

Title: 13/14 PSI - Explorations in Condensed Matter - Lecture 3

Date: Mar 19, 2014 10:15 AM

URL: <http://pirsa.org/14040024>

Abstract:

The image shows the MATLAB R2013b desktop environment. The interface includes a top toolbar with tabs for HOME, PLOTS, and APPS. Below the toolbar is a ribbon with various functions grouped into FILE, VARIABLE, CODE, ENVIRONMENT, and RESOURCES. The main workspace is divided into three panes:

- Current Folder:** Displays a list of files and folders in the current directory. The files include:
 - PSI 2014 Session I TEST
 - ABChiNew10.mat
 - Analysis.m
 - breakT.m
 - breakT2.m
 - buildNewTensor.m
 - buildNewTensorExact.m
 - CompressMN.m
 - ComputeScalingDimensions.m
 - Contractor.m
 - DeltaSIIsingN6Chi26.eps
 - DeltaSIIsingN6Chi26.fig
 - eigApprox.m
 - ErrorsIsingN6Chi26.eps
 - ErrorsIsingN6Chi26.fig
 - ErrorsIsingN6Chi32.eps
 - ErrorsIsingN6Chi32.fig
 - ExDiagT.m
 - findContractor.m
 - hs_err_pid1264.log
 - invert.m
 - invertD.m
 - Ising.m
 - Ising2x2Chi4.mat
 - Ising2x2Chi4Isotropic.mat
 - Ising3x3Chi8Isotropic.mat
 - Ising3x3Chi18Isotropic.mat
- Command Window:** Shows the MATLAB command prompt. The current command is `v = rand(4,1)`, which has been executed. The output is displayed as a column vector:


```
v =
    0.8147
    0.9058
    0.1270
    0.9134
```
- Workspace:** Displays the current workspace variables. The variable `v` is listed with its value: `[0.8147;0.9058;0.1270;0.9134]`.

The Command History pane at the bottom right shows the sequence of commands entered, including `EV`, `U*EV*U'`, `H`, `U*EV*U'`, `U*EV*U'-H`, `norm(ans)`, `Basics`, `IsingN3`, and the current command `v = rand(4,1)`.

LECTURE 2

Matlab session I: quantum spin chains, exact diagonalization

$$V = \begin{pmatrix} \cdot \\ \cdot \\ \cdot \\ \cdot \end{pmatrix}$$

$$V^+ \cdot V = \begin{pmatrix} & \\ & \\ & \\ & \end{pmatrix}$$

$$V \cdot V^+ = \begin{pmatrix} & \\ & \\ & \\ & \end{pmatrix}$$

LECTURE 2

Matlab session I: quantum spin chains, exact diagonalization

$$V = \begin{pmatrix} \cdot \\ \cdot \\ \cdot \\ \cdot \end{pmatrix}$$

$$V^+ V = \begin{pmatrix} & & & \end{pmatrix} \begin{pmatrix} \\ \\ \\ \end{pmatrix} = \#$$

$$V V^+ = \begin{pmatrix} & & & \end{pmatrix} \begin{pmatrix} \\ \\ \\ \end{pmatrix} = \begin{pmatrix} & & & \end{pmatrix}$$

The screenshot displays the MATLAB environment with the Editor and Command Window open.

Editor Window: The file `Basics.m` is open. The script contains the following code:

```
1 % PSI 2014 Session I Basics.m
2 % Editor -> SCRIPT + RUN
3
4 clear all
5 D
```

The status bar at the bottom of the Editor indicates the cursor is at `Ln 5 Col 2`.

Command Window: The Command Window shows the output of the script. It displays the value of `D` as 3, followed by the results of the `rand` function calls. The output is as follows:

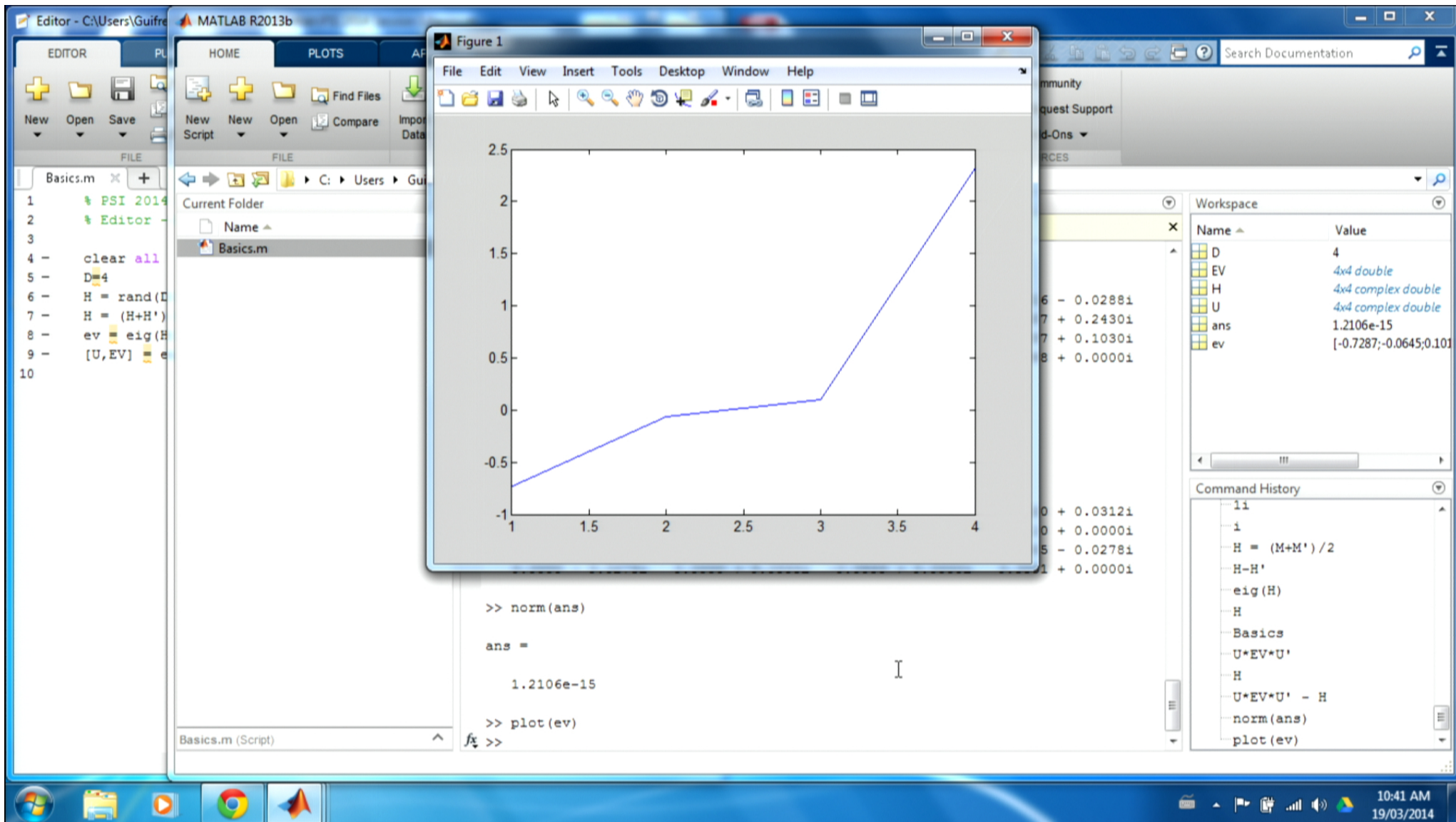
```
+ 0.1634i 0.4859 + 0.0541i
+ 0.0000i 0.5703 + 0.1294i
- 0.1294i 0.9502 + 0.0000i
```

Workspace: The Workspace pane shows the variables defined in the script:

Name	Value
D	3
H	[0.7060 + 0.0000i; 0.0344i; 0.0411i]
M	[0.7060 + 0.0344i; 0.0411i; -0.2750 + 0.5160i]
ans	[-0.2750 + 0.5160i; 1.5124 + 0.6324i; 0.9575i; 0.0909i]
v	[0.6324 + 0.9575i; 0.0909i]
x	[0.6324 - 0.9575i; 0.0909i]

Command History: The Command History pane shows the sequence of commands executed:

```
v' * v
D=3
M = rand(D,D)
M = rand(D)
M = rand(D,D) + 1i*rand
1i
i
H = (M+M') / 2
H-H'
eig(H)
H
```



$$H = -J \sum_i \sigma_i^x \sigma_{i+1}^x - h \sum_i \sigma_i^z$$

Editor - C:\Users\Guifre Vidal\Documents\Matlab\PSI 2014 Session I\IsingN3.m*

EDITOR PUBLISH VIEW

Find Files Compare EDIT NAVIGATE Breakpoints Run Run and Advance Run Section Advance Run and Time

FILE BREAKPOINTS RUN

Basics.m x IsingN3.m x +

```
1 % PSI 2014 Session I IsingN3.m
2
3 clear all
4 h = 1; % magnetic field Z
5 J = 1; % two-spin Hamiltonian term XX
6
7 X = [0 1; 1 0];
8 Z = [1 0; 0 -1];
9 I = eye(2);
10
11 XX = kron(X,X);
12 XI = kron(X,I);
13 IXX = kron(I,XX);
14 XXI = kron(XX,I);
15 XIX = kron(XI,X);
16
17 ZI = kron(Z,I);
18 IZ = kron(I,Z);
19 ZII = kron(ZI,I);
20 IZI = kron(IZ,I);
21 IIZ = kron(I,IZ);
22
```

script Ln 22 Col 1

Search Documentation

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Session I

examples, or read [Getting Started](#).

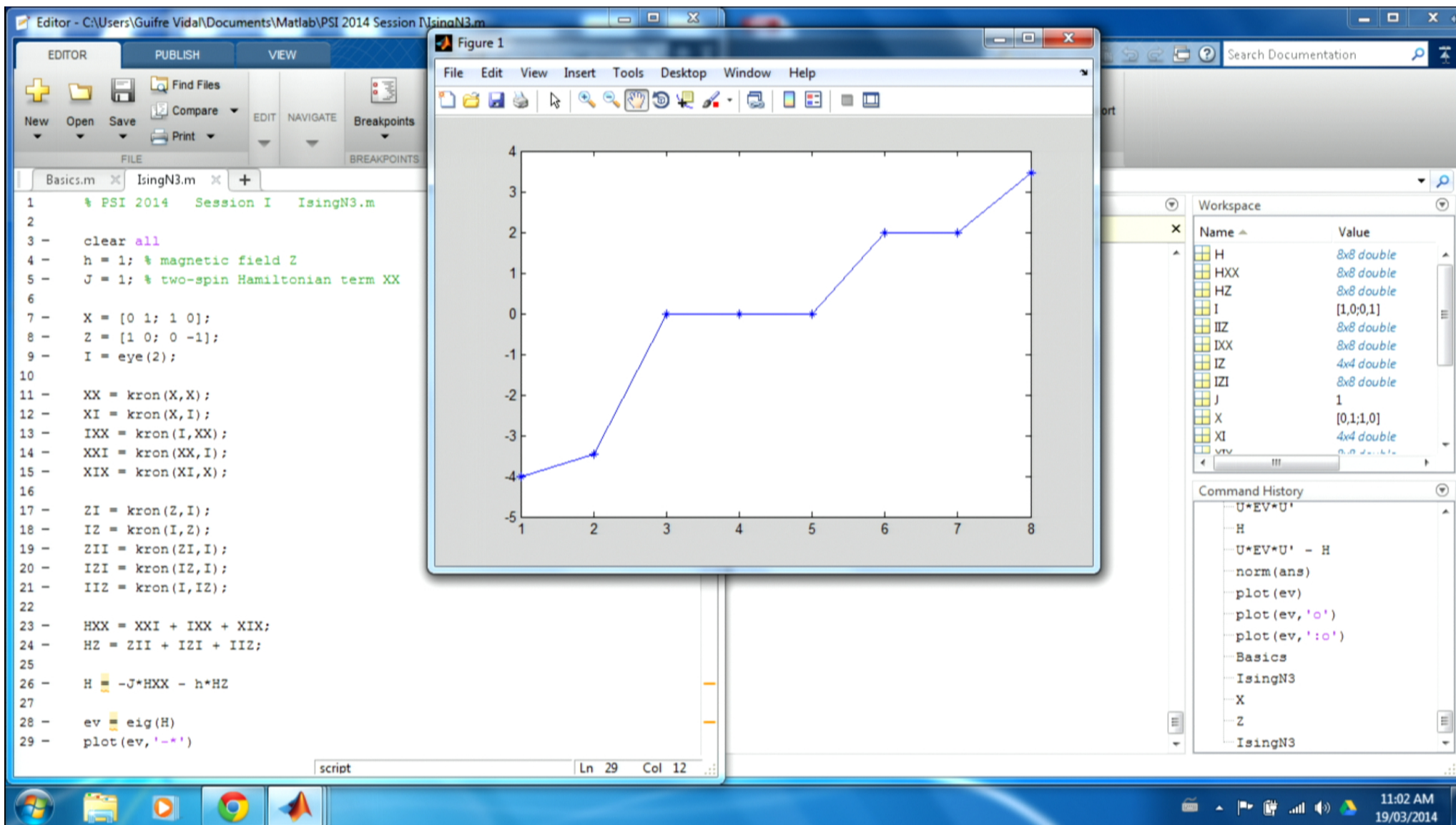
Workspace

Name	Value
I	[1,0;0,1]
IXX	8x8 double
J	1
X	[0,1;1,0]
XI	4x4 double
XIX	8x8 double
XX	4x4 double
XXI	8x8 double
Z	[1,0;0,-1]
h	1

Command History

```
U*EV*U'
H
U*EV*U' - H
norm(ans)
plot(ev)
plot(ev,'o')
plot(ev,'o')
```

Basics
IsingN3
X
Z
IsingN3



Editor - C:\Users\Guifre\Documents\MATLAB\PSI 2014 Session I

HOME PLOTS APPS

FILE VARIABLE CODE ENVIRONMENT RESOURCES

Current Folder

- Basics.asv
- Basics.m
- CreateIsingHamiltonian.m
- IsingN.m
- IsingN3.asv
- IsingN3.m

Command Window

New to MATLAB? Watch this [Video](#), see [Examples](#), or read [Getting Started](#).

```

>> EV(1,1)

ans =

-14.0533

>> gs'*H*gs

ans =

-14.0533

```

Workspace

Name	Value
EV	2048x2048 double
H	2048x2048 double
J	1
N	11
U	2048x2048 double
ans	-14.0533
boundary	1
gs	2048x1 double
h	1

Command History

- Basics
- IsingN3
- X
- Z
- IsingN3
- IsingN
- EV
- diag(EV)
- EV(1,1)
- gs
- EV(1,1)
- gs'*H*gs

CreateIsingHamiltonian.m (Function)

11:17 AM 19/03/2014