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% This program integrates the 1-D Schrodinger equation for a
% specified initial wave function and static potential.
%
% J. Peatross
%
% Number of spatial points on grid
nmax=2048;
% Width of grid in units of Bohr radii
xWidth=300;
dx=xWidth/nmax;
x=-dx*(nmax/2):dx:dx*(nmax/2-1);
% Potential in units of hBar^2/(mass*(Bohr radius)^2)
V=(x/100).^2;
% Initial wave function
psi=exp(-.0071*(x+0).^2+i*.5*x);
% Number of time steps
nsteps=1000;
% Integration time in units of mass*(Bohr radius)^2/hBar
tmax=500;
dt=tmax/nsteps;
% Number of frames displayed
frames=100;
nframe=round(nsteps/frames);
% Integrate Schrodinger equation using FFT method
dnu=1/(dx*nmax);
nu=-dnu*(nmax/2):dnu:dnu*(nmax/2-1);
nu=fftshift(nu);
for n=0:nsteps;
    if rem(n,nframe)==0
        plot(x,real(psi),'g', x,imag(psi),'y',x,(abs(psi)).^2,'b',x,V,'r')
        ylim([-1 1])
        xlabel('x')
        ylabel('|psi|^2 (blue), Re{psi} (green), Im{psi} (yellow), V (red)')
        text(-.8*xWidth/2,.75, strcat('t =', num2str(n*dt)))
        drawnow
    end
    psi=psi.*exp(-i*dt*V);
    psi2=fft(psi);
    psi2=psi2.*exp(-i*dt/2*(2*pi*nu).^2);
    psi=ifft(psi2);
end

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