

# *The Virtual Observatory*

## Enrique Solano

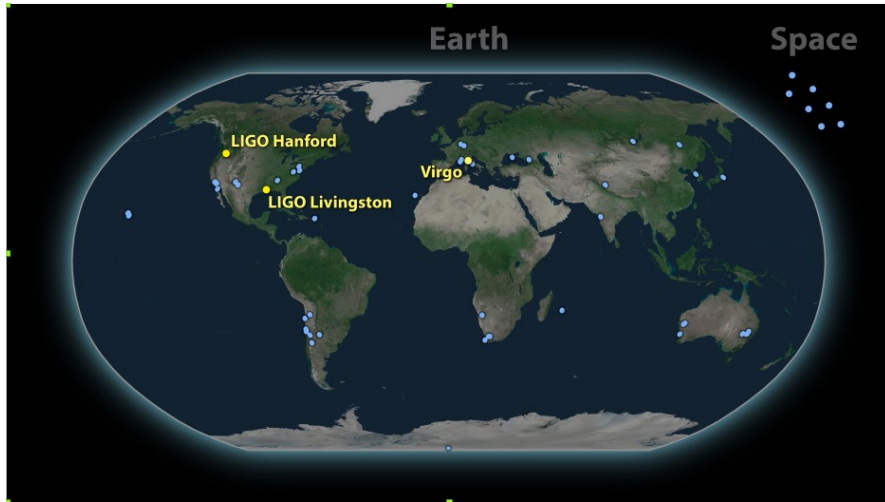
Centro de Astrobiología (INTA-CSIC).  
Spanish Virtual Observatory, Madrid. Spain.



Astronomy ESFRI & Research Infrastructure Cluster  
ASTERICS - 653477



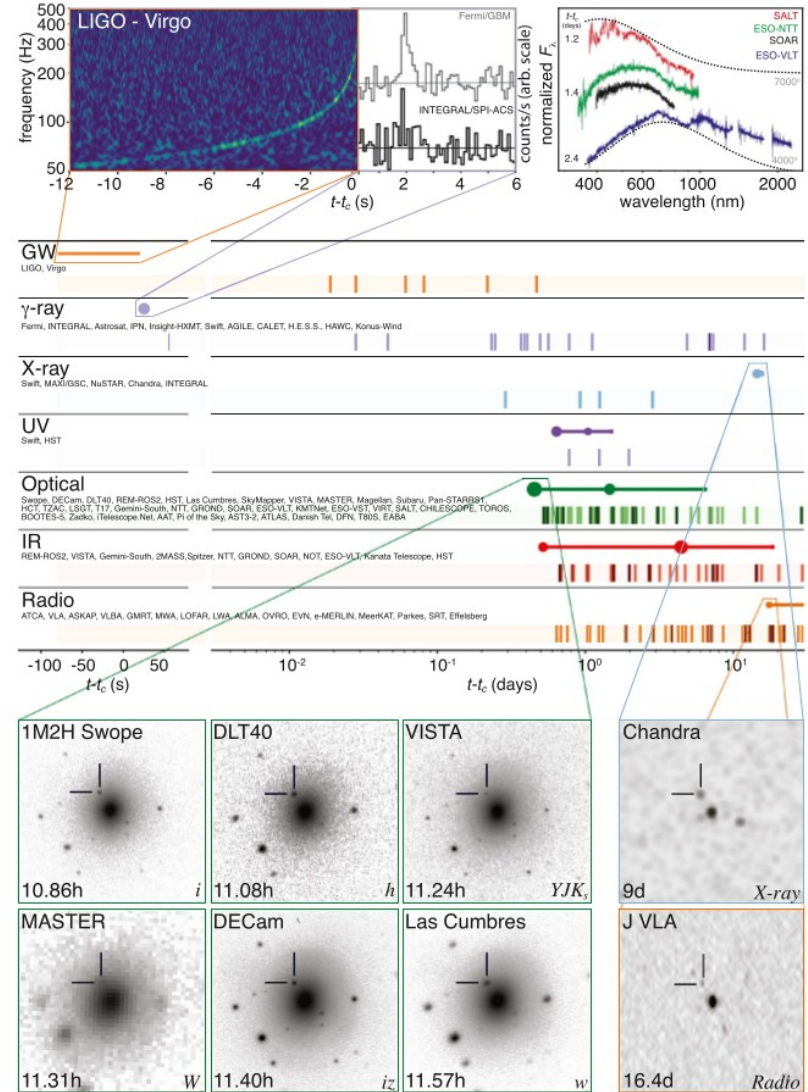
# Interoperability in Astronomy



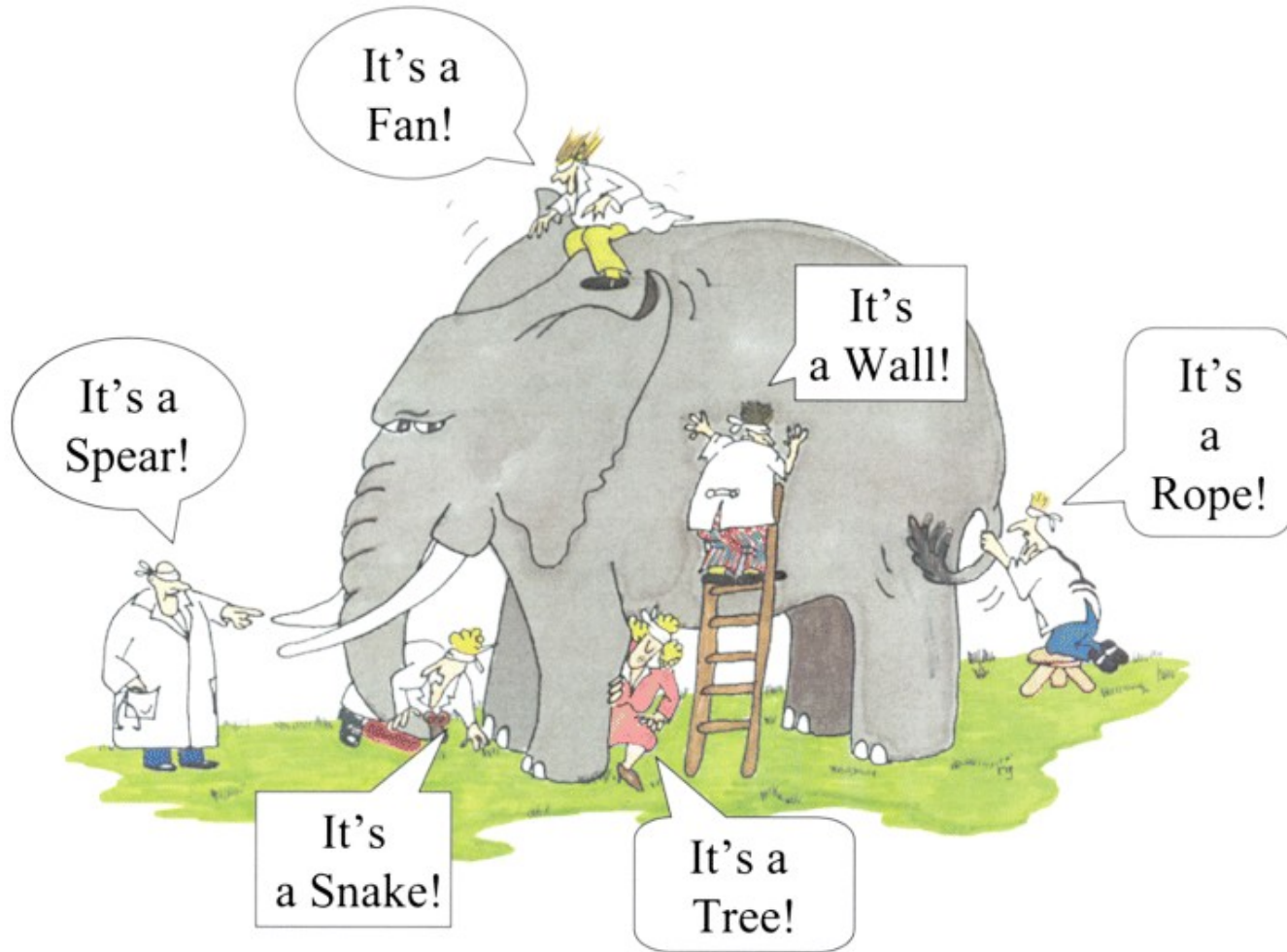
GW170817

THE ASTROPHYSICAL JOURNAL LETTERS, 848:L12 (59pp), 2017 October 20

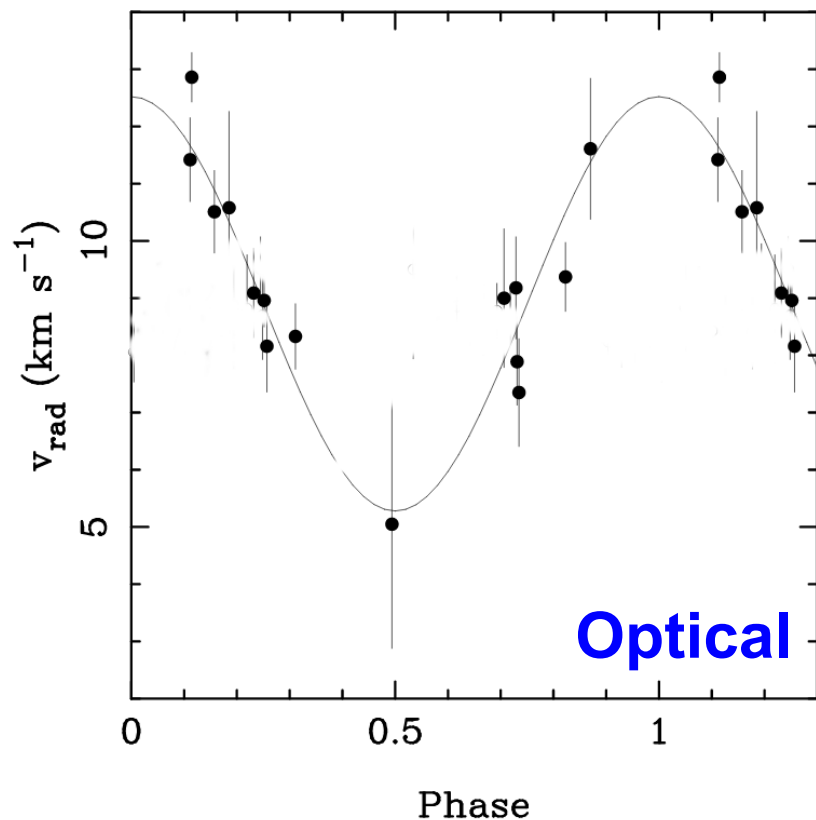
Abbott et al.



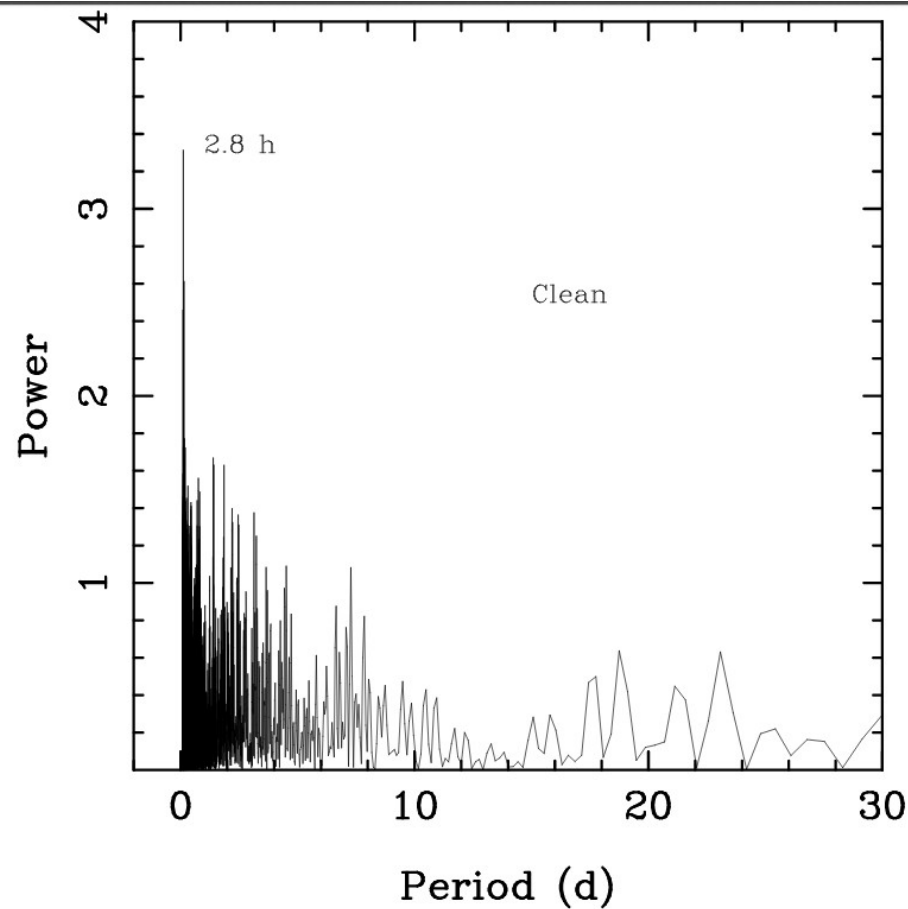
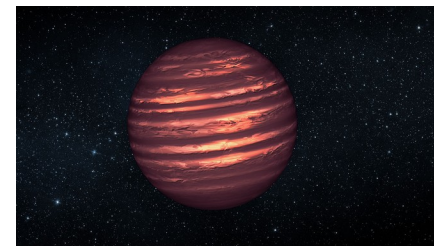
# Multi- $\lambda$ Astronomy



# Multi- $\lambda$ Astronomy

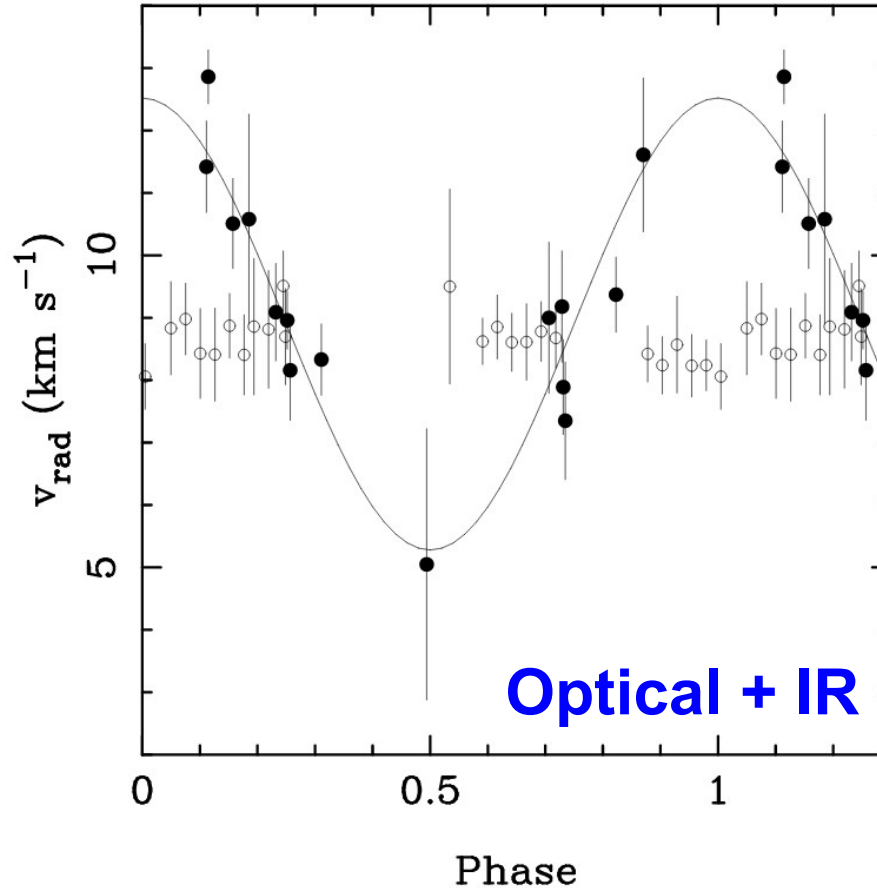


LP 944-20



- 14 nights covering 841 days
- Period: 2.5 – 3.7 hours

# Multi- $\lambda$ Astronomy



IR data rules out the planetary hypothesis

# The challenge

Findable



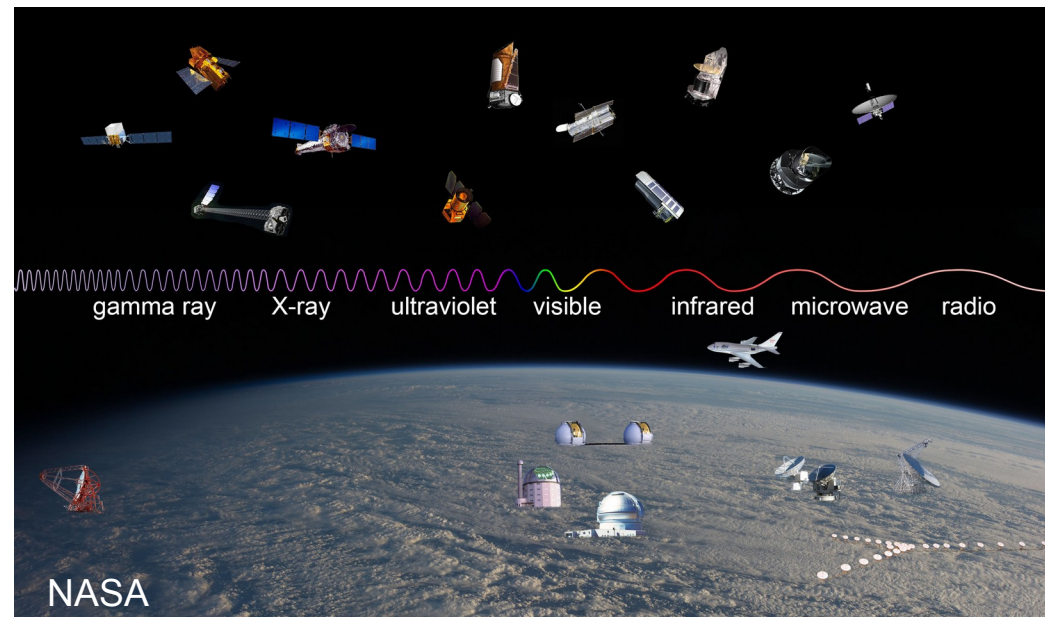
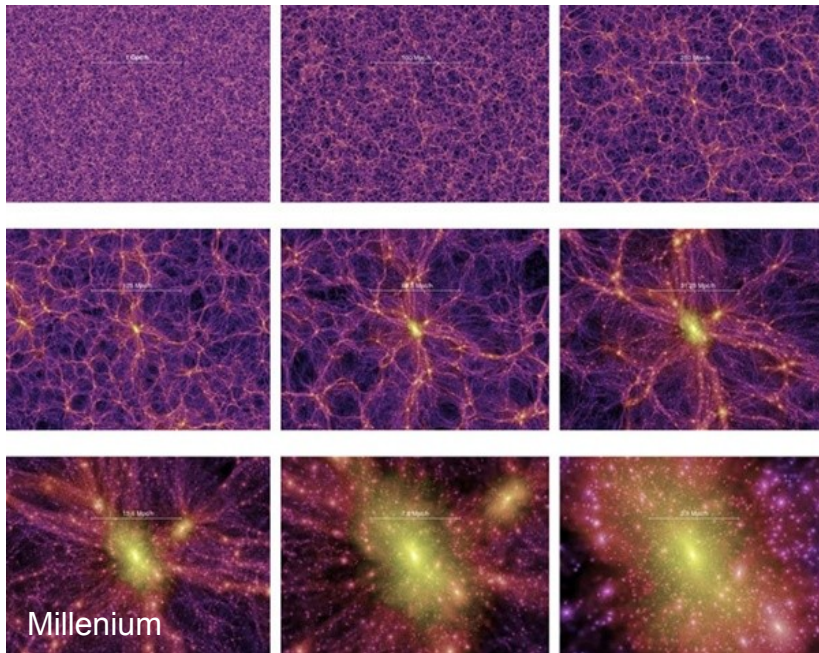
Accessible



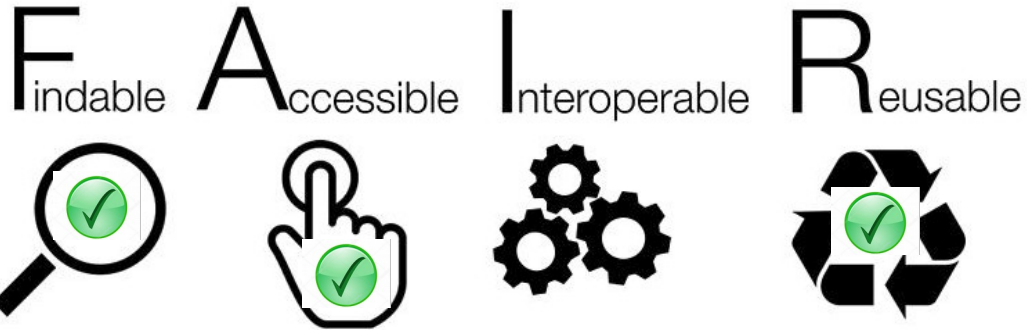
Interoperable



Reusable



# The challenge



**ESAC SCIENCE DATA CENTRE**

**Astronomy Science Archives**

- esasky
- herchel
- isa pathfinder
- exoat
- hubble space telescope
- planck
- gala
- iso
- xmm-newton

**Heliophysics Science Archives**

- cluster
- proba-2
- double star
- soho
- ISS-SolACEs\*
- ulysses

**The Planetary Science Archive**

- cassini
- mars express
- venus express
- huygens
- exomars
- rosetta
- giotto
- smart-1



Information at zero meters from you

# The challenge

F indable    A ccessible    I nteroperable    R eusable

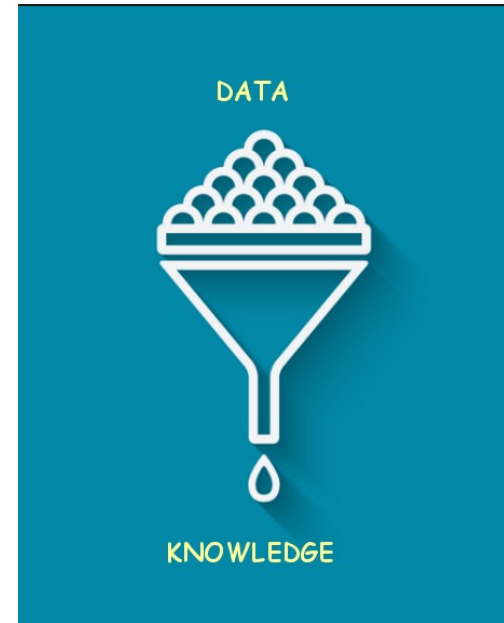
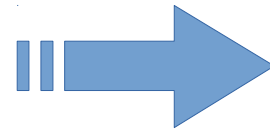


SO FAR,  
SO GOOD





# From data to knowledge



# The International Virtual Observatory Alliance



# Where do the funds come from?



- [AyA2017-84089 \(2018-2020\)](#)
- [AyA2014-55216 \(2015-2018\)](#)
- [AyA2011-24052 \(2012-2015\)](#)
- [AyA2008-02156 \(2009-2011\)](#)
- [AyA2005- 04286 \(2006-2008\)](#)
- [AyA2004-00253 \(2005\)](#)



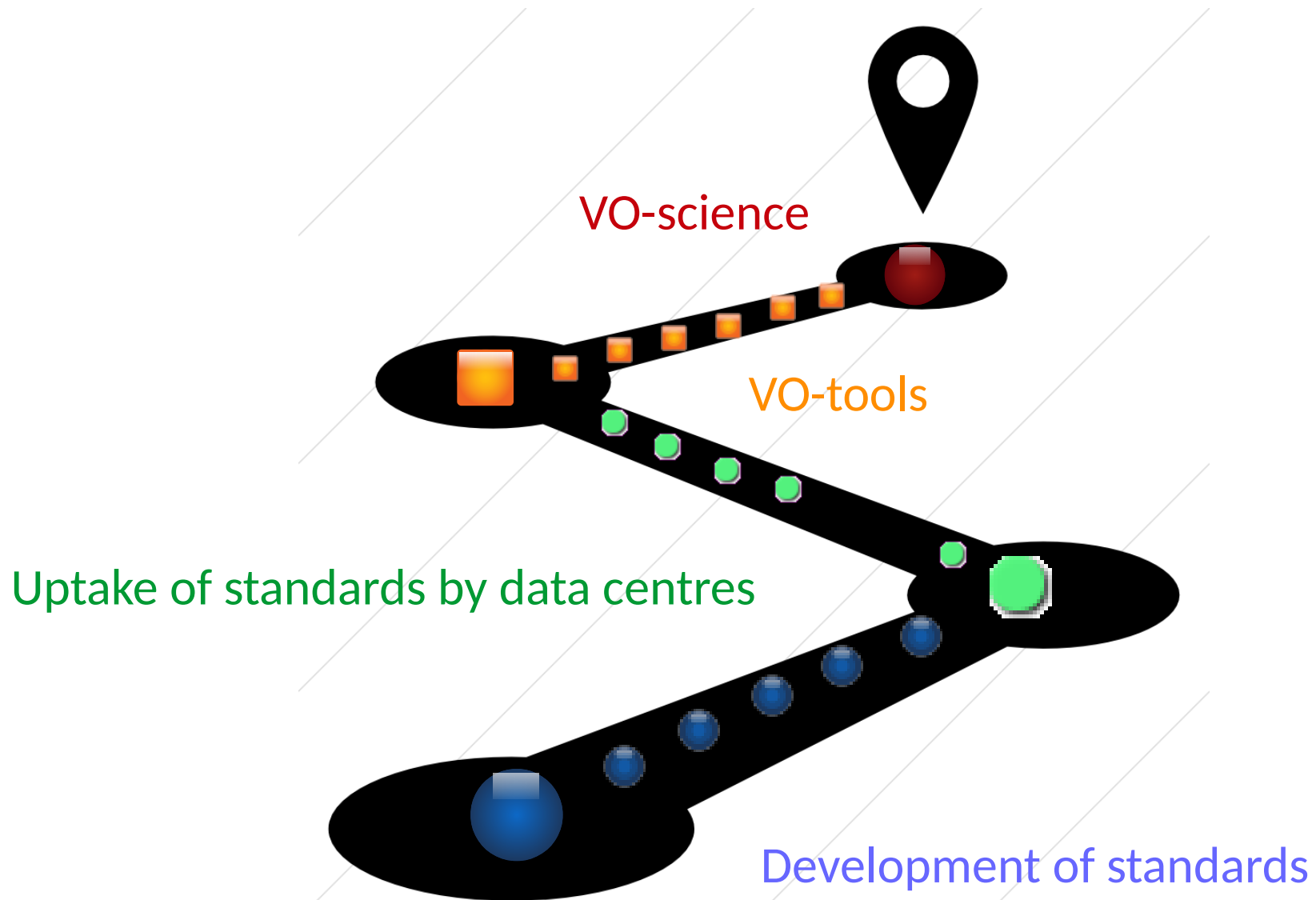
- FP6 (EuroVO-DCA)
- FP7 (EuroVO-AIDA, CoSADIE, ARCHES, GENIUS),
- H2020: [ASTERICS \(May2019\)](#), [Exoplanets A \(March 2021\)](#)



- [ASTRID](#), [ASTROMADRID](#), [SPACETEC \(2018\)](#).

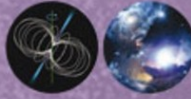


# The Virtual Observatory roadmap



# VO-science

MONTHLY NOTICES  
of the Royal Astronomical Society



ABOUT THIS JOURNAL CONTACT THIS JOURNAL SUBSCRIPTIONS CURR

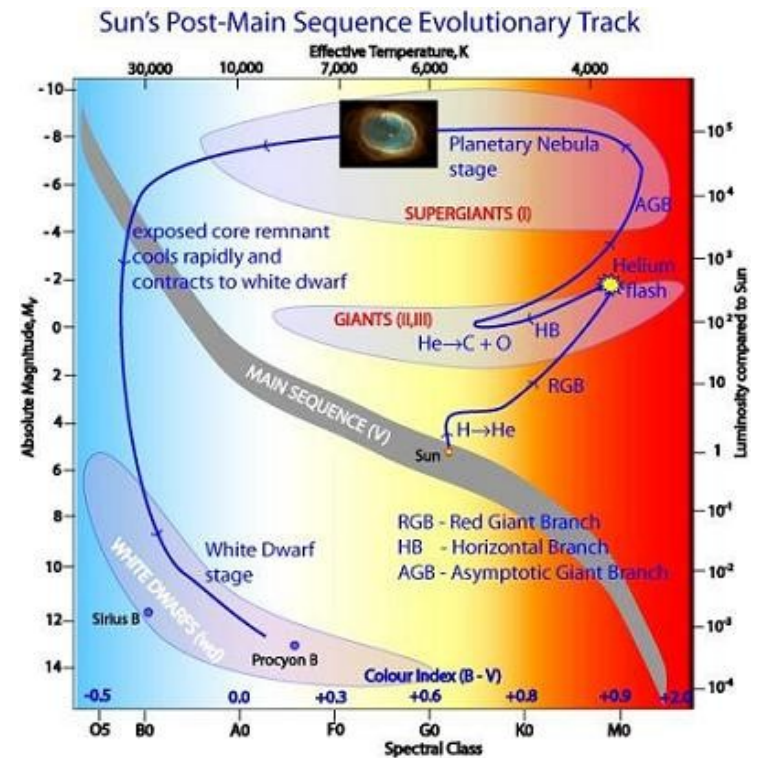
Oxford Journals > Science & Mathematics > MNRAS > Volume 457, Issue 3 > Pp. 3396-3408.

## A search for new hot subdwarf stars by means of virtual observatory tools II

E. Pérez-Fernández<sup>1,2,\*</sup>, A. Ulla<sup>2</sup>, E. Solano<sup>3,4</sup>, R. Oreiro<sup>5</sup> and C. Rodrigo<sup>3,4</sup>

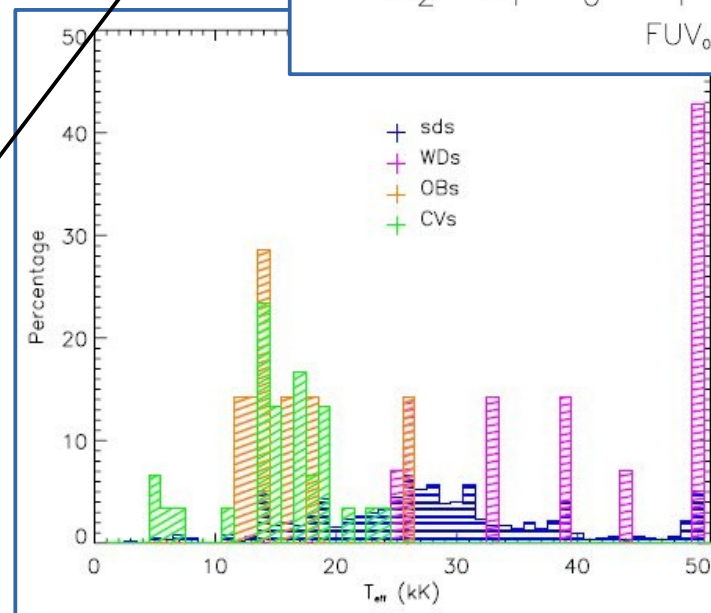
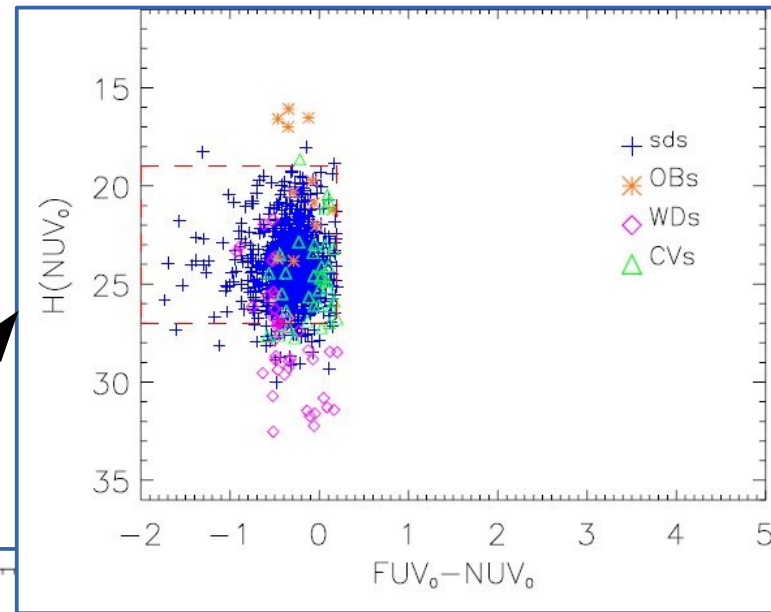
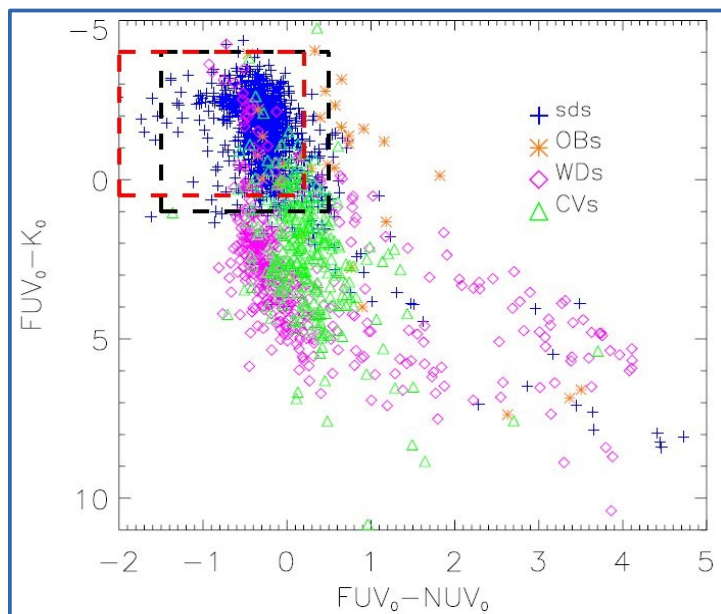
- Increase the number of hot subdwarfs
  - More robust statistical confrontation with theoretical evolutionary scenarios.
- Discovering of rare, interesting objects
  - Pulsating sdBs, sdOs in asteroseismic fields.
  - Subdwarfs as central stars of planetary nebulae.

- $T_{\text{eff}} > 19000 \text{ K}$
- $R: 0.3\text{-}0.5 R_{\text{sun}}$
- $\log g > 5 \text{ dex.}$
- $M: 0.5 M_{\text{sun}}$
- $M_{\text{env}} < 0.05 M_{\text{sun}}$



# VO-science: Methodology

- Described in Oreiro et al. (2011)
  - Photometric, astrometric and phys. param criteria.
  - GALEX (GR6/GR7), 2MASS (PSC), SDSS (DR7), Supercosmos
  - High rate of success: > 90%
  - Census increased in 20%.



# Take-home ideas

- Federation of data centres sharing data through a common set of standards (“Astronomical Google”).
- VO tools:
  - Not a “does-it-all” software
  - Different tools for different problems
- VO science: A reality since 10 years ago.

# The VO Schools

- Ten schools at national level since 2009. > 250 participants.



IAC. March 2017



ESAC. November 2017





# The school

- **Goals:**
  - Teach participants on how to efficiently use the VO tools for their own research.
  - Gather your feedback and requirements on VO tools and services.
- **Methodology:**
  - Tutorials based on real science cases.

# Participants' profile

	Aladin	TOPCAT	STILTS	VOSA
Never	5	5	9	10
Beginner	5	4	4	2
Intermediate	1	2	0	1
Advanced	2	2	0	0

	X-match	Images	SEDs
YES	10	10	9
NO	3	3	4

# The school: Schedule

## Day 1. Thursday 24 May

- 10:00 - 10:25 Introduction to the VO and the school (Enrique Solano)
- 10:25 - 12:10 Tutorial #1
  - Title: **Discovery of Brown Dwarfs mining the 2MASS and SDSS databases (PDF)**
  - VO-tools: Aladin, TOPCAT
  - Auxiliary files: [Script](#), [Params](#), [script\\_stilts.txt](#)
  - Tutor: Miriam Cortés
- 12:10 - 12:30 Coffee break
- 12:30 - 14:10 Tutorial #2
  - Title: **Determination of stellar physical parameters using VOSA (PDF)**
  - VO-tools: VOSA
  - Auxiliary files:
    - [Intro](#)
    - [vosa\\_usecase\\_final.txt](#)
    - [vosa\\_usecase\\_paper\\_final.txt](#)
    - [vosa\\_excess.txt](#)
    - [vosa\\_extinction.txt](#)
  - Tutor: Enrique Solano
- 14:10 - 15:30 Lunch
- 15:30 - 17:15 Tutorial #3
  - Title: **The CDS tutorial**
  - VO-tools: Simbad, Vizier, CDS services.
  - Tutor: Francisco Jiménez.

## Day 2. Friday 25 May

- 10:00 - 10:45 **Advanced Aladin (PDF)**
  - Tutor: Enrique Solano
  - Auxiliary file: [Guide](#)
- 10:45 - 11:30 **Advanced TOPCAT**
  - Tutor: Miriam Cortés
- 11:30 - 12:15 **Advanced VOSA**
  - Tutor: Enrique Solano
- 12:15 - 12:35 Coffee-break
- 12:35 - 14:10 Tutorial #4
  - Title: **ADQL**
  - Tutor: Enrique Solano
- 15:30 - 16:30 Support to participants' projects and specific questions.
- 16:30 - 17:00 Feedback and wrap-up