

CLAIMS

What is claimed is:

1. A Galectin-9 (GAL9) antigen binding molecule, comprising: a first antigen binding site (ABS) specific for a first epitope of a first GAL9 antigen, wherein the first antigen binding site comprises all three VH CDRs from any one of the ABS clones selected from P9-01, P9-02A, P9-03, P9-06, P9-07, P9-11, P9-12, P9-14, P9-23, P9-24, P9-25, P9-29, P9-30, P9-34, P9-37, P9-38, P9-40, P9-41, P9-42, P9-43, P9-44, P9-45, P9-46, P9-50, P9-51, P9-52, P9-53, P9-56, and P9-57.
2. A Galectin-9 (GAL9) antigen binding molecule, comprising a first antigen binding site (ABS) specific for a first epitope of a first GAL9 antigen, wherein the first antigen binding site comprises all three VL CDRs from any one of the ABS clones selected from P9-01, P9-02A, P9-03, P9-06, P9-07, P9-11, P9-12, P9-14, P9-23, P9-24, P9-25, P9-29, P9-30, P9-34, P9-37, P9-38, P9-40, P9-41, P9-42, P9-43, P9-44, P9-45, P9-46, P9-50, P9-51, P9-52, P9-53, P9-56, and P9-57.
3. A Galectin-9 (GAL9) antigen binding molecule, comprising a first antigen binding site (ABS) specific for a first epitope of a first GAL9 antigen, wherein the first antigen binding site comprises all three VH CDRs and all three VL CDRs from any one of the ABS clones selected from P9-01, P9-02A, P9-03, P9-06, P9-07, P9-11, P9-12, P9-14, P9-23, P9-24, P9-25, P9-29, P9-30, P9-34, P9-37, P9-38, P9-40, P9-41, P9-42, P9-43, P9-44, P9-45, P9-46, P9-50, P9-51, P9-52, P9-53, P9-56, and P9-57.
4. A Galectin-9 (GAL9) antigen binding molecule, comprising a first antigen binding site (ABS) specific for a first epitope of a first GAL9 antigen, comprising the VL sequence and the VH sequence from any one of the ABS clones selected from P9-01, P9-02A, P9-03, P9-06, P9-07, P9-11, P9-12, P9-14, P9-23, P9-24, P9-25, P9-29, P9-30, P9-34, P9-37, P9-38, P9-40, P9-41, P9-42, P9-43, P9-44, P9-45, P9-46, P9-50, P9-51, P9-52, P9-53, P9-56, and P9-57.
5. The GAL9 antigen binding molecule of claim 4, wherein the first antigen binding site (ABS) further comprises a first IgG heavy chain polypeptide and a first light chain polypeptide.
6. The GAL9 antigen binding molecule of any one of claims 1-5, wherein the GAL9 antigen is a human GAL9 antigen.

7. The GAL9 antigen binding molecule of any of claims 1-6, wherein the GAL9 antigen binding molecule further comprises a second antigen binding site (ABS).
8. The GAL9 antigen binding molecule of claim 7, wherein the second ABS is specific for a GAL9 antigen.
9. The GAL9 antigen binding molecule of claim 7, wherein the second ABS is specific for a second epitope of the first GAL9 antigen.
10. The GAL9 antigen binding molecule of claim 7, wherein the second ABS is specific for the first epitope of the first GAL9 antigen and is identical to the first ABS.
11. The GAL9 antigen binding molecule of any one of claims 7-10, wherein the second ABS comprises all three VH CDRs, all three VL CDRs, or all three VH CDRs and all three VL CDRs from another ABS clone selected from P9-01, P9-02A, P9-03, P9-06, P9-07, P9-11, P9-12, P9-14, P9-23, P9-24, P9-25, P9-29, P9-30, P9-34, P9-37, P9-38, P9-40, P9-41, P9-42, P9-43, P9-44, P9-45, P9-46, P9-50, P9-51, P9-52, P9-53, P9-56, and P9-57.
12. The GAL9 antigen binding molecule of claim 11, wherein the second antigen binding site comprises the VL sequence and the VH sequence from the other ABS clone.
13. The GAL9 antigen binding molecule of claim 12, wherein the second antigen binding site comprises a full immunoglobulin heavy chain sequence comprising the VH sequence and a full immunoglobulin light chain sequence comprising the VL sequence from the other ABS clone.
14. The GAL9 antigen binding molecule of claim 7, wherein the second antigen binding site is specific for an antigen other than the first GAL9 antigen.
15. The GAL9 antigen binding molecule of any one of the preceding claims, wherein the first antigen binding site comprises all three VH CDRs, all three VL CDRs, or all three VH CDRs and all three VL CDRs from any one of the ABS clones selected from: P9-11, P9-24, P9-34, and P9-37.
16. The GAL9 antigen binding molecule of any of claims 1-14, wherein the first antigen binding site comprises all three VH CDRs, all three VL CDRs, or all three VH CDRs and all three VL CDRs from any one of the ABS clones selected from P9-11, P9-24, and P9-34.

17. The GAL9 antigen binding molecule of any of claims 1-14, wherein the first antigen binding site comprises all three VH CDRs, all three VL CDRs, or all three VH CDRs and all three VL CDRs from ABS clone P9-11.
18. The GAL9 antigen binding molecule of any of claims 1-14, wherein the first antigen binding site comprises all three VH CDRs, all three VL CDRs, or all three VH CDRs and all three VL CDRs from ABS clone P9-24.
19. The GAL9 antigen binding molecule of any of claims 1-14, wherein the first antigen binding site comprises all three VH CDRs, all three VL CDRs, or all three VH CDRs and all three VL CDRs from ABS clone P9-34.
20. The GAL9 antigen binding molecule of any of claims 1-14, wherein the first antigen binding site comprises all three VH CDRs, all three VL CDRs, or all three VH CDRs and all three VL CDRs from ABS clone P9-37.
21. The GAL9 antigen binding molecule of any of claims 1-20, wherein the GAL9 antigen binding molecule comprises an antibody format selected from the group consisting of: full-length antibodies, Fab fragments, Fvs, scFvs, tandem scFvs, Diabodies, scDiabodies, DARTs, tandAbs, minibodies, and B-bodies.
22. The GAL9 antigen binding molecule of any of claims 1-21, wherein the GAL9 antigen binding molecule decreases TNF- α secretion by activated immune cells upon contact, wherein the decrease is about at least a 30%, 35%, 40%, 45%, 50%, 55%, or 60% decrease, relative to activated immune cells treated with a control agent.
23. The GAL9 antigen binding molecule of any of claims 1-22, wherein the GAL9 antigen binding molecule decreases IFN- γ secretion by activated immune cells upon contact, wherein the decrease is about at least a 20%, 25%, 30%, 35%, 40%, 45%, or 50% decrease relative to activated immune cells treated with a control agent.
24. The GAL9 antigen binding molecule of any of claims 1-23, wherein the GAL9 antigen binding molecule increases IL-10 secretion by activated immune cells upon contact, wherein the increase is about at least a 5%, 10%, 15%, 20%, 25%, 30%, 35% or 40% increase relative to activated immune cells treated with a control agent.
25. The GAL9 antigen binding molecule of any of claims 1-24, wherein the GAL9 antigen binding molecule does not modulate PD-1 surface expression on activated immune cells relative to activated immune cells treated with a control agent.

26. The GAL9 antigen binding molecule of any of claims 1-25, wherein the GAL9 antigen binding molecule does not modulate PD-L1 surface expression on activated immune cells relative to activated immune cells treated with a control agent.
27. The GAL9 antigen binding molecule of any of claims 1-26, wherein the GAL9 antigen binding molecule does not modulate CTLA-4 surface expression on activated immune cells relative to activated immune cells treated with a control agent.
28. The GAL9 antigen binding molecule of any of claims 1-27, wherein the GAL9 antigen binding molecule does not modulate TIM3 surface expression on activated immune cells relative to activated immune cells treated with a control agent.
29. The GAL9 antigen binding molecule of any of claims 1-28, wherein the GAL9 antigen binding molecule does not modulate LAG3 surface expression on activated immune cells relative to activated immune cells treated with a control agent.
30. The GAL9 antigen binding molecule of any of claims 1-29, wherein the GAL9 antigen binding molecule decreases 4-1BB surface expression on CD8⁺ T-cells, relative to CD8⁺ T-cells treated with a control agent.
31. The GAL9 antigen binding molecule of any of claims 1- 30, wherein the GAL9 antigen binding molecule decreases CD40L surface expression on CD8⁺ T-cells, relative to CD8⁺ T-cells treated with a control agent.
32. The GAL9 antigen binding molecule of any of claims 1- 31, wherein the GAL9 antigen binding molecule decreases OX40 surface expression on CD8⁺ T-cells, relative to CD8⁺ T-cells treated with a control agent.
33. The GAL9 antigen binding molecule of any of claims 22-32, wherein the control agent is a negative control agent or positive control agent.
34. The GAL9 antigen binding molecule of claim 33, wherein the control agent is a control antibody.
35. The GAL9 antigen binding molecule of claim 34, wherein the control antibody is selected from the group consisting of: an ECA42 clone anti-GAL9 antibody, an RG9.1 clone anti-GAL9 antibody, an RG9.35 clone anti-GAL9 antibody, an anti-PD1 antibody, a 108A2 clone anti-GAL9 antibody, and a non-GAL9 binding isotype control antibody.

36. The GAL9 antigen binding molecule of any one of claims 22-35, wherein the activated immune cells were activated by peptide stimulation, anti-CD3, or dendritic cells.
37. A GAL9 antigen binding molecule, wherein the GAL9 antigen binding molecule decreases TNF- α secretion by activated immune cells upon contact, wherein the decrease is about at least a 30%, 35%, 40%, 45%, 50%, 55%, or 60% decrease relative to activated immune cells treated with a control agent.
38. A GAL9 antigen binding molecule, wherein the GAL9 antigen binding molecule decreases IFN- γ secretion by activated immune cells upon contact, wherein the decrease is about at least a 20%, 25%, 30%, 35%, 40%, 45%, or 50% decrease relative to activated immune cells treated with a control agent.
39. A GAL9 antigen binding molecule, wherein the GAL9 antigen binding molecule increases IL-10 secretion by activated immune cells upon contact, wherein the increase is about at least a 5%, 10%, 15%, 20%, 25%, 30%, 35% or 40% increase relative to activated immune cells treated with a control agent
40. A GAL9 antigen binding molecule, wherein the GAL9 antigen binding molecule does not modulate PD-1 surface expression on activated immune cells relative to activated immune cells treated with a control agent.
41. A GAL9 antigen binding molecule, wherein the GAL9 antigen binding molecule does not modulate PD-L1 surface expression on activated immune cells relative to activated immune cells treated with a control agent.
42. A GAL9 antigen binding molecule, wherein the GAL9 antigen binding molecule does not modulate CTLA-4 surface expression on activated immune cells relative to activated immune cells treated with a control agent.
43. A GAL9 antigen binding molecule, wherein the GAL9 antigen binding molecule does not modulate TIM3 surface expression on activated immune cells relative to activated immune cells treated with a control agent.
44. A GAL9 antigen binding molecule, wherein the GAL9 antigen binding molecule does not modulate LAG-3 surface expression on activated immune cells relative to activated immune cells treated with a control agent.

45. A GAL9 antigen binding molecule decreases 4-1BB surface expression on activated CD8⁺ T-cells relative to activated CD8⁺ T-cells treated with a control agent.
46. A GAL9 antigen binding molecule decreases CD40L surface expression on activated CD8⁺ T-cells relative to activated CD8⁺ T-cells treated with a control agent.
47. A GAL9 antigen binding molecule decreases OX40 surface expression on activated CD8⁺ T-cells relative to activated CD8⁺ T-cells treated with a control agent.
48. A GAL9 antigen binding molecule, wherein the GAL9 antigen binding molecule demonstrates one or more of the following properties:
- A) decreases TNF- α secretion by activated immune cells, wherein the decrease is about at least a 30%, 35%, 40%, 45%, 50%, 55%, or 60% decrease relative to activated immune cells treated with a control agent;
 - B) decreases IFN- γ secretion by activated immune cells, wherein the decrease is about at least a 20%, 25%, 30%, 35%, 40%, 45%, or 50% decrease relative to activated immune cells treated with a control agent;
 - C) increases IL-10 secretion by activated immune cells, wherein the increase is about at least a 5%, 10%, 15%, 20%, 25%, 30%, 35%, or 40% increase relative to activated immune cells treated with a control agent;
 - D) does not modulate PD-1 surface expression on activated immune cells relative to activated immune cells treated with a control agent;
 - E) does not modulate PD-L1 surface expression on activated immune cells relative to activated immune cells treated with a control agent;
 - F) does not modulate CTLA-4 surface expression on activated immune cells relative to activated immune cells treated with a control agent;
 - G) does not modulate TIM3 surface expression on activated immune cells relative to activated immune cells treated with a control agent;
 - H) does not modulate LAG3 surface expression on activated immune cells relative to activated immune cells treated with a control agent;
 - I) decreases 4-1BB surface expression on activated CD8⁺ T-cells relative to activated CD8⁺ T-cells treated with a control agent;

- J) decreases CD40L surface expression on activated CD8⁺ T-cells relative to activated CD8⁺ T-cells treated with a control agent; or
- K) decreases OX40 surface expression on activated CD8⁺ T-cells relative to activated CD8⁺ T-cells treated with a control agent.
- 49.** The GAL9 antigen binding molecule of any one of claims 37-48, wherein the control agent is a negative control agent or positive control agent.
- 50.** The GAL9 antigen binding molecule of claim 49, wherein the control agent is a control antibody.
- 51.** The GAL9 antigen binding molecule of claim 50, wherein the control antibody is selected from the group consisting of: an ECA42 clone anti-GAL9 antibody, an RG9.1 clone anti-GAL9 antibody, an RG9.35 clone anti-GAL9 antibody, an anti-PD1 antibody, an 108A2 clone anti-GAL9 antibody, and a non-GAL9 binding isotype control antibody.
- 52.** The GAL9 antigen binding molecule of any one of claims 37-51, wherein the activated immune cells, were activated by peptide stimulation, anti-CD3 or dendritic cells.
- 53.** The GAL9 antigen binding molecule of any of claims 37-49, comprising a first antigen binding site specific for a first epitope of a first GAL9 antigen, wherein the first antigen binding site comprises all three VH CDRs and all three VL CDRs from any one of the ABS clones selected from P9-01, P9-02A, P9-03, P9-06, P9-07, P9-11, P9-12, P9-14, P9-23, P9-24, P9-25, P9-29, P9-30, P9-34, P9-37, P9-38, P9-40, P9-41, P9-42, P9-43, P9-44, P9-45, P9-46, P9-50, P9-51, P9-52, P9-53, P9-56, and P9-57.
- 54.** The GAL9 antigen binding molecule of claim 53, comprising the VL sequence and the VH sequence from any one of the ABS clones selected from P9-01, P9-02A, P9-03, P9-06, P9-07, P9-11, P9-12, P9-14, P9-23, P9-24, P9-25, P9-29, P9-30, P9-34, P9-37, P9-38, P9-40, P9-41, P9-42, P9-43, P9-44, P9-45, P9-46, P9-50, P9-51, P9-52, P9-53, P9-56, and P9-57.
- 55.** The GAL9 antigen binding molecule of claim 54, comprising a full immunoglobulin heavy chain sequence comprising the VH sequence and a full immunoglobulin light chain sequence comprising the VL sequence, wherein the VH sequence and the VL sequence are from any one of the ABS clones selected from P9-01, P9-02A, P9-03,

P9-06, P9-07, P9-11, P9-12, P9-14, P9-23, P9-24, P9-25, P9-29, P9-30, P9-34, P9-37, P9-38, P9-40, P9-41, P9-42, P9-43, P9-44, P9-45, P9-46, P9-50, P9-51, P9-52, P9-53, P9-56, and P9-57.

56. The GAL9 antigen binding molecule of any one of claims 37-55, wherein the GAL9 antigen is a human GAL9 antigen.
57. The GAL9 antigen binding molecule of any of claims 37-56, wherein the GAL9 antigen binding molecule further comprises a second antigen binding site.
58. The GAL9 antigen binding molecule of claim 57, wherein the second antigen binding site is specific for the GAL9 antigen.
59. The GAL9 antigen binding molecule of claim 58, wherein the second antigen binding site is identical to the first antigen binding site.
60. The GAL9 antigen binding molecule of claim 57, wherein the second antigen binding site is specific for a second epitope of the first GAL9 antigen.
61. The GAL9 antigen binding molecule of claim 60, wherein the second antigen binding site comprises all three VH CDRs and all three VL CDRs from another ABS clone selected from P9-01, P9-02A, P9-03, P9-06, P9-07, P9-11, P9-12, P9-14, P9-23, P9-24, P9-25, P9-29, P9-30, P9-34, P9-37, P9-38, P9-40, P9-41, P9-42, P9-43, P9-44, P9-45, P9-46, P9-50, P9-51, P9-52, P9-53, P9-56, and P9-57.
62. The GAL9 antigen binding molecule of claim 61, wherein the second antigen binding site comprises the VL sequence and the VH sequence from the other ABS clone.
63. The GAL9 antigen binding molecule of claim 62, wherein the second antigen binding site comprises a full immunoglobulin heavy chain sequence comprising the VH sequence and a full immunoglobulin light chain sequence comprising the VL sequence from the other ABS clone.
64. The GAL9 antigen binding molecule of claim 57, wherein the second antigen binding site is specific for an antigen other than the first GAL9 antigen.
65. The GAL9 antigen binding molecule of any of claims 53-64, wherein the first antigen binding site comprises all three VH CDRs and all three VL CDRs from any one of the ABS clones selected from: P9-11, P9-24, P9-34, and P9-37.

66. The GAL9 antigen binding molecule of any of claims 53-64, wherein the first antigen binding site comprises all three VH CDRs and all three VL CDRs from any one of the ABS clones selected from: P9-11, P9-24, and P9-34 .
67. The GAL9 antigen binding molecule of any of claims 53-64, wherein the first antigen binding site comprises all three VH CDRs and all three VL CDRs from ABS clone P9-11.
68. The GAL9 antigen binding molecule of any of claims 53-64, wherein the first antigen binding site comprises all three VH CDRs and all three VL CDRs from ABS clone P9-24.
69. The GAL9 antigen binding molecule of any of claims 53-64, wherein the first antigen binding site comprises all three VH CDRs and all three VL CDRs from ABS clone P9-34.
70. The GAL9 antigen binding molecule of any of claims 53-64, wherein the first antigen binding site comprises all three VH CDRs and all three VL CDRs from ABS clone P9-37.
71. The GAL9 antigen binding molecule of any of claims 37-70, wherein the GAL9 antigen binding molecule comprises an antibody format selected from the group consisting of: full-length antibodies, Fab fragments, Fvs, scFvs, tandem scFvs, Diabodies, scDiabodies, DARTs, tandAbs, minibodies, and B-bodies.
72. A GAL9 antigen binding molecule which binds to the same epitope as a GAL9 antigen binding molecule of any one of the preceding claims.
73. A GAL9 antigen binding molecule which competes for binding with a GAL9 antigen binding molecule of any one of the preceding claims.
74. The GAL9 antigen binding molecule of any one of the preceding claims, which is purified.
75. A pharmaceutical composition comprising the GAL9 antigen binding molecule of any one of the preceding claims and a pharmaceutically acceptable diluent.
76. A method for treating a subject with an autoimmune disease, comprising: administering a therapeutically effective amount of the pharmaceutical composition of claim 75 to the subject.

77. The method of claim 76, wherein the subject with an autoimmune disease has increased PD-L2 expression on dendritic cells relative to dendritic cells from a healthy control.
78. The method of claim 76, wherein the autoimmune disease is selected from the group consisting of: inflammatory bowel disease, Crohn's disease, ulcerative colitis, colitis, celiac disease, rheumatoid arthritis, Behçet's disease, amyloidosis, psoriasis, psoriatic arthritis, systemic lupus erythematosus nephritis, graft-versus-host disease (GvHD), nonalcoholic steatohepatitis (NASH), and ankylosing spondylitis.
79. The method of claim 76, wherein the treatment results in reducing inflammation, reducing an autoimmune response, prolonging remission, inducing remission, re-establishing immune tolerance, improving organ function, reducing progression of a disease, reducing the risk of progression or development of a second disease, or increasing overall survival.