Identificación de estrellas Be

Reddening-free Q indices to identify Be star candidates

VIII JORNADAS DE CLOUD COMPUTING, BIG DATA & EMERGING TOPICS





Yael Aidelman — Facultad de Ciencias Astronómicas y Geofísicas, Universidad Nacional de La Plata

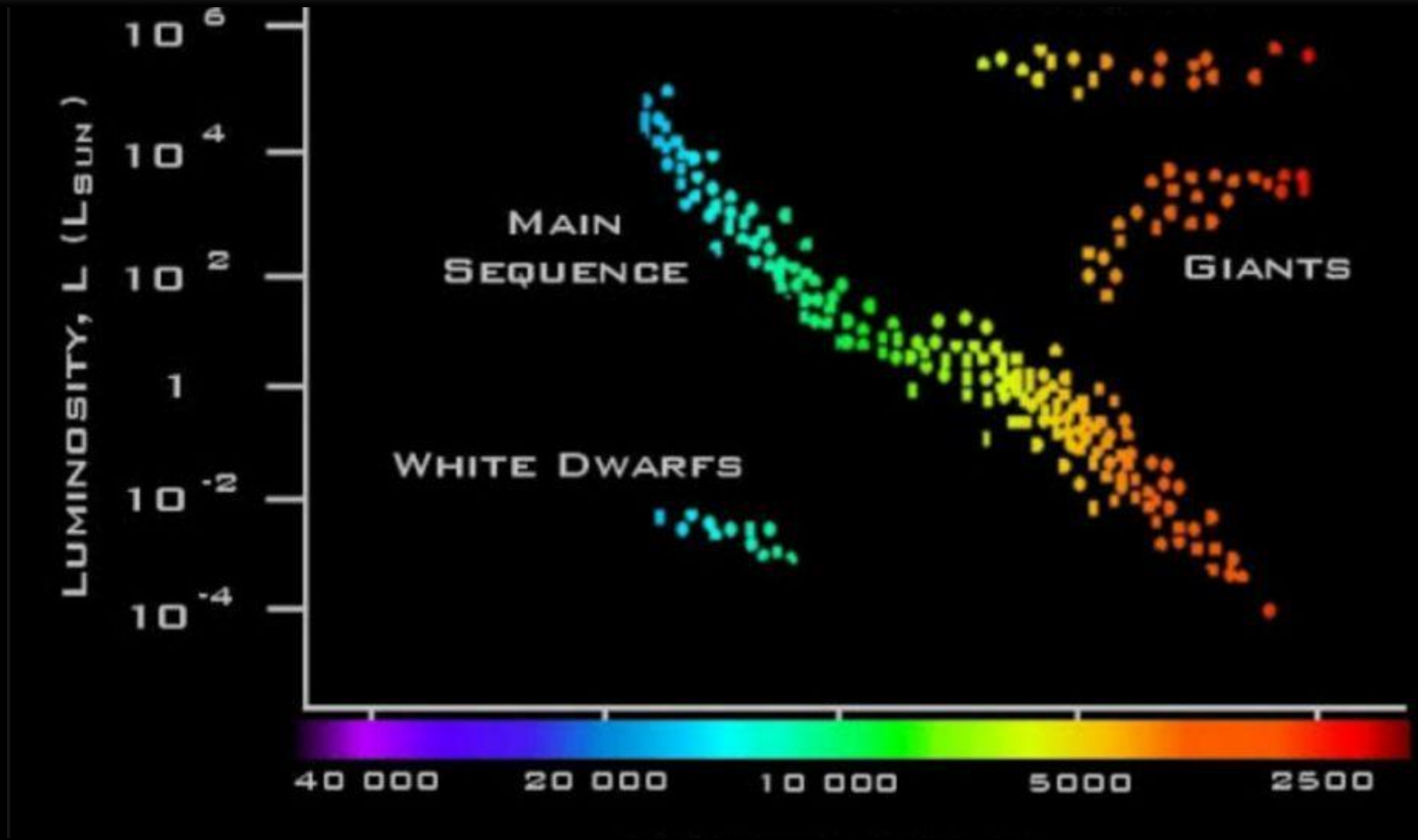
Carlos Escudero — CONICET

Anahí Granada — Río Negro, Universidad Nacional, Sede Andina

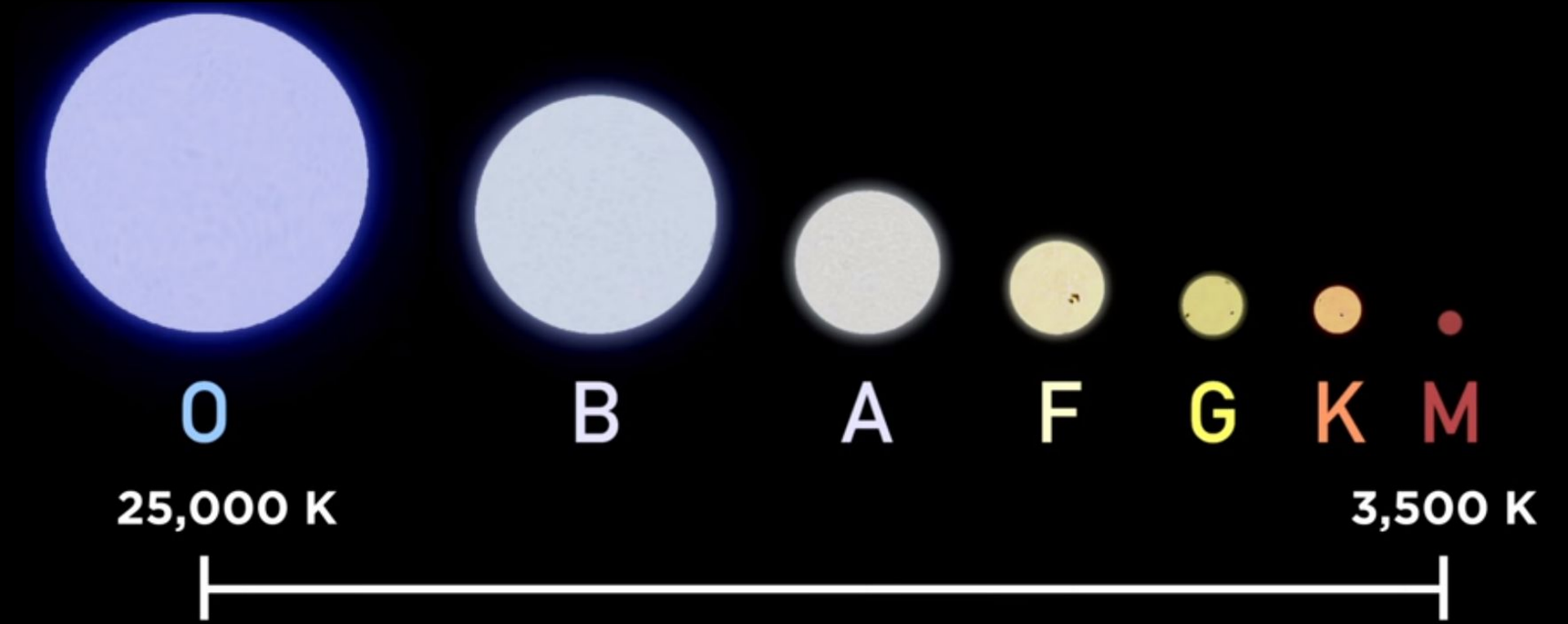
Franco Ronchetti — CIC

Facundo Quiroga — III-LIDI

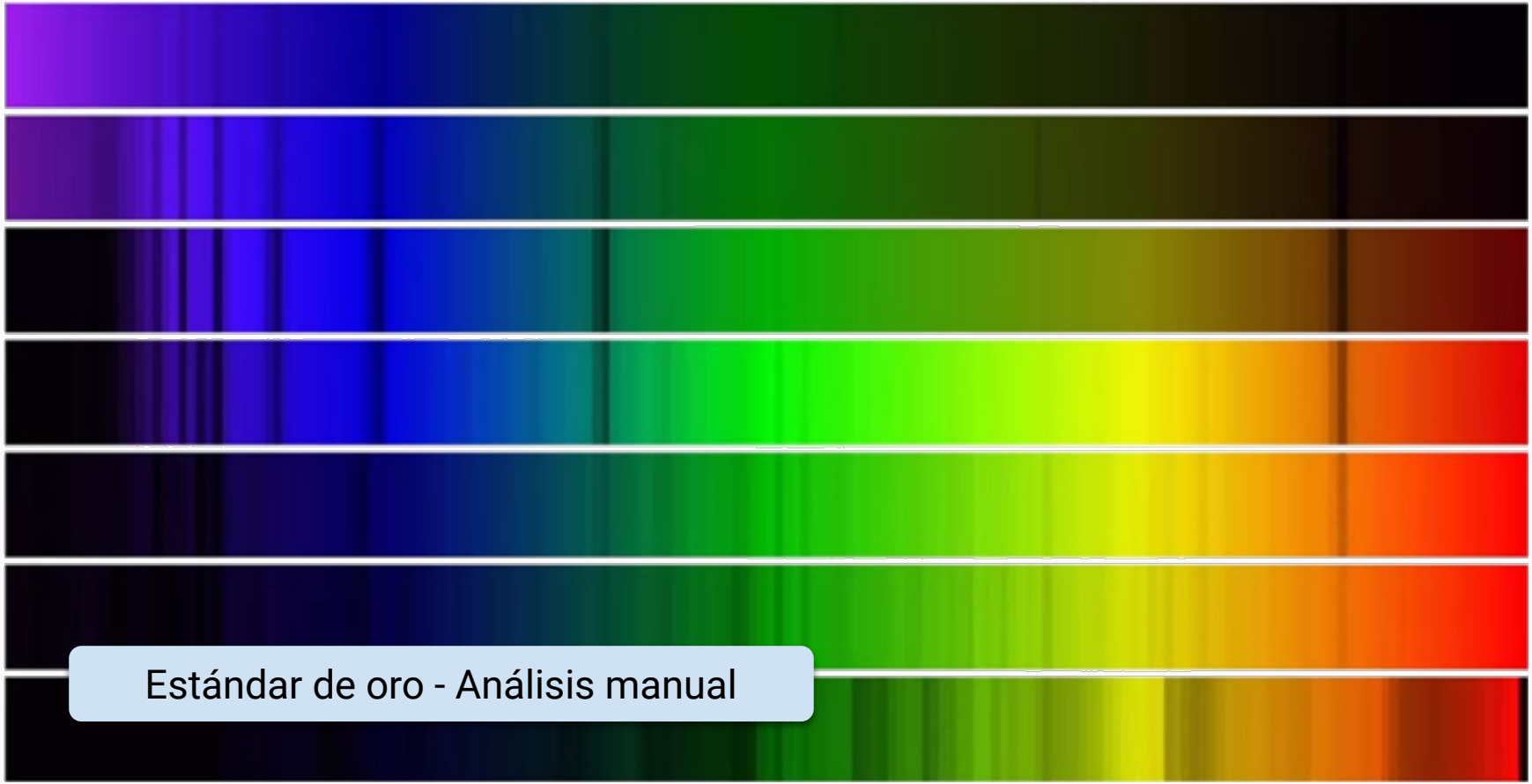
Clasificación de Estrellas - Diagrama HR



Clasificación Estelar - Masa, color y temperatura



Clasificación Estelar - Espectrometría



Clasificación Estelar - Estrellas Be

Disco circunestelar

Estrella

No supergigante
Tipo espectral B

Emisión en Hα
(650nm)

Objetivo: Identificar nuevas estrellas BE

Obtención de datos: Fotometría Estelar

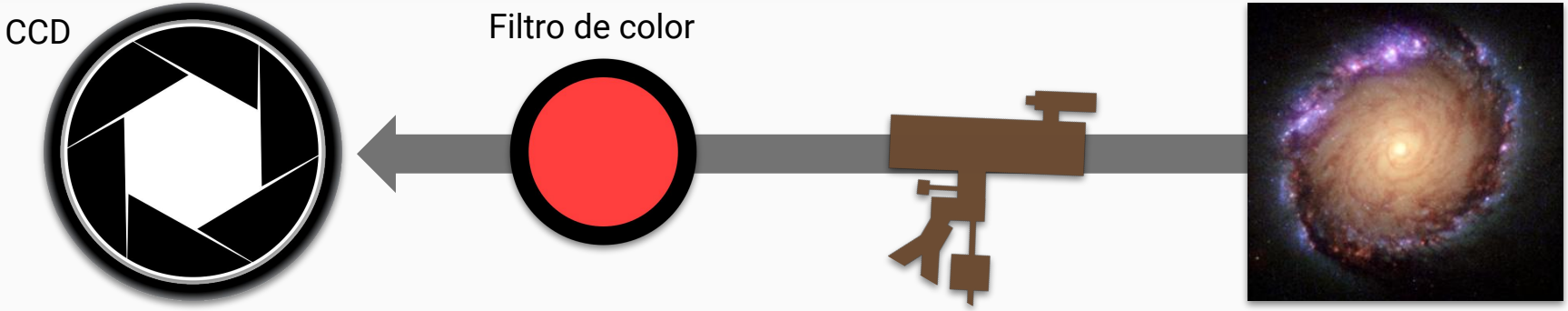
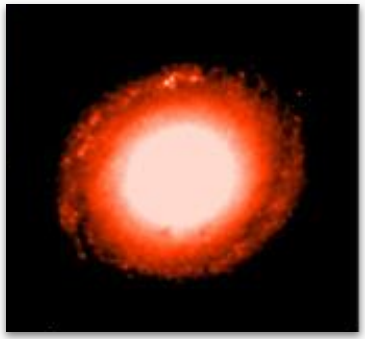
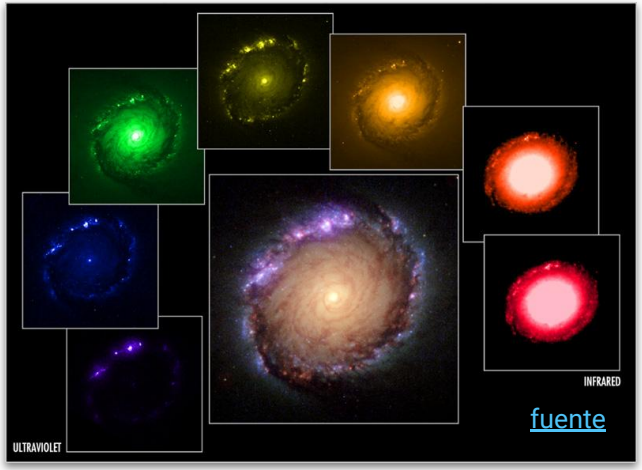


Imagen de banda
o canal rojo



Promedio

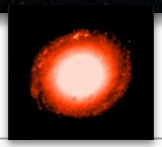
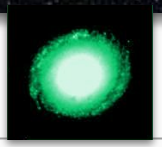
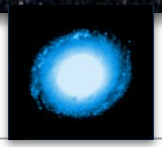
Flujo



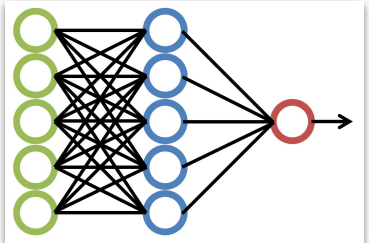
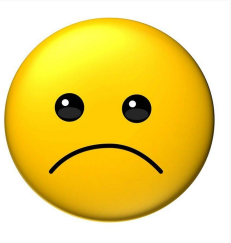
fuente

Datos de **baja** calidad, **fáciles** de obtener

Clasificación de Be con Fotometría y ML

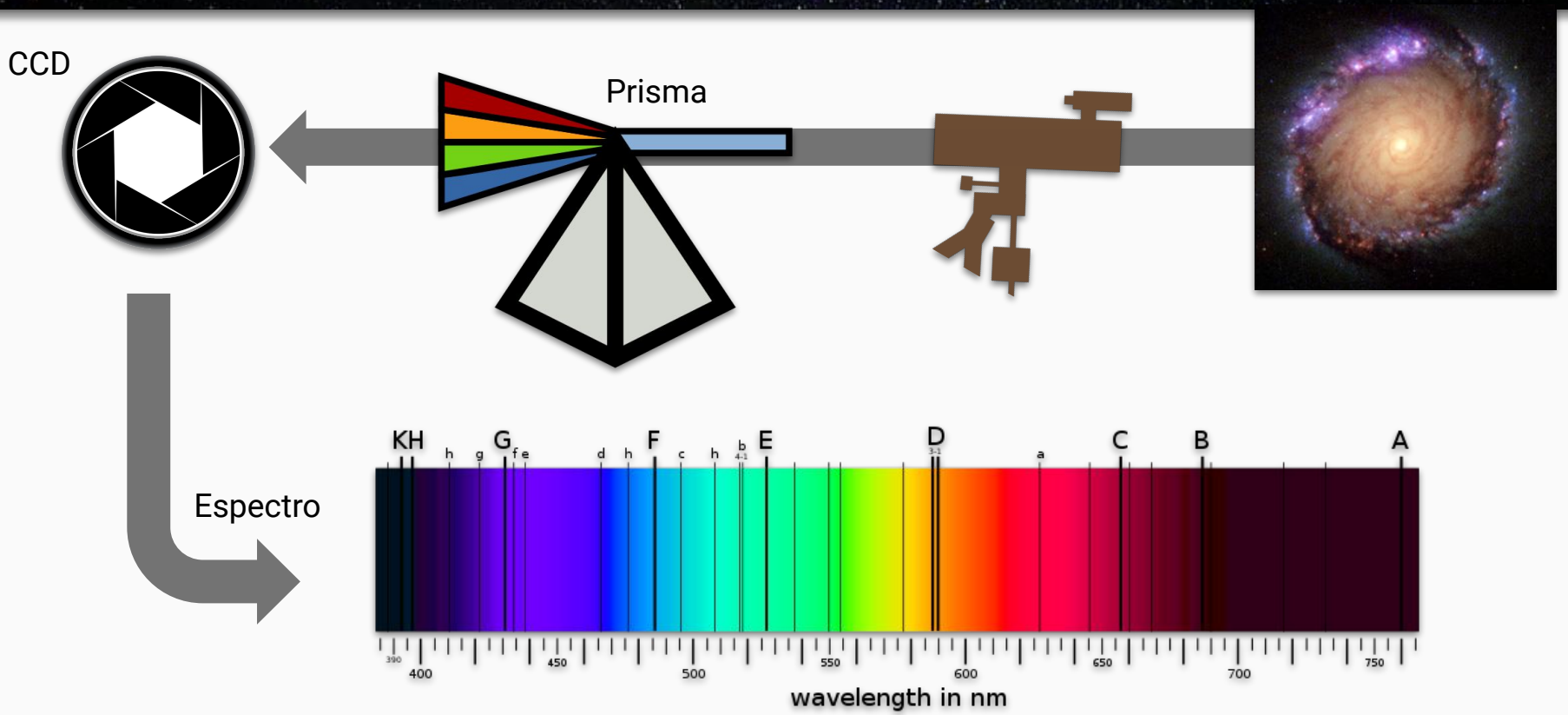




ID	Intensidad promedio en filtro 1	Intensidad promedio en filtro ...	Intensidad promedio en filtro N	Clase
1	1.3	...	2.5	Be
2	0.5	...	2.1	Otra
...	...	...	...	...

\+  = 

Difícil determinar clase con Fotometría

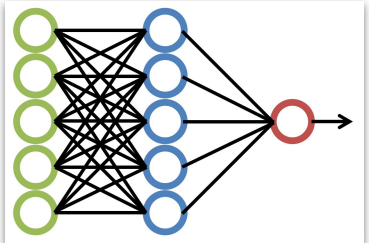
Obtención de datos: Espectrometría Estelar



Datos de **alta** calidad, **costosos** de obtener

Clasificación de Be con Espectrometría y ML

ID	Intensidad en longitud de onda 1	Intensidad en longitud de onda ...	Intensidad en longitud de onda N	Clase
1	1.3	...	2.5	Be
2	0.5	...	2.1	Otra
...	...	...	...	...

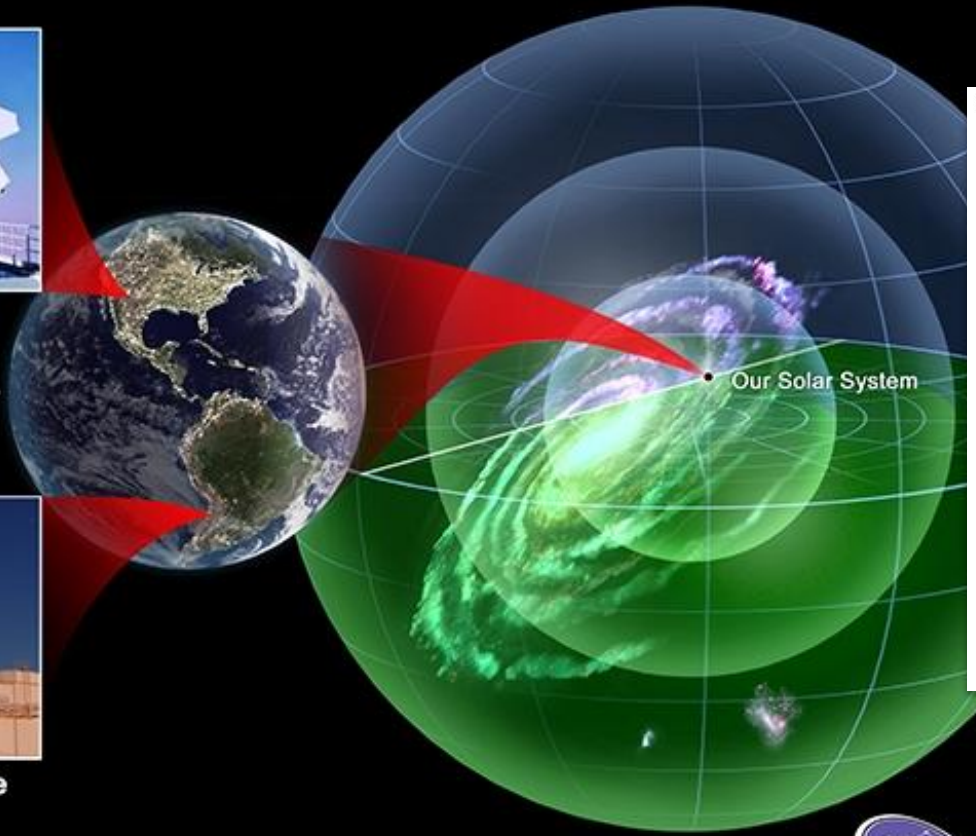
\+  = 

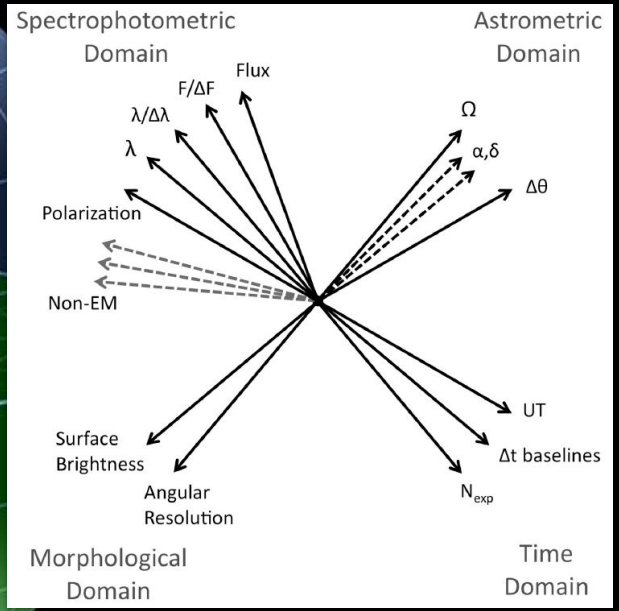
Pocos datos espectrométricos

Fuentes de datos -> *Surveys* del cielo

Sloan Foundation
Telescope
New Mexico, U.S.A.

du Pont Telescope
Chile



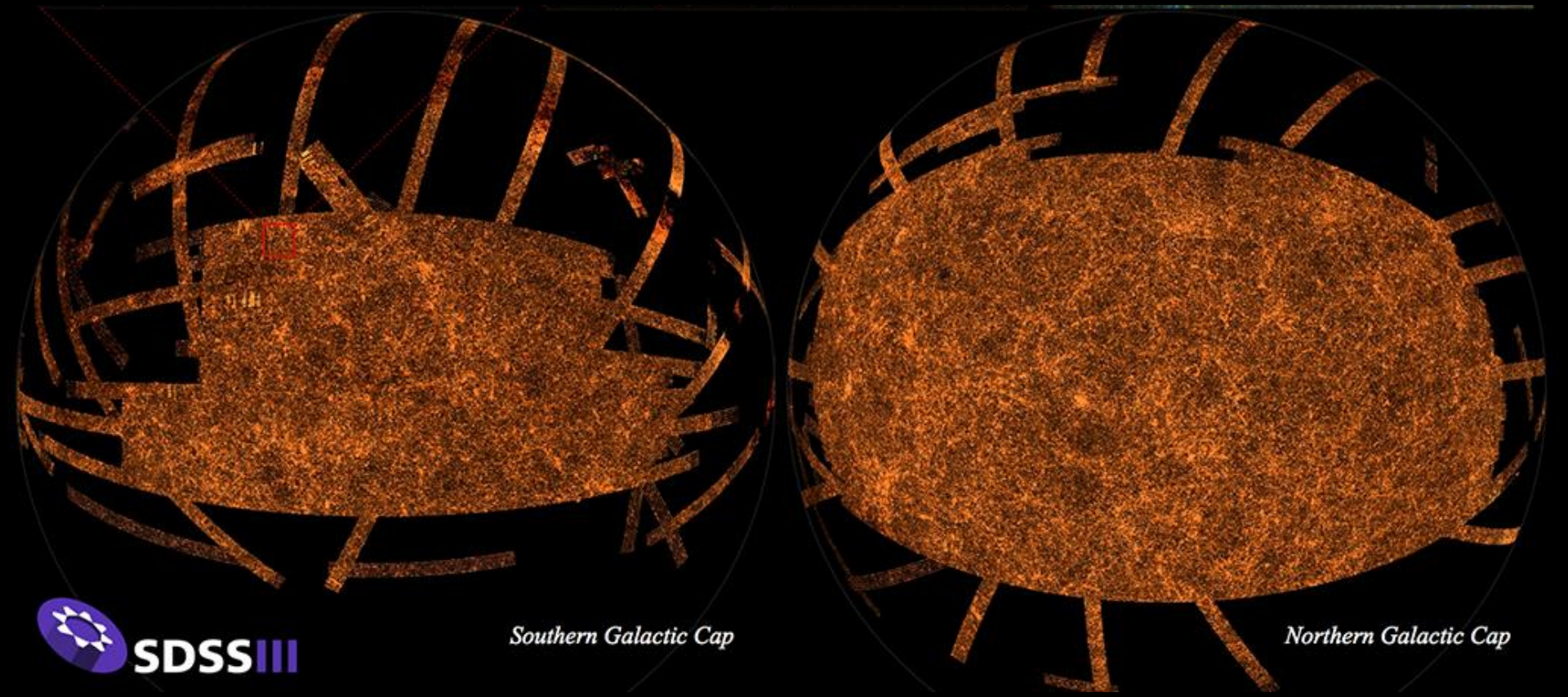


SDSS

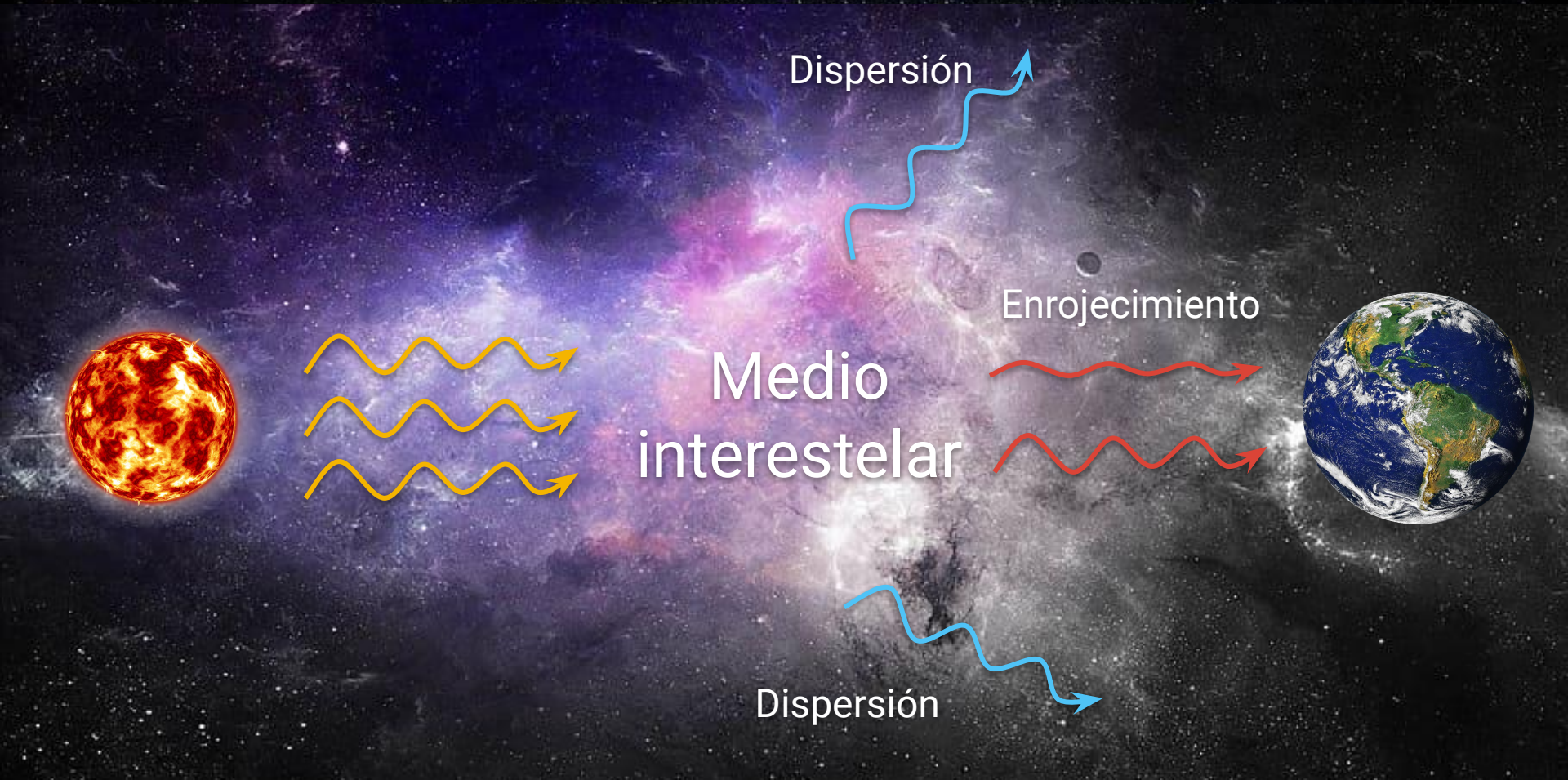
Surveys del cielo - Alta variabilidad

Survey	Type	Duration	Bandpasses	Lim. flux	Area coverage	$N_{sources}$	Notes
DSS scans	Visible	1950's-1990's	*B* (~ 450 nm) *R* (~ 650 nm) *I* (~ 800 nm)	21 – 22 mag 20 – 21 mag 19 – 20 mag	Full sky	~ 10^9	Scans of plates from the POSS and ESO/SERC surveys
SDSS-I SDSS-II SDSS-III	Visible	2000-2005 2005-2008 2009-2014	*u* (~ 800 nm) *g* (~ 800 nm) *r* (~ 800 nm) *i* (~ 800 nm) *z* (~ 800 nm)	22.0 mag 22.2 mag 22.2 mag 21.3 mag 20.5 mag	14,500 deg^2	4.7×10^8	Numbers quoted for DR8 (2011). In addition, spectra of ~ 1.6 million objects
2MASS	Near IR	1997-2001	*J* (~ 1.25 μm) *H* (~ 1.65 μm) K_s (~ 2.15 μm)	15.8 mag 15.1 mag 14.3 mag	Full sky	4.7×10^8	
UKIDSS	Near IR	2005-2012	*Y* (~ 1.05 μm) *J* (~ 1.25 μm) *H* (~ 1.65 μm) *K* (~ 2.2 μm)	20.5 mag 20.0 mag 18.8 mag 18.4 mag	7,500 deg^2	~ 10^9	Estim. final numbers quoted for the LAS; deeper surveys over smaller areas also done
IRAS	Mid/Far IR (space)	1983-1986	12 μm 25 μm 60 μm 100 μm	0.5 Jy 0.5 Jy 0.5 Jy 1.5 Jy	Full sky	1.7×10^5	
NVSS	Radio	1993-1996	1.4 GHz	2.5 mJy	32,800 deg^2	1.8×10^6	Beam ~ 45 arcsec

Surveys del cielo - Cobertura



Extinción estelar (enrojecimiento)



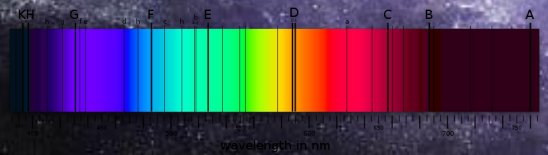
Resumen de Desafíos

Nuestro enfoque - Datos fotométricos etiquetados

Etiquetado

Sin Etiquetar

Etiquetado



Se reducen significativamente las fuentes de datos

Nuestro enfoque - Bases de datos

Dataset	Normal OB	EM	*Total*
Mohr-Smith et al. (2017 [20])	5629	248	*5877*
Liu et al. (2019 [17])	185	98	*283*

Mohr-Smith et al.

Uso: Entrenamiento y Prueba

Surveys: VPHAS+ 2MASS

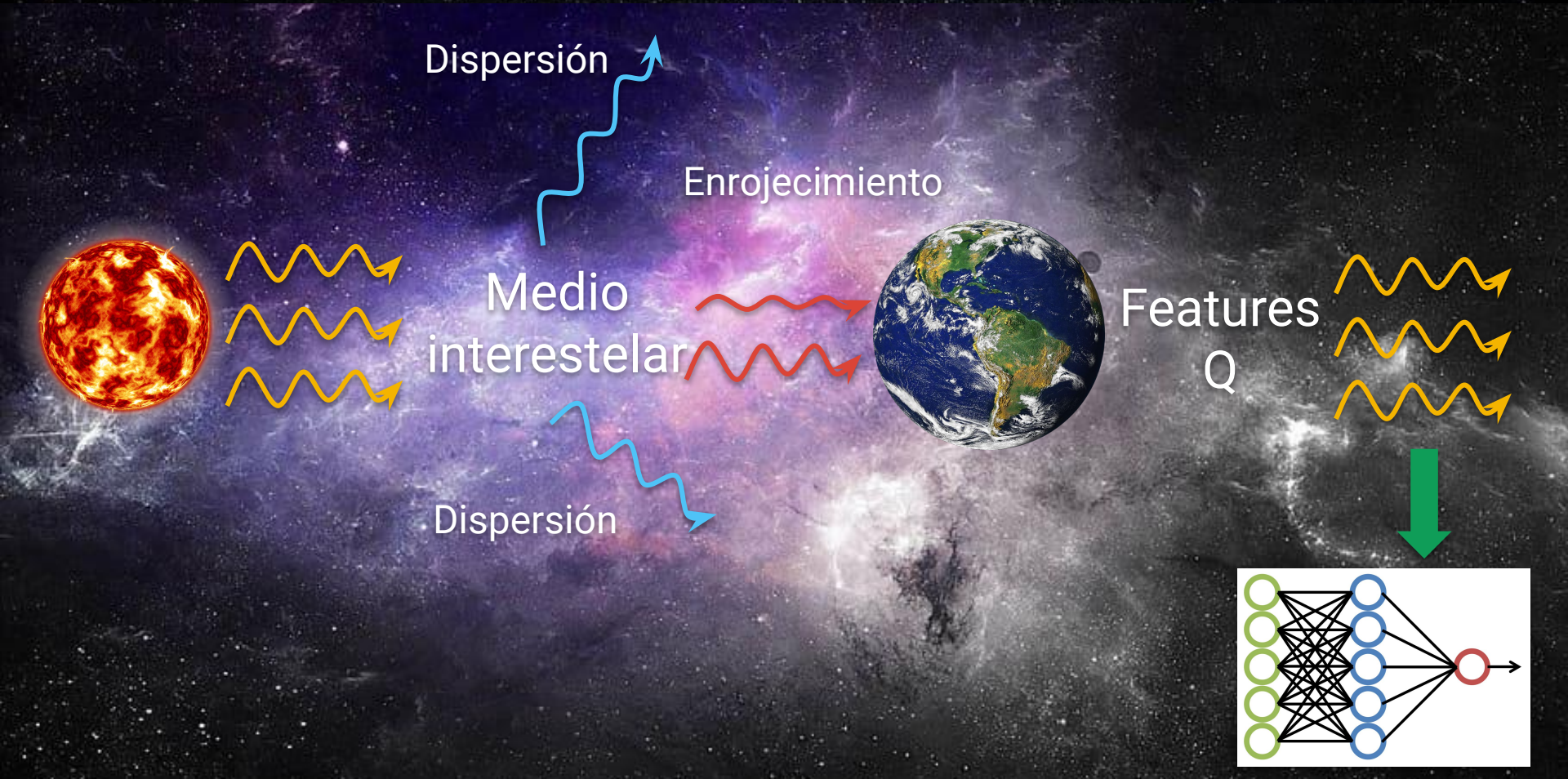
Liu et al.

Uso: Prueba

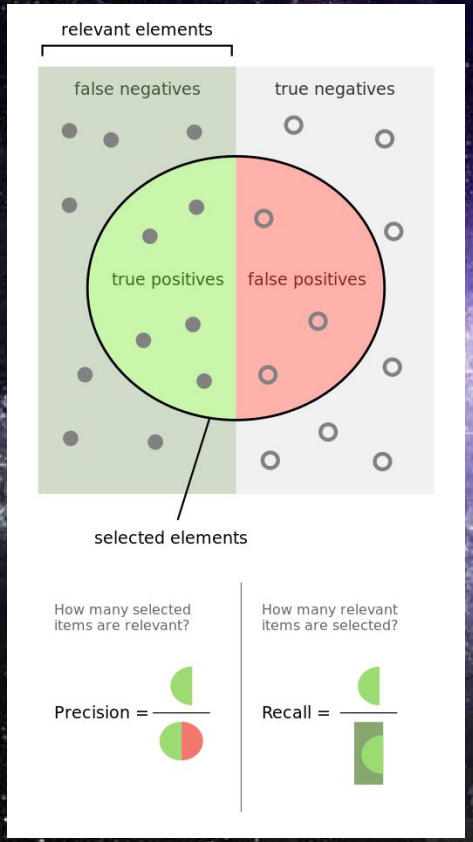
Surveys: VPHAS+ IPHAS

Evaluar las generalización a otras áreas y surveys

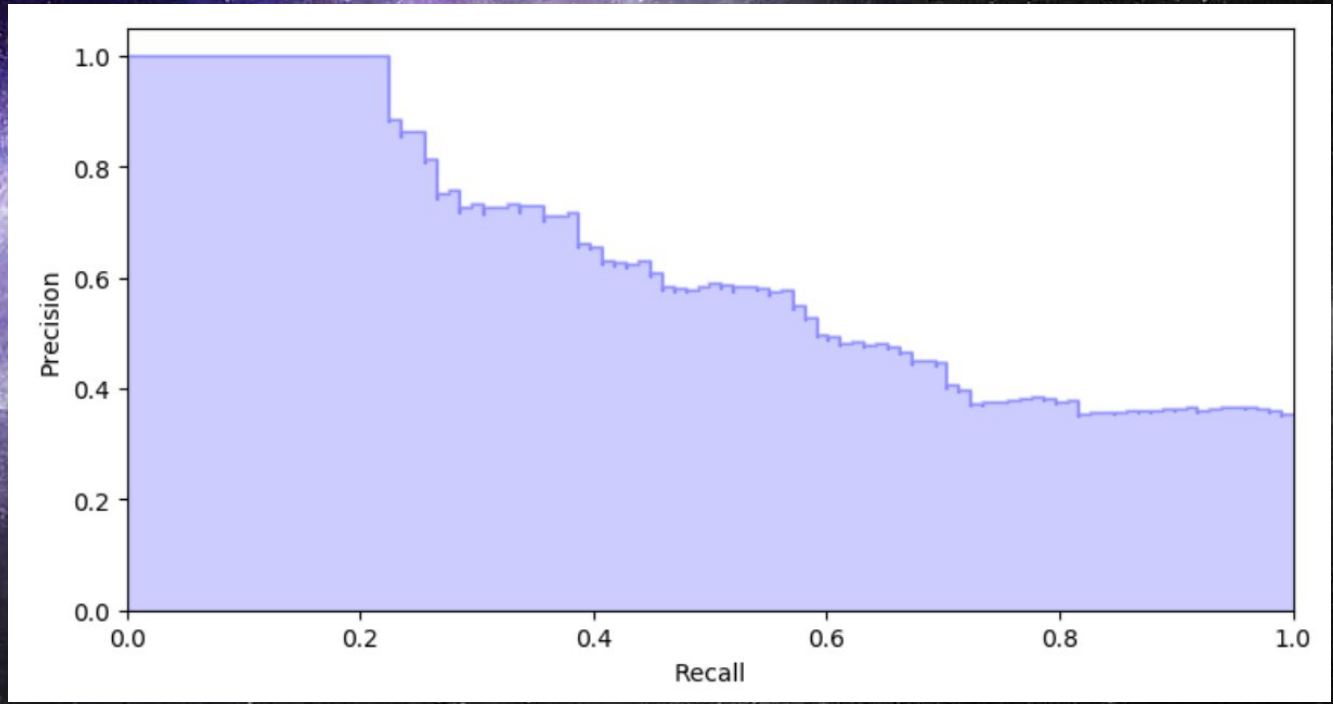
Features Q + Redes Neuronales



Metodología de evaluación - Precision y Recall



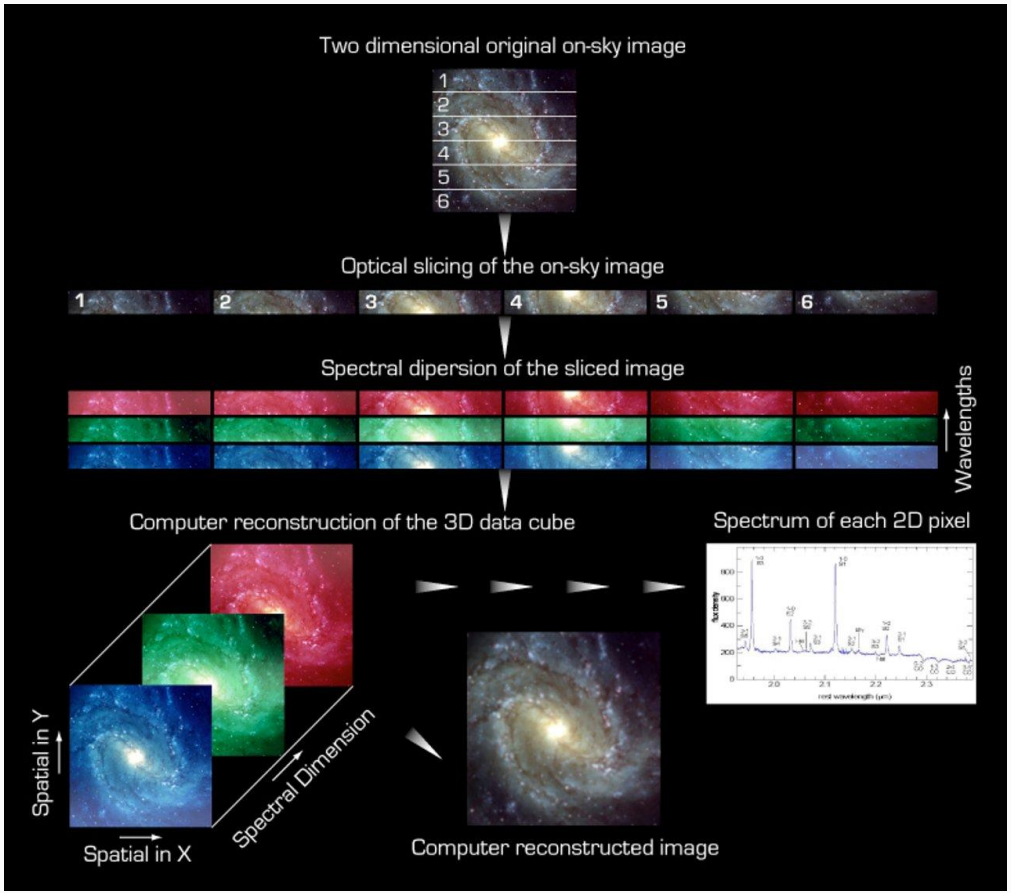
Modelo probabilístico: P(Estrella Be)>umbral
Variando umbral -> Curva de Precision - Recall



Resultados: Recall al 99% de Precision

Model	Features	Mohr-Smith (Recall)	Liu (Recall)
Log. Regression	Magnitudes	84.2 (±7)%	5.7 (±0.1)%
Log. Regression	Q	81.3 (±12)%	5.5 (±10)%
Log. Regression	NCA	74.6(±11)%	13.9 (±9)%
SVM (Linear)	Magnitudes	82.4(±14)%	0(±0)%
SVM (Linear)	Q	85.2(±9)%	9.2 (±11)%
SVM (Gaussian)	Magnitudes	85.2(±11)%	13.1 (±2)%
SVM (Gaussian)	Q	37.2(±3)%	4.7 (±3)%
Neural Network	Magnitudes	84.8(±8)%	9.5(±4)%
Neural Network	Q	85.2(±14)%	**25 (±8)%**

Conclusión: Features Q aumentan la generalización


Two dimensional original on-sky image
1
2
3
4
5
6
Optical slicing of the on-sky image
1
2
3
4
5
6
Spectral dipersion of the sliced image
Wavelengths
Computer reconstruction of the 3D data cube
Spectrum of each 2D pixel
Spatial in Y
Spectral Dimension
Spatial in X
Computer reconstructed image