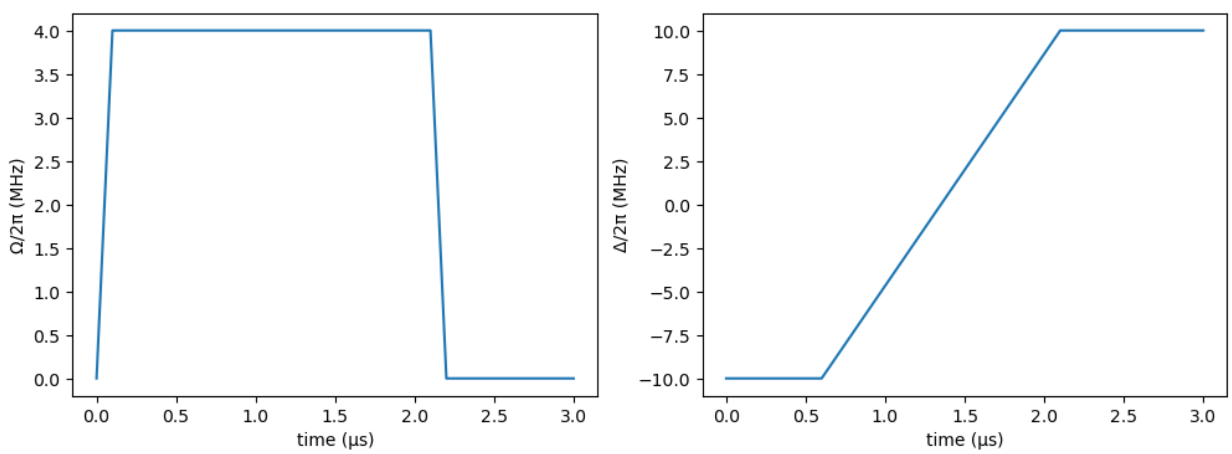
In [2]:
```julia
using Bloqade
using PythonCall
using KrylovKit
using SparseArrays

plt = pyimport("matplotlib.pyplot");
```

In [2]:
```julia
t_tot = 3.0;
Ω_max = 2π * 4;
Ω = piecewise_linear(clocks = [0.0, 0.1, 2.1, 2.2, t_tot], values = [0
U = 2π * 10;
Δ = piecewise_linear(clocks = [0.0, 0.6, 2.1, t_tot], values = [-U, -U

fig, (ax1, ax2) = plt.subplots(ncols = 2, figsize = (12, 4))
Bloqade.plot!(ax1, Ω)
ax1.set_ylabel("Ω/2π (MHz)")
Bloqade.plot!(ax2, Δ)
ax2.set_ylabel("Δ/2π (MHz)")
fig
```

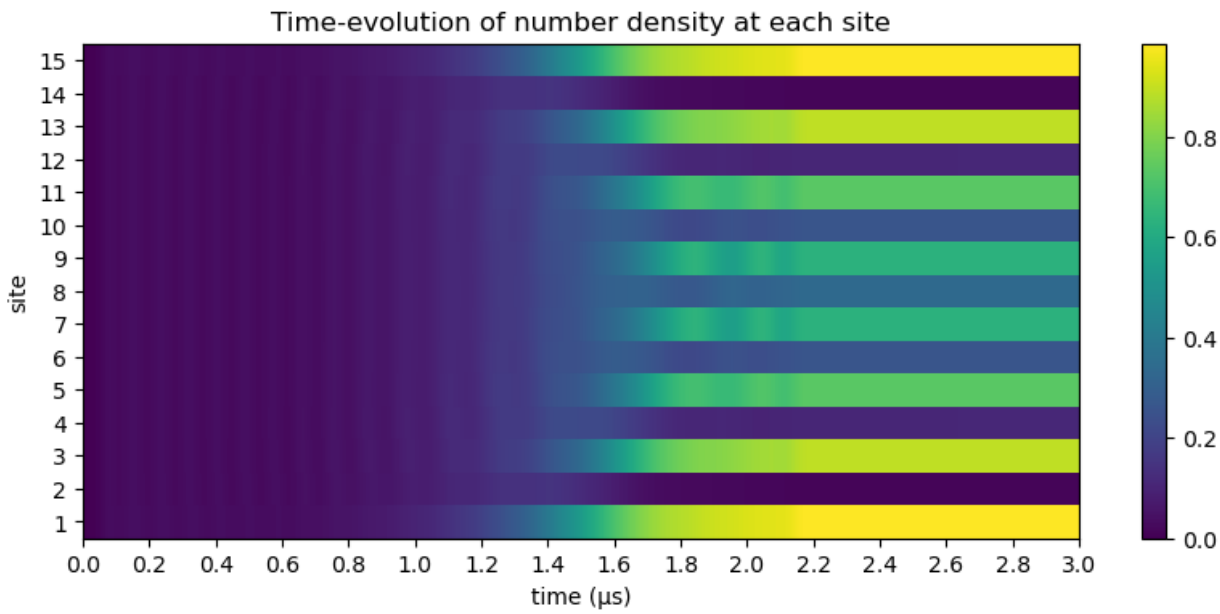
Out[2]:



In [74]:
```julia
nsites = 15
atoms = generate_sites(ChainLattice(), nsites, scale = 5.48);
h = rydberg_h(atoms; Δ, Ω);
reg = zero_state(nsites);
prob = SchrodingerProblem(reg, t_tot, h);
integrator = init(prob, Vern8());
densities = []
for _ in TimeChoiceIterator(integrator, 0.0:1e-3:t_tot)
    push!(densities, rydberg_density(reg))
end
D = hcat(densities...);
```

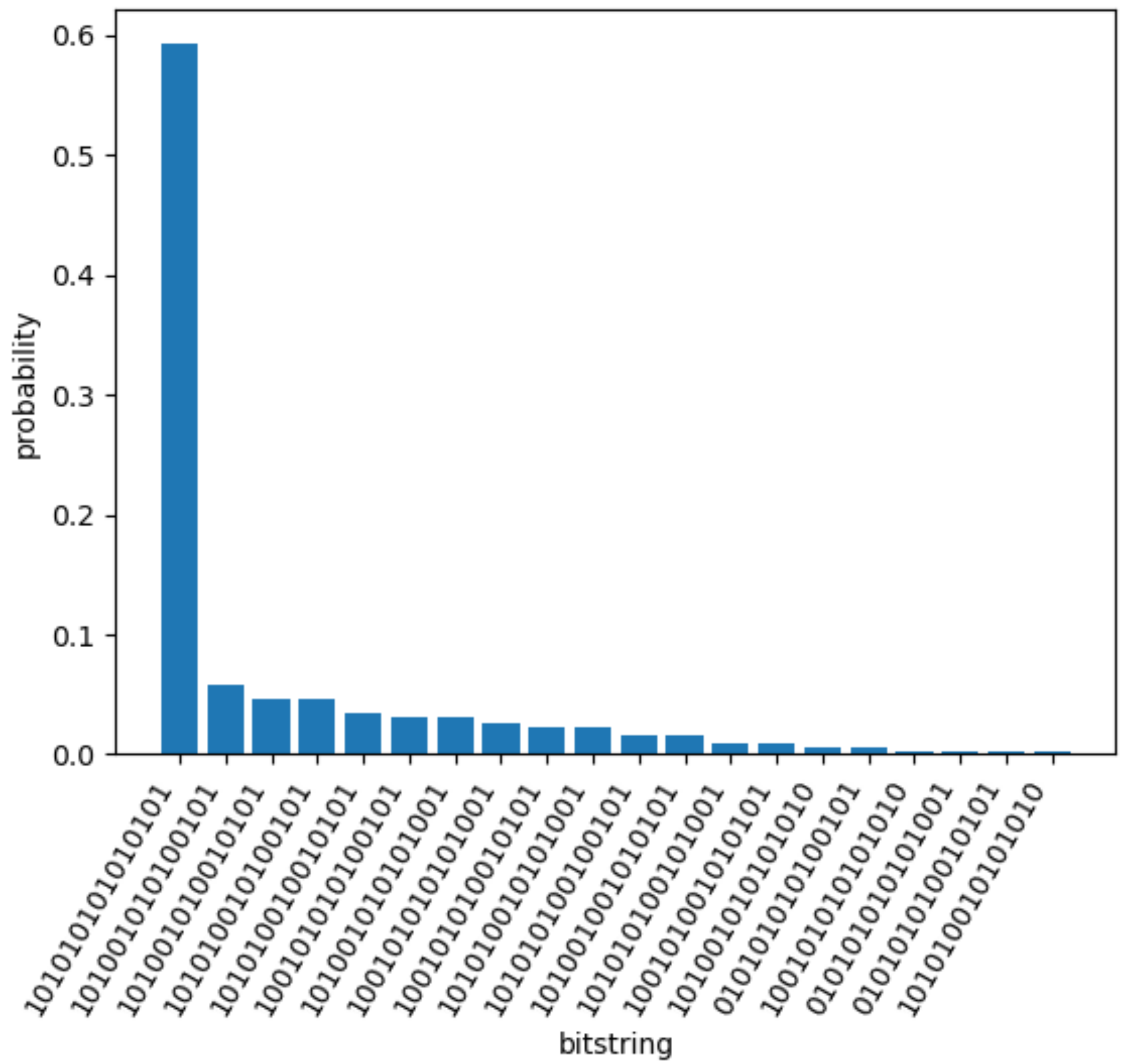
In [75]:
```
fig, ax = plt.subplots(figsize = (10, 4))
shw = ax.imshow(real(D), interpolation = "nearest", aspect = "auto", e
ax.set_title("Time-evolution of number density at each site")
ax.set_xlabel("time (μs)")
ax.set_ylabel("site")
ax.set_xticks(0:0.2:t_tot)
ax.set_yticks(1:nsites)
bar = fig.colorbar(shw)
fig
```

Out[75]:



In [76]:
```
bitstring_hist(reg; nlargest = 20)
```

Out[76]:



In [58]:
```
C6 = 2π*862690;
Rb = (C6/Ω_max)^(1/6);
a = Rb/sqrt(2);
println("Rb = ", Rb)
println("a = ", a)
```

```
Rb = 7.744008044106029
a = 5.475840601550545
```

In [77]:
```
nsites = 15
atoms = generate_sites(ChainLattice(), nsites, scale = 5.48)
```

Out[77]:

In [82]:
```
Rb/1.4
```

Out[82]:
```
5.531434317218593
```

In [92]:
```
space = blockade_subspace(atoms, 5.5)
```

Out[92]:
```
15-qubits 1597-elements Subspace{Int64, Vector{Int64}}:
    1 │ 0
    2 │ 1
    3 │ 2
    ⋮ │ ⋮
 1595 │ 21842
 1596 │ 21844
 1597 │ 21845
```

In [93]:
```
reg = zero_state(space)
```

Out[93]:
```
SubspaceArrayReg{2, ComplexF64, Vector{ComplexF64}, Subspace{Int64, V
ector{Int64}}}(15, ComplexF64[1.0 + 0.0im, 0.0 + 0.0im, 0.0 + 0.0im,
0.0 + 0.0im, 0.0 + 0.0im, 0.0 + 0.0im, 0.0 + 0.0im, 0.0 + 0.0im, 0.0
+ 0.0im, 0.0 + 0.0im  …  0.0 + 0.0im, 0.0 + 0.0im, 0.0 + 0.0im, 0.0 +
0.0im, 0.0 + 0.0im, 0.0 + 0.0im, 0.0 + 0.0im, 0.0 + 0.0im, 0.0 + 0.0i
m, 0.0 + 0.0im], Subspace{Int64, Vector{Int64}}(15, Dict(8232 => 629,
1028 => 148, 16464 => 1017, 17417 => 1138, 17554 => 1176, 1090 => 168
, 5184 => 543, 20994 => 1456, 10528 => 912, 4136 => 396…), [0, 1, 2,
4, 5, 8, 9, 10, 16, 17  …  21828, 21829, 21832, 21833, 21834, 21840,
21841, 21842, 21844, 21845]))
```

In [94]:
```
h = rydberg_h(atoms; Δ, Ω)
```

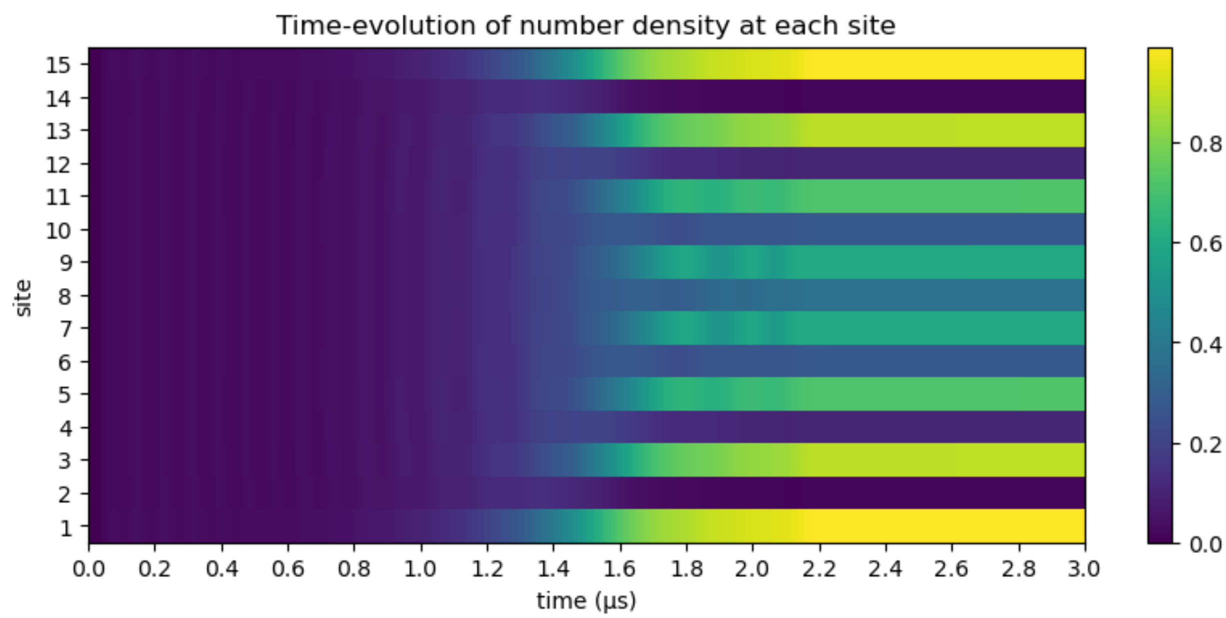
Out[94]:

$$\sum \frac{2\pi \cdot 0.863 \times 10^{6.0}}{|r_i - r_j|^6} n_i n_j + 1 \cdot \Omega(t) \cdot \sum \sigma_i^x - \Delta(t) \cdot \sum n_i$$

In [95]:
```
prob = SchrodingerProblem(reg, t_tot, h);
integrator = init(prob, Vern8());

densities = []
for _ in TimeChoiceIterator(integrator, 0.0:1e-3:t_tot)
    push!(densities, rydberg_density(reg))
end
D = hcat(densities...);
```

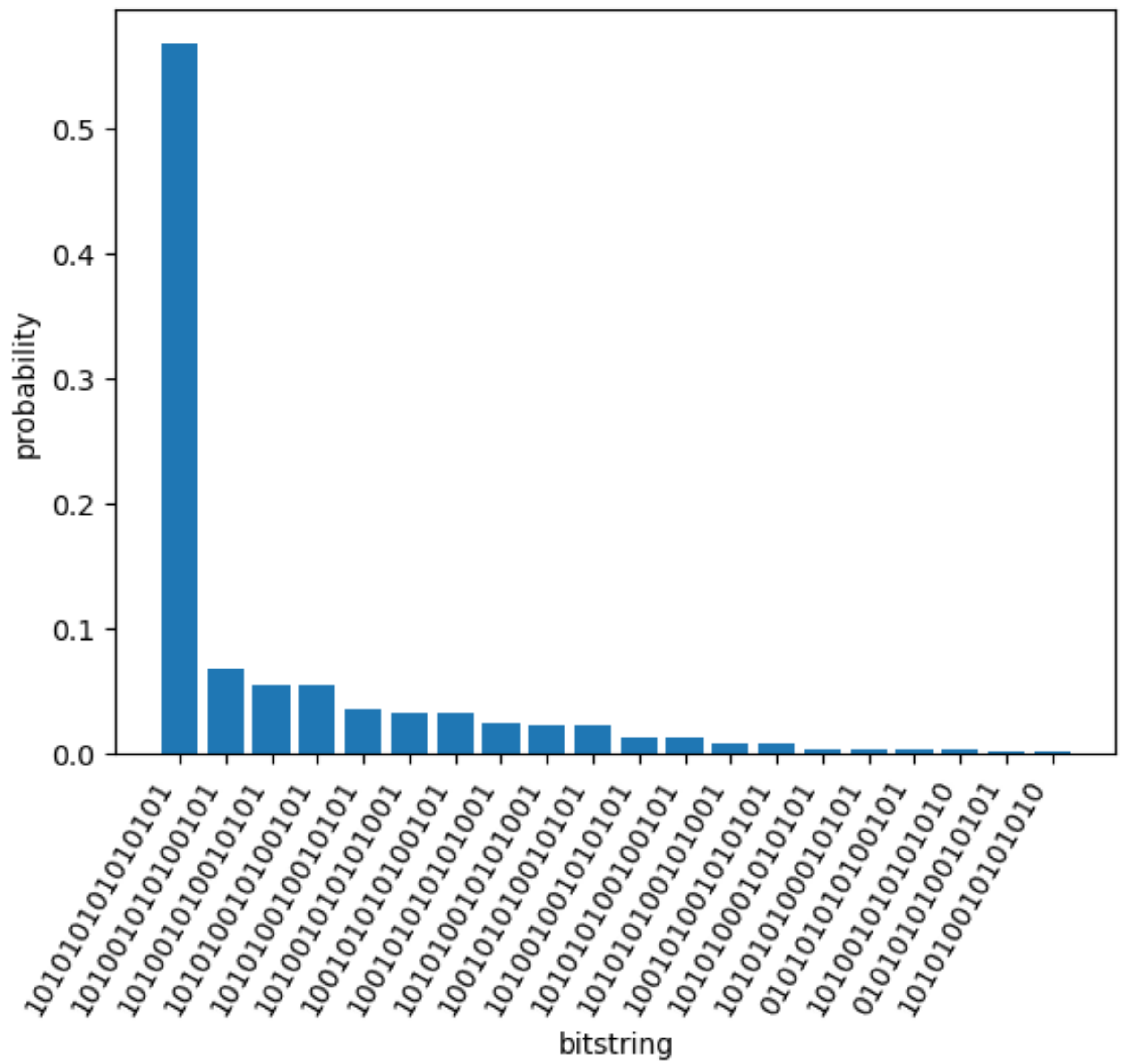
In [96]:
```
fig, ax = plt.subplots(figsize = (10, 4))
shw = ax.imshow(real(D), interpolation = "nearest", aspect = "auto", e
ax.set_title("Time-evolution of number density at each site")
ax.set_xlabel("time (μs)")
ax.set_ylabel("site")
ax.set_xticks(0:0.2:t_tot)
ax.set_yticks(1:nsites)
bar = fig.colorbar(shw)
fig
```

Out[96]:



In [97]:
```
bitstring_hist(prob.reg; nlargest = 20)
```

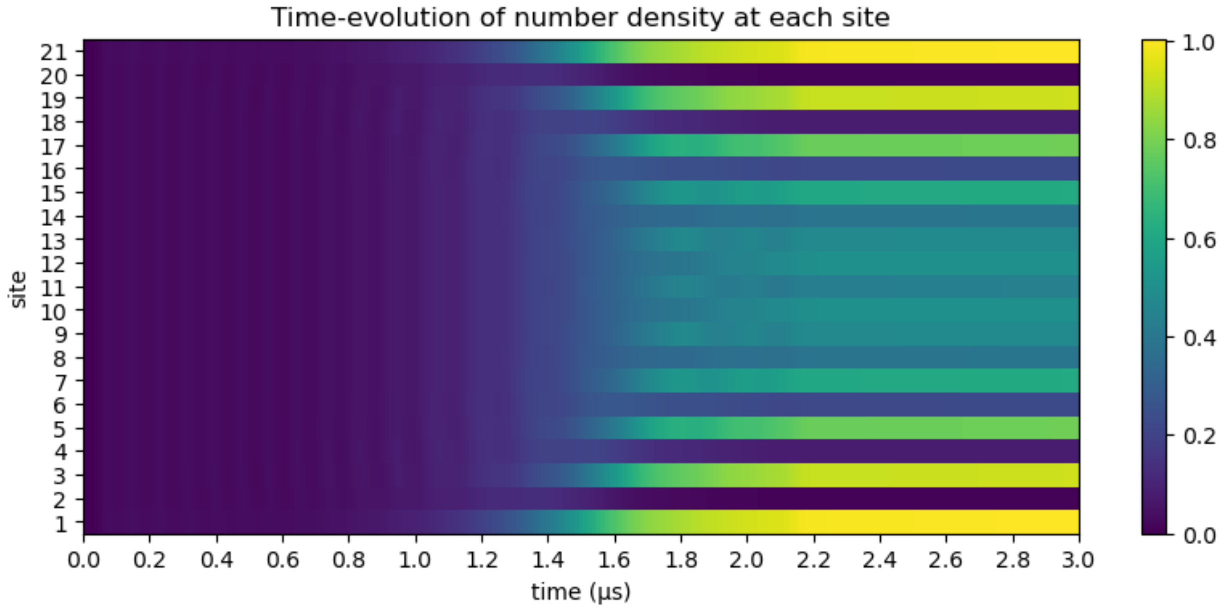
Out[97]:



In [5]:
```
nsites = 21
atoms = generate_sites(ChainLattice(), nsites, scale = 5.48);
space = blockade_subspace(atoms, 5.5);
h = rydberg_h(atoms; Δ, Ω);
reg = zero_state(space);
prob = SchrodingerProblem(reg, t_tot, h);
integrator = init(prob, Vern8());
densities = []
for _ in TimeChoiceIterator(integrator, 0.0:1e-3:t_tot)
    push!(densities, rydberg_density(reg))
end
D = hcat(densities...);
```

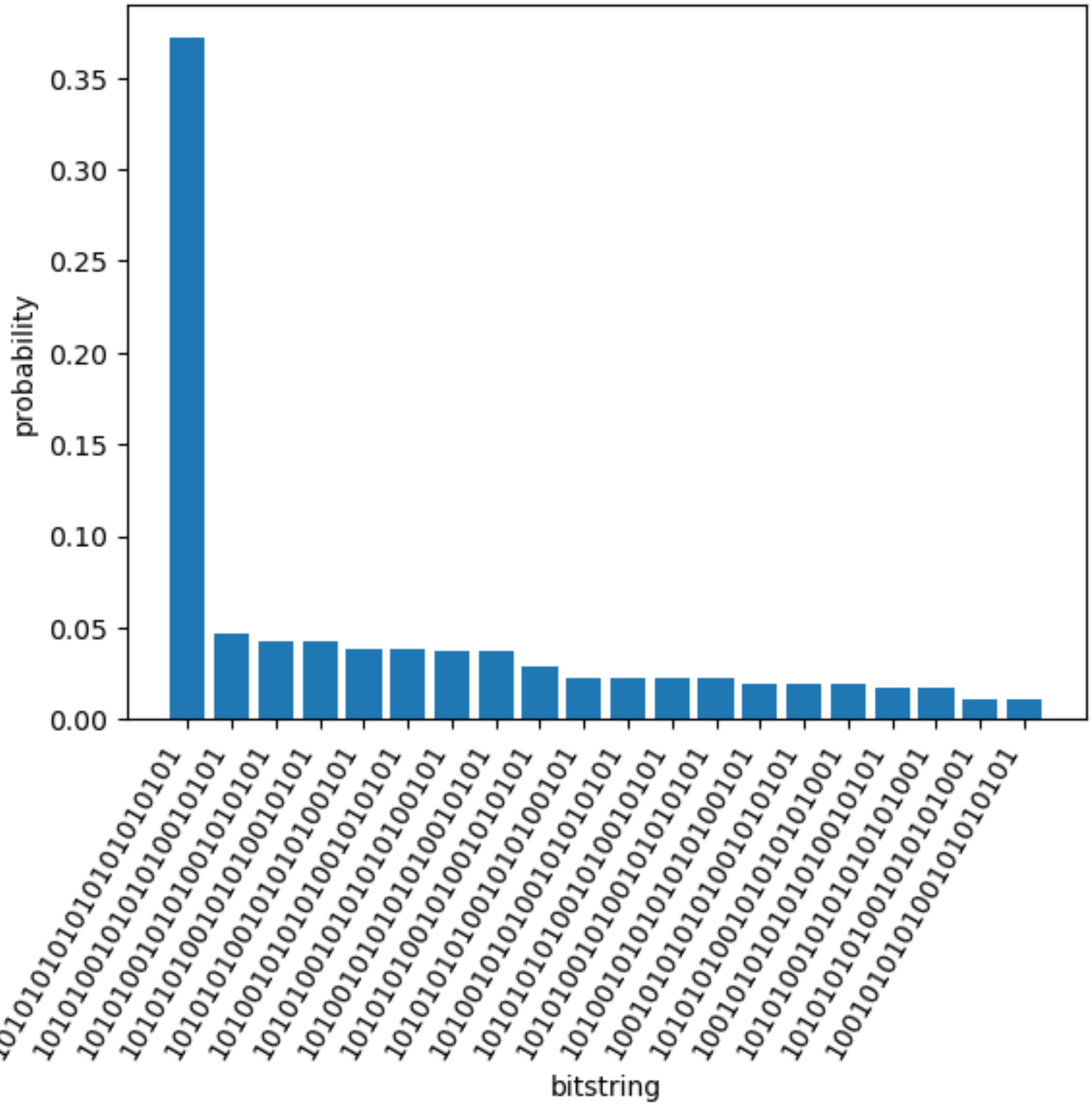
In [6]:
```
fig, ax = plt.subplots(figsize = (10, 4))
shw = ax.imshow(real(D), interpolation = "nearest", aspect = "auto", e
ax.set_title("Time−evolution of number density at each site")
ax.set_xlabel("time (μs)")
ax.set_ylabel("site")
ax.set_xticks(0:0.2:t_tot)
ax.set_yticks(1:nsites)
bar = fig.colorbar(shw)
fig
```

Out[6]:



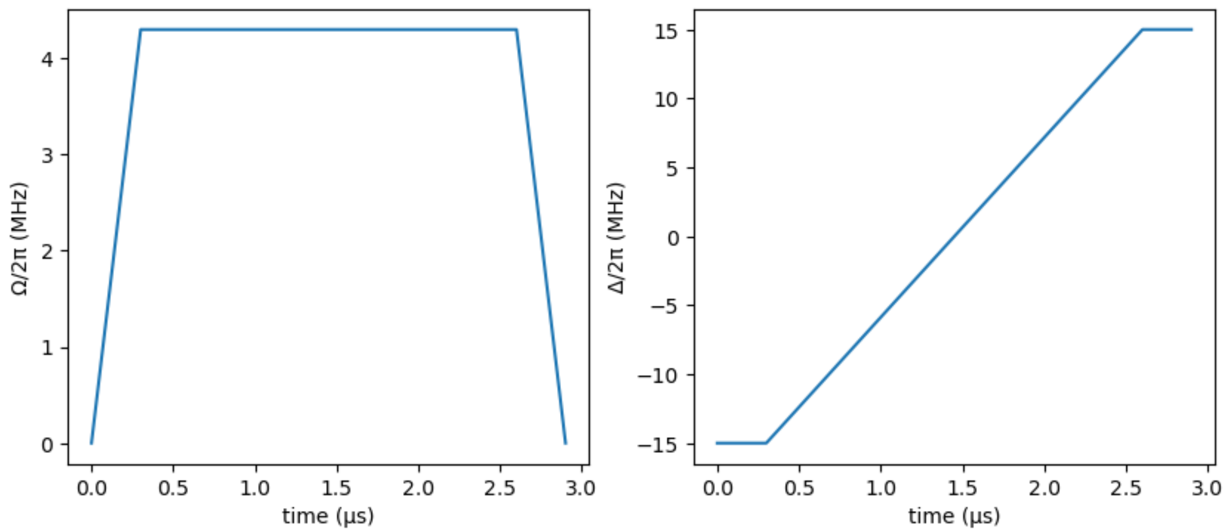
In [7]:
```
bitstring_hist(prob.reg; nlargest = 20)
```

Out[7]:



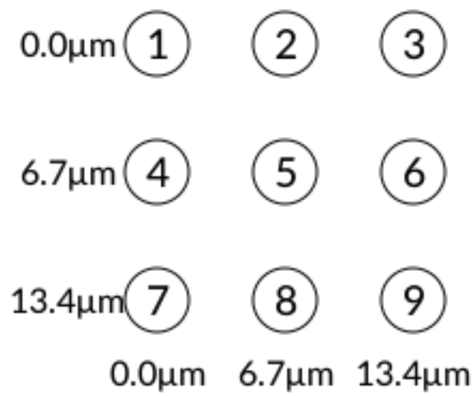
In [3]:
```
total_time = 2.9
Ω_max = 2π * 4.3
Ω = piecewise_linear(clocks = [0.0, 0.3, 2.6, total_time], values = [0
U = 2π * 15.0
Δ = piecewise_linear(clocks = [0.0, 0.3, 2.6, total_time], values = [-

fig, (ax1, ax2) = plt.subplots(ncols = 2, figsize = (10, 4))
Bloqade.plot!(ax1, Ω)
ax1.set_ylabel("Ω/2π (MHz)")
Bloqade.plot!(ax2, Δ)
ax2.set_ylabel("Δ/2π (MHz)")
fig
```

Out[3]:



In [4]:
```
nx, ny = 3, 3
nsites = nx * ny
atoms = generate_sites(SquareLattice(), nx, ny, scale = 6.7)
```

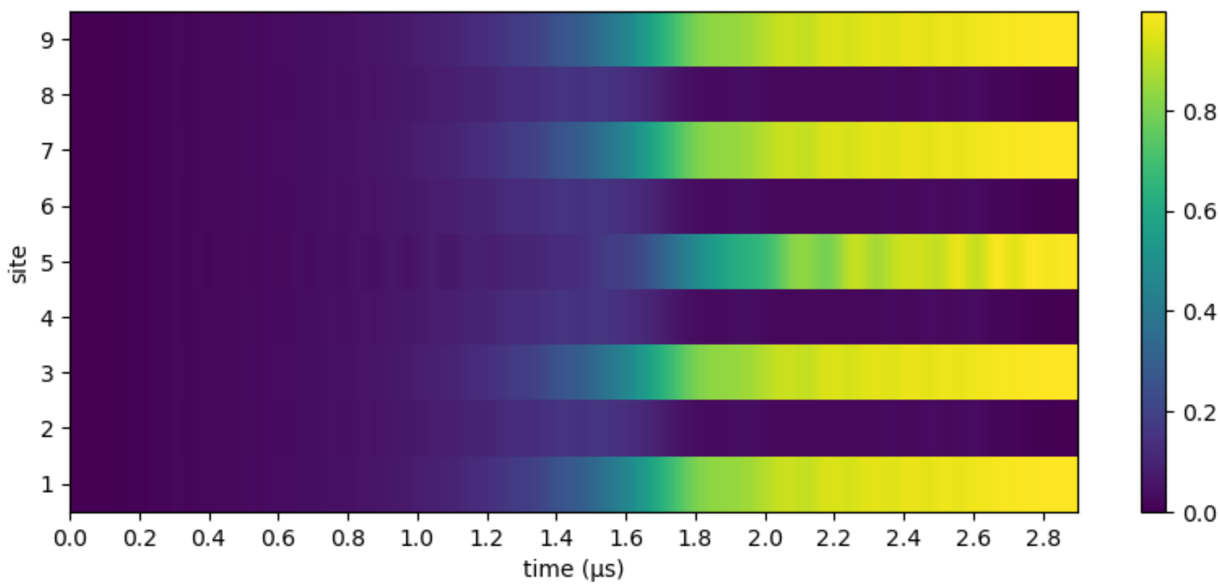
Out[4]:



In [5]:
```
h = rydberg_h(atoms; Δ, Ω)
reg = zero_state(9);
prob = SchrodingerProblem(reg, total_time, h);
integrator = init(prob, Vern8());
```

In [6]:
```
densities = [];
for _ in TimeChoiceIterator(integrator, 0.0:1e-3:total_time)
    push!(densities, rydberg_density(reg))
end
D = hcat(densities...)

fig, ax = plt.subplots(figsize = (10, 4))
shw = ax.imshow(real(D), interpolation = "nearest", aspect = "auto", e
ax.set_xlabel("time (μs)")
ax.set_ylabel("site")
ax.set_xticks(0:0.2:total_time)
ax.set_yticks(1:nsites)
bar = fig.colorbar(shw)
fig
```

Out[6]:

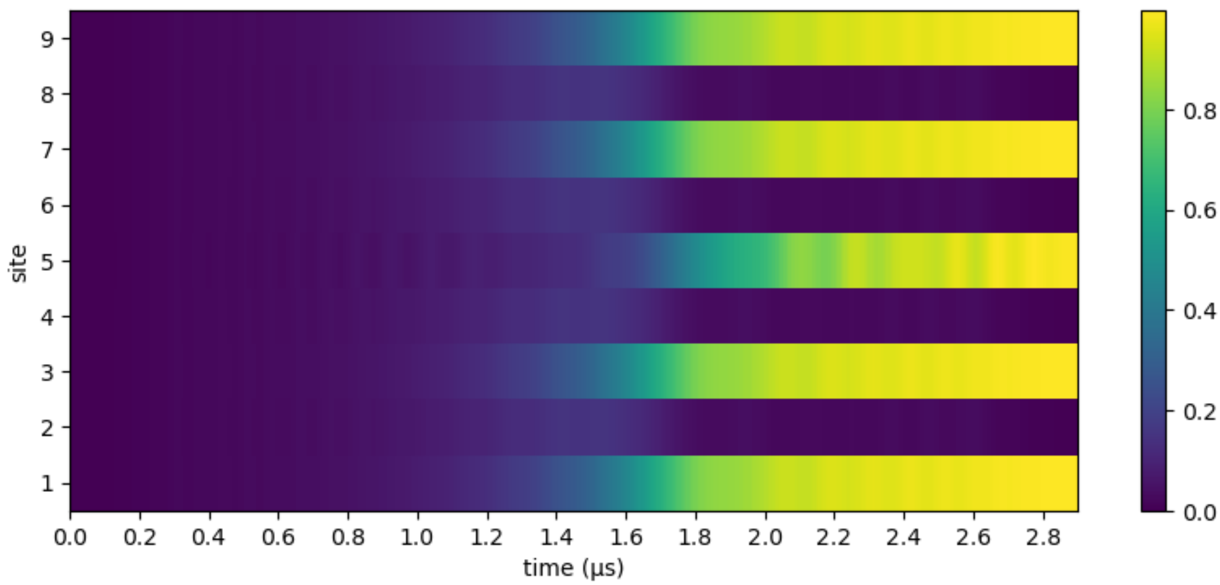


In [4]:
```
function den_sq(nx, ny)
    nsites = nx * ny
    atoms = generate_sites(SquareLattice(), nx, ny, scale = 6.7)
    h = rydberg_h(atoms; Δ, Ω)
    reg = zero_state(nsites);
    prob = SchrodingerProblem(reg, total_time, h);
    integrator = init(prob, Vern8());
    densities = [];
    for _ in TimeChoiceIterator(integrator, 0.0:1e-3:total_time)
        push!(densities, rydberg_density(reg))
    end
    D = hcat(densities...)
    return D, reg
end
```

Out[4]:
```
den_sq (generic function with 1 method)
```

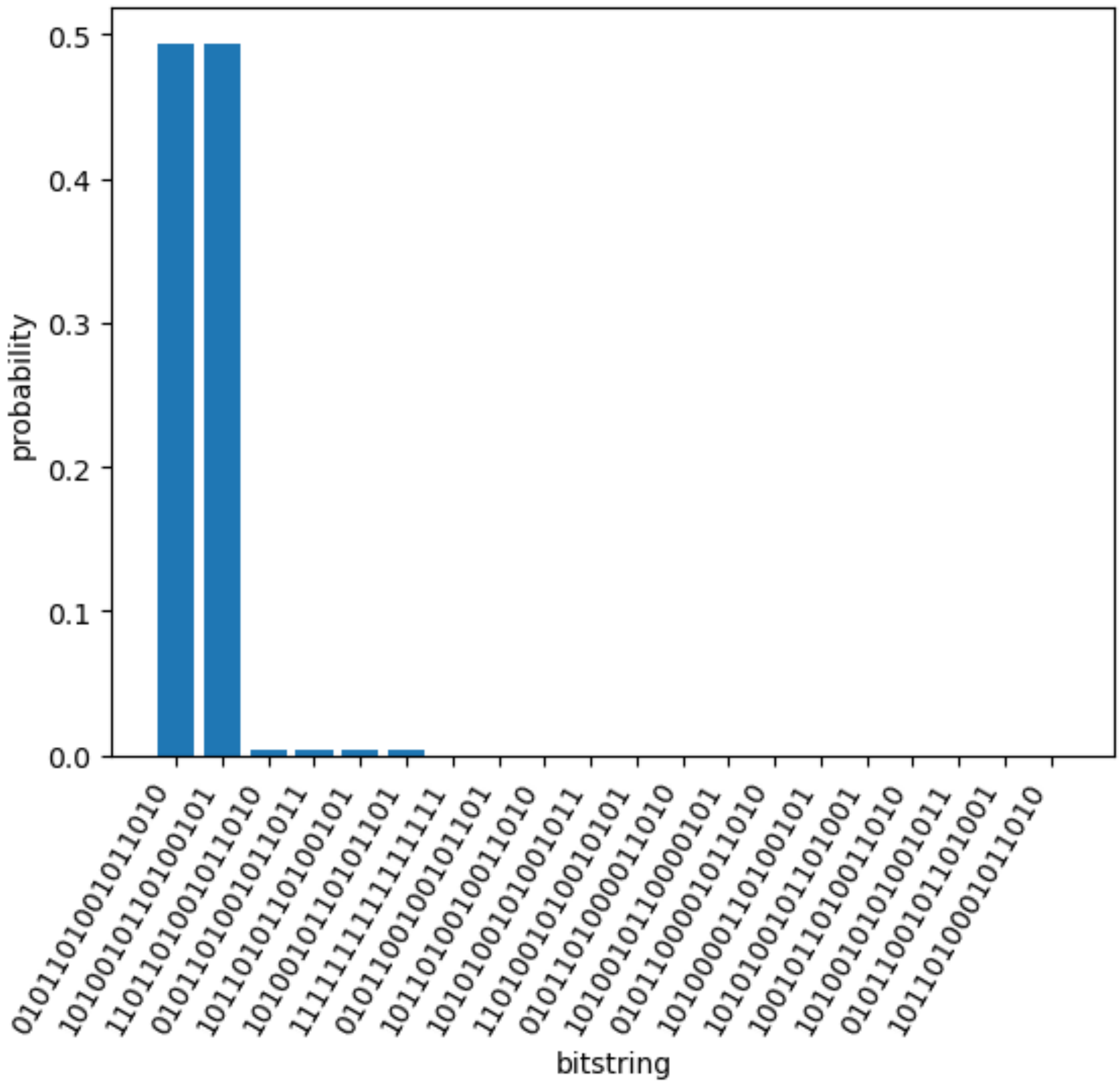
In [13]:
```
dens, reg = den_sq(4,4);

fig, ax = plt.subplots(figsize = (10, 4))
shw = ax.imshow(real(D), interpolation = "nearest", aspect = "auto", e
ax.set_xlabel("time (μs)")
ax.set_ylabel("site")
ax.set_xticks(0:0.2:total_time)
ax.set_yticks(1:nsites)
bar = fig.colorbar(shw)
fig
```

Out[13]:



In [14]:
```
bitstring_hist(reg; nlargest = 20)
```

Out[14]:



In [15]:
```
measure(reg)[]
```

Out[15]:
```
1010010110100101 ₍₂₎
```

In [ ]:
```
dens, reg = den_sq(5,5);

fig, ax = plt.subplots(figsize = (10, 4))
shw = ax.imshow(real(D), interpolation = "nearest", aspect = "auto", e
ax.set_xlabel("time (μs)")
ax.set_ylabel("site")
ax.set_xticks(0:0.2:total_time)
ax.set_yticks(1:nsites)
bar = fig.colorbar(shw)
fig
```

In [ ]:
```

```