

先進プラズマ理工学 report 2023/4/26

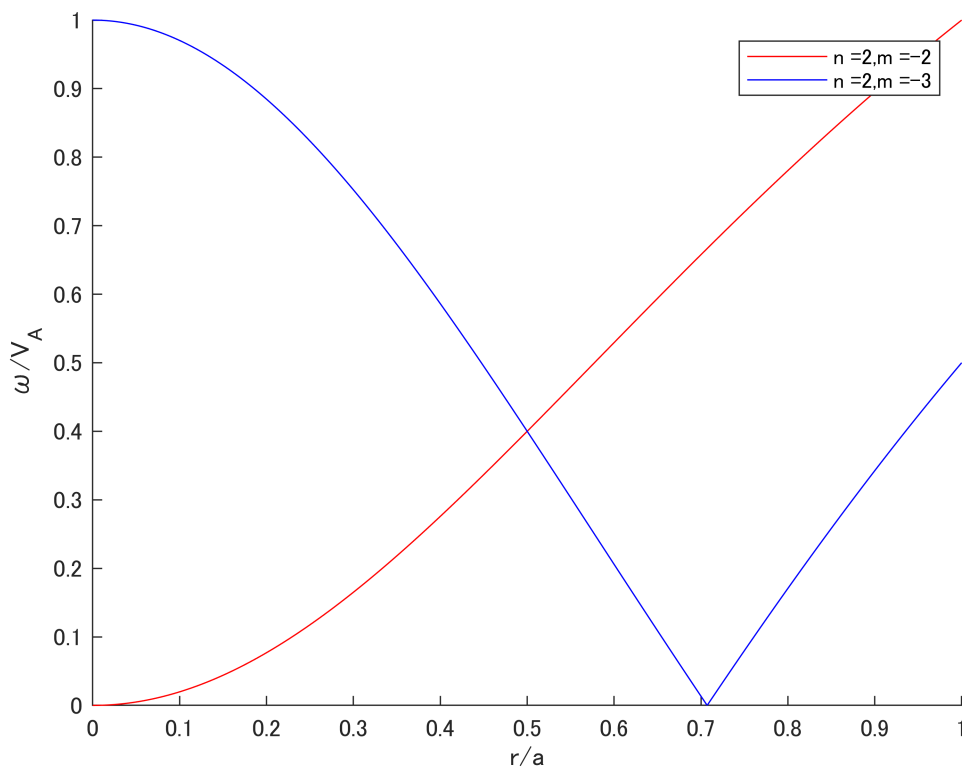
```
clear all;

%パラメータ設定
r = linspace(0,0.25,1000);
a = 0.25;
x = r./a;
R0 = 1;
n = 2;
m1 = -2;
m2 = -3;
```

(1) 円柱近似トカマク中のアルヴェン共鳴周波数

```
km1 = alfven_resonance_freq(n,m1,r,a,R0);
km2 = alfven_resonance_freq(n,m2,r,a,R0);

figure;
hold on
plot(x, km1, 'r');
plot(x, km2, 'b');
%xlim([0,1]);
xlabel('r/a');
ylabel('ω/V_A');
legend(strcat('n = ', num2str(n), ', ', ' ', 'm = ', num2str(m1)), ...
       strcat('n = ', num2str(n), ', ', ' ', 'm = ', num2str(m2)));
hold off
```



(2) トロイダル効果を導入した場合のアルヴェン共鳴周波数

```
[p_y1,n_y1] = alfven_resonance_freq_toroidal(n,m1,r,a,R0);
[p_y2,n_y2] = alfven_resonance_freq_toroidal(n,m2,r,a,R0);

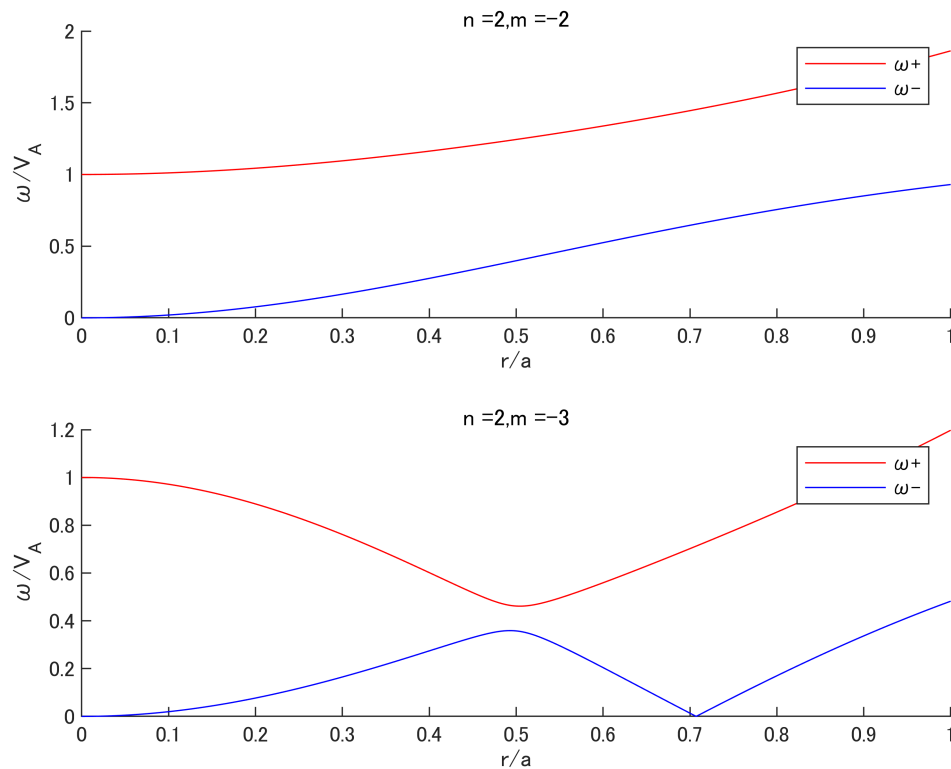
figure;
subplot(2,1,1);
hold on
plot(x, p_y1,'r');
plot(x, n_y1,'b');
%xlim([0,1]);
xlabel('r/a');
ylabel('ω/V_A');
legend('ω+', 'ω-');
title(strcat('n = ', num2str(n), ', ', ' ', 'm = ', num2str(m1)));
hold off

subplot(2,1,2);
hold on
plot(x, p_y2,'r');
plot(x, n_y2,'b');
%xlim([0,1]);
xlabel('r/a');
ylabel('ω/V_A');
```

```

legend('ω+', 'ω-');
title(strcat('n = ', num2str(n), ', ', 'm = ', num2str(m2)));
hold off

```



(3) $r/R_0 \rightarrow 0$

```

clearvars -except a x n m1 m2
r = linspace(0,0.25,1000);
R0 = 10000000;

[p_y1,n_y1] = alfven_resonance_freq_toroidal(n,m1,r,a,R0);
[p_y2,n_y2] = alfven_resonance_freq_toroidal(n,m1,r,a,R0);
figure;
subplot(2,1,1);
hold on
plot(x, p_y1, 'r');
plot(x, n_y1, 'b');
xlabel('r/a');
ylabel('ω/V_A');
legend('ω+', 'ω-');
title(strcat('n = ', num2str(n), ', ', 'm = ', num2str(m1)));
hold off

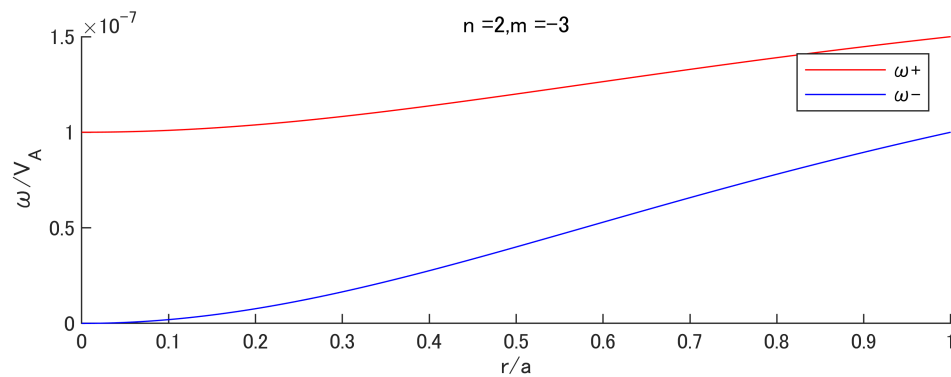
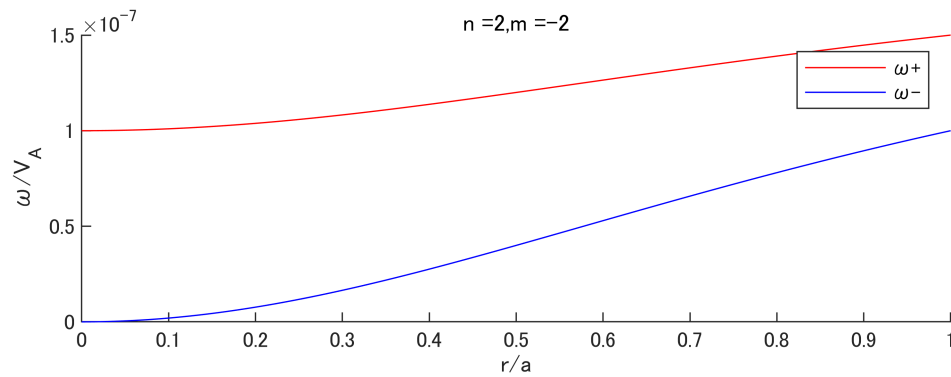
subplot(2,1,2);
hold on

```

```

plot(x, p_y2, 'r');
plot(x, n_y2, 'b');
xlabel('r/a');
ylabel('ω/V_A');
legend('ω+', 'ω-');
title(strcat('n = ', num2str(n), ', ', 'm = ', num2str(m2)));
hold off

```



```
clear all;
```

```
%パラメータ設定
```

```

r = linspace(0,0.25,1000);
a = 0.25;
x = r./a;
R0 = 1;

```

```

% function check
% alfvén_resonance_freq

```

```

n = 1;
m1 = 1;
m2 = 2;
m_1 = -1;
m_2 = -2;

```

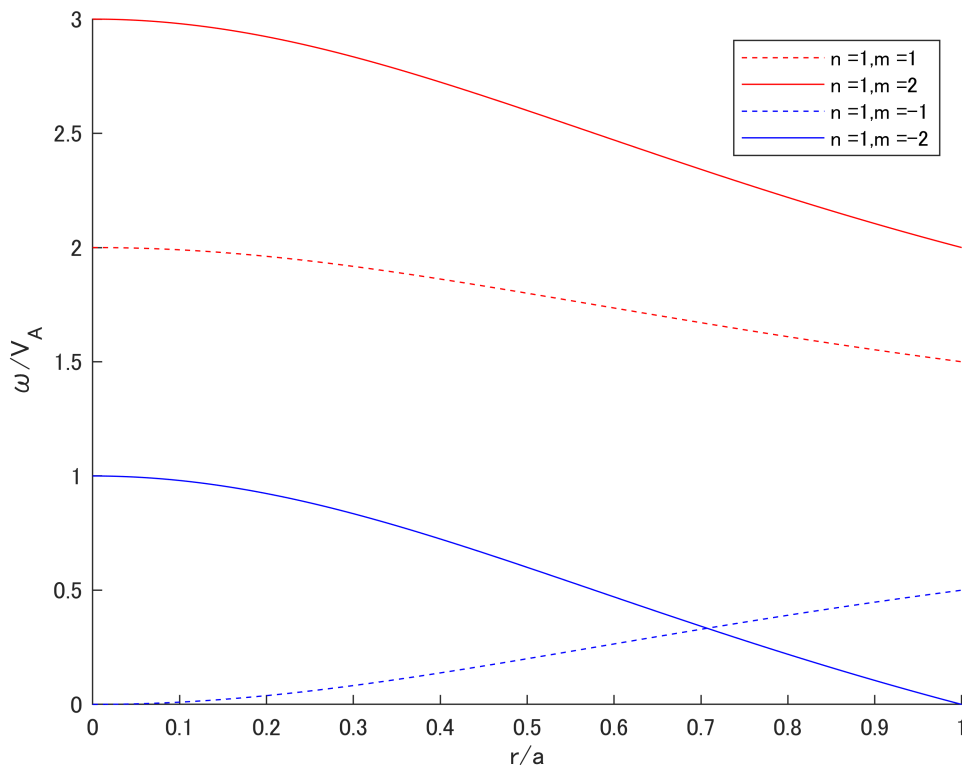
```

km1 = alfven_resonance_freq(n,m1,r,a,R0);
km2 = alfven_resonance_freq(n,m2,r,a,R0);
km_1 = alfven_resonance_freq(n,m_1,r,a,R0);
km_2 = alfven_resonance_freq(n,m_2,r,a,R0);

figure;
hold on
plot(x, km1,'r--');
plot(x, km2,'r');
plot(x, km_1,'b--');
plot(x, km_2,'b');

xlabel('r/a');
ylabel('ω/V_A');
legend(strcat('n = ', num2str(n), ', ', 'm = ', num2str(m1)), ...
      strcat('n = ', num2str(n), ', ', 'm = ', num2str(m2)), ...
      strcat('n = ', num2str(n), ', ', 'm = ', num2str(m_1)), ...
      strcat('n = ', num2str(n), ', ', 'm = ', num2str(m_2)));
hold off

```



```

% function check
% alfven_resonance_freq_toroidal

```

```

[p_y1,n_y1] = alfven_resonance_freq_toroidal(n,m_1,r,a,R0);

```

```

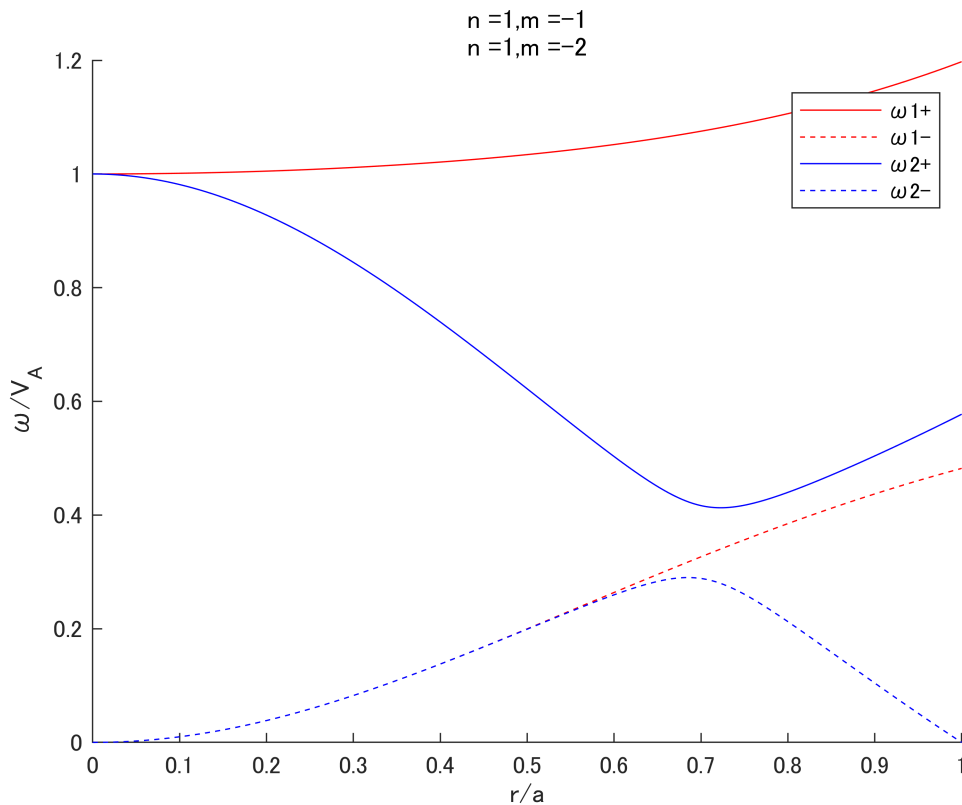
[p_y2,n_y2] = alfven_resonance_freq_toroidal(n,m_2,r,a,R0);

figure;

hold on
plot(x, p_y1,'r');
plot(x, n_y1,'r--');
plot(x, p_y2,'b');
plot(x, n_y2,'b--');

xlabel('r/a');
ylabel('ω/V_A');
legend('ω1+', 'ω1-', 'ω2+', 'ω2-');
title(strcat('n = ', num2str(n), ', ', 'm = ', num2str(m_1)), ...
      strcat('n = ', num2str(n), ', ', 'm = ', num2str(m_2)));
hold off

```



```

function km = alfven_resonance_freq(n,m,r_array,a,R0)
% 定数
x_array = r_array./a;
q = 1+x_array.^2;
km = sqrt((R0.^-2)*(n + m./q).^2);

end

```

```

function [p_y, n_y] = alfven_resonance_freq_toroidal(n,m,r_array,a,R0)
% 定数
km = alfven_resonance_freq(n,m,r_array,a,R0);
km1 = alfven_resonance_freq(n,m+1,r_array,a,R0);

sq_km = km.*km;
sq_km1 = km1.*km1;

sq_x = (2.*r_array./R0).^2;

p = sq_km+sq_km1 + sqrt((sq_km-sq_km1).^2 + 4.*sq_km.*sq_km1.*sq_x);
n = sq_km+sq_km1 - sqrt((sq_km-sq_km1).^2 + 4.*sq_km.*sq_km1.*sq_x);
under = 2.*(1-sq_x);

p_y = sqrt(p./under);
n_y = sqrt(n./under);
clearvars -except p_y n_y;
end

```