

# Quantum Computing

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# Goals

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- Learn about quantum mechanics
- Learn about quantum computing
- Finish my project

# Computers

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## Conventional

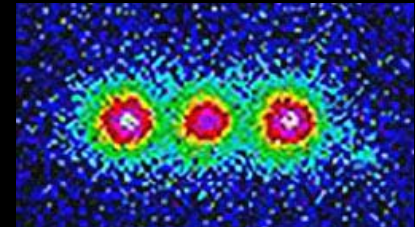
- Bit
  - ~200nm x 30nm
  - Is zero or one
    - On or off
- Can only do one thing at a time



<http://www.hudsonlibrary.org/Hudson%20Website/Computer%20Lab/MPj04100840000%5B1%5D.jpg>

## Quantum

- Qubit
  - Size of an atom  
~100 - 200pm
  - Have superposition
    - A mixture of spin up and spin down
- Potential for Unlimited Parallelism

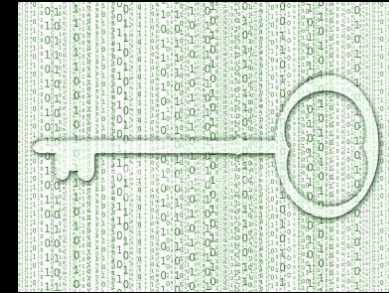


[http://www.nist.gov/public\\_affairs/quantum/how\\_to\\_entangle\\_ions.html](http://www.nist.gov/public_affairs/quantum/how_to_entangle_ions.html)

# Uses of Quantum Computers

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- Breaking encryption codes
- Doing calculations
- Search Engines
- Not sure how well it will work for everyday applications.



<http://zieglers.files.wordpress.com/2008/10/encryption.jpg>



[http://www.propertyinvestornetwork.co.za/campus/images/stories/calculating\\_deals.jpg](http://www.propertyinvestornetwork.co.za/campus/images/stories/calculating_deals.jpg)

# Electron Spin

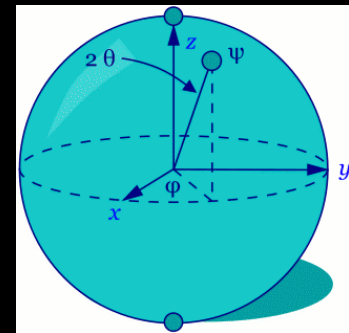
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- Is a mixture of up and down
- Changes with
  - interactions
  - direction of motion
  - magnetic fields
- Does not like to stay where we want it to

# Spin Problems

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- Relaxation
  - spin flips
- Dephasing
  - no longer can know the phase
- Decoherence
  - caused by dephasing



# Why Make the Website

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- Mostly for researchers and students
- A reference to get information
- Have a compiled list of useful articles
- Interactive figure

# Article Search

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- ISI Web of Knowledge
- Google Scholar
- Journal Sites
- Citations and References
- >300
- Excel



<http://www.lib.ku.ac.th/html2/dmdocuments/searching.jpg>



<http://ghostradio.files.wordpress.com/2009/01/quantumuniverse.jpg>



# Coding

- HTML
  - base
- JavaScript
  - search and interactivity
- ActionScript3
  - animation
- Excel
  - updating articles

```
<title>Purdue Physics Quantum Computing</title>
</head>
<body onload="set(); Si();">
  <div style="background:black">
    <table width="100%">
      <tr>
        <td width="1"><a href="http://www.purdue.edu"></a></td>
        <td rowspan="2"><center></center></td>
      </tr>
      <tr>
        <td><a href="http://www.physics.purdue.edu"></a></td>
      </tr>
    </table>
    </div>
    <div style="background:#B1946C">
      <table width="100%">
        <tr>
          <td width="12%" align="center"><a href="QC_REU_LS.html"></a>
          <td width="11%" align="center"><a href="Intro.html"></a>
          <td width="12%" align="center"><a href="Relax.html"></a>
          <td width="38%" align="center" style="text-align:center">Current Technologies </h2></td>
          <td width="18%" align="center"><a href="Dephass.html"></a>
          <td width="17%" align="center"><a href="Diss.html"></a>
        </tr>
      </table>
    </div>
  </body>
</html>
```

```
<script type="text/javascript">
var articles;
var SiArticles;
var GosArticles;
var HeArticles;
var OtherArticles;

function set(){
  SiArticles = document.getElementById("siArticles").innerHTML;
  document.getElementById("siArticles").innerHTML = "";
  GosArticles = document.getElementById("gosArticles").innerHTML;
  document.getElementById("gosArticles").innerHTML = "";
  HeArticles = document.getElementById("heArticles").innerHTML;
  document.getElementById("heArticles").innerHTML = "";
  PhononArticles = document.getElementById("phononArticles").innerHTML;
  document.getElementById("phononArticles").innerHTML = "";
  OtherArticles = document.getElementById("otherArticles").innerHTML;
  document.getElementById("otherArticles").innerHTML = "";
}

function pdf(fIle)
{
  articles=document.getElementById("area").innerHTML
  document.getElementById("area").innerHTML="<input type='button' value='ret'>";
}

function returnArticles()
{
  document.getElementById("area").innerHTML=articles;
}

function Si()
{
  document.getElementById("explanation").innerHTML="Things about Si. Advanta
  document.getElementById("area").innerHTML = SiArticles;
  document.getElementById("animation").src="images/siliconPic.png";
  document.getElementById("animation2").src=""
}
</script>
```

```
Private Sub cleanButton_Click()
Dim i As Integer
Dim j As Integer
Rows("I120").RowHeight = 15.75
'replace "" inside of cells with ""
For i = 2 To 6000
  'only checks until it reaches the end of the articles
  If (Cells(i, 3) = "") Then
    Exit Sub
  End If
  For j = 1 To 10
    Cells(i, j) = Replace(Cells(i, j), Chr(34), "")
  Next j
Next i
'replace line returns with html breaks
For i = 2 To 6000
  If (Cells(i, 1) = "") Then
    Exit Sub
  End If
  For j = 1 To 10
    Cells(i, j) = Replace(Cells(i, j), Chr(10), " <br/>")
  Next j
Next i
End Sub

Private Sub sortButton_Click()
' sorts articles: change order by changing what is in the different Keys
Range("A1").Select
Range("A1:Z6000").Select
Selection.Sort Key1:=Range("Q2"), Order1:=xlAscending, Key2:=Range("E2"), _
  Order2:=xlAscending, Key3:=Range("B2"), Order3:=xlAscending, Header:= _
  xlNone, OrderCustom:=1, MatchCase:=False, Orientation:=xlTopToBottom, _
  DataOption1:=xlSortNormal, DataOption2:=xlSortNormal, DataOption3:= _
  xlSortNormal
End Sub

Private Sub startButton_Click()
Dim lookWhere As Integer
Dim i As Integer
Dim j As Integer
```

```
//resets the stage
function resetNow(e:MouseEvent):void
{
  myTimer.reset();
  myClip.graphics.clear();
}

//math and whatnot for rotation
function rotateFunc(e:TimerEvent):void
{
  myClip.graphics.clear();
  myClip.graphics.lineStyle(2, 0x000000, 100);
  myClip.graphics.moveTo(200,200);
  myClip.graphics.lineTo(100,200);
  myClip.graphics.moveTo(200,200);
  myClip.graphics.lineTo(200,100);
  myClip.graphics.moveTo(200,100);
  myClip.graphics.lineTo(300,200);
  myClip.graphics.moveTo(200,200);
  myClip.graphics.lineTo(300,200);
}

//it
if(myTimer.currentCount < maxI)
{
  myClip.graphics.lineStyle(2, 0x000000, 100)
  for (var i = myTimer.currentCount;(i<myTimer.currentCount-Math.PI*200&&(i>0);i--)
  {
    x3dLine = r1*Math.sin(i/100);
    y3dLine = hi;
    x3dLineFinal = x3dLine*Math.cos(theta1) - y3dLine*Math.sin(theta1);
    y3dLineFinal = y3dLine*Math.cos(theta1) + x3dLine*Math.sin(theta1);
    myClip.graphics.moveTo(x3dLineFinal+199,y3dLineFinal+199);
    myClip.graphics.lineTo(x3dLineFinal+200,y3dLineFinal+200);
  }
  x3dLine = r1*Math.sin(myTimer.currentCount/100);
  y3dLine = hi;
  x3dLineFinal = x3dLine*Math.cos(theta1) - y3dLine*Math.sin(theta1);
  y3dLineFinal = y3dLine*Math.cos(theta1) + x3dLine*Math.sin(theta1);
  myClip.graphics.moveTo(200,200);
  myClip.graphics.lineTo(x3dLineFinal+200,y3dLineFinal+200);
  if(myTimer.currentCount == (maxI-1))
  {
  }
}
}
```

# The Site

**PURDUE**  
UNIVERSITY

Purdue Physics  
Department

[search articles](#)



Introduction

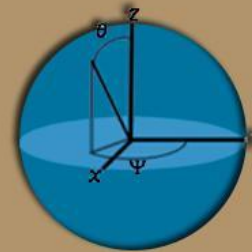
Spin Relaxation

Spin Dephasing

Quantum Computing

Spin Decoherence and Dissipation

Current Technologies



## Description of Quantum Computing

Deutsch, D.. Quantum Theory, the Church-Turing Principle and the Universal Quantum Computer. Proceeding of the Royal Society 400.1818: (1985).

It is argued that underlying the Church-Turing hypothesis there is an implicit physical assertion. Here, this assertion is presented explicitly as a physical principle: 'every finitely realizable physical system can be perfectly simulated by a universal model computing machine operating by finite means'. Classical physics and the universal Turing machine, because the former is continuous and the latter discrete, do not obey the principle, at least in the strong form above. A class of model computing machines that is the quantum generalization of the class of Turing machines is described, and it is shown that quantum theory and the 'universal quantum computer' are compatible with the principle. Computing machines resembling the universal quantum computer could, in principle, be built and would have many remarkable properties not reproducible by any Turing machine. These do not include the computation of non-recursive functions, but they do include 'quantum parallelism', a method by which certain probabilistic tasks can be performed faster by a universal quantum computer than by any classical restriction of it. The intuitive explanation of these properties places an intolerable strain on all interpretations of quantum theory other than Everett's. Some of the numerous connections between the quantum theory of computation and the rest of physics are explored. Quantum complexity theory allows a physically more reasonable definition of the 'complexity'

# Search

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- Two keywords
- Author/Title/Abstract
- and/ or
- Sorting feature

The screenshot shows the Purdue University Quantum Computing website. At the top left is the Purdue University logo and the text "Purdue Physics Department". The main heading is "Quantum Computing" with a diagram of four blue spheres and green arrows. Below the heading is a navigation bar with buttons for "Main Page", "Introduction", "Spin Relaxation", "Spin Dephasing", "Spin Decoherence and Dissipation", and "Current Technologies". At the bottom, there is a search interface with two input fields, dropdown menus for "Author", "AND", and a "search" button.

**PURDUE**  
UNIVERSITY

Purdue Physics  
Department

Quantum Computing

Main Page Introduction Spin Relaxation Spin Dephasing Spin Decoherence and Dissipation Current Technologies

search Author  Author  AND  search

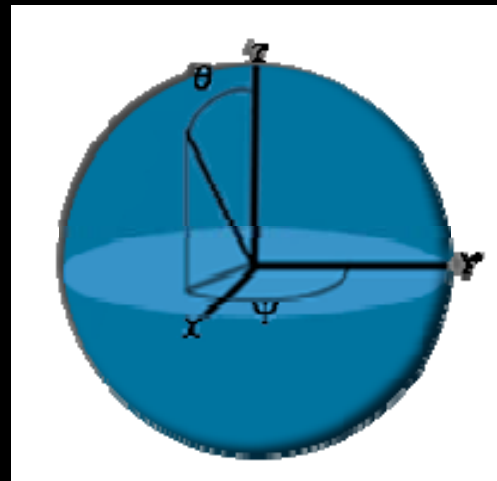
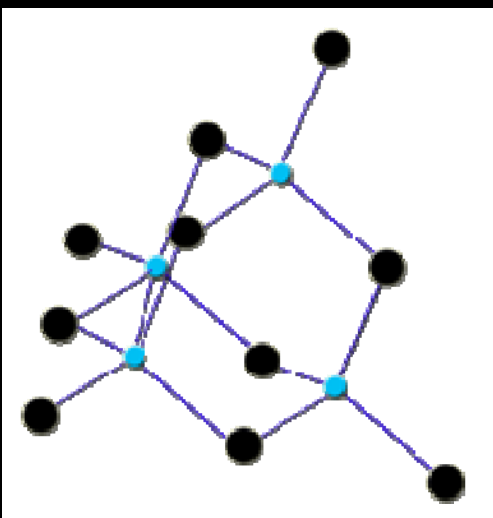
# Animation

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- Electron moving in a circle
- What happens to its spin
- Can change:
  - Magnetic field strength
  - Angle the magnetic field
  - Rotational velocity of the electron
  - If in resonance

# Graphics

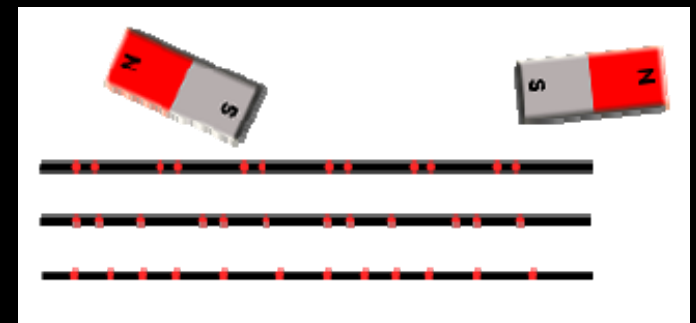
- Photoshop



Quantum Computing



Spin Dephasing



# Thanks

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- Professor Layanda-Geller
- Professor Savikhin