Homework 04

Phase velocity and the group velocity polar plots

Plot the phase velocity and the group velocity polar plots for $C_S = 0.25C_A$ and $C_S = 4C_A$.

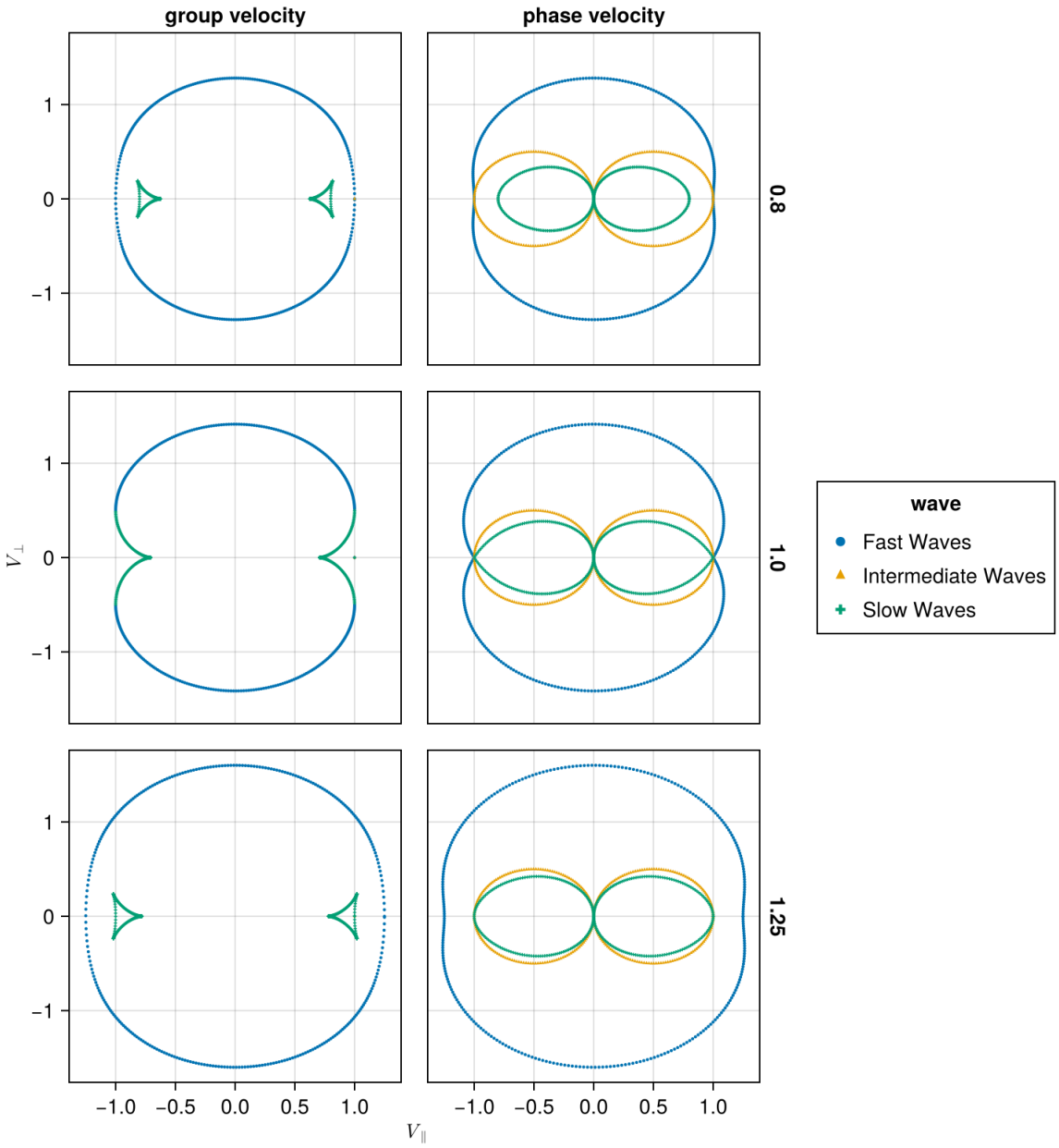
```
include("main.jl")
using AlgebraOfGraphics
using CairoMakie
```

```
dfs = [0.8, 1, 1.25] .|> VpVg_fastandslow_df
df = vcat(dfs...);
```

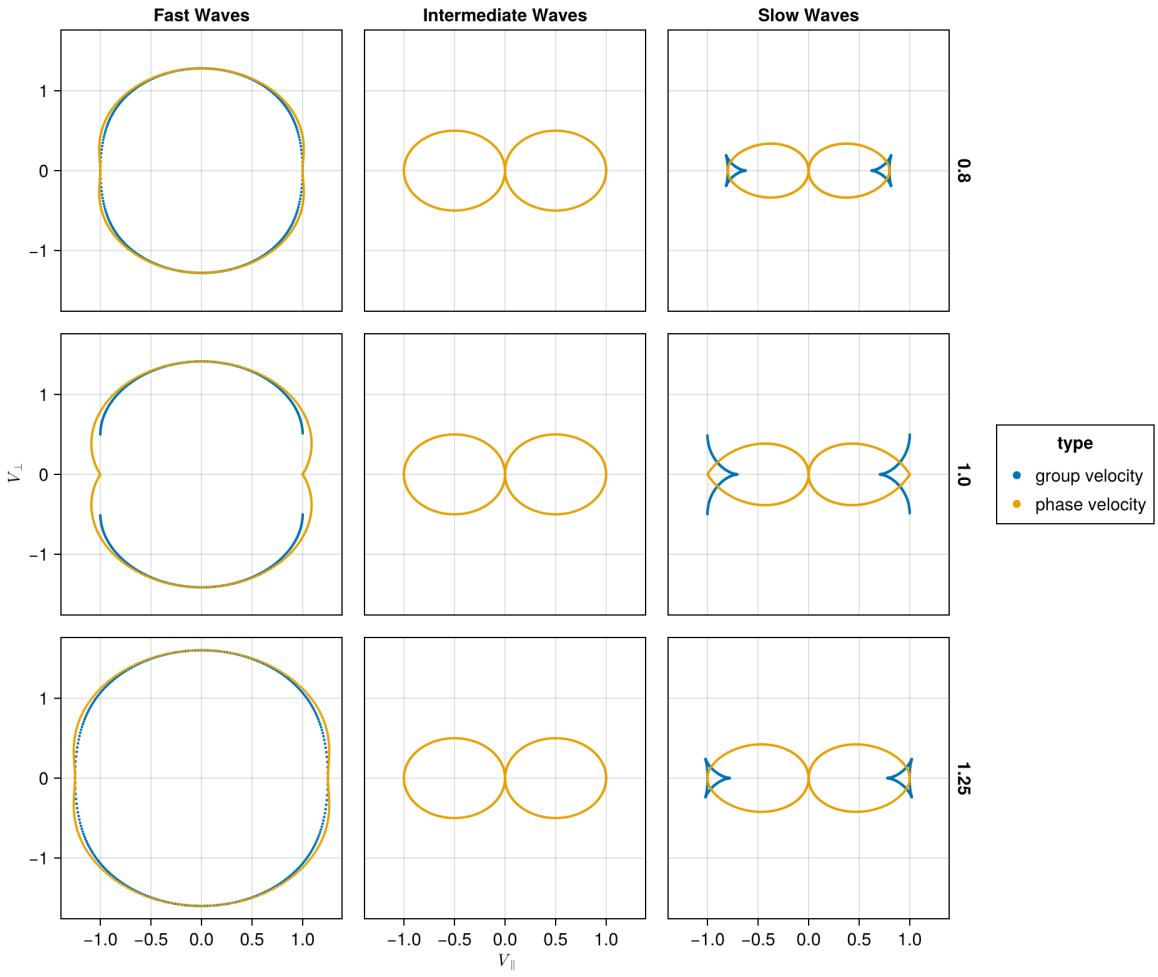
```
axis = (width = 225, height = 225)

base_map = data(df) * mapping(
    :v_parp => L"V_{\parallel}",
    :v_perp => L"V_{\perp}",
) * visual(Scatter, markersize = 3);
```

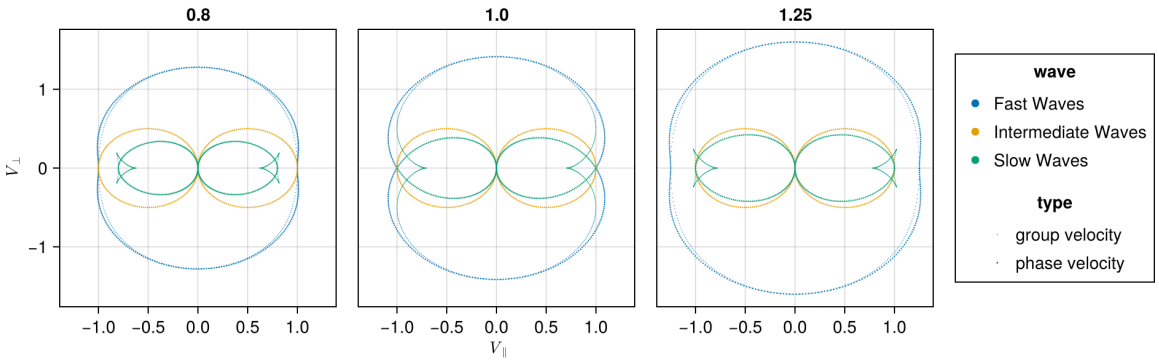
```
plt=  base_map * mapping(color=:wave, marker=:wave, row=:cs=>nonnumeric, col=:type)
fg = draw(plt,axis=axis)
save("mhd_waves_1.png", fg)
fg
```



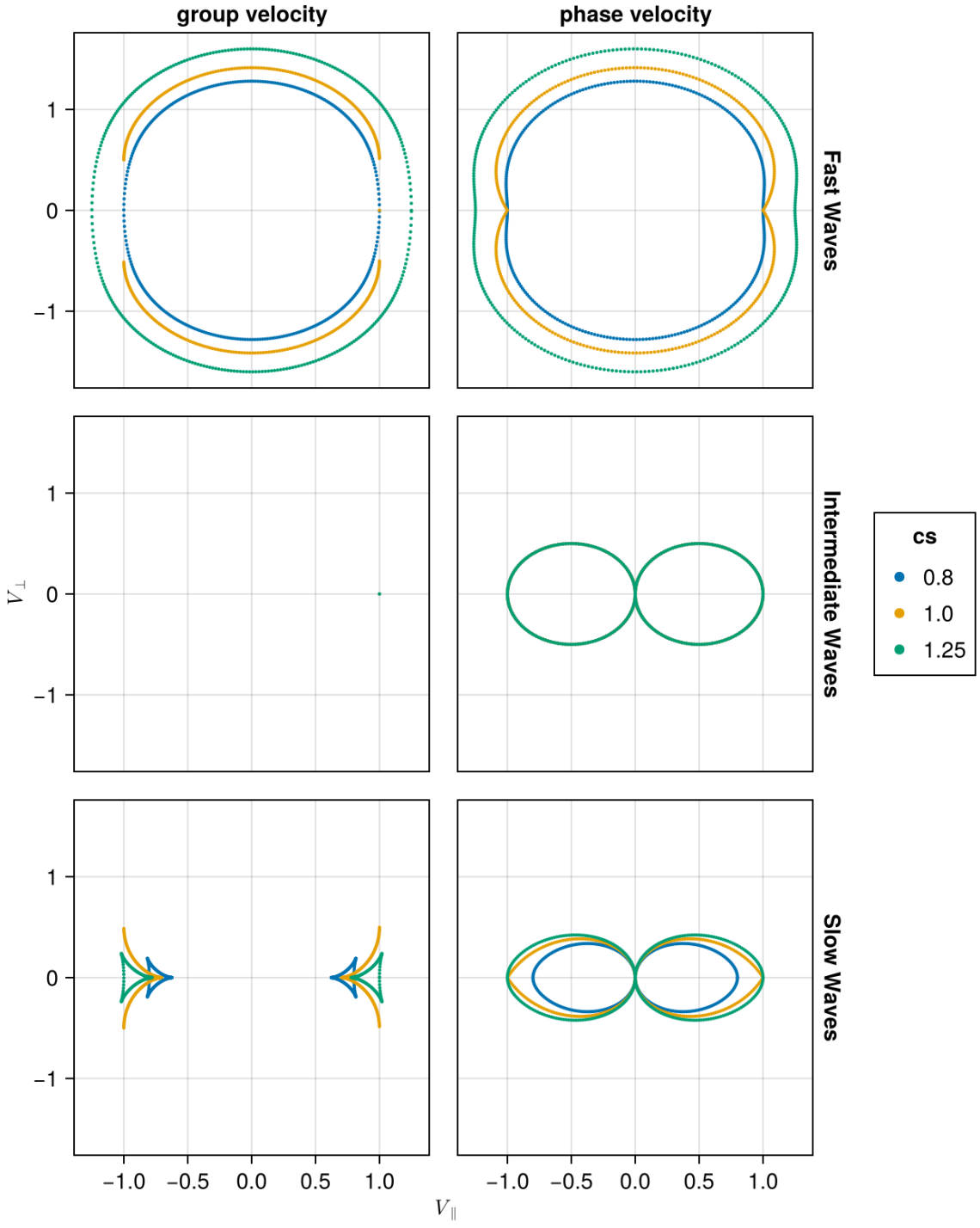

```
plt = base_map * mapping(col=:wave,row=:cs=>nonnumeric,color=:type)
fg = draw(plt, axis=axis)
save("mhd_waves_2.png", fg)
fg
```




```
plt = base_map * mapping(color=:wave, marker=:type, markersize=:type, col=:cs=>nonnumeric)
fg = draw(plt, axis=axis)
save("mhd_waves_4.png", fg)
fg
```




```
plt = base_map * mapping(row=:wave,color=:cs=>nonnumeric,col=:type)
fg = draw(plt, axis=axis)
save("mhd_waves_3.png", fg)
fg
```


group velocity
phase velocity
Fast Waves
Intermediate Waves
Slow Waves
cs
0.8
1.0
1.25
1
0
−1
−1.0
−0.5
0.0
0.5
1.0
$V_\perp$
$V_\parallel$

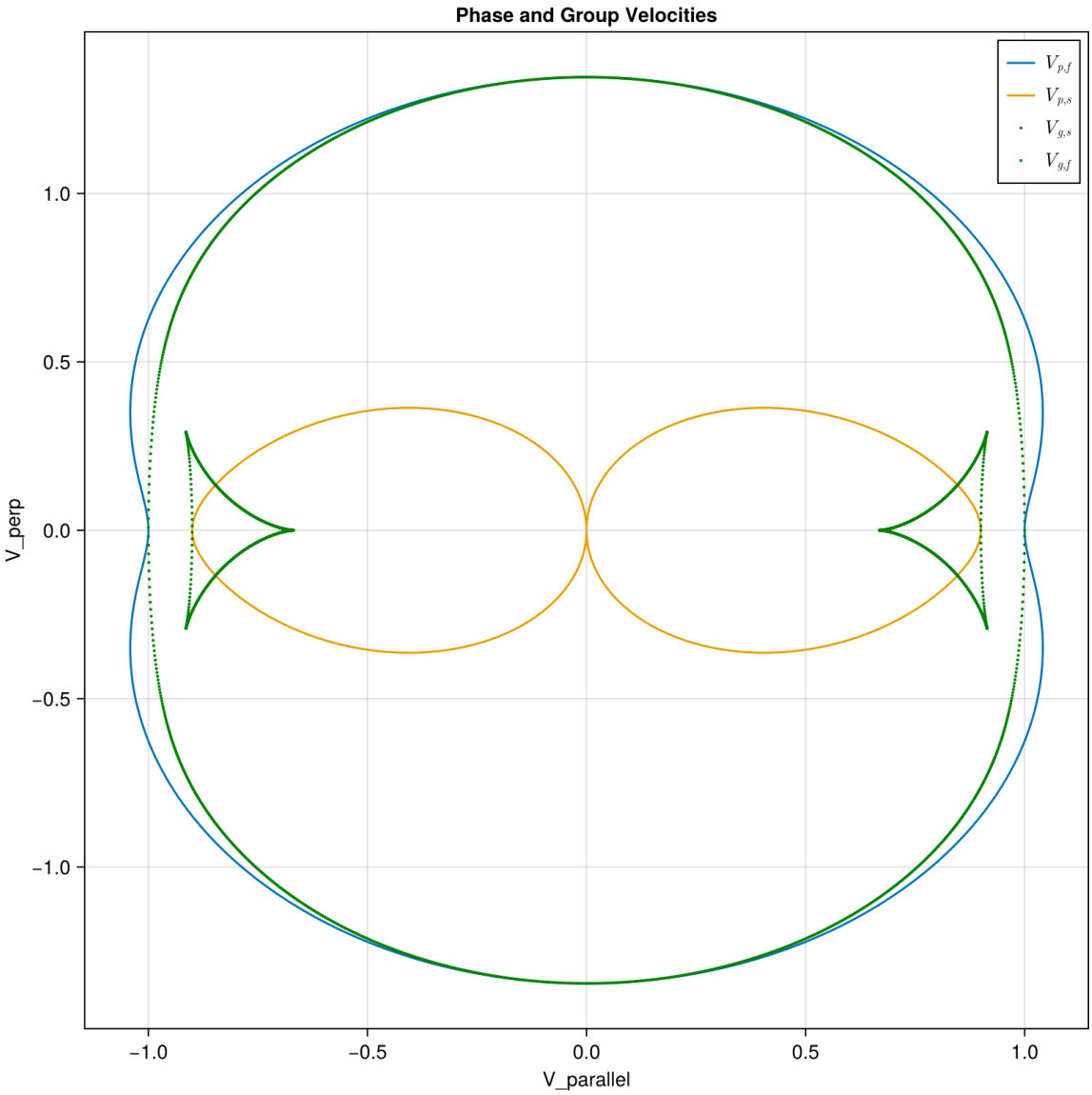
```
ca = 1.0

function plot(cs)
     s = 0:0.005:2

    fig = Figure(size = (800, 800))
    ax = Axis(fig[1, 1], title = "Phase and Group Velocities", xlabel = "V_parallel", ylabel

    Vps, Vpf, Vgs_perp, Vgs_para, Vgf_perp, Vgf_para = calc_VpVg_fastandslow(cs, ca)
    lines!(Vpf .* cos.( s), Vpf .* sin.( s), label = L"V_{p,f}")
    lines!(Vps .* cos.( s), Vps .* sin.( s), label = L"V_{p,s}")
    scatter!(Vgs_para, Vgs_perp, markersize = 3, color = :green, label = L"V_{g,s}")
    scatter!(Vgf_para, Vgf_perp, markersize = 3, color = :green, label = L"V_{g,f}")
    axislegend()
    return fig
end

plot(0.9)
```


Phase and Group Velocities
$V_{p,f}$
$V_{p,s}$
$V_{g,s}$
$V_{g,f}$
1.0
0.5
0.0
−0.5
−1.0
V_perp
−1.0
−0.5
0.0
0.5
1.0
V_parallel