The **immune** system that protects humans body from infections, diseases, and other threats, such as cancer. It consists of various elements that work together to ensure our safety. One example of immune cells is **T lymphocytes**. They act as guardians, constantly monitoring our body in search of "bad" cells, including **cancer cells**. Cytotoxic T lymphocytes can be compared to the special units that can directly attack these "bad" cells, leading to their destruction. Unfortunately, cancer cells have the ability to hide and themselves. Although they are detected, they are not destroyed by lymphocytes. They exploit a special mechanism called the **PD-1/PD-L1 signaling pathway**. Each lymphocyte (molecular guard) is equipped with a safety switch - the PD-1 protein, activation of which disarms the lymphocyte and inhibits the body's immune response. Under normal conditions, deactivation of lymphocytes is necessary to prevent attacking healthy cells, which present another protein on their surface - PD-L1. **By binding to PD-1, the PD-L1 disarms the T lymphocyte**. Unfortunately, cancer cells also have PD-L1. Although they are detected, the lymphocyte cannot attack the cancer cell because it has been disarmed by the PD-1/PD-L1 interaction. Cancer cells can therefore grow and spread across the body, causing significant damage. **Inhibition the PD-1/PD-L1 interaction** prevents **lymphocytes** from being disarmed and allows them to **fight and destroy cancer cells**. This approach, called **anticancer immunotherapy** therapy, is considered a modern treatment of cancer, and for their contributions to its development, James P. Allison and Tasuku Honjo were awarded the Nobel Prize in Physiology or Medicine in 2018. Blocking the PD-1/PD-L1 pathway relies on the use of monoclonal antibodies, which act as specially designed tools. These antibodies bind specifically to PD-L1 or PD-1, blocking their surface and preventing lymphocyte disarmament. Unfortunately, antibody therapy has many drawbacks, such as unwanted reactions from the immune system and high costs. Therefore, alternative approaches, such as **small molecules** (inhibitors), are being sought by scientists. Currently, our team is working on two generations of such compounds. The first class is **covalent inhibitors**, which form **durable and irreversible** covalent bonds with PD-L1, prolonging the drug's duration of action and minimizing its dosing frequency. This allows for maintaining therapeutic efficacy over a longer period, which may be beneficial in the treatment of chronic cancers. The second generation are inhibitors whose activity can be **controlled by light**, allowing for the precise **activation and deactivation** of the drug only at the site of action, namely on cancer cells.

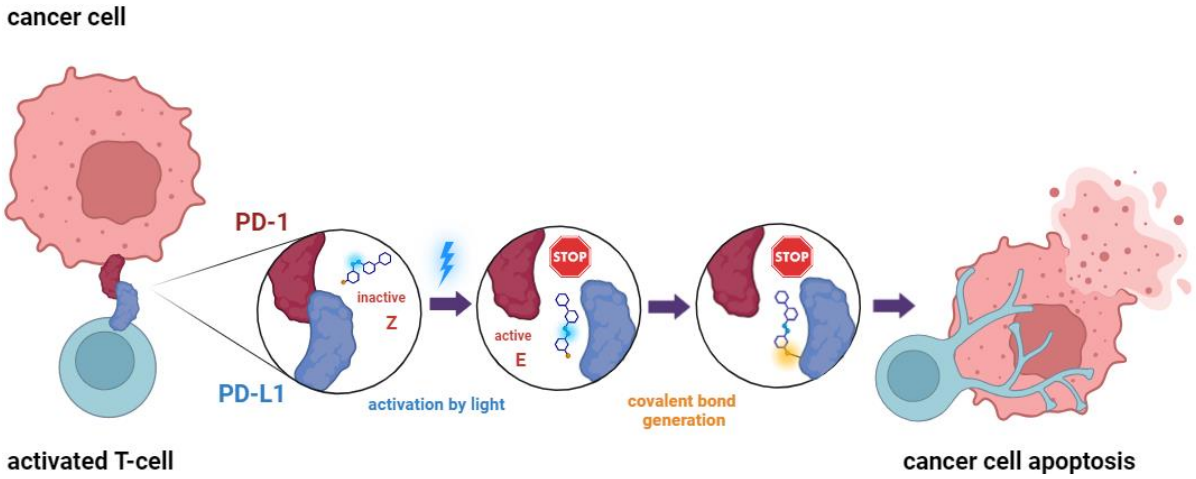

Figure 1 | Cancer immunotherapy with light-controlled covalent PD-L1 inhibitors.

The combination of these two concepts will allow for **controlling the activity** of inhibitors in time and space, ensuring more precise and effective **eradication of cancer cells** while **minimizing damage to healthy tissues**. Our project makes a significant contribution to the development of cancer immunotherapy, and the compounds synthesized by us have the potential to become new drugs used in the treatment of cancer.