How to observe with

carmenes

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1. The spectrograph

- *Really* high resolution
- *RIZJH* bands in one shot
- Two channels: VIS + NIR
- Thermo-mechanicallly stabilised → rms(RV) ~ 1 m s^{-1} in VIS, 5-10 m s^{-1} NIR
- Scrambled, not sliced ("Shaken, not stirred")
- Not long slit, but fibre fed from Cassegrain focus to coudé room
- Calibration λ: U-Ne, Th-Ne, U-Ar and Fabry-Pérot

Summary table ↑

	VIS channel	NIR channel
Wavelength coverage, Δλ*	520-960 nm (*[V]RIZ*)	960-1710 nm (*YJH*)
Detector	1 x 4kx4k e2v CCD231-84	2 x 2kx2k Hawaii-2RG (2.5 μm cutoff)
Wavelength calibration	Th-Ne lamps & Fabry-Pérot etalon	U-Ne lamps & Fabry-Pérot etalon
Working temperature, T_{work}	285.000 ± 0.005 K	140.000 ± 0.005 K
Spectral resolution, R	**94,600**	**80,400**
Mean sampling	2.8 pixels	
Mean inter-fibre spacing	7.0 pixels	
Cross disperser	Grism, LF5 glass	Grism, infrasil
Reflective optics coating	Silver	Gold
No. of orders	55	28
Échelle grating	2 x Richardson Gratings R4 (31.6 mm^{-1})	
Target fibre field of view	1.5 arcsec	
A&G system field of view	3 arcmin	
A&G system band	Approx. *R*	

*: There is a dichroic at 960 nm that splits the light into two beams, one for each channel. The detectors are actually sensitive until 1050 nm (VIS) and from 900 nm (NIR). There are some gaps in the wavelength coverage wider than 10 nm redwards of 1550 nm. The strongest telluric absorption is at the *JH* boundary

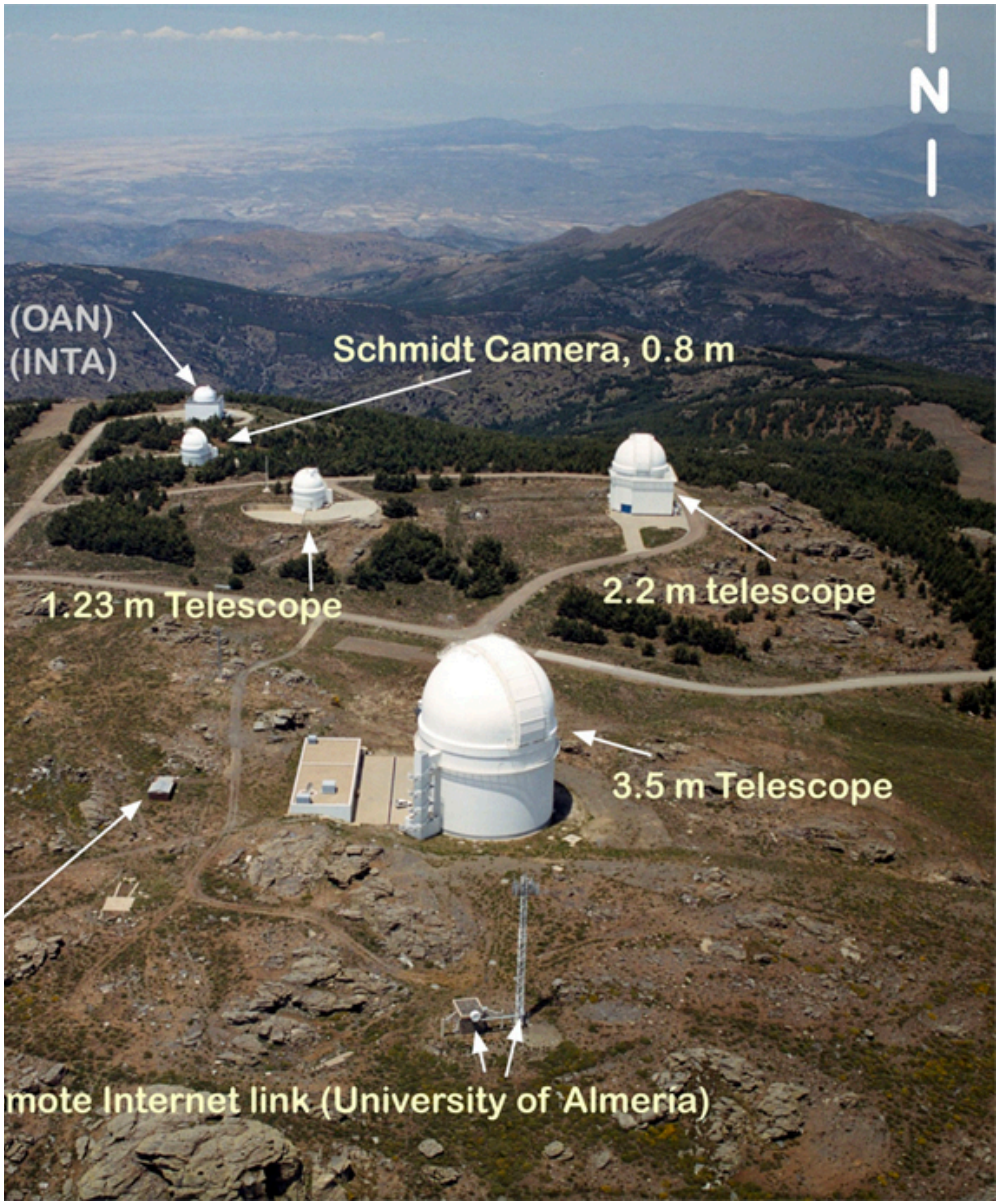
2. The telescope

- Zeiss 3.5 m Calar Alto telescope [not 10.4 m…]
- Made-in-Germany (not German) equatorial mount → Excellent pointing & tracking
- CARMENES + PMAS in Cassegrain focus (Omega-2000 y LAICA in prime focus)
- Future: CARMENES + LUCA (2023+)

3. The observatory

- CAHA = Centro Astronómico Hispano…
- Calar Alto (2168 m), Sierra de Los Filabres: 37.2236° N, 2.5461° W
- Declinación δ > -23 deg
- 100% Spanish since January 2019 (CSIC + Junta de Andalucía)
- ICTS: minimum 20% Spanish open time

[ICTS: Infraestructura Científica Técnica Singular]



4a. How to apply?

www.caha.es

Application for Observing Time at the Calar Alto Telescopes

- General Information -

Applications for observing time at the 2.2- and 3.5-m telescopes for Fall semester 2019 (July 1 through December 31)

Spanish Open Time at the 2.2-m and 3.5-m telescopes

The Principal Investigator (PI) of the proposal must be affiliated with a Spanish Institution at the time of submission (see exceptions below). Co-investigators (CoIs) from all countries are welcome to participate along with the Spanish PI.

- **Earliest date for submission is Februrary 19, 2019.**

DEADLINE FOR FALL 2019 PROPOSALS

- **March 20, 2019 23:59:59 CET**

PIs coming from other **European countries** are kindly asked to apply via NorthStar/Opticon. This semester, up to 10 nights are available on the 3.5-m telescope and 10 nights also on the 2.2 m. Travel funds are available for accepted OPTICON proposals. Please also note the possible different deadlines!
Proposals of PIs from **non-European countries** may be granted with observing time only if they are extremely well rated by the TAC. International teams can also buy observing time (see below).

News and remarks

- **3.5-m and 2.2-m telescopes**
  As an ICTS (Spanish Singular Scientific Facility) Calar Alto offers a minimum of 20% of the available observing time. Due to the new status of the observatory, the number of available observing nights for the Spanish community will be larger from 2019. For this reason, Calar Alto encourages Spanish PIs to send their proposals and take advantage of the new situation.

  Calar Alto also offers the option to buy observing time at the 3.5-m and 2.2-m telescopes. A separate operations agreement between CAHA A.I.E. and the respective user institution shall be signed. For further information, please contact CAHA director (director at caha.es).

4b. How to apply?

- Open time (~20%* 2019B, Spanish PI)
- OPTICON (10 N 2019B, European PI)
- DDT Director's Discretionary Time (~5%, <6 h proposal)
- Non-European: <DDT or buy time! (ask director@caha.es)

[* Open-time fraction will increase after CARMENES GTO completion]

Notes: Robotic. Request in hours. LOTUS and RINGO 3 are not available.						
Telescopio Nazionale Galileo (ORM, La Palma)	10 Nights	1 Nov - 31 March 2020	Yes	Yes	Possible with severe limitations	
Notes: GIARPS (simultaneous use of HARPS-N and GIANO) SHARED RISK OFFER. Please provide a backup program with one instrument only (HARPS-N or GIANO-B) in case the GIARPS configuration is not available. Service and visitor modes, not queuing. Service time is scheduled on fixed nights so, e.g., seeing requirements do not apply. Objects included in the TNG Protected Target List cannot be requested. Fractional nights can be requested in 1 hour blocks, assume 9hr per night. *A Long-Term program on the optical counterparts of gravitational wave events is already running at TNG. Therefore, proposals on this topic will not be accepted anymore.* ***October not available due to technical reasons.***						
CAHA 2.2m (Calar Alto)	10 Nights	1 July -31 Dec	Yes	Yes	No	Yes
Notes: CAFE, CAFOS, BUSCA, ASTRALUX are available.						
CAHA 3.5m (Calar Alto)	10	1 July - 31 Dec	Yes	Yes*	No	Yes*
Notes: *only possible with PMAS and CARMENES Proposals applying for CARMENES should consider that the main science case of the CARMENES Guaranteed Time Observations is the detection, follow-up and characterization of planets around M dwarfs with radial velocities. The agreement between CAHA and the CARMENES consortium protects this science case. Principal investigators of proposals which might overlap with this science case are encouraged to contact the CARMENES consortium for collaboration. CARMENES, PMAS, Omega 2000 and LAICA are available.						
Anglo-Australian Telescope. (Siding Spring)	10	1 Aug - 31 Jan	No	Yes	Yes	Yes

5. What to (not) apply?

"We remind the main science case of the CARMENES Guaranteed Time Observations: **the detection, follow-up and characterization of planets around M dwarfs with radial velocities**. The agreement between CAHA and the CARMENES consortium **protects** this science case. PIs of Open Time proposals to CARMENES that might overlap with this science case are encouraged to contact the CARMENES consortium for collaboration. In all other cases, arguments explaining why the science case does not overlap should be provided in the 'Astrophysical Context' subsection (8a) of the proposal."

6a. Time Allocation Committee (CAHA)

Current members

name, first name	city	comment
Aceituno, Jesús	Calar Alto	Director
González, Omaira	CRyA-UNAM, Mexico	Chair
Villaver, Eva	UAM, Madrid	
Courtois, Helene	Lyon University, France	
Martí, Josep	Jaen University	
Pinilla, Noemí	UCF - Florida, EEUU	
Rodríguez López, Cristina	IAA, Granada	
Suarez, Juan Carlos	Granada University	substitute
Bergond, Gilles	Calar Alto	secretary (non-voting)

Last meeting

November, 2018, evaluation of the proposals for Spring 2019 Semester, from January 1 to June 30

6b. Time Allocation Committee (OPTICON)

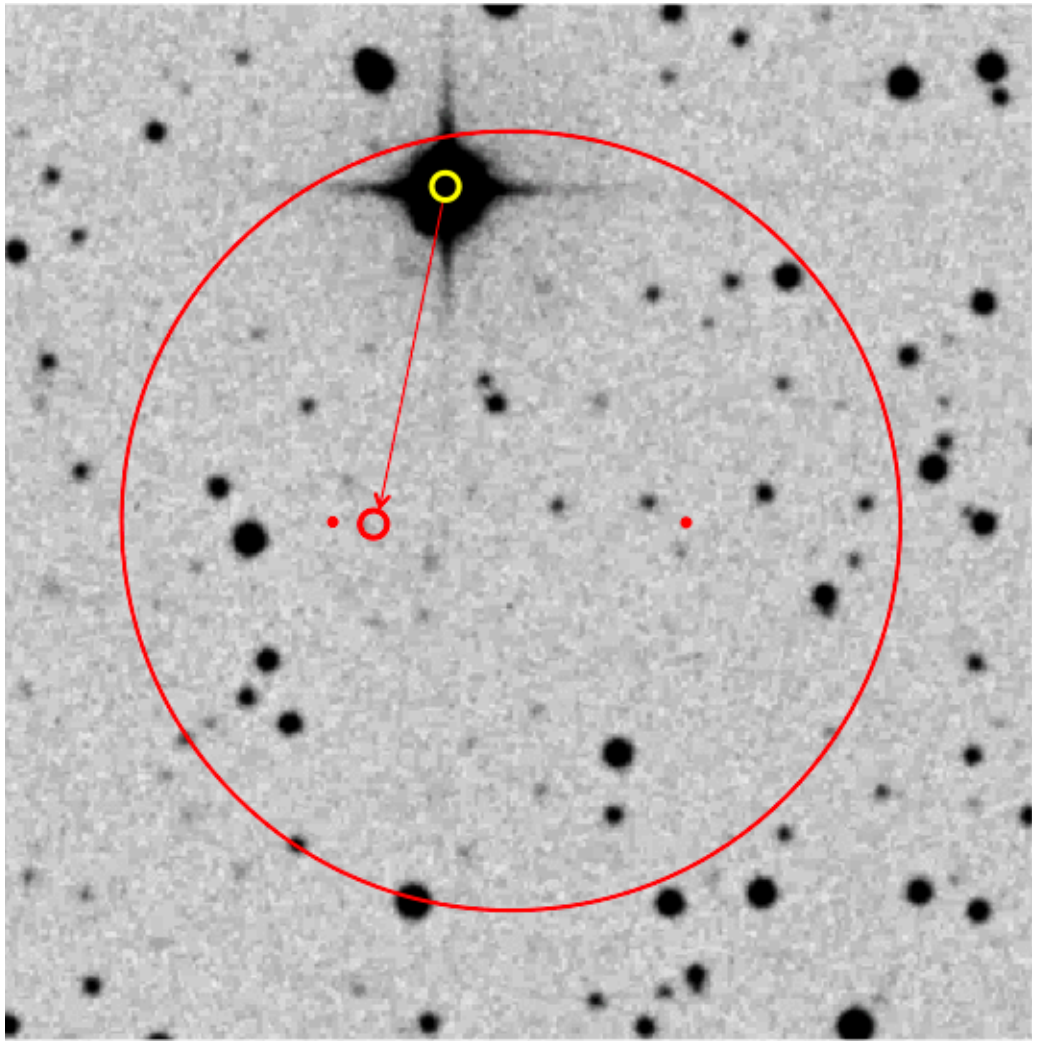
Time Allocation Committee

TAC Member Information

Name	Organisation	Country
Laura Affer	Palermo Observatory	Italy
Roi Alonso	IAC	Tenerife Spain
Frank Grundahl	Aarhus University	Denmark
Jochen Heidt (Chair)	LSW, Heidelberg	Germany
Renata Minkevičiūtė	University of Vilnius	Lithuania
Annelies Mortier	University of Cambridge	UK
Helene Roussel	Institut Astrophysique de Paris	France

7a. Observing

- Service-time observations vs. visitor mode (PhD students)
- Instrumental configuration (few movable parts):
  - Target on fibre A
  - Calibration (Fabry-Pérot, for precise RV measures) or sky on fibre B (for the rest)
- VIS+NIR simultaneously always



7b. Observing

- Calibrations: all done (pre- and post-night calibration runs; peri-night RV and telluric standard stars)
- Mind the atmospheric dispersion corrector ADC (recommendation: update every 30 min during continuous monitoring)
- Care of target observability (airmass < 2.00) and magnitude
- Exposure time reference band: *J* (not *V*!)
- t_{exp} [s] = 26.5 (SNR/150)^2 10$^{(J-4.2)/2.5}$ (maximum t_{exp} = 1800 s; barycentric correction)
- Overhead time: limited by telescope dome!
- ["Observing blocks"; possibility of changing between CARMENES and PMAS in ~5 min]

7c. Observing

How to observe with CARMENES?

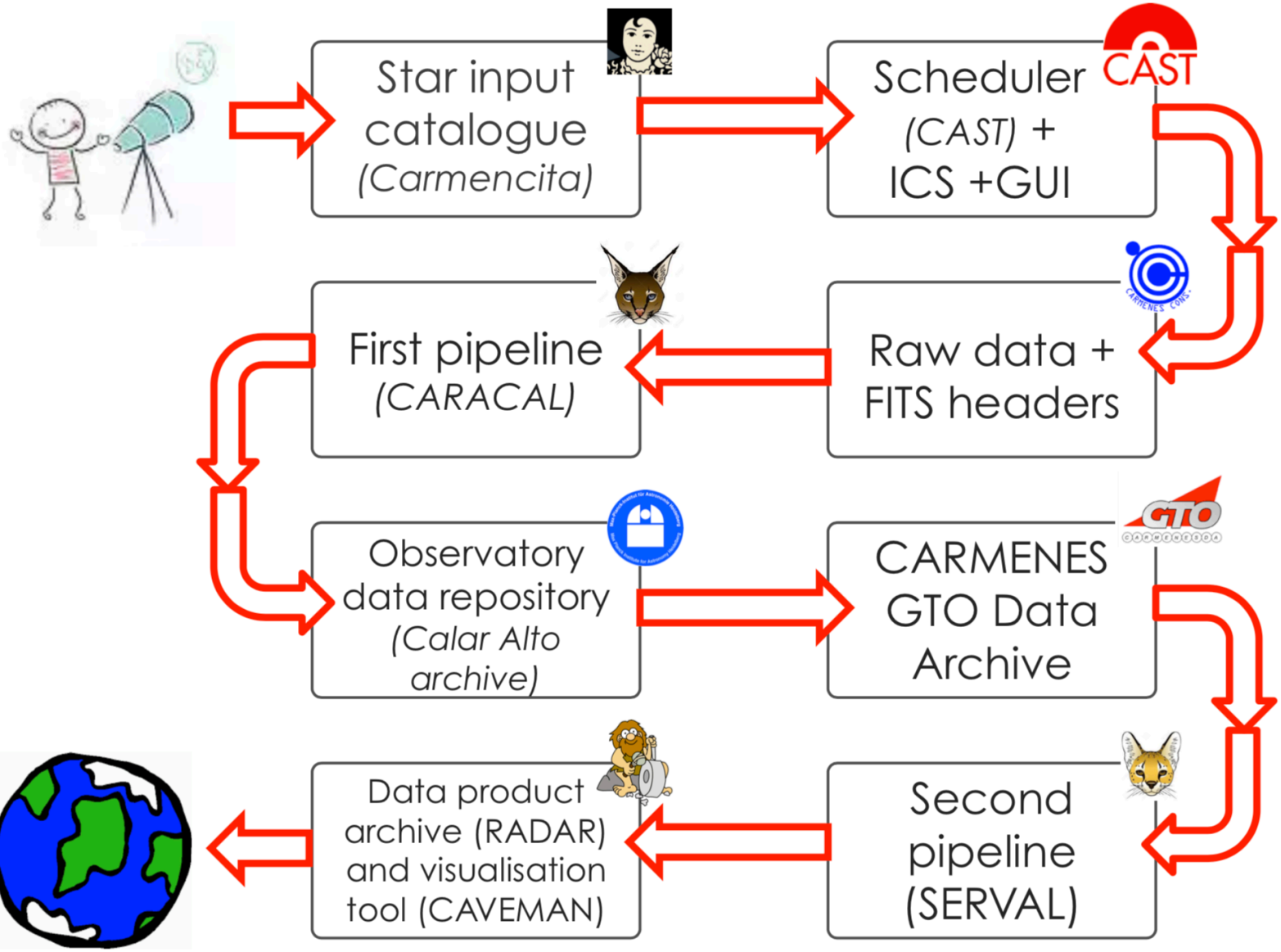
- **Instrument observing manual**. Most, if not all, observations can be done in service mode by the CAHA Astronomy Department
- **Sensitivity**. Approximate exposure time needed to get a total spectral signal-to-noise ratio SNR as a function of *J* magnitude (valid only for M dwarf spectral types):

J → **SNR** ↓	**6.0 mag**	**7.0 mag**	**8.0 mag**	**9.0 mag**	**10.0 mag**
50	15 s	40 s	100 s	240 s	615 s
100	60 s	155 s	390 s	980 s	2 x 1230 s
150	140 s	350 s	880 s	2 x 1100 s	4 x 1385 s

Alternatively use this formula: t_{exp} [s] = 26.5 (SNR/150)^2 $10^{(J-4.2)/2.5}$

- SNR = 150 allows reaching 1 m s^{-1} precision. We discourage observing targets fainter than *J* = 10.5 mag. Maximum individual exposure time is 1800 s
- Please ask the Instrument Astronomer for further information

8a. Data


Star input catalogue (Carmencita)
Scheduler (CAST) + ICS +GUI
CAST
First pipeline (CARACAL)
Raw data + FITS headers
Observatory data repository (Calar Alto archive)
CARMENES GTO Data Archive
GTO
Data product archive (RADAR) and visualisation tool (CAVEMAN)
Second pipeline (SERVAL)

8b. Data

- Automatic pipeline reduces spectrum before starting guiding on next target! (**CARACAL**: extraction, wavelength calibration, RV relative to ~M0V synthetic spectrum)
- Raw and processed data (including A&G images, A+B extracted spectra) available via **CAHA FTP** in the following morning!
- Non-GTO: pipeline for precise RV of M dwarfs available in GitHub (**SERVAL**; Zechmeister et al. 2018)
- All open-time proposal data available through **Calar Alto Archive** (SVO) after one-year proprietary time

9. Acknowledgments

- CARMENES: "*Based on observations collected at the Centro Astronómico…*", cite Quirrenbach et al. (201X) [X=0:2:8; e.g. SPIE 2014] and tell Santos Pedraz
- Calar Alto Archive: "*Based on data from the CARMENES data archive at CAB (INTA-CSIC)*"
- [GTO: long formula in private web]

10. Future

- Hardware: front-end, fibres, λ calibration, insulation, LN2 feeding, computers…
- Software: ICS (GUI), pipelines (python)

- + Operation and maintenance
- + Stability
- + Data quality

CARMENES+ (with LUCA) for *PLATO* RV follow-up 2030 and beyond…

11. Example

"El trabajo con CARMENES en Júpiter es para medir vientos con espectroscopia Doppler y alta resolución espacial. Este es el motivo principal de la propuesta que hicimos y que fue efectuada. Las observaciones las analiza un colaborador portugués especialista en este área. Hay una segunda tanda de observaciones en mayo. Los datos espectrales también son naturalmente adecuados para el estudio de la estructura vertical de nubes, composición química y para poder determinar *constrains* observacionales sobre la naturaleza de los cromóforos en Júpiter. Sabemos hoy en día que hay distintos cromóforos en diferentes latitudes y regiones dinámicas pero no se sabe cúales son." (R. Hueso, S. Pérez-Hoyos, A. Sánchez-Lavega @ EHU/UPV)

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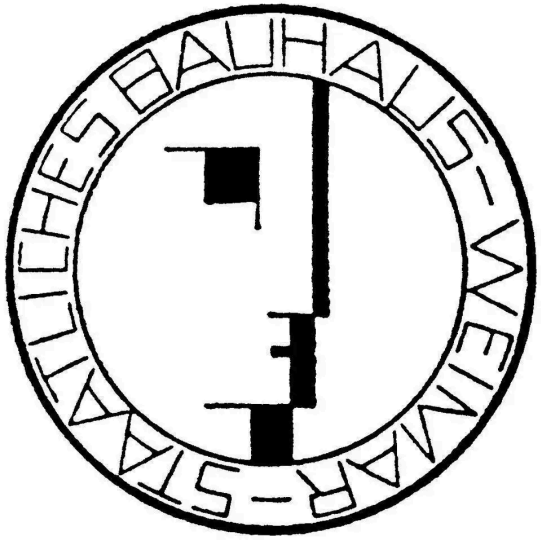

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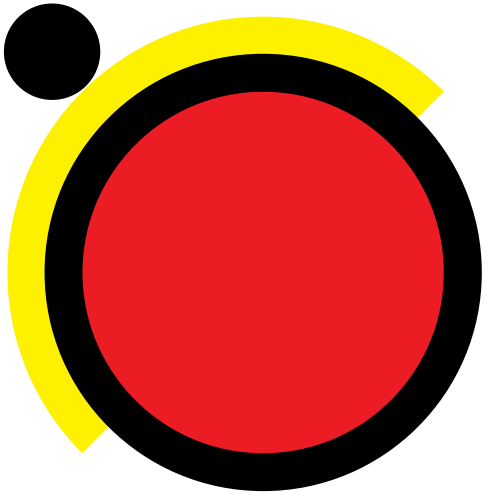

carmenes

MAX-PLANCK-GESELLSCHAFT CSIC ICE Institut für Astrophysik Göttingen TLS hs Unión Europea Fondo Europeo de Desarrollo Regional "Una manera de hacer Europa" Calar Alto KTS DFG DLR