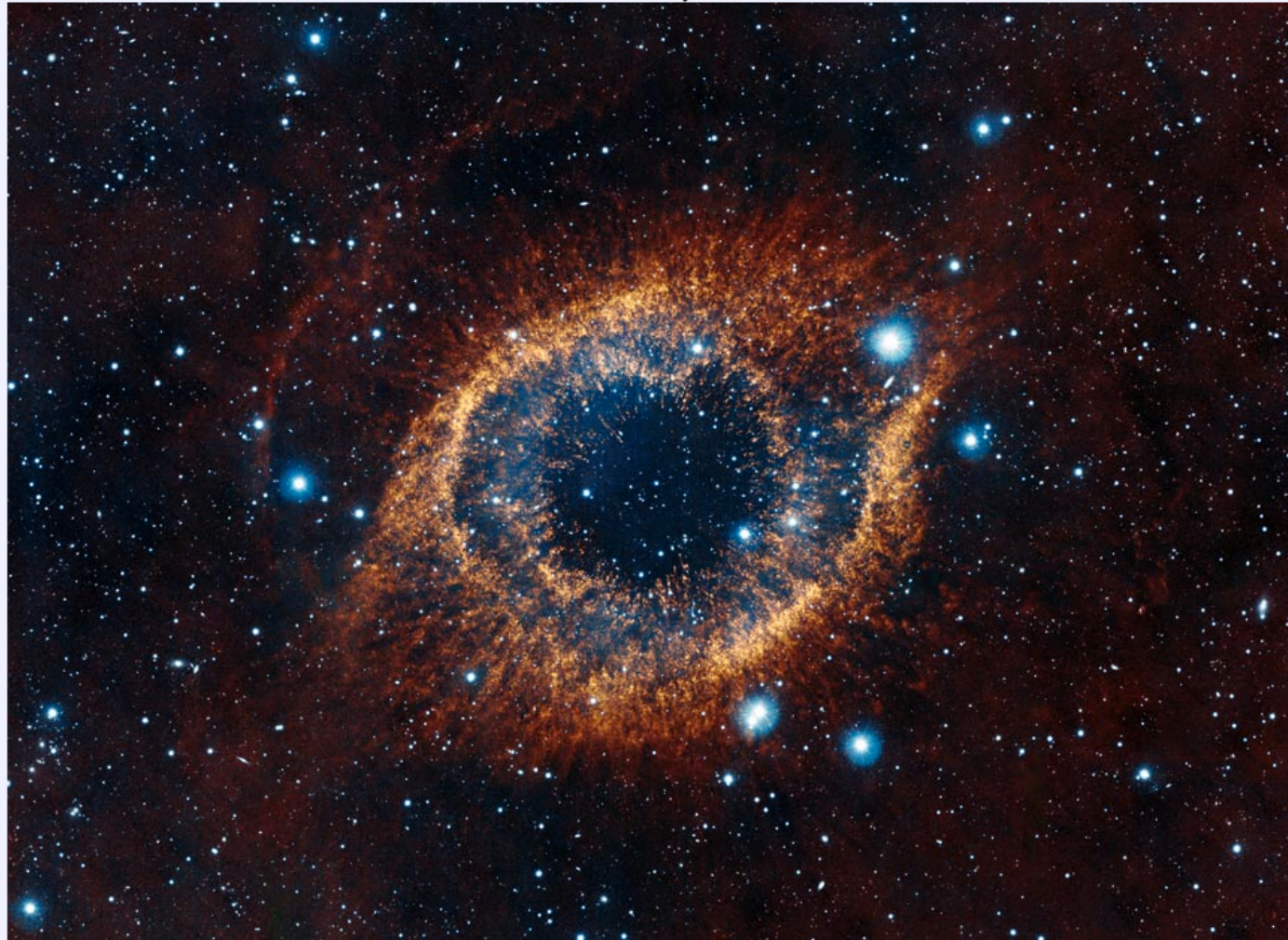
Jim Emerson

Queen Mary, University of London

# Astronomy Picture of the Day

[Discover the cosmos!](#) Each day a different image or photograph of our fascinating universe is featured, along with a brief explanation written by a professional astronomer.

2012 January 31



**The Helix Nebula from the VISTA Telescope**

**Credit:** [ESO/VISTA](#)/J. Emerson; **Acknowledgment:** [Cambridge Astronomical Survey Unit](#)

**Explanation:** Will our [Sun](#) look like this one day? The [Helix Nebula](#) is one of brightest and closest examples of a [planetary nebula](#), a gas [cloud created](#) at the end of the life of a Sun-like star. The outer gasses of the star [expelled into space](#) appear from our vantage point as if we are looking down a [helix](#). The remnant central stellar core, destined to become a [white dwarf star](#), glows in light so [energetic](#) it causes the previously expelled gas to [fluoresce](#). The [Helix Nebula](#), given a technical designation of [NGC 7293](#), lies about 700 [light-years](#) away towards the [constellation](#) of the Water Bearer ([Aquarius](#)) and spans about 2.5 light-years. The [above picture](#) was taken three colors on [infrared light](#) by the 4.1-meter [Visible and Infrared Survey Telescope for Astronomy](#) (VISTA) at the [European Southern Observatory's Paranal Observatory](#) in [Chile](#). A [close-up](#) of the [inner edge](#) of the [Helix Nebula](#) shows complex gas knots of [unknown origin](#).



# Yesterday

- Findlay had successful PhD oral
- Supervisor Will Sutherland
  
- Findlay et al found with VIKING data
- 4<sup>th</sup> most distant quasar
- 3<sup>rd</sup> most distant quasar
- 2<sup>nd</sup> most distant quasar



2 months ago

- 1st release of VISTA survey products 2011-12-01

[www.eso.org/sci/observing/phase3/  
data\\_releases.html](http://www.eso.org/sci/observing/phase3/data_releases.html)





# What & Why VISTA?

Telescope + near infrared (0.85-2.3 $\mu\text{m}$ )  
camera which images a wide field (1.65 $^\circ$ )

- Make infrared **Surveys** of southern sky
- Locate and select interesting objects for ESO's four 8-metre Very Large Telescopes to study in detail
- Do science directly from surveys themselves



# Why infrared?

- Observe Heat rather than Light
  - Relatively unexplored
- Cool Universe
  - Brown dwarfs
- High redshift Universe
  - Distant galaxies – look back in time
- Obscured Universe (dust obscures & reddens)
  - Galactic Plane
  - Reddened Active Galactic Nuclei, starbursts, Extreme Red Objects



# Why Surveys?

- Large object samples for **high significance**
- Large object samples to **find rare objects**
- Large area to find **Large Scale Structures**
- Variability over time in **brightness or position**



# How to Survey?

Surveys need to be FAST:

Needs Depth (low  $S$ ) & Area (high  $\Omega$ )

- Depth: large mirror
- Depth: good images, high efficiency, & small pixels
- Depth: good 'seeing' (minimal twinkling) at site
- Area: large instantaneous field of view on sky





# Money & People

- Funded by £38-million JIF/STFC grants to QMUL, leader of the 18 University VISTA Consortium
- Science Requirements and oversight by QMUL
- Project Scientist **Will Sutherland**, PI JPE
- Technical work managed by UK ATC
- Project completed 2009
- Earned £27-m discount off the £72-m ESO joining fee
- Operated by European Southern Observatory (ESO)



# Enclosure







# Enclosure



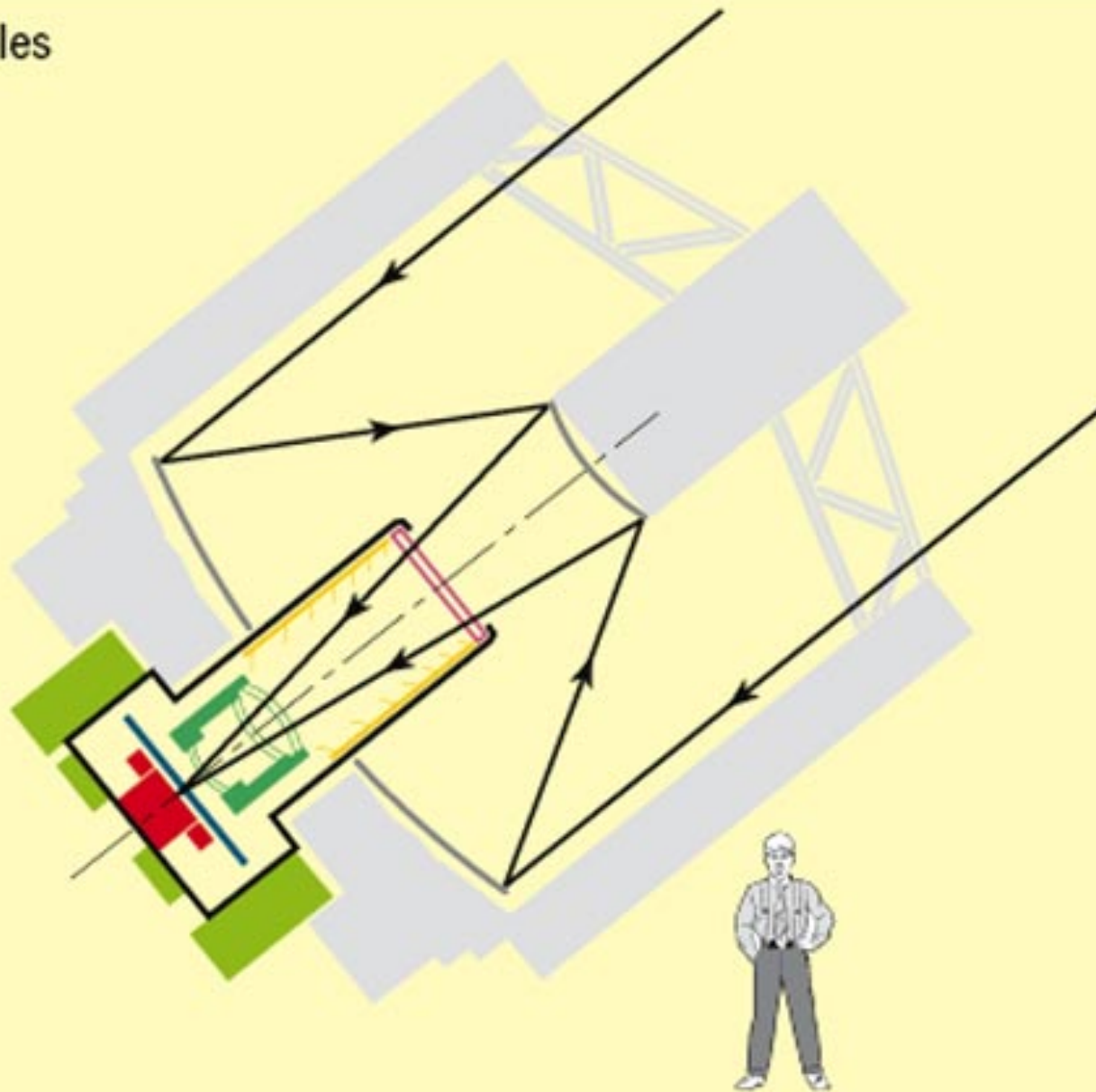
4.1-m diameter f/1 meniscus mirror Ag coated





# Telescope & Camera

- detector array modules (infrared and CCD)
- filter barrel
- lens barrel
- baffle tube
- pressure window
- cryostat vessel
- electronics rack
- telescope structure and mirrors



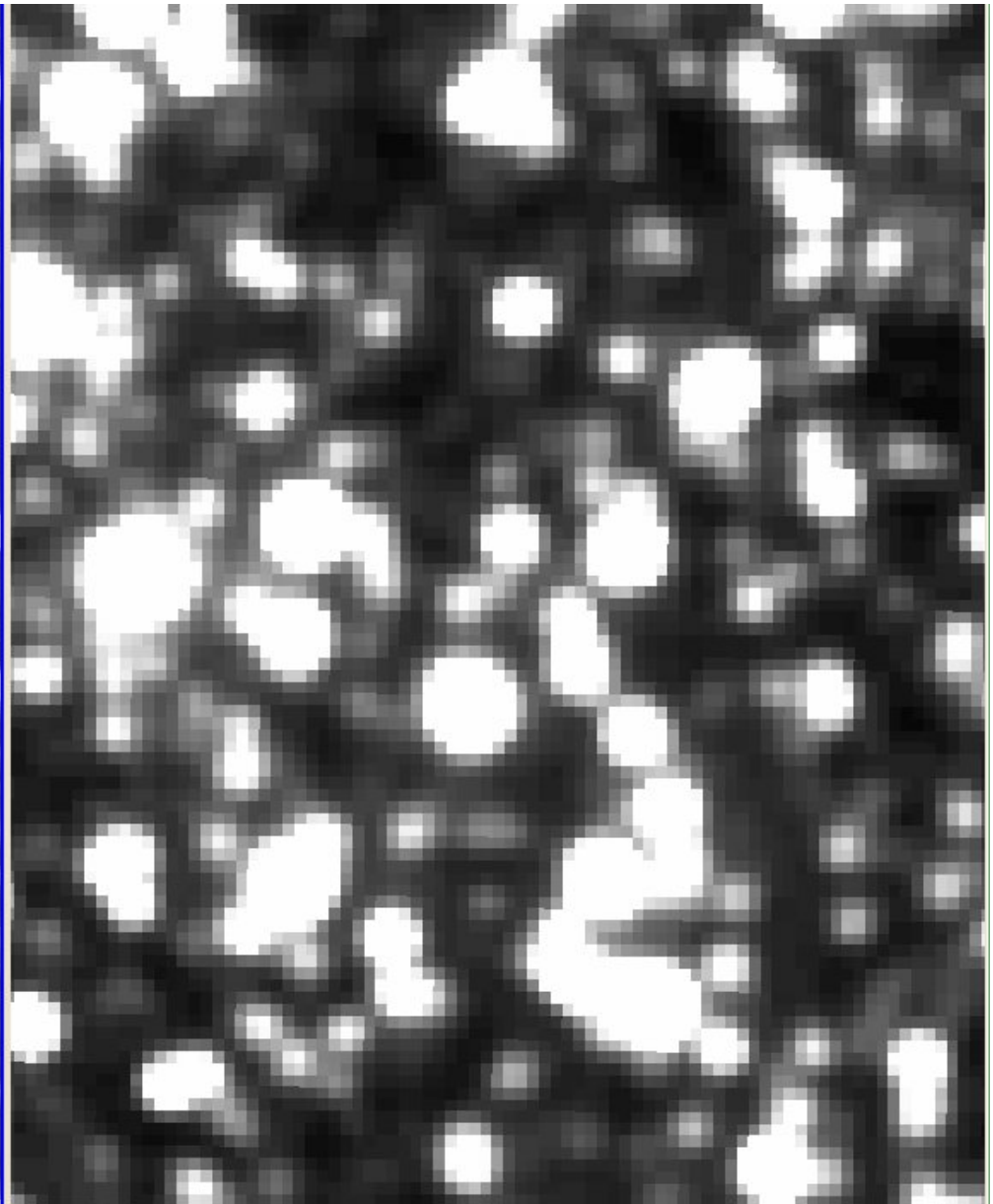
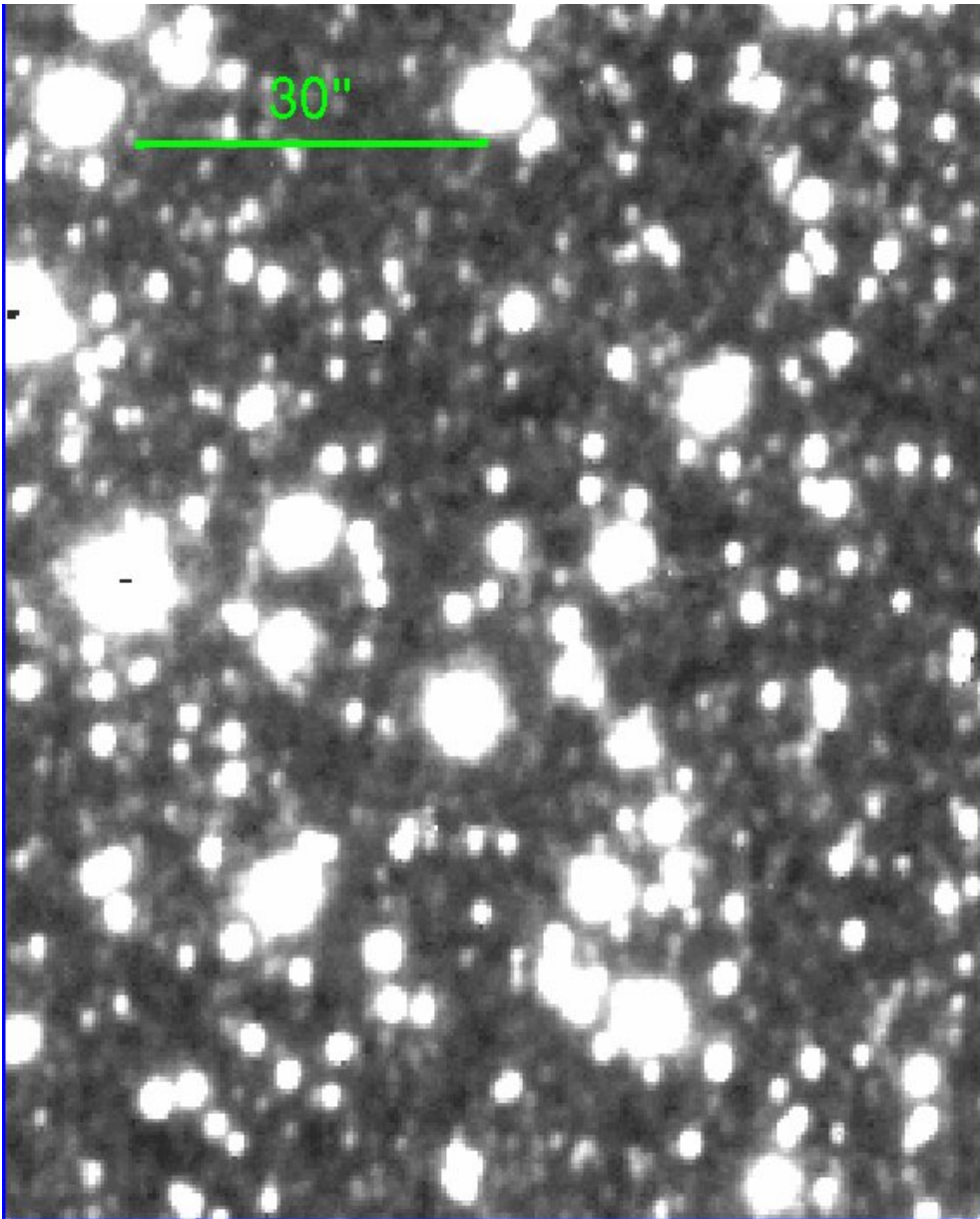




# Telescope





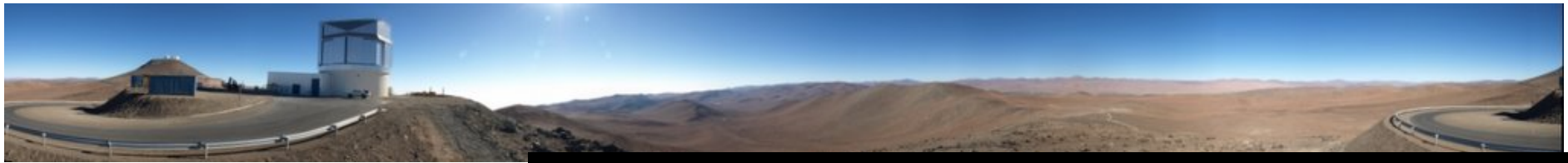




Flame  
Nebula:  
NGC 2024  
& NGC  
2023 &  
Horsehead







# Flame Nebula: NGC 2024 & NGC 2023 & Horsehead

Core of the Flame Nebula



HH 92

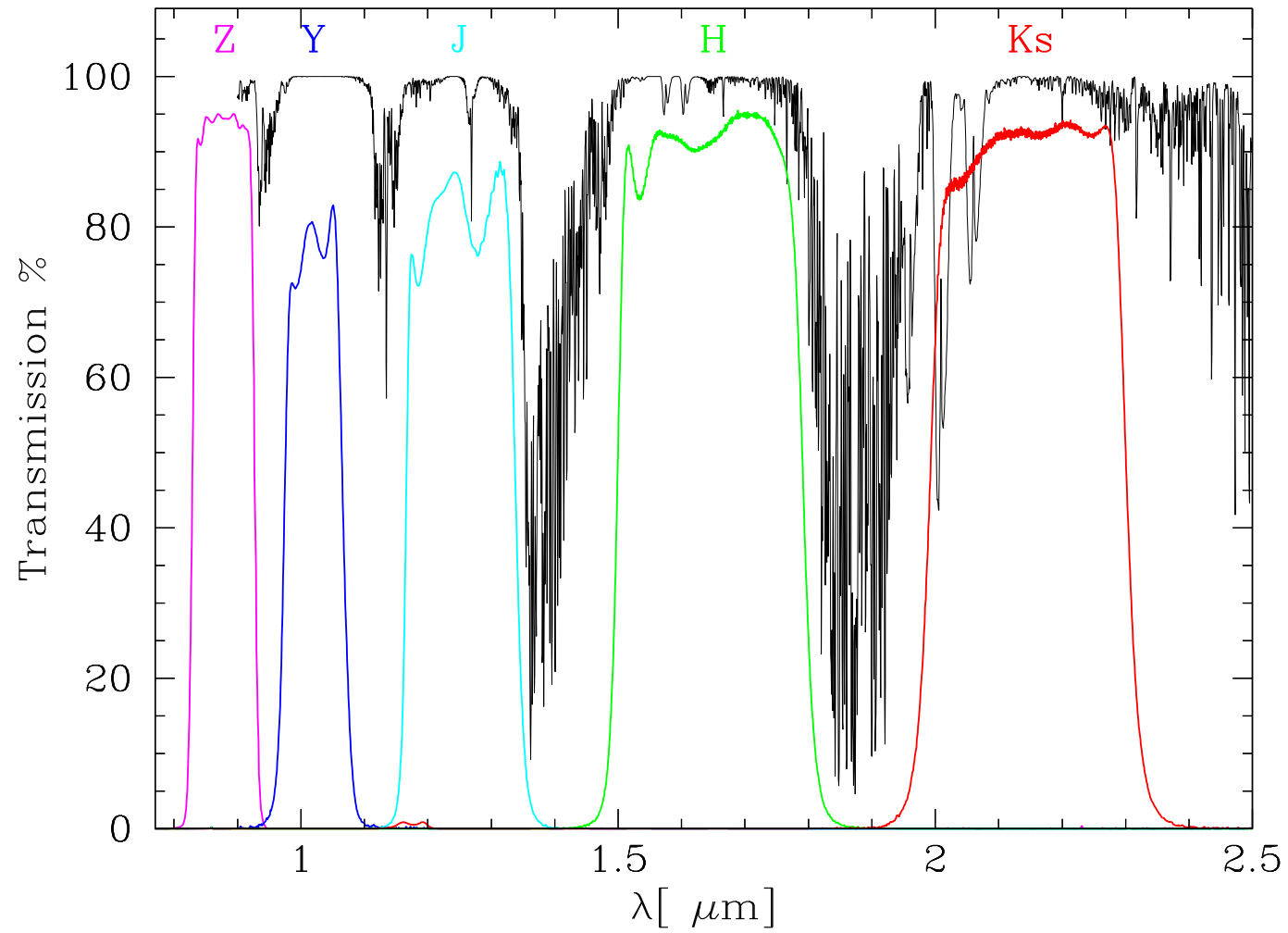


NGC 2023

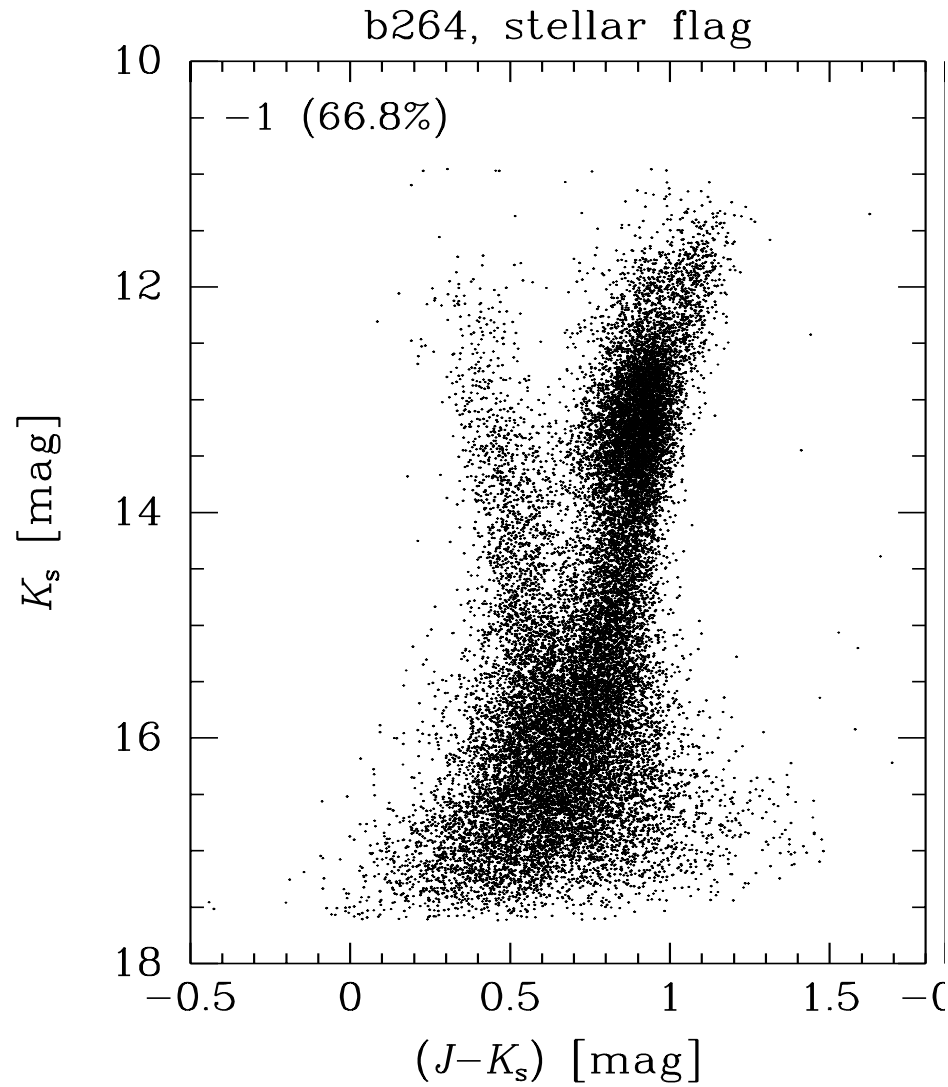


Horsehead Nebula





# Colour-magnitude diagram

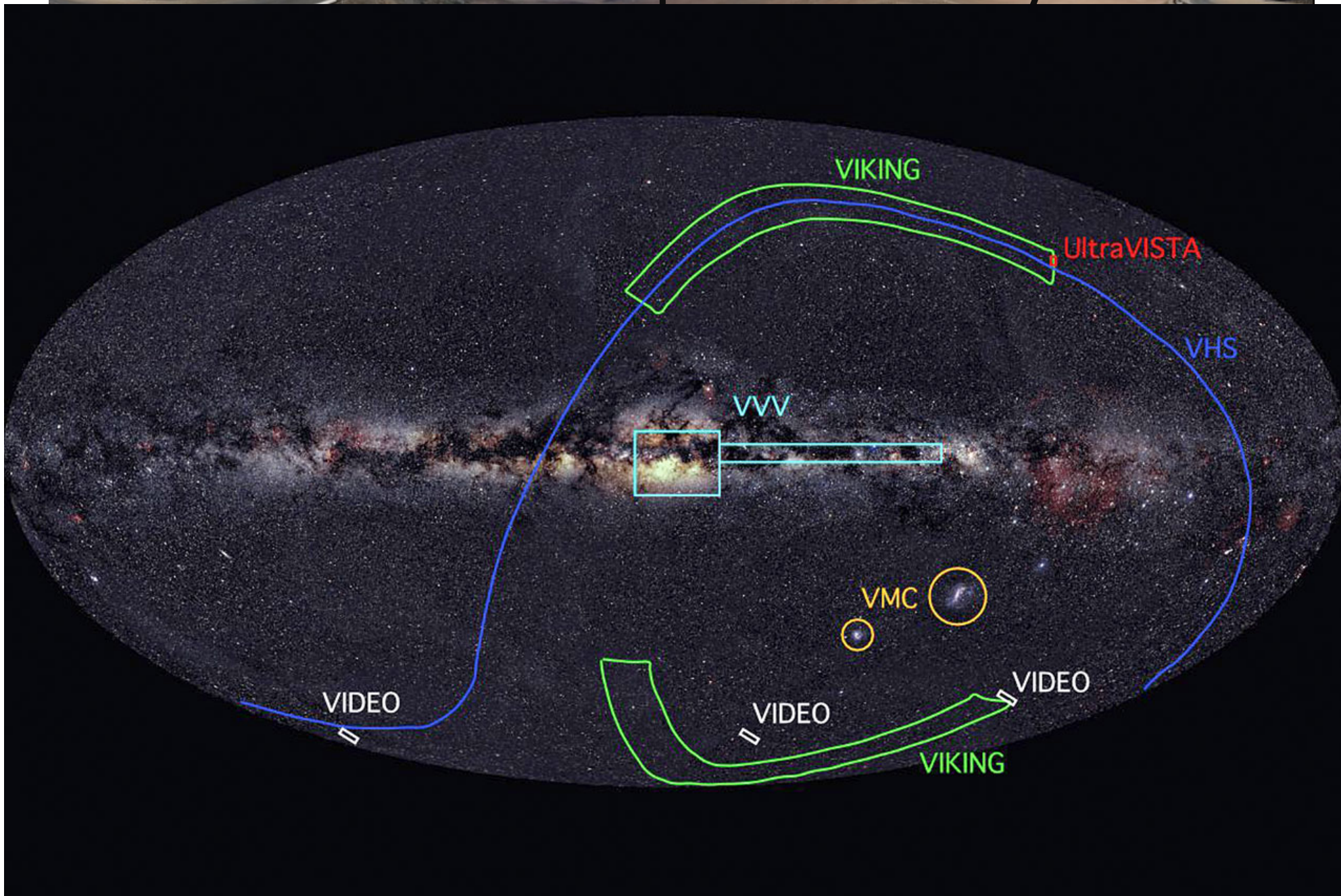


And others pairs of the 5 filters

From Saito et al A&A 537, A107,2012 et al



# VISTA's 6 public surveys

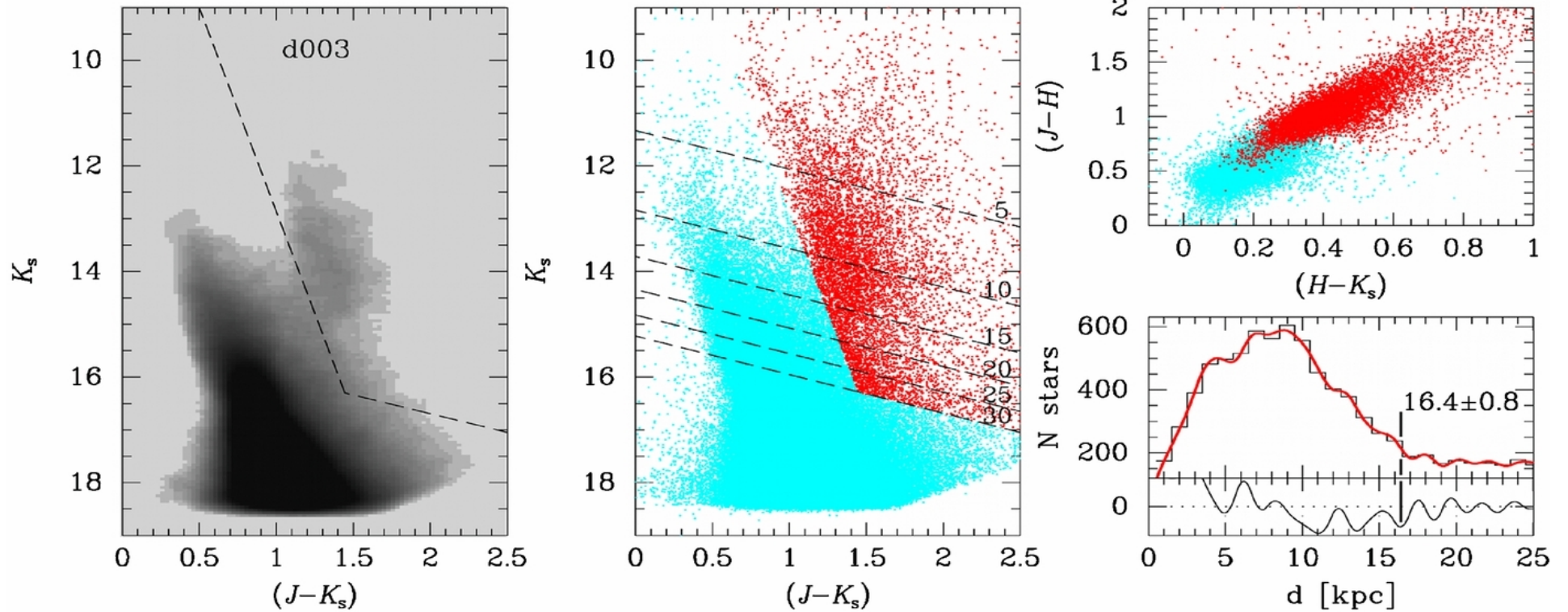






# Seeing to the edge of our Galaxy

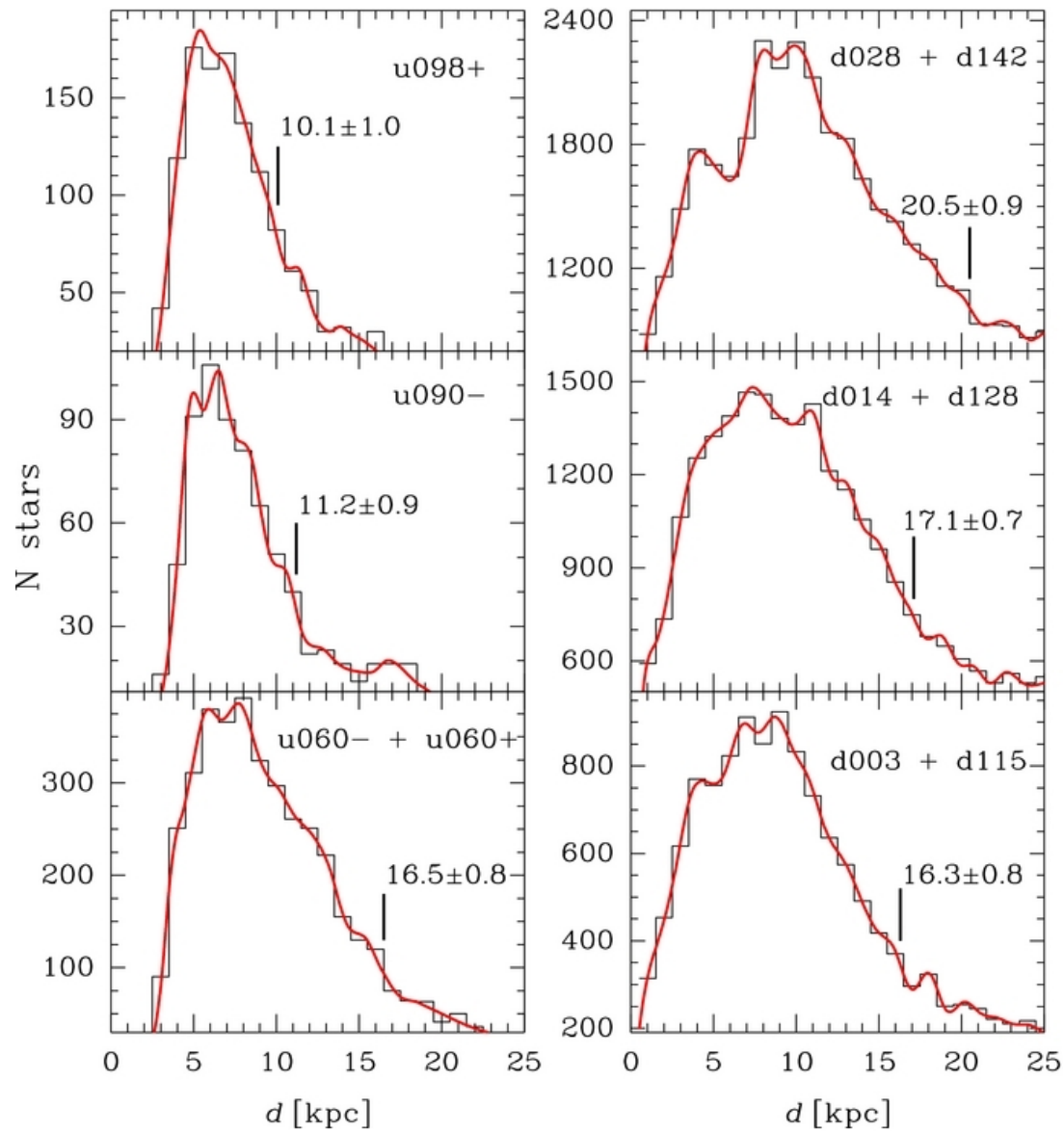
# Edge of Milky Way Disk Revealed Using Clump Giant Stars



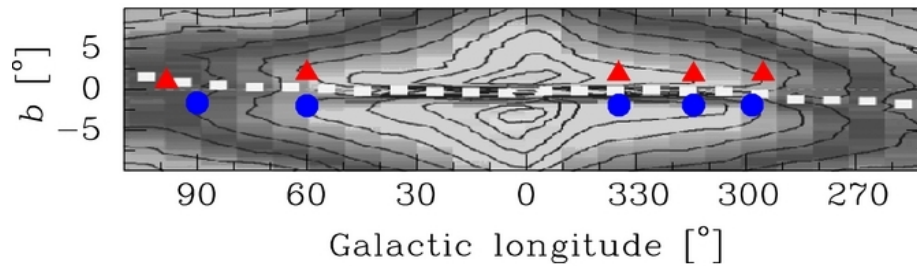
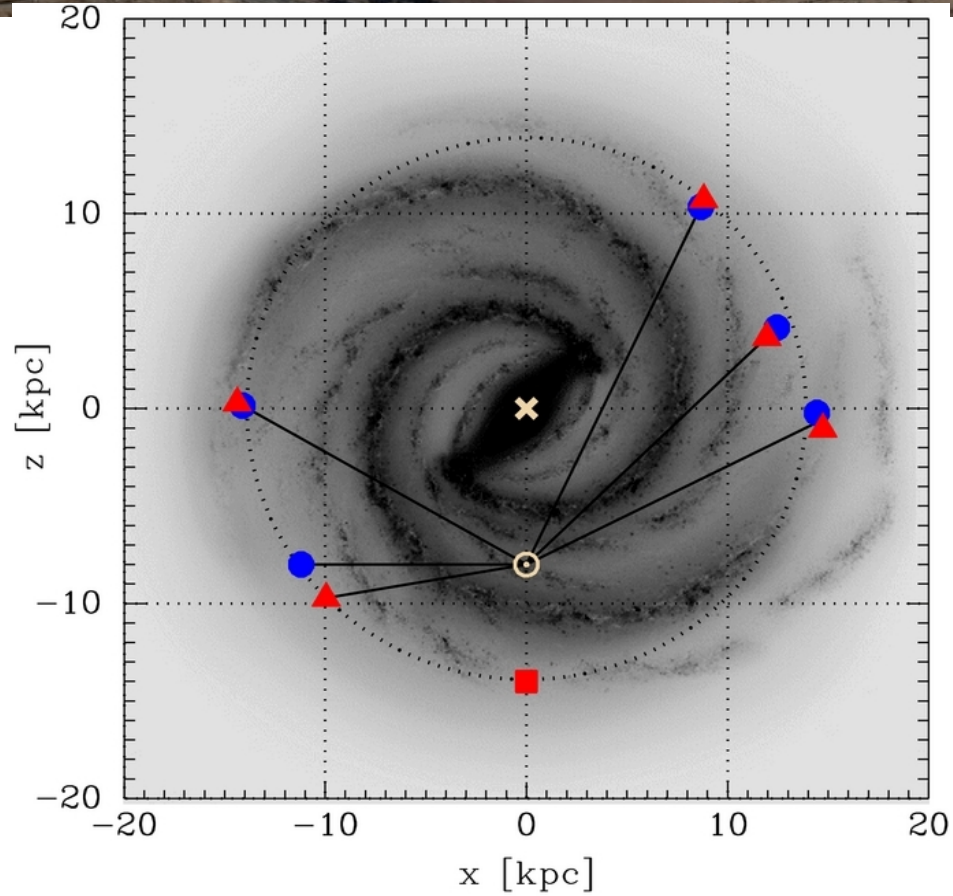
Selection of red giant clump stars

From Minniti et al ApJLett 733, L43, 2011

# Distance distribution in different lines of sight



From Minniti et al ApJLett 733, L43, 2011



From Minniti et al ApJLett 733, L43, 2011

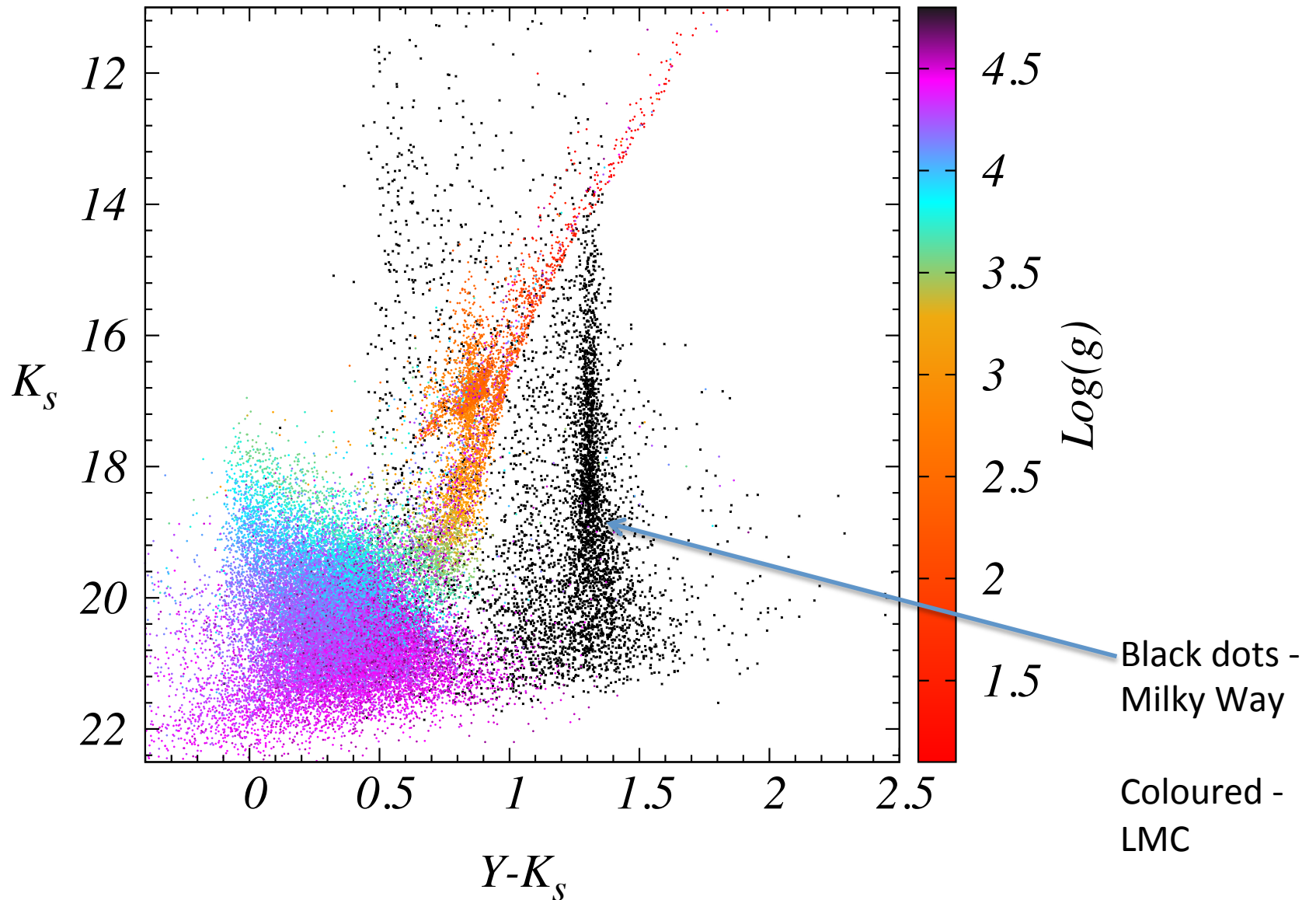




# Magellanic Clouds

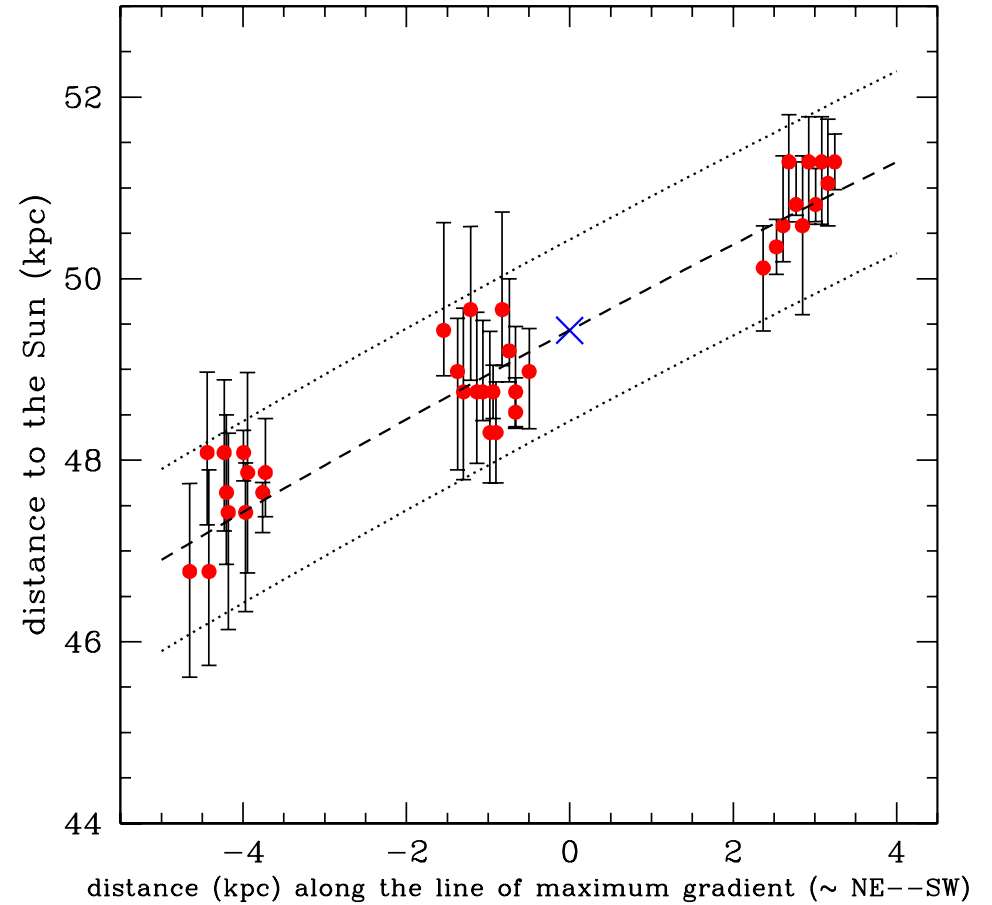
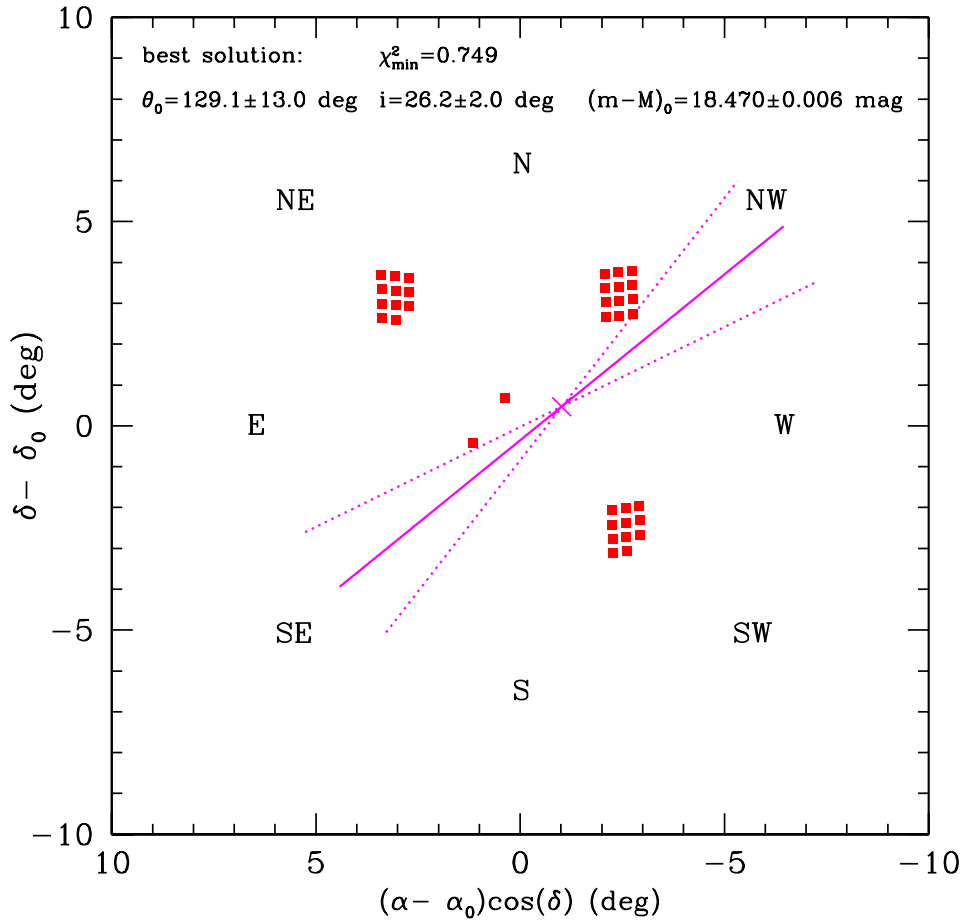


# Simulation



From Rubele et al A&A 537,A106,2012

# Best fitting model of LMC disk



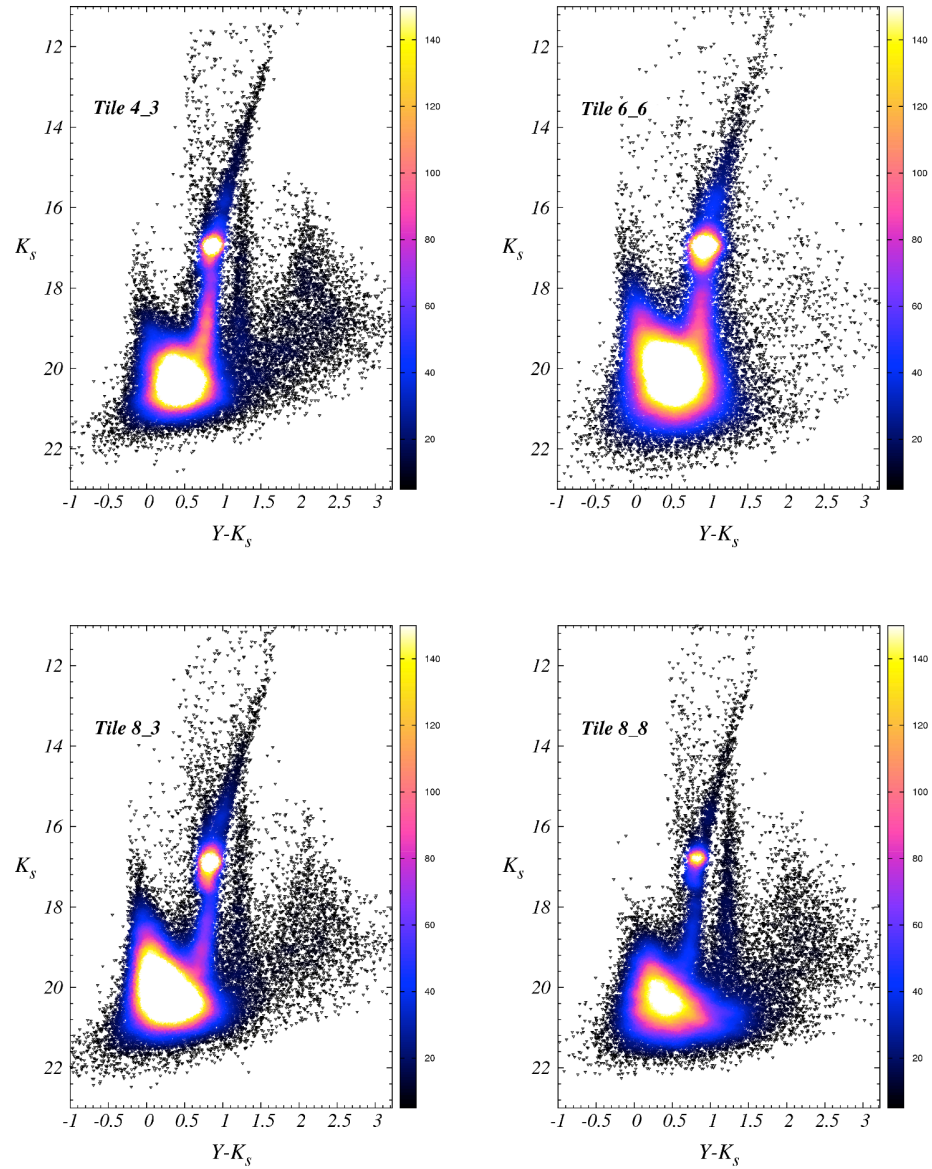
From Rubele et al A&A 537,A106,2012



# Large Magellanic Cloud (eso1033)

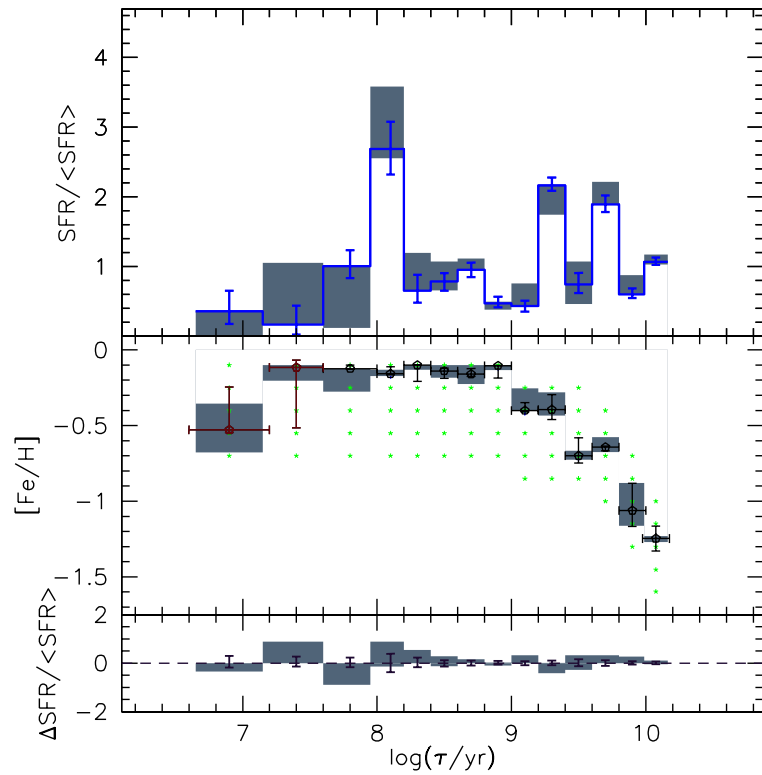




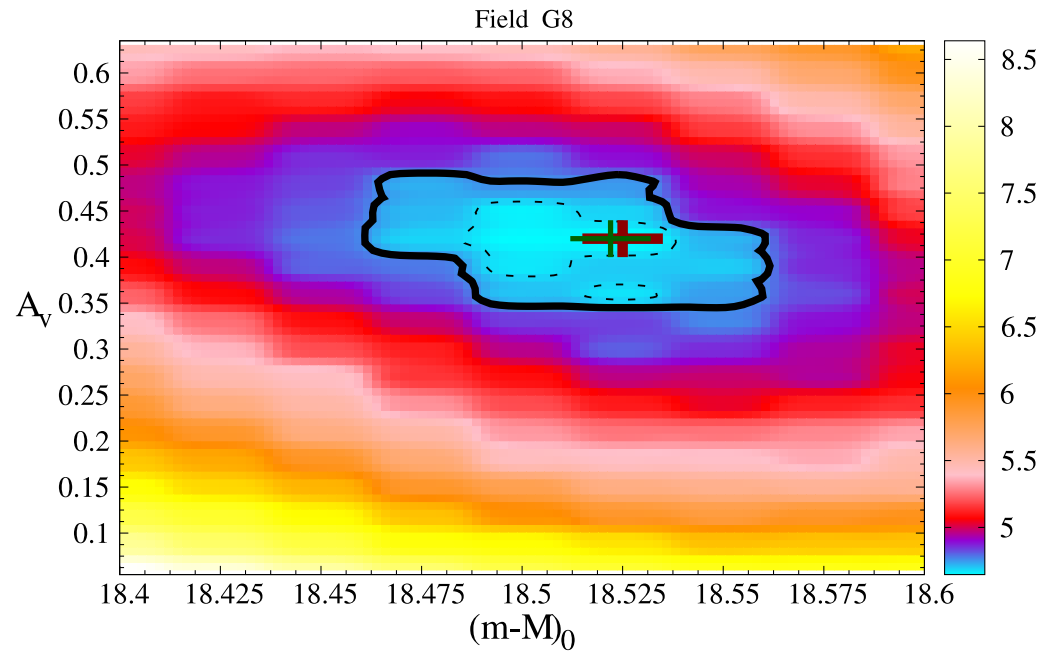


From Rubele et al A&A 537,A106,2012

# Best fitting Star Formation history



History



Goodness of fit

Tile 4\_3

From Rubele et al A&A 537,A106,2012





# Conclusion

- VISTA works as expected – the novel systems all work well
- Astronomers pleased with their data
- First public data released (1<sup>st</sup> 6 months)
- 1<sup>st</sup> science papers published
- VISTA is making it's impact