

Using the CDS and the VO to investigate the dependence of X-ray luminosity on stellar and wind parameters for galactic O stars?



Ada Nebot Gomez-Moran



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Observatoire Astronomique de Strasbourg

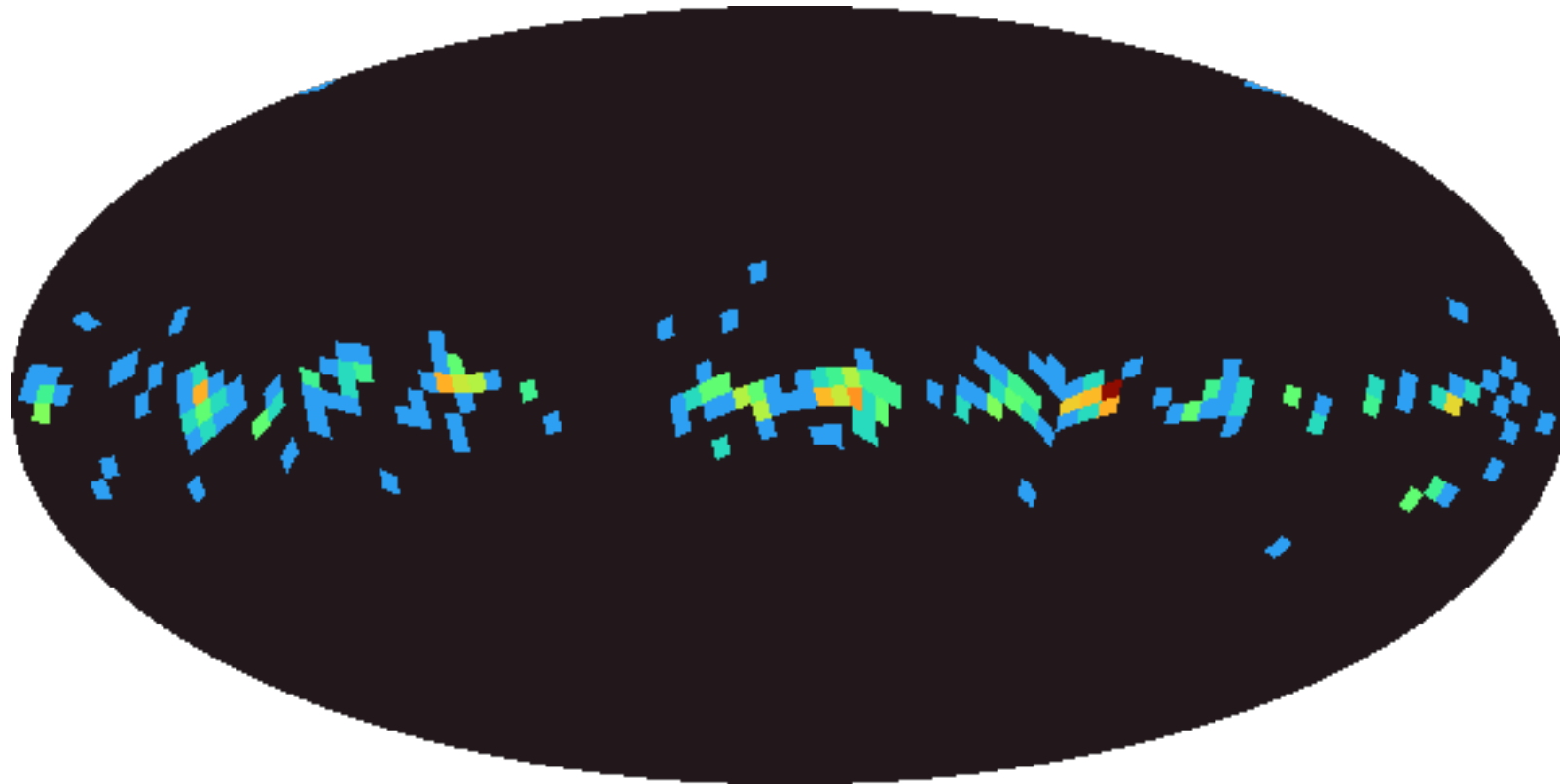


□ Use Case 1: X-ray properties of O stars

Is there a dependence of X-ray luminosity on stellar and wind parameters?

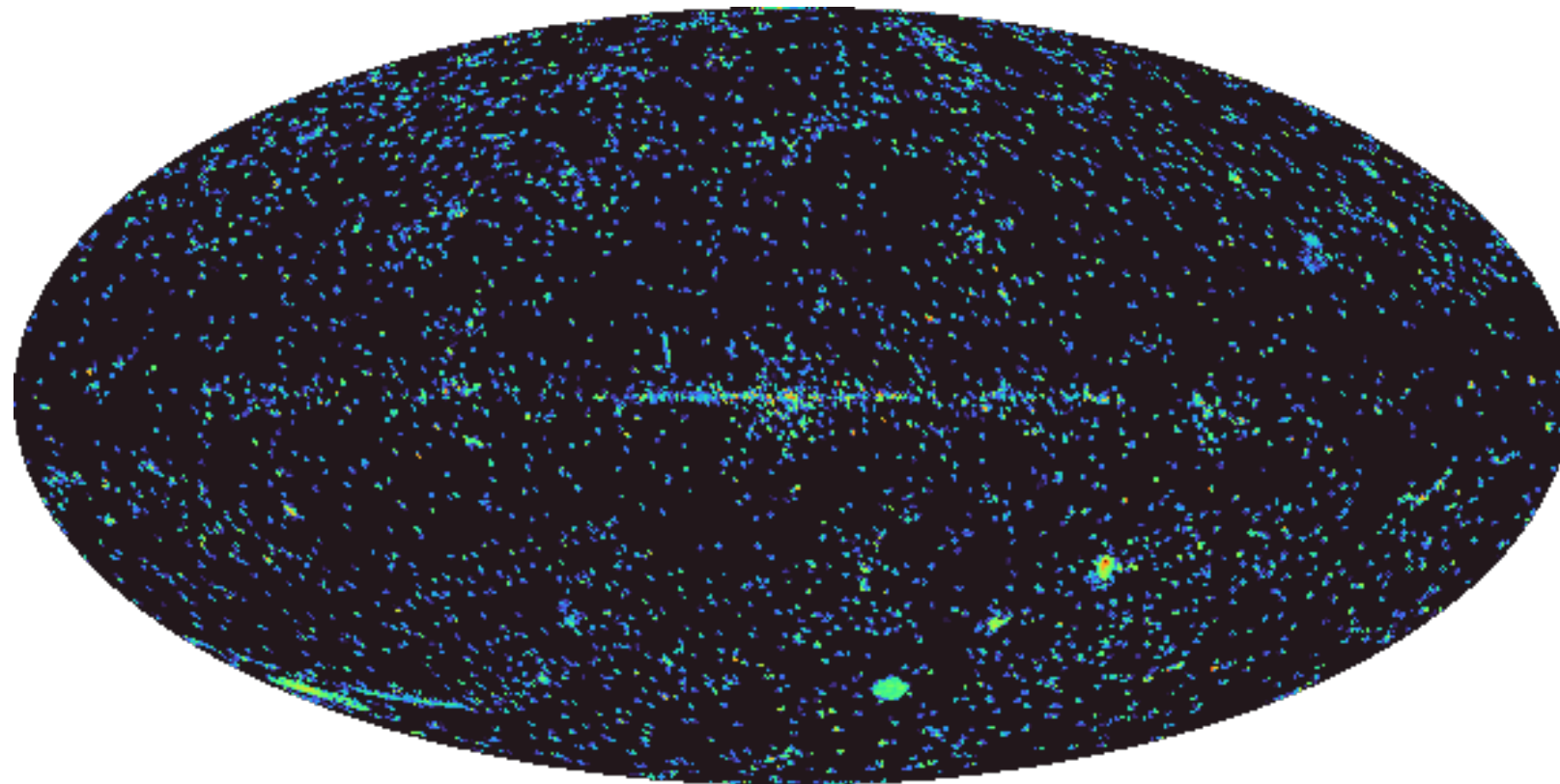
□ Use Case 1: X-ray properties of O stars

- Starting point: Well characterised O stars in the Milky Way
 - Sota et al 2014
 - ~ 448 spectroscopically confirmed and well studied O stars



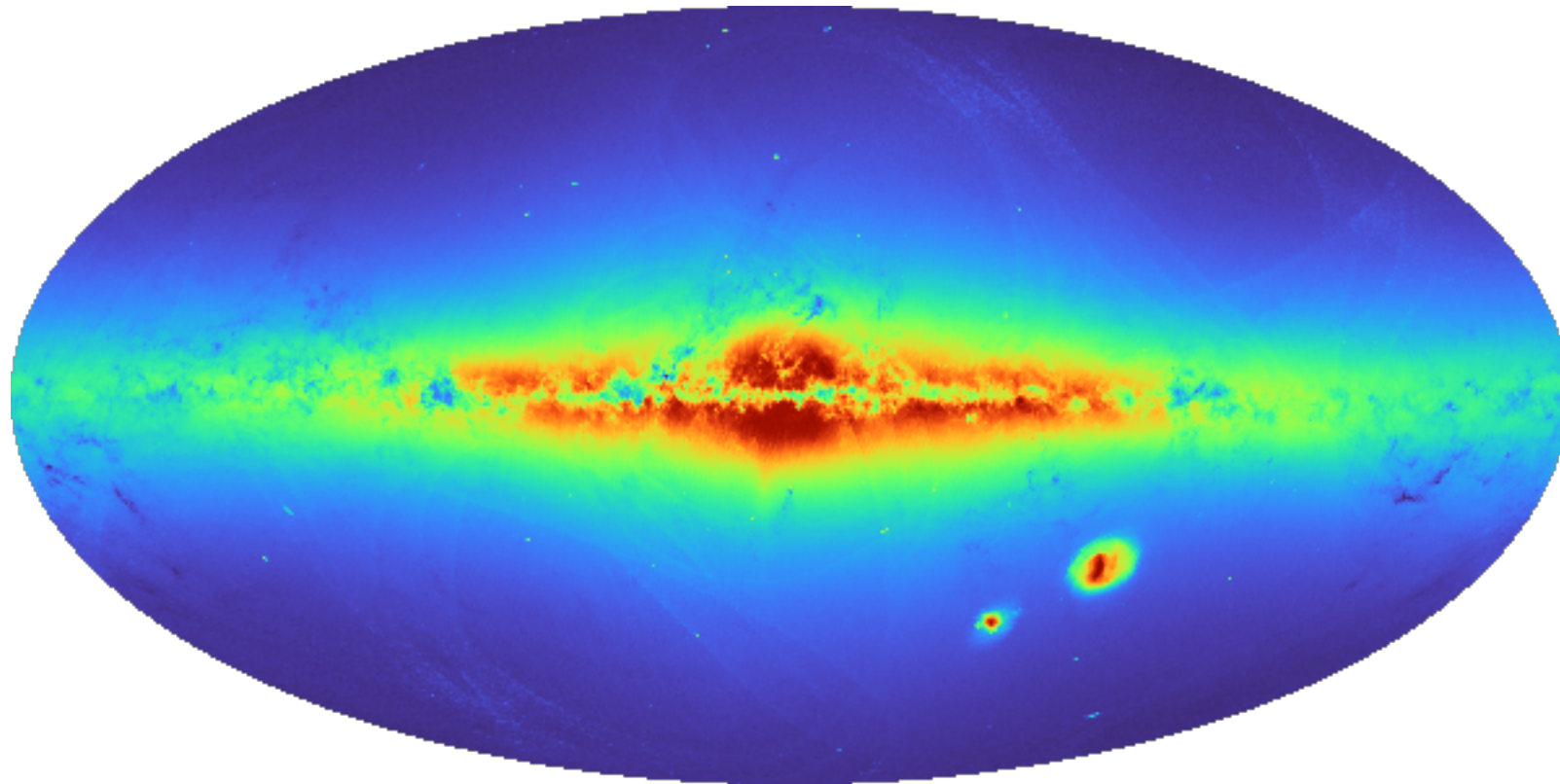
□ Use Case 1: X-ray properties of O stars

- The 3XMM-DR7 catalogue
 - ~ 1/2 million X-ray sources
 - Observations cover from 2000 to 2016



□ Use Case 1: X-ray properties of O stars

- Gaia DR2 catalogue contains
 - ~ 1692 million optical sources
 - All sky



Aladin v12.6 *** PROTOTYPE VERSION (based on v12.691) ***

Available data

Command

Frame ICRS

Projection Aitoff

ALADIN

DSS PanSTARRS SDSS 2MASS GALEX XMM Gaia Simbad NED YourName +

Collections

select

pan

disr

phot

draw

tag

moc

spect

filter

cross

x-y

rgb

assoc

crop

cont

pixel

prop

del

Welcome to Aladin,
your professional sky atlas.

Discover all astronomical
data available over the net!

Compare them with your
own data.

Prepare your observation
missions.

To start, type any object
name, such as M1, and
press ENTER...

Or easier, clic in the main
frame and enjoy the sky...

Or take the official version for a secure usage.

ALADIN

CDS

Aladin is developed by Pierre Fernique,
Thomas Boch, Anaïs Oberto, François Bonnarel and Chaitra.

select

from -- all collections --

exp. sort view scan filter

grid studywink redonorthhdr multiview match

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0 sel / 0 src 0Mb

ASTRO-CC -- bash - java - 107x25

java:75)

at java.awt.EventQueue.dispatchEvent(EventQueue.java:730)
at java.awt.EventDispatchThread.pumpOneEventForDispatch(EventDispatchThread.java:225)
at java.awt.EventDispatchThread.pumpEventsForFilter(EventDispatchThread.java:115)
at java.awt.EventDispatchThread.pumpEventsForHierarchy(EventDispatchThread.java:130)
at java.awt.EventDispatchThread.pumpEvents(EventDispatchThread.java:121)
at java.awt.EventDispatchThread.pumpEvent(EventDispatchThread.java:93)
at java.awt.EventDispatchThread.run(EventDispatchThread.java:82)

[4]- Done java -jar Aladin.jar
cds-zach@astro-cc:~\$
cds-zach@astro-cc:~\$
cds-zach@astro-cc:~\$
cds-zach@astro-cc:~\$
cds-zach@astro-cc:~\$
cds-zach@astro-cc:~\$ java -jar Aladin.jar &
[4] 62854
cds-zach@astro-cc:~\$
Aladin (v12.691) is starting...
Aladin is developed by Pierre Fernique, Thomas Boch, Anaïs Oberto, François Bonnarel and Chaitra
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Free JVR software is java 1.8.0_252 / Oracle Corporation
Sep 24, 2026 3:22:51 PM org.astrosurf.com.aladin.kitpServer start
INFO: Server http://127.0.0.1:8068 starting
||

Screenshot 2026-0...110.18.4

Screenshot 2026-0...13.02.2

Screenshot 2026-0...13.02.3

Screenshot 2026-0...13.05.2

Screenshot 2026-0...14.28.5

Screenshot 2026-0...14.19.1

Screenshot 2026-0...116.52.1

Screenshot 2026-0...110.12.2

Screenshot 2026-0...11.07.2

Screenshot 2026-0...08.31.2

Screenshot 2026-0...08.44.2

Screenshot 2026-0...14.30.



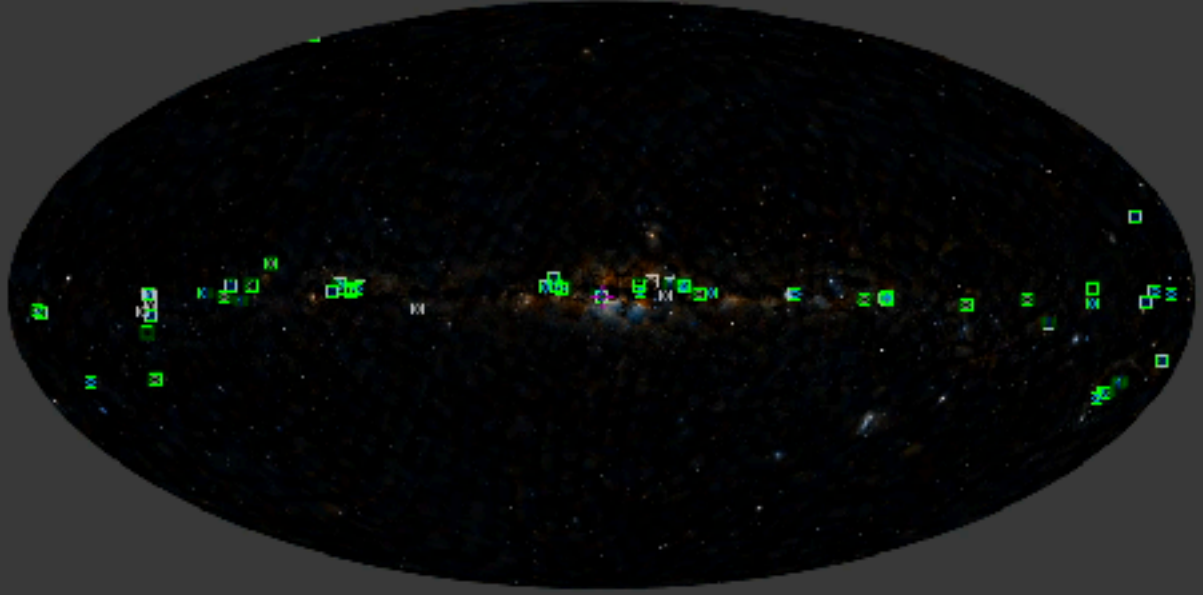
□ Use Case 1: X-ray properties of O stars

- Dealing with source confusion:
 - Two or more optical sources for one single X-ray source (unresolved X-ray, PSF is larger in the X-ray)
 - Two X-ray sources for one single optical source (positional X-ray errors larger than optical)
- **Visual inspection** and further analysis is needed to evaluate which is the correct match
- Back to Aladin

Available data → 4 / 41236
in viewout view

ins → 4 / 41236
g → 4 / 38799
r → 4 / 37238
-High-Energy data → 3 / 121
XMM-Newton Serendipitous Source Catalog
The 3XMM-DR7 Catalog, "slim" version
List of observations (summary)
3XMM-DR7s serendipitous source catalog
urnal table → 1 / 35338
A+A → 1 / 11310
2XMMi/SDSS DR7 cross-correlation (P

Command
DSS PanSTARRS SDSS 2MASS GALEX XMM Gaia Simbad NED YourName +
DSS2 color



360° x 180°
[Plane @2] - CDS/IX/54/xmm3r7s via Xmatch Search

rectno	GOS	Name	HD	m	HD >
12	007.00-00.25_01	HD 164492 A	164492	A	18 02
28	016.94+00.84_01	HD 168075	168075		18 18
29	016.94+00.84_02	HD 168076 AB	168076	AB	18 18
30	016.98+00.85_01	BD -13 4927			18 18
31	018.25+01.68_01	MY Ser AaAb	167971	AaAb	18 18
32	018.25+01.69_01	BD -12 4979			18 18
33	018.44+01.62_01	HD 168112	168112		18 18
35	018.92+03.63_01	HD 166734	166734		18 18

select XMM DR7
from -- all collections --

coll. sort view scan filter

3XMM-DR7
- Regime: X-ray
- Sources loaded: 148
- Total: 499,266
The 3XMM-DR7 Catalog, slim version (xmm3r7s)

select
pan
dist
phor
draw
tag
moc
spect
filter
cross
x-y
rgb
assoc
crop
cont
pixel
prop
del

CDS/IX/54/xmm3r7s
CDS/P/DSS2/color
epo...
size
dens...
opac...
zoom...
005.97081 -01.17370
no time filter

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148 sel / 148 src 29fps / 544Mb

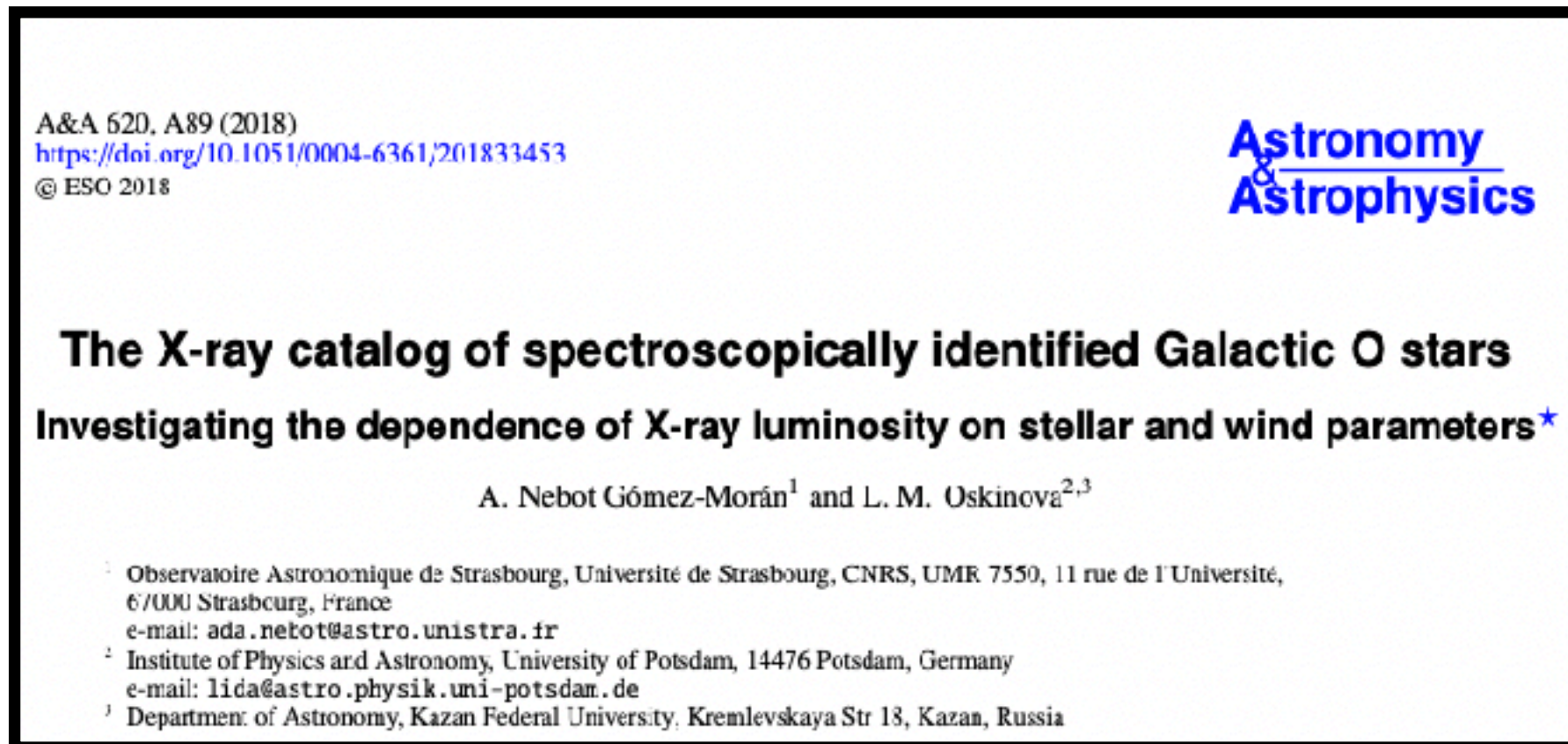


□ Use Case 1: X-ray properties of O stars

- 127 O stars with Gaia photometry and a unique & unambiguous XMM counterpart
- Workflow and the VO:
 1. Homogeneous coordinates and optical information → X-Match with Gaia
 2. Have these stars been covered by XMM-Newton ? → MOC
 3. Have they been detected in X-rays? → X-Match
 4. Visualise the whole process → Aladin + HiPS

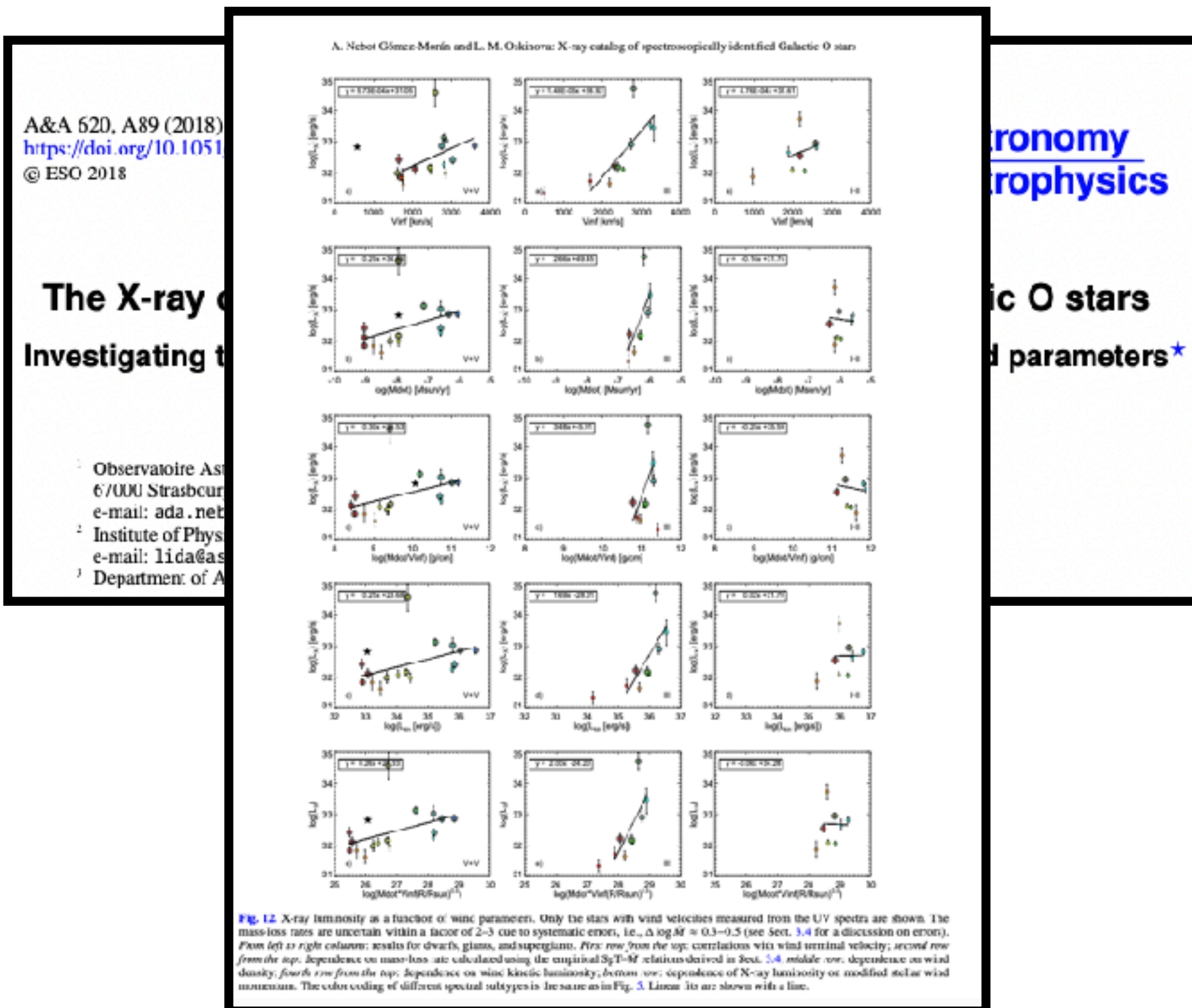
□ Use Case 1: X-ray properties of O stars

- Is there a dependence of X-ray luminosity on stellar and wind parameters?



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<https://doi.org/10.1051/0004-6361/324139>
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The X-ray
Investigating

1 Observatoire
 67000 Strass
 e-mail: ada.
 2 Institute of P
 e-mail: lida
 3 Department

my
 physics

stars
 meters★

Table 1. An example of entry in the GOSXMM catalog and column descriptions.

Column Name		Explanation
GOSS	006.01-01.20_01	Name in the GOSS catalogue
NAME	9 Sgr	Alternative name
XMM-NAME	J180352.4-242139	XMM Name as in DR9
GaiaDR2_source_id	4066072591147527552	Gaia source identifier, identical to the Gaia-DR2 source_id
RA	18.03 52.446	RAJ2000
Dec	-24.21 38.64	DecJ2000
M_V	(mag)	Absolute magnitude from Martins et al. (2005a)
error_ M_V	(mag)	Absolute magnitude error
M_{bol}	(mag)	Bolometric magnitude from Martins et al. (2005a)
error_ M_{bol}	(mag)	Bolometric magnitude error
T_{eff}	(K)	Effective temperature from Martins et al. (2005a)
error_ T_{eff}	(K)	Effective temperature error
$\log g$		Effective gravity from Martins et al. (2005a)
error_ $\log g$		Effective gravity error
$\log L_{bol}$	(erg s ⁻¹)	Bolometric luminosity derived from spectrophotometric distance
v_{∞}	(km s ⁻¹)	Terminal wind velocity from Peña et al. (1999)
$\log \dot{M}_{wind}$	(M _⊙ yr ⁻¹)	Mass-loss rate from the Vink et al. (2000) recipe
$\log \dot{M}$	(M _⊙ yr ⁻¹)	Mass-loss rate from this work
distance_Gaia	(kpc)	Parallaxic distance from Bailer Jones et al. (2018)
min_distance_Gaia	(kpc)	Minimum parallaxic distance from Bailer Jones et al. (2018)
max_distance_Gaia	(kpc)	Maximum parallaxic distance from Bailer Jones et al. (2018)
distance_ M_V	(kpc)	Spectrophotometric distance
error_distance_ M_V	(kpc)	Error on the spectrophotometric distance
B	(mag)	B magnitude
error_ B	(mag)	B magnitude error
V	(mag)	V magnitude
error_ V	(mag)	V magnitude error
E_{B-V}	(mag)	Color excess
error_ E_{B-V}	(mag)	Color excess error
A_V	(mag)	Extinction in the V band
error_ A_V	(mag)	Error in the extinction in the V band
N_H	(cm ⁻²)	Hydrogen column density
PN count_rate	(s ⁻¹)	PN Count rate (0.2–12 keV)
error_count_rate	(s ⁻¹)	PN Count rate error (0.2–12 keV)
f_X	(erg s ⁻¹ cm ⁻²)	Unabsorbed X-ray flux (0.2–12 keV)
$f_{X, min}$	(erg s ⁻¹ cm ⁻²)	Minimum X-ray flux (0.2–12 keV)
$f_{X, max}$	(erg s ⁻¹ cm ⁻²)	Maximum X-ray flux (0.2–12 keV)
$\log(f_{bol})$	(erg s ⁻¹ cm ⁻²)	Bolometric flux
error_ $\log(f_{bol})$	(erg s ⁻¹ cm ⁻²)	Bolometric flux error
$\log(f_X/f_{bol})$		X-ray to bolometric flux ratio
min_ $\log(f_X/f_{bol})$		Minimum X-ray to bolometric flux ratio
max_ $\log(f_X/f_{bol})$		Maximum X-ray to bolometric flux ratio
$\log L_X$	(erg s ⁻¹)	X-ray luminosity (0.2–12 keV)
log L_ X, min	(erg s ⁻¹)	minimum X-ray luminosity (0.2–12 keV)
log L_ X, max	(erg s ⁻¹)	maximum X-ray luminosity (0.2–12 keV)
$\log L_{bol}$	(erg s ⁻¹)	Bolometric luminosity derived from parallaxic distance
min_ $\log L_{bol}$	(erg s ⁻¹)	Minimum bolometric luminosity
max_ $\log L_{bol}$	(erg s ⁻¹)	Maximum bolometric luminosity
HR2		Hardness ratio HR2
error_HR2		Error on the hardness ratio HR2
HR3		Hardness ratio HR3
error_HR3		Error on the hardness ratio HR3

□ Use Case 2: XMM-Newton Data Catalogues

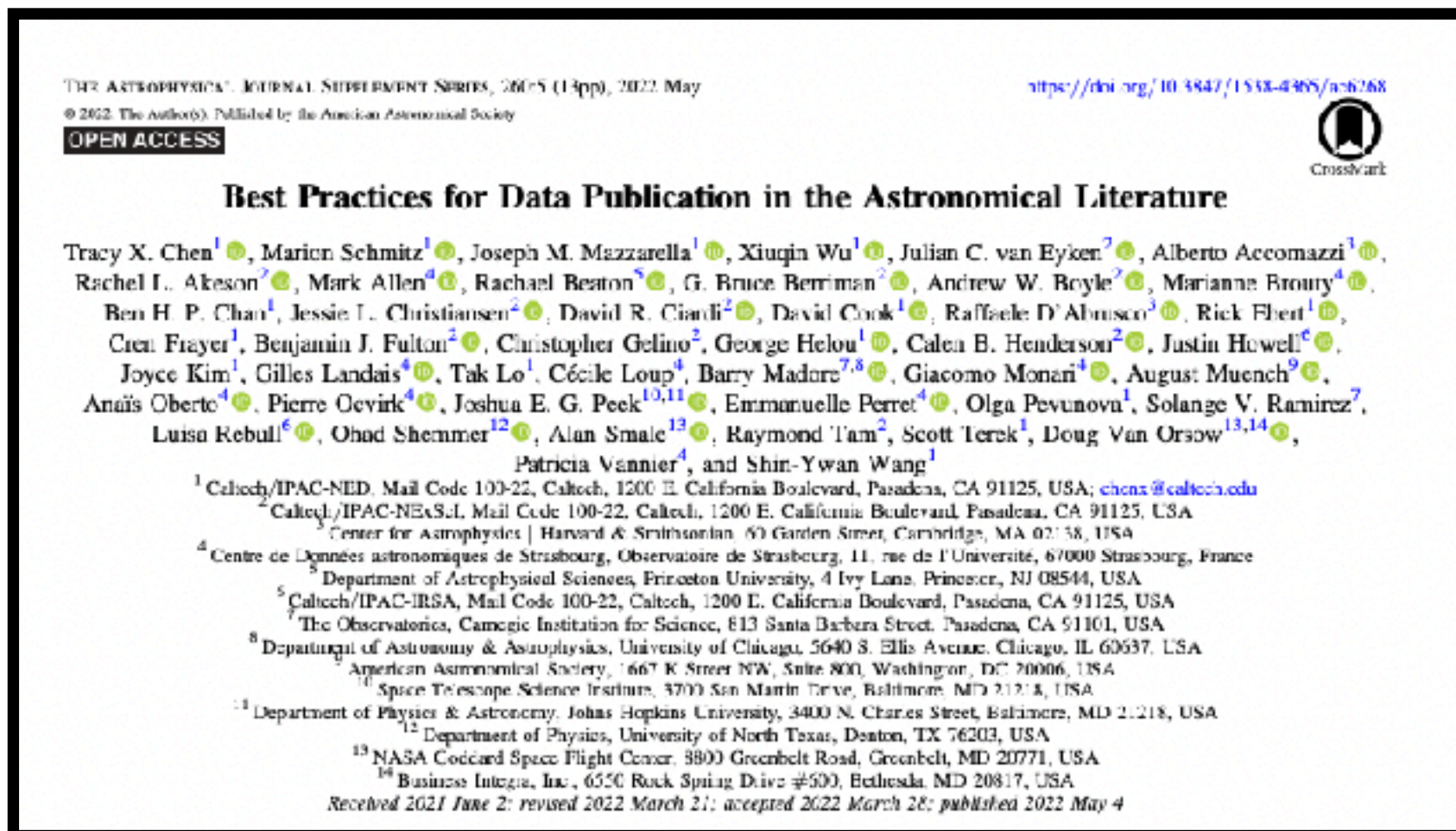
- **Observations covering more than 25 years of X-ray data!**
- Data catalogues are published every year: latest catalogue 5XMM DR15
- We use the VO to add value to X-ray sources and to data products
 - Multi-wavelength photometry (from UV to radio)
 - Source classification and photo-z
 - Added metadata so users and tools can unambiguously identify what columns in the catalogue mean
- We make the data accessible through the VO



□ Use Case 3: yours!

- You might publish data yourself. And if so...
- Are there tips to make your data easier to be re-used and contribute to the VO?
- But my data is particular, because... ok, give us feedback!

□ Best practices for data publication



Abstract

1. Introduction

2. Astrophysical Data Guidelines

3. Data Presentation

4. Data Archiving and Access

5. Citations and Credits

6. Data Content Keywords

7. Summary

Appendix A: Checklist of Recommendations for Publishing Data in the Literature

Appendix B: Data Repositories

Appendix C: List of DOIs

Footnotes

References



Appendix A: Checklist of Recommendations for Publishing Data in the Literature

This checklist is a digested version of detailed information given in this article. It is intended to be a short reference for authors, referees, and science editors to consult in order to avoid various pitfalls that often impede the interpretation of data and metadata by readers, and parsing by software, and therefore also complicate and delay integration of the data into astronomical databases.

1. General rules (Section [2](#)):

- (a) Define all symbols, acronyms, and abbreviations at first use.
- (b) Provide uncertainty and confidence level when reporting a new measurement.
- (c) Present the appropriate number of significant figures for numerical measurements and uncertainties that match the precision of the measurements.
- (d) Report the units for measurements if present, and adopt commonly used ones.
- (e) Indicate preferred values if applicable.

2. Nomenclature (Section [2.1](#)):

□ Key takeaways

It all starts with a question

- Handling of large catalogues requires new methods
- The VO provides us with
 - Data and services to access and manipulate the data
 - Formats like HiPS and MOC are becoming the norm
 - Tools like XMatch and Aladin
- You can have the next VO science case

The VO helps solve parts of the puzzle

