

## Appendix C

### Relevant transitions in $^{40}\text{Ca}$ for AC-stark shift due to blackbody radiation

This appendix tabulates the relevant transitions in  $^{40}\text{Ca}$  affected by the blackbody shift of the  $^1S_0$  ground state or the  $^3P_1$  excited state and used for the calculation of the blackbody systematic effect discussed in section 6.5.1.2. Table C.1 gives the transitions that affect the energy splitting of levels connected to the  $^1S_0$  state, and Table C.2 gives the transitions affecting the  $^3P_1$  state. I obtained the list of relevant transitions given in these tables from the NIST Atomic Spectra Database.

The transitions are labelled by their electron configuration, followed by their transitions given in spectroscopic notation,  $(2S+1)L(J)$ , in parenthesis.  $A_{ki}$  is the Einstein coefficient for the transition. The starred transitions (\*) were not included in the calculation. For the  $^3P_1$  case, we must take into consideration that the given  $A_{ki}$  is the total rate for all accessible levels. To calculate the rate for an individual m level, we have to multiply  $A_{ki}$  by  $A = (2J_{upper}+1)/(3(2J_{lower}+1))$ , where  $J_{upper}$  is the J value for the upper level and  $J_{lower}$  is the J value for the lower level.  $J_{lower}$  for the  $^3P_1$  state is then 1, so  $A = (2J_{upper}+1)/9$ .

Table C.1: Relevant transitions:  $^1S_0$  energy level.

<b>Transition</b>	<b>Wavelength (nm)</b>	<b><math>A_{ki} * 10^8 \text{ s}^{-1}</math></b>
$4s^2 - 4s8p (1S - 1P0)$	215.0795	6.1 e-02
$4s^2 - 4s7p (1S - 1P0)$	220.0727	1.53 e-01
$4s^2 - 4snp (1S - 1P0)$	227.5466	3.01 e-01
$4s^2 - 4s6p (1S - 1P0)$	239.8559	1.67 e-01
$4s^2 - 3d4p (1S - 3P0)$	254.1481	1.7 e-04*
$4s^2 - 3d4p (1S - 3D0)$	261.7541	1.6 e-04*
$4s^2 - 4s5p (1S - 1P0)$	272.1644	2.7 e-03
$4s^2 - 4s4p (1S - 1P0)$	422.6728	2.18 e+00

Table C.2: Relevant transitions:  ${}^3P_1$  energy level.

Transition	Wavelength	$A_{ki} * 10^8 \text{ s}^{-1}$	$J_i - J_k$	<b>A</b>
4s4p - 3d <sup>2</sup> (3P1 - 3P)	299.7316	2.41 e-01	1-2	5/9
4s4p - 3d <sup>2</sup> (3P1 - 3P)	299.9645	2.79 e-01	1-1	3/9
4s4p - 3d <sup>2</sup> (3P1 - 3P)	300.0863	1.58 e+00	1-0	1/9
4s4p - 4s10s (3P1 - 3S)	310.7393	1.0 e-02	1-1	3/9
4s4p - 4s8d (3P1 - 3D)	314.0786	4.9 e-02	1-2	5/9
4s4p - 4s8d (3P1 - 3D)	314.1159	3.0 e-02	1-1	3/9
4s4p - 4s9s (3P1 - 3S)	316.9839	2.0 e-02	1-1	3/9
4s4p - 4s7d (3P1 - 3D)	321.5169	1.1 e-01	1-2	5/9
4s4p - 4s7d (3P1 - 3D)	321.5342	5.1 e-02	1-1	3/9
4s4p - 4s8s (3P1 - 3S)	327.4671	3.0 e-02	1-1	3/9
4s4p - 4s6d (3P1 - 3D)	335.0203	1.78 e-01	1-2	5/9
4s4p - 4s6d (3P1 - 3D)	335.0355	1.11 e-01	1-1	3/9
4s4p - 4s7s (3P1 - 3S)	347.4763	4.6 e-02	1-1	3/9
4s4p - 4s5d (3P1 - 3D)	363.0752	2.97 e-01	1-2	5/9
4s4p - 4s5d (3P1 - 3D)	363.0978	1.53 e-01	1-1	3/9
4s4p - 4s6s (3P1 - 3S)	395.7054	9.8 e-02	1-1	3/9
4s4p - 4p <sup>2</sup> (3P1 - 3P)	428.3011	4.34 e-01	1-2	5/9
4s4p - 4p <sup>2</sup> (3P1 - 3P)	429.8988	4.66 e-01	1-1	3/9
4s4p - 4p <sup>2</sup> (3P1 - 3P)	430.7744	1.99 e+00	1-0	1/9
4s4p - 4s4d (3P1 - 3D)	443.4957	6.7 e-01	1-2	5/9
4s4p - 4s4d (3P1 - 3D)	443.5679	3.42 e-01	1-1	3/9
4s4p - 4s5s (3P1 - 3S)	612.2217	2.87 e-01	1-1	3/9
4s4p - 4s3d (3P1 - 3D)	1950	6.8 e-03	1-2	5/9
4s4p - 4s3d (3P1 - 3D)	1950	3.8 e-03	1-1	3/9