Table S1 Character table for $D_{6h}$ point group

<table>
<thead>
<tr>
<th></th>
<th>E</th>
<th>$2C_6$</th>
<th>$2C_3$</th>
<th>$C_2$</th>
<th>$3C''_2$</th>
<th>i</th>
<th>$2S_3$</th>
<th>$2S_6$</th>
<th>$\sigma_h$</th>
<th>$3\sigma_d$</th>
<th>$3\sigma_v$</th>
<th>Linear, rotations</th>
<th>Quadratic</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_{1g}$</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>$x^2+y^2$, $z^2$</td>
</tr>
<tr>
<td>$A_{2g}$</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
<td>R$_z$</td>
<td></td>
</tr>
<tr>
<td>$B_{1g}$</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>$B_{2g}$</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>$E_{1g}$</td>
<td>2</td>
<td>1</td>
<td>-1</td>
<td>-2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>-1</td>
<td>-2</td>
<td>0</td>
<td>0</td>
<td>(R$_x$, R$_y$)</td>
</tr>
<tr>
<td>$E_{2g}$</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>(x$^2$-y$^2$, xy)</td>
</tr>
<tr>
<td>$A_{1u}$</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>z</td>
</tr>
<tr>
<td>$A_{2u}$</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>$B_{1u}$</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>$B_{2u}$</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>-1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>$E_{1u}$</td>
<td>2</td>
<td>1</td>
<td>-1</td>
<td>-2</td>
<td>0</td>
<td>0</td>
<td>-2</td>
<td>-1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>(x, y)</td>
</tr>
<tr>
<td>$E_{2u}$</td>
<td>2</td>
<td>-1</td>
<td>-1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>-2</td>
<td>1</td>
<td>1</td>
<td>-2</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Fig. S1 Raman spectra of WSe$_2$, GaSe, CuS, GeSe and Bi$_2$Te$_2$S under 633 nm. The modes (251 cm$^{-1}$ ($A_{1g}$) for WSe$_2$, 209.3 cm$^{-1}$ ($E_{1g}$) for GaSe, 65.0 cm$^{-1}$ ($E_{2g}$) for CuS, 175 cm$^{-1}$ ($A_{2g}$) for GeSe and 34.9 cm$^{-1}$ ($E_{1g}$) for Bi$_2$Te$_2$S) which are absent under 532-nm excitation had been detected under 633-nm excitation.

Fig. S2 Raman spectra of bulk SnSe$_2$ under 532-nm and 633-nm excitations. These weak modes are marked in green.