Synergies between ARIEL and the ELTs

Enric Palle, ARIEL-ELT Synergies WG, et al.

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A quick review of ARIEL - ELT overlapping observations

Waiting till 2028/2030 …

252 288 000.0 s remaining

Waiting till 2028 …
Exoplanets with ELTs

High contrast imaging: **METIS**

- Volume-limited sample vs mag-limited sample
- Self-luminous young massive vs typically evolved planets
- Cold planets (100’s AU) vs hot planets
- Same initial composition, different ages/evolution
- Non-transiting vs transiting

High resolution spectroscopy: **HIRES**

- Science Case: *Exo-planet atmospheres and signatures of life* So, focus in small rocky planets
- Transit spectroscopy and reflected light
- Visible and near IR only 0.5-2.4 μm
- Extremely powerful for Jupiter and Neptune planets
Synergies: Atmospheric chemistry

ELTs will detect atomic and ion species.

Metallicities will tell us about planet formation

_Hoeijmakers et al, 2018_  
_Kelt-9b, Teq 400K_
Synergies: Atmospheric chemistry

ELTs will detect atomic and ion species.

Fe, Fe$^+$, Mg$^+$, Ti$^+$, Ca$^+$, ...

Kelt-9b, Teq 4000K

MASCARA-2, Teq 2200K

Casasayas et al, 2019
Synergies: Atmospheric evolution

ARIEL is setup to do **taxonomy** of planetary atmosphere types and evolution.

But ARIEL will not measure stellar lines that might be crucial to **understand evaporation and atmospheric evolution processes** and put its own measurements in context.

**Ha line** related to planetary escape  
*Yan et al, 2018*

The full Balmer series can be detected  
*Casasayas et al, 2019*
Synergies: Atmospheric evolution

A new tracer is the He I metastable triplet

HST detection

Spake et al, 2018
Synergies: Atmospheric evolution

A new tracer is the He I metastable triplet

He I absorption
*Nortmann et al, 2018*

Line profiles
Escape velocities
Geometry
Synergies: Atmospheric evolution

A new tracer is the He I metastable triplet
Synergies: Albedos

The ELT will have the capability of detecting reflected light and do spectral albedo measurements for a range of planets.

Visible range species (TiO, VO, FeH,..) might be detected this way.

ESPRESSO already attempting the low hanging fruits

Martins et al, 2018
Synergies: multi-resolution puzzle solving

A Framework to Combine Low- and High-resolution Spectroscopy for the Atmospheres of Transiting Exoplanets

Authors: M. Brogi, M. Line, J. Bean, J.-M. Désert, and H. Schwarz

Synergies: multi-resolution puzzle solving

Reconciling High and low resolution observations, the case of WASP-52b

Chen et al, 2017

Chen et al, sub., 2020
Synergies: multi-resolution puzzle solving

Reconciling High and low resolution observations, the case of WASP-127b, WASP-21b or HD209456b

Nikolov et al, 2018

Chen et al, 2018

CARMENES, HARPS and ESPRESSO observations do not detect these species

ARIEL Science Conference, ESTEC Jan 2020
Synergies: Rise to new challenges

With great SNR comes ... greater nasty effects to be accounted for.

*Effects like the CLV and RME become very relevant*

*Casasayas et al, 2020*
The Landscape in 2025/8

Multi-resolution approach common

Low-resolution spectra

- Composition
- Pressure levels
- Rayleigh slopes
- Clouds/hazes

High-resolution spectra

- Line profiles
- Metallicities,
- Planetary escape
- Albedos

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Thanks !!