

# PhD Experience

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# OUTLINE

- Personal details
- PhD experience
- Teaching and Research experience
- Outlook



# PhD Experience

- Undergraduate studies (Bsc) at UNIVEN in Limpopo (2003-2006)
- Postgraduate studies (Bsc Hons. And Msc) at UWC under MANUS/MATScie program (2007-2009)
  - Why I moved to Western Cape
  - Experiments I did
- PhD at UJ (2010-2014)
  - Experiments performed at iThemba LABS



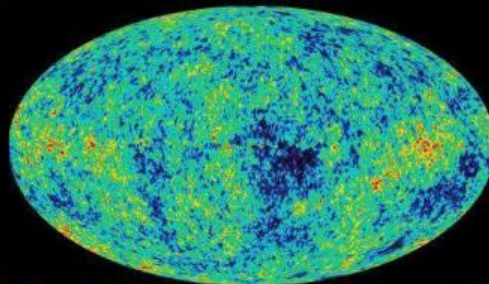
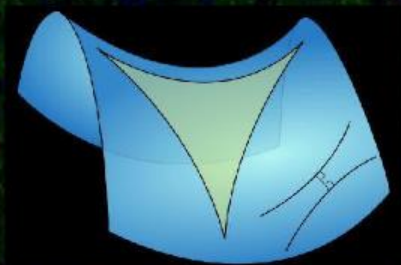
# How I chose to do Nuclear Physics

## Cosmology (Lectures I & II)

Mathieu de Naurois

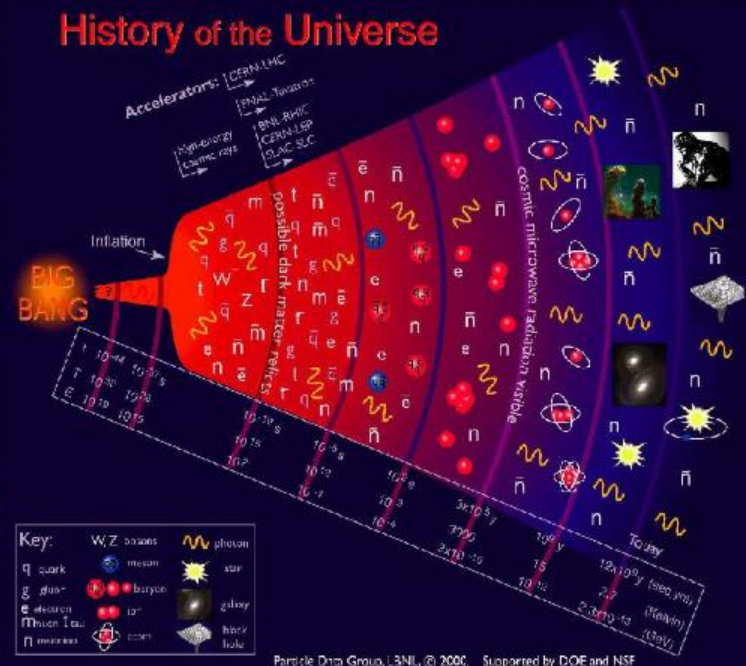
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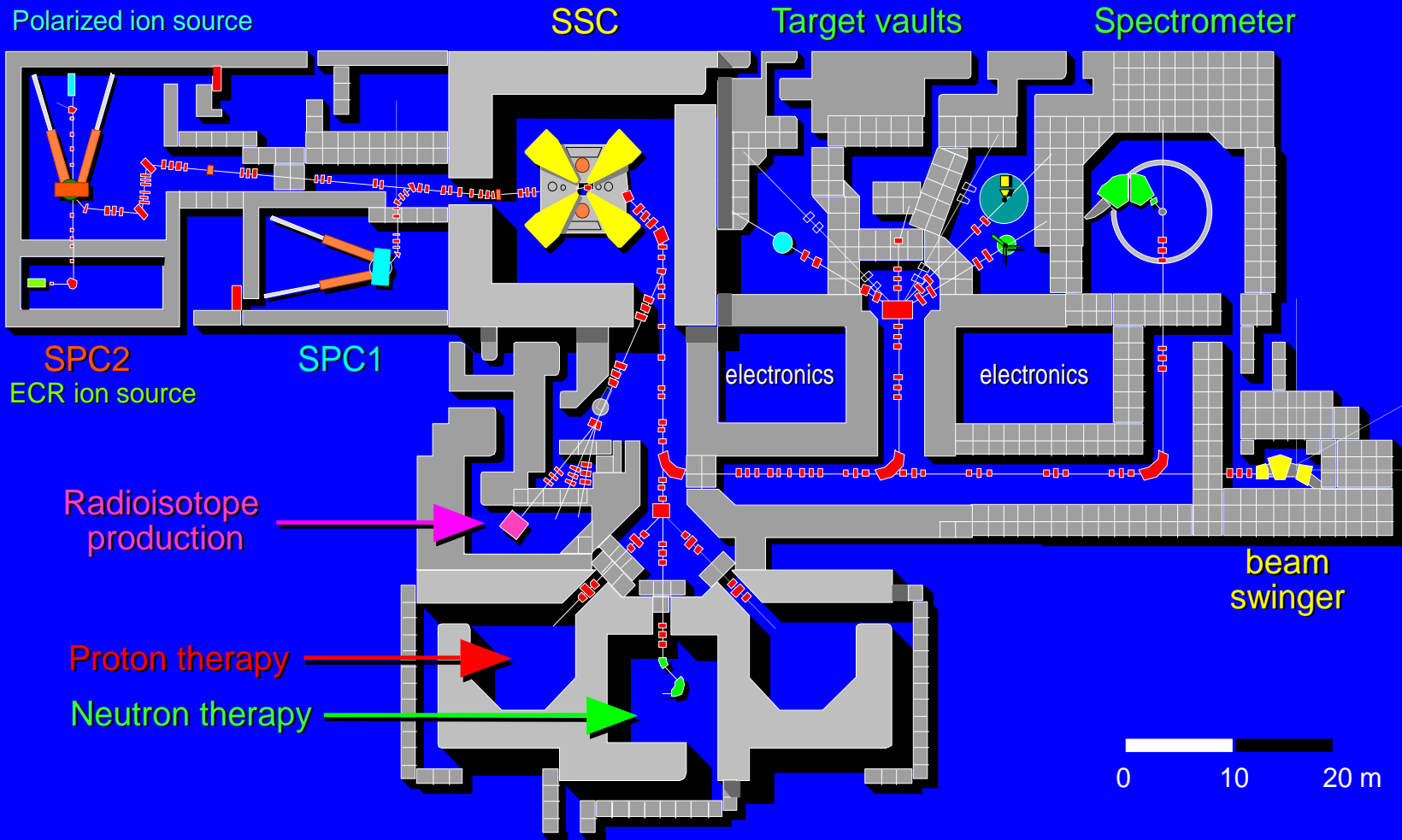
Mathieu de Naurois

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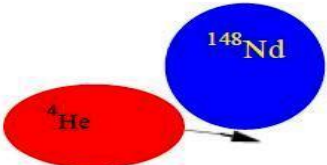
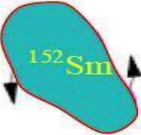
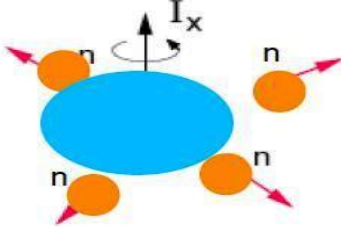
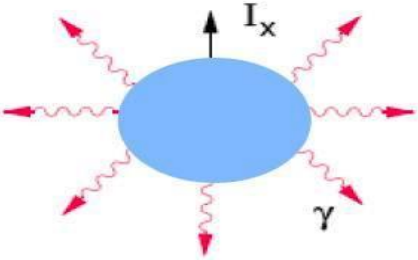



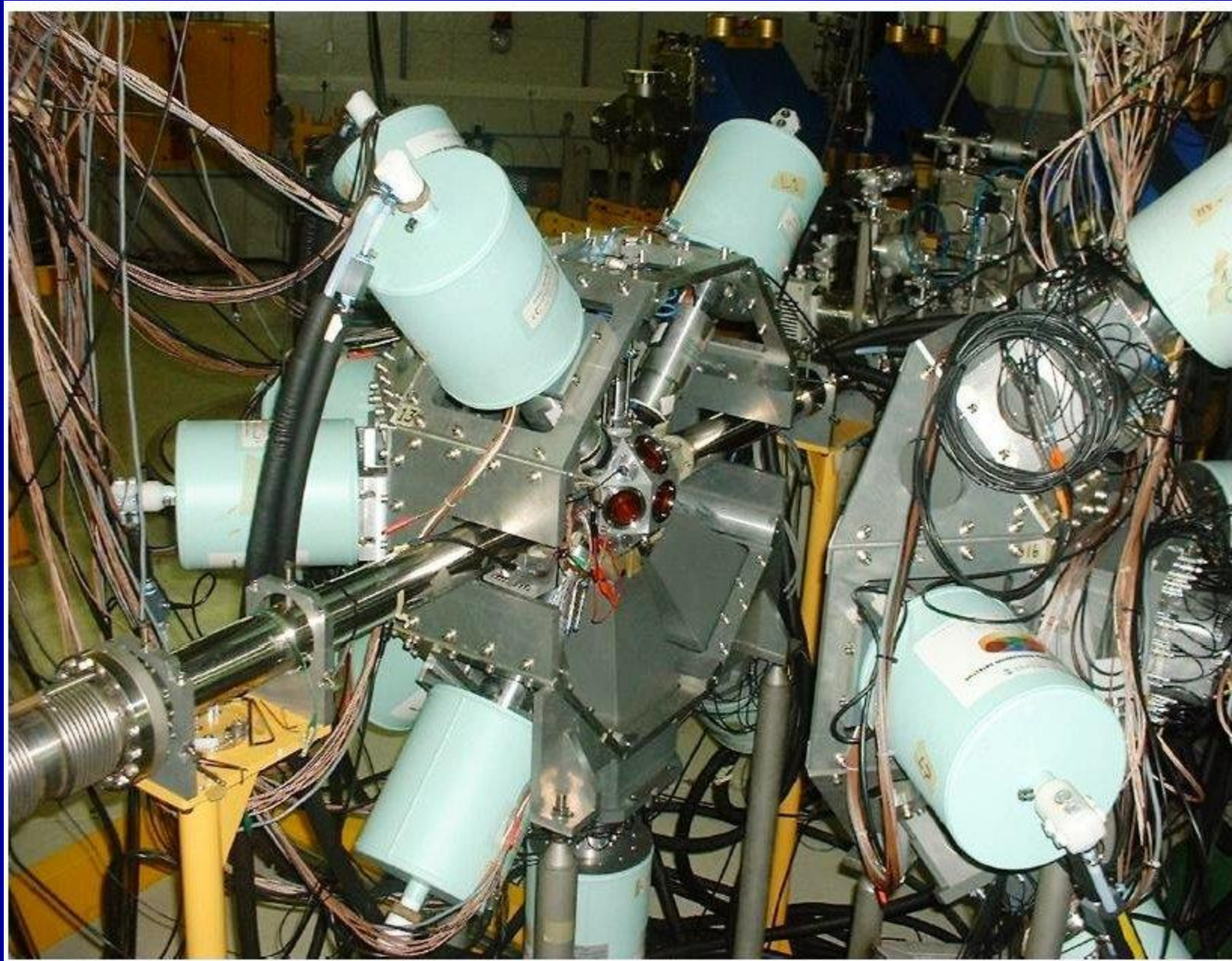
# Separated-Sector Cyclotron Facility



	Er 151 23 s	Er 152 10,1 s	Er 153 36 s	Er 154 3,75 m	Er 155 5,3 m	Er 156 18,6 m	Er 157 ~ 25 m	Er 158 2,25 h	Er 159 36 m	Er 160 28,6 h	Er 161 3,24 h	Er 162 0,14		
148 s	Ho 149 21 s	Ho 150 24 s 88 s	Ho 151 42 s 35,6 s	Ho 152 52,3 s 2,4 m	Ho 153 2,0 m 9,3 m	Ho 154 3,3 m 11,8 m	Ho 155 48 m	Ho 156 5,8 m 55 m ~ 2 m	Ho 157 12,6 m	Ho 158 21 m 27 m 11 m	Ho 159 8,3 s 33 m	Ho 160 1 h 5,0 h 25 m	Ho 161 6,7 s 2,...	
662	$\beta^+$ $\gamma$ 1091; 1073; 1584	$\beta^+$ $\gamma$ 301; 553; 394; 951	$\beta^+$ $\gamma$ 681; 775; 527; 647	$\beta^+$ $\gamma$ 4,45; 514; 647	$\beta^+$ $\gamma$ 3,91; 236; 365; 35...	$\beta^+$ $\gamma$ 4,01; 535; 412; 473	$\beta^+$ $\gamma$ 3,77; 535; 412; 473	$\beta^+$ $\gamma$ 35; 30...	$\beta^+$ $\gamma$ 3,8; 73; 367...	$\beta^+$ $\gamma$ 1,1...; 624; 649...	$\beta^+$ $\gamma$ no $\gamma$	$\beta^+$ $\gamma$ 827...	$\alpha$ 19	
147 ?	Dy 148 3,1 m	Dy 149 4,1 m	Dy 150 7,2 m	Dy 151 17 m	Dy 152 2,4 h	Dy 153 6,29 h	Dy 154 ~ 10 <sup>7</sup> a	Dy 155 10,0 h	Dy 156 0,06	Dy 157 8,1 h	Dy 158 0,10	Dy 159 144,4 d	Dy 160 2,34	
1079	$\beta^+$ $\gamma$ 101; 1777; 789; 1806...	$\beta^+$ $\gamma$ 101; 1777; 789; 1806...	$\beta^+$ $\gamma$ 4,23; 3,97	$\beta^+$ $\gamma$ 4,07; 3,88; 49; 546; 176...	$\beta^+$ $\gamma$ 3,63; 257	$\beta^+$ $\gamma$ 3,46...; 81; 214; 100; 254...	$\alpha$ 2,67	$\beta^+$ $\gamma$ 0,9; 1,1...; 227...	$\beta^+$ $\gamma$ 326...	$\beta^+$ $\gamma$ 326...	$\beta^+$ $\gamma$ 58...	$\beta^+$ $\gamma$ 58...	$\alpha$ 81	
1079	Tb 147 1,83 m 1,65 h	Tb 148 2,2 m 60 m	Tb 149 4,2 m 4,1 h	Tb 150 5,8 m 3,67 h	Tb 151 25 s 17,6 h	Tb 152 4,2 m 17,5 h	Tb 153 2,34 d	Tb 154 23 h 9,0 h 12 h	Tb 155 5,32 d	Tb 156 24 h 5,4 h 5,4 d	Tb 157 150 a	Tb 158 10,5 s 150 a	Tb 159 100	
1079	$\beta^+$ $\gamma$ 134; 194; 190...	$\beta^+$ $\gamma$ 784; 794; 652; 498; 882	$\beta^+$ $\gamma$ 3,90; 6; 1,6...; 795; 264; 166...	$\beta^+$ $\gamma$ 4,07; 3,88; 49; 546; 176...	$\beta^+$ $\gamma$ 3,63; 257	$\beta^+$ $\gamma$ 3,46...; 81; 214; 100; 254...	$\beta^+$ $\gamma$ 212; 170; 110; 102; 83...	$\beta^+$ $\gamma$ 245; 347; 1426; 244; 104; 129; 540...	$\beta^+$ $\gamma$ 9; 105; 180; 265...	$\beta^+$ $\gamma$ 5,4; 5,4; 1222	$\beta^+$ $\gamma$ 54	$\beta^+$ $\gamma$ 10,5; 150	$\beta^+$ $\gamma$ 10,5; 150	$\alpha$ 25,5
1079	Gd 146 23,9 m	Gd 147 38,1 h	Gd 148 ~ 90 a	Gd 149 9,5 d	Gd 150 1,8 · 10 <sup>9</sup> a	Gd 151 120 d	Gd 152 0,20	Gd 153 241,6 d	Gd 154 2,18	Gd 155 14,80	Gd 156 20,47	Gd 157 15,65	Gd 158 24,84	
1079	$\beta^+$ $\gamma$ 156; 116; 115...	$\beta^+$ $\gamma$ 229; 396; 929	$\alpha$ 3,163	$\beta^+$ $\gamma$ 3,01; 150; 299; 347...	$\alpha$ 2,72	$\beta^+$ $\gamma$ 2,60; 154; 243; 175...	$\alpha$ 2,14; 1100	$\beta^+$ $\gamma$ 97; 103...	$\beta^+$ $\gamma$ 9; 105; 180; 265...	$\beta^+$ $\gamma$ 5,4; 5,4; 1222	$\beta^+$ $\gamma$ 54	$\beta^+$ $\gamma$ 10,5; 150	$\beta^+$ $\gamma$ 10,5; 150	
1079	Eu 145 5,93 d	Eu 146 4,51 d	Eu 147 24,6 d	Eu 148 55,6 d	Eu 149 93,1 d	Eu 150 12,6 h 35,8 a	Eu 151 47,8	Eu 152 96 m 9,3 h 33,3 a	Eu 153 52,2	Eu 154 46,0 m 8,8 a	Eu 155 4,96 a	Eu 156 15,2 d	Eu 157 15,15	
1079	$\beta^+$ $\gamma$ 1,7...; 694; 1650; 654...	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	$\beta^+$ $\gamma$ 1,5; 2,1...; 747; 633; 634	
1079	Sm 144 3,1	Sm 145 340 d	Sm 146 1,03 · 10 <sup>9</sup> a	Sm 147 15,0	Sm 148 11,3	Sm 149 13,8	Sm 150 7,4	Sm 151 93 a	Sm 152 26,7	Sm 153 46,75 h	Sm 154 22,7	Sm 155 22,4 m	Sm 156 9,4 h	
1079	$\alpha$ ~ 0,7	$\beta^+$ $\gamma$ 61; 1492...	$\alpha$ 2,55	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	$\beta^+$ $\gamma$ 1,06 · 10 <sup>11</sup> a	
1079	Pm 143 265 d	Pm 144 1,0 a	Pm 145 17,7 a	Pm 146 5,53 a	Pm 147 2,62 a	Pm 148 41,3 d 5,37 d	Pm 149 53,1 h	Pm 150 2,7 h	Pm 151 28 h	Pm 152 15 m 7,5 m 4,2 m	Pm 153 5,3 m	Pm 154 2,7 m 1,7 m	Pm 155 2,7 m 1,7 m	
1079	$\beta^+$ $\gamma$ 618; 697; 477	$\beta^+$ $\gamma$ 2,24; 72; 87	$\beta^+$ $\gamma$ 2,24; 72; 87	$\beta^+$ $\gamma$ 0,6...; 454; 747; 736...	$\beta^+$ $\gamma$ 0,2...; 121...	$\beta^+$ $\gamma$ 0,2...; 121...	$\beta^+$ $\gamma$ 1,1...; 286...	$\beta^+$ $\gamma$ 2,3; 3,4...; 334; 1325; 1166...	$\beta^+$ $\gamma$ 0,4; 1,2...; 94; 166...	$\beta^+$ $\gamma$ 1,2; 1,8...; 122; 3,3...; 215; 345; 961; 342...	$\beta^+$ $\gamma$ 1,7...; 36; 127; 28; 120...	$\beta^+$ $\gamma$ 1,5...; 104; 246; 141...	$\beta^+$ $\gamma$ 0,7...; 204; 86; 10...	
1079	Nd 142 27,13	Nd 143 12,18	Nd 144 23,80	Nd 145 8,30	Nd 146 17,19	Nd 147 10,98 d	Nd 148 5,76	Nd 149 1,73 h	Nd 150 5,64	Nd 151 12,4 m	Nd 152 11,4 m	Nd 153 32 s	Nd 154 40 s	
1079	$\alpha$ 18,7	$\alpha$ 325	$\alpha$ 1,53	$\alpha$ 3,6	$\alpha$ 42	$\beta^+$ $\gamma$ 0,8; 0,9...; 91; 531...	$\beta^+$ $\gamma$ 1,4; 1,6...; 211; 114; 270...	$\beta^+$ $\gamma$ 1,4; 1,6...; 211; 114; 270...	$\beta^+$ $\gamma$ 1,2; 2,3...; 117; 256; 1181...	$\beta^+$ $\gamma$ 0,9; 1,2...; 117; 256; 1181...	$\beta^+$ $\gamma$ 418; 105; 475...	$\beta^+$ $\gamma$ 400; 700; 9	$\beta^+$ $\gamma$ 400; 700; 9	
1079	Pr 141 100	Pr 142 14,6 m 19,13 h	Pr 143 13,57 d	Pr 144 7,2 m 17,3 m	Pr 145 5,98 h	Pr 146 24,0 m	Pr 147 13,6 m	Pr 148 2,0 m 2,27 m	Pr 149 2,25 m	Pr 150 ~ 5 s 8,1 s	Pr 151 22,4 s	Pr 152 0,162	Pr 153 94	
1079	$\alpha$ 3,9 + 7,6	$\beta^+$ $\gamma$ 22...; 576; 20	$\beta^+$ $\gamma$ 0,9...; 742	$\beta^+$ $\gamma$ 3,0...; 189; 514...	$\beta^+$ $\gamma$ 1,8...; 748; 676...	$\beta^+$ $\gamma$ 4,1...; 454; 1525...	$\beta^+$ $\gamma$ 2,1; 2,7...; 315; 641; 578; 78...	$\beta^+$ $\gamma$ 3,0; 451; 698; 616...	$\beta^+$ $\gamma$ 1,9; 1,65; 109...	$\beta^+$ $\gamma$ 5...; 130; 304; 339...	$\beta^+$ $\gamma$ 680; 189; 195; 105...	$\beta^+$ $\gamma$ 400; 700; 9	$\beta^+$ $\gamma$ 400; 700; 9	



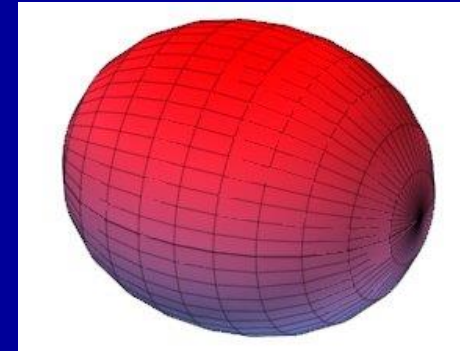
Stages		Time Scale	Number of Rotations
<i>Preformation</i>		0 sec	0
<i>Formation of Compound Nucleus</i>		$10^{-22}$ s	<1
<i>Particle Evaporation</i>		$10^{-19}$ s	10 - 100
<i>Gamma Emission</i>		$10^{-17}$ - $10^{-10}$ s	$10^5$ - $10^{10}$
<i>Ground State</i>		$10^{-9}$ s	$10^{11}$



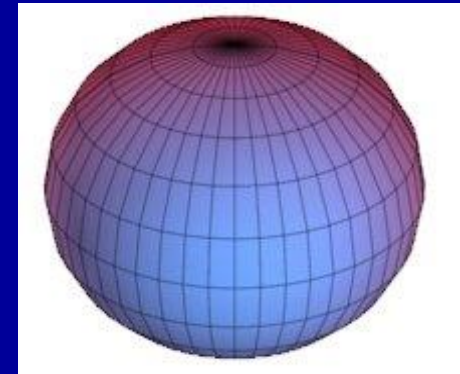
## We want to classify the levels in terms of:

- ◆ Nuclear Shape
- Excitation Mode
  - Collective Excitation
    - ◆ is the nucleus rotating ?
    - ◆ vibrating ?
  - ◆ Single Particle Excitation
    - ◆ What orbitals are the protons and neutrons moving in ?

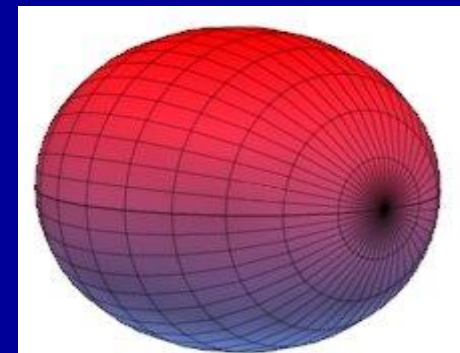
Prolate



Oblate



Triaxial





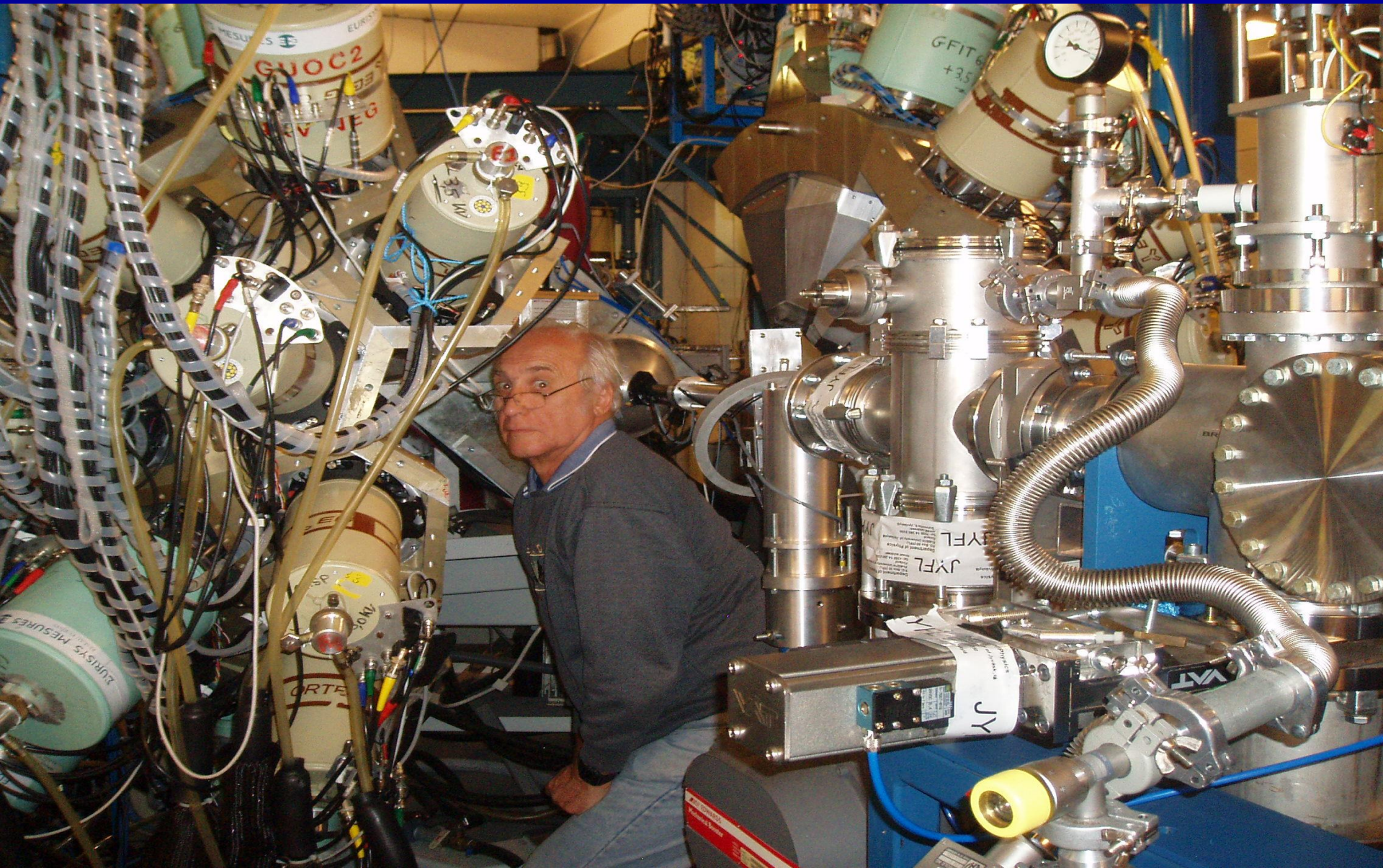


# International collaborations

- PhD experiment performed in Finland
- Part of Analysis performed in Hungary
- Presentations made at ASP-Ghana, Italy



# Inspiration from mentors





# Current activities

- Teaching
  - Physics for Radiography students
  - Physics for Somatology students
  - Engineering Metallurgy
- Research
  - Supervising two MSc students
  - Grants

# OUTLOOK

- I will be teaching at UJ for the next coming three years
- Data is available for Msc/PhD students
- Possibility of doing a postdoc
- Writing grant proposals
- I will be teaching in ASP2016

# THANK YOU

A proton and a neutron were walking one day, and the proton said to the neutron! I think I lost an electron! The neutron said, are you sure? The Proton replied and said! Yes I'm positive!!!