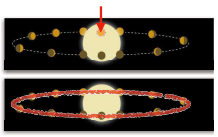
Jargon

Let's recap on the established jargon!

Quantity	Definition
Geometric albedo	Albedo at zero phase angle (superior conjunction)
Spherical albedo	Albedo over all phase angles
Bond albedo	Spherical albedo over all wavelengths
Phase integral	Ratio of spherical to geometric albedo
Single-scattering albedo	Fraction of light scattered in a single event



$$A_B = \frac{\int A_\lambda I_\star \, d\lambda}{\int I_\star \, d\lambda}$$

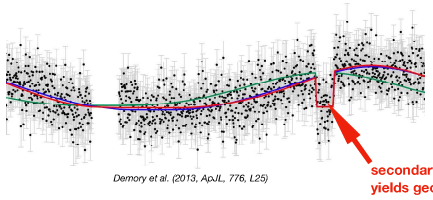
$$q = \frac{A_s}{A_g} = 2\int_0^\pi \Psi \sin\alpha \, d\alpha$$

ω

Re-interpreting phase curves

Standard practice so far:
Fit shape and amplitude of phase curve independently using an ad hoc series of sinusodial functions

$A_g \Psi$



Demory et al. (2013, ApJL, 776, L25)

With our newly discovered solutions:
Shape and amplitude are determined by a set of fundamental parameters.

$A_g(\omega, g)$

$\Psi(\omega, g)$

Heng, Morris & Kitzmann (2021, Nature Astronomy, 5, 1001)

Review: scattering asymmetry factor

$g = 0$ isotropic scattering

$g = +1$ forward scattering

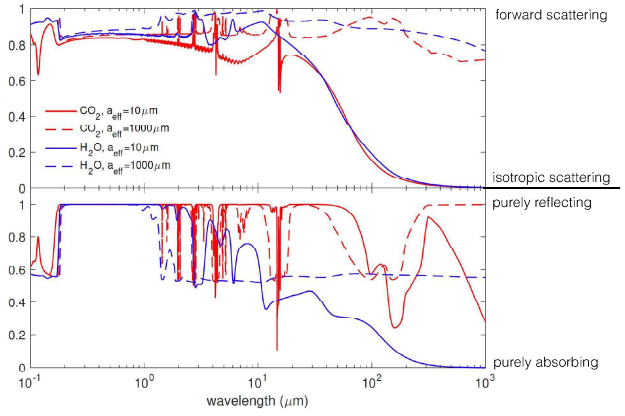
$g = -1$ backward scattering

Rayleigh scattering: almost isotropic!

Examples: CO_2 versus H_2O ice particles

g

ω



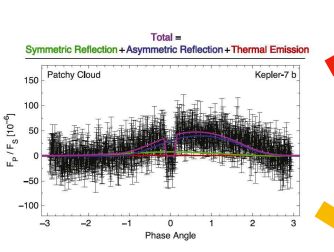
CO_2 ice is a better scatterer of infrared radiation

Heng & Kitzmann (2017, ApJS, 232, 20) + Kitzmann & Heng (2018, MNRAS, 475, 94)

Application to data: case studies

- *Kepler* phase curve of hot Jupiter Kepler-7b
- Population study of a (small) sample of hot Jupiters
- *Cassini* phase curves of Jupiter
- *Cassini* phase curves of Enceladus
- *CHEOPS* occultation of hot Jupiter HD 209458b
- *CHEOPS* occultation of hot Jupiter HD 189733b
- Holistic interpretation framework for *JWST + ARIEL* [in progress]

How Do We Interpret Phase Curves? Standard Practice



Hu et al. (2015, ApJ, 802, 51)

thermal emission

Dayside temperature
Nightside temperature
Redistribution efficiency
Bond albedo

reflected light

Geometric albedo