

Table S7: GO process analysis of top 100 signals, when compared to all signals, from CEU population using the  $T_2$  test statistic.

| Description                                                                                      | $p$ -value            | Enrichment | Genes                                                                                                         |
|--------------------------------------------------------------------------------------------------|-----------------------|------------|---------------------------------------------------------------------------------------------------------------|
| Interferon-gamma-mediated signaling pathway                                                      | $8.3 \times 10^{-11}$ | 24.9       | HLA-A, HLA-B, HLA-C, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                |
| Cellular response to interferon-gamma                                                            | $5.9 \times 10^{-10}$ | 20.1       | HLA-A, HLA-B, HLA-C, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                |
| Response to interferon-gamma                                                                     | $3.5 \times 10^{-9}$  | 16.5       | HLA-A, HLA-B, HLA-C, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                |
| Antigen processing and presentation of peptide antigen                                           | $4.2 \times 10^{-8}$  | 10.4       | ERAP1, HLA-A, HLA-B, HLA-C, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                         |
| Antigen processing and presentation                                                              | $1.5 \times 10^{-7}$  | 9.1        | ERAP1, HLA-A, HLA-B, HLA-C, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                         |
| Antigen processing and presentation of exogenous peptide antigen                                 | $2.8 \times 10^{-7}$  | 10.0       | HLA-A, HLA-B, HLA-C, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                |
| Antigen processing and presentation of exogenous antigen                                         | $3.2 \times 10^{-7}$  | 9.9        | HLA-A, HLA-B, HLA-C, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                |
| Detection of bacterium                                                                           | $7.0 \times 10^{-7}$  | 53.7       | HLA-A, HLA-B, HLA-DRB1, PGLYRP4                                                                               |
| T cell costimulation                                                                             | $1.3 \times 10^{-6}$  | 17.2       | HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                                     |
| Lymphocyte costimulation                                                                         | $1.4 \times 10^{-6}$  | 16.9       | HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                                     |
| Regulation of immune response                                                                    | $3.3 \times 10^{-6}$  | 4.7        | DMBT1, ERAP1, HLA-A, HLA-B, HLA-C, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1, MAP2K3, PGLYRP4 |
| T cell receptor signaling pathway                                                                | $4.8 \times 10^{-6}$  | 13.8       | HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                                     |
| Cytokine-mediated signaling pathway                                                              | $5.3 \times 10^{-6}$  | 6.1        | HLA-A, HLA-B, HLA-C, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1, NUP88                         |
| Detection of biotic stimulus                                                                     | $8.2 \times 10^{-6}$  | 30.3       | HLA-A, HLA-B, HLA-DRB1, PGLYRP4                                                                               |
| Antigen processing and presentation of exogenous peptide antigen via MHC class II                | $8.6 \times 10^{-6}$  | 12.5       | HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                                     |
| Immune response-activating signal transduction                                                   | $9.0 \times 10^{-6}$  | 7.8        | DMBT1, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1, MAP2K3                                      |
| Antigen processing and presentation of peptide or polysaccharide antigen via MHC class II        | $9.8 \times 10^{-6}$  | 12.2       | HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                                     |
| Antigen processing and presentation of peptide antigen via MHC class II                          | $9.8 \times 10^{-6}$  | 12.2       | HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1                                                     |
| Immune response-regulating signaling pathway                                                     | $1.4 \times 10^{-5}$  | 7.3        | DMBT1, HLA-DPA1, HLA-DPB1, HLA-DQA1, HLA-DQB1, HLA-DRA, HLA-DRB1, MAP2K3                                      |
| Antigen processing and presentation of exogenous peptide antigen via MHC class I TAP-independent | $1.5 \times 10^{-5}$  | 58.2       | HLA-A, HLA-B, HLA-C                                                                                           |

GO categories in which false discovery rate is less than 0.01.