A Modelers Opacity Wish List

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Abstract. At the Aug. 1–4, 2017 Workshop on Astrophysical Opacities, several attendees voiced their interest in a list of absorption data, that are missing from or inadequate in current models of astrophysical objects. This is a wish list by modelers, meant as motivation and inspiration for experimentalists and theoreticians alike.

1. The Wish List

Table 1 is the opacity wish list as I have compiled from the responses I have received from both the workshop attendees and from several 1D and 3D stellar atmosphere groups. The first column lists the absorber system, the second column lists the absorption mechanism: Rotational, vibrational and electronic transitions in molecules, bound-bound (bb) and bound-free (bf) electronic transitions in atoms/ions, and collision induced absorption (CiA) from transient dipoles by pairs of passing particles. The third and fourth columns list the requests for laboratory experiment and/or theoretical calculations, and the last column lists the kind of objects for which modeling will improve with updated atomic/molecular physics.

1.1. Some Recent and Pending Calculations

A new high-temperature (up to 1 500 K) line-list for acetylene (HCCH or C_2H_2) has been published by Lyulin & Perevalov (2017), with several experimental spectra cited. Chubb et al. (2017) performed a critical compilation of measured spectra and derived rovibrational parameters for acetylene.

Calculations of the collision-induced-absorption has been carried out by Karman et al. (2015) 50–330 μm and Hartmann et al. (2017) at 2.05–2.3 μm, but only for room-temperature and below. Experimental spectra are cited in both papers.

The ExoMol (Yurchenko & Tennyson 2012, and elsewhere in these proceedings) team is very productive, and has already addressed a great number of requests from the community, notably HCN/HNC by Barber et al. (2014); NH_3 by Yurchenko et al. (2011), with updates expected early 2018. In addition, an ExoMol calculation of C_2H_2

Table 1. The opacity wish list.

Absorber	Mechanism	Exp.	Calc.	For objects
CH_2, C_3H	Rot+vib+e	X	X	Cool star/C-star atm.
CaOH, LaO, YO	Rot+vib+e	X	X	Cool dwarf atm.
ScO, TiS, ZrS			—||—	
C_2H[a]	Rot+vib		X	C-star atm.
N_2-H_2, N_2-He, N_2-Ne	CiA		X	M-dwarf atm.
N_2-N_2, H_2-Ne			—||—	
H-H[b]	CiA		X	Cool dwarf atm.
O, Fe-peak, Zn, Pb[c]	bb, bf	X	X	Stars in general

[a]No data are currently available for C_2H.

[b]This is a request for an update of the old Doyle (1968) result, and to match it to the red end of Allard et al. (1998)'s Lyα satellites from H-H collisions.

[c]Completeness is important for non-LTE calculations. Neutral atoms have highest priority.

is slated to be published by the first half of 2018, and C_3 should be completed later that year.

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