

Instituto Tecnológico y de Estudios Superiores de Monterrey

23 de Mayo

MRI Activity

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Grupo 301

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19 de Mayo

Monterrey, Nuevo León

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MRI activity.

Open the simulator in <https://phet.colorado.edu/en/simulations/mri>

1. NMR

Place yourself in the tab *Simplified NMR*. Remember that the Larmour relationship relates the magnetic field to the resonant frequency:

where the resonant frequency is the gyromagnetic ratio and B_0 is the magnetic field.

Table1. Gyromagnetic ratios for different nuclei.

Nuclei	Gyromagnetic ratio	Nuclei	Gyromagnetic ratio
^1H	42,58	^{65}Cu	12,09
^7Li	16,55	^{75}As	7,291
^9Be	5,984	^{77}Se	8,118
^{11}B	13,66	^{81}Br	11,50
^{13}C	10,71	^{87}Rb	13,93
^{15}N	4,314	^{93}Nb	10,41
^{17}O	5,772	^{117}Sn	15,17

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^{19}F	40,05	^{121}Sb	10,19
^{23}Na	11,42	^{127}I	8,518
^{27}Al	11,09	^{133}Cs	5,584
^{29}Si	8,458	^{195}Pt	9,153
^{31}P	17,24	^{199}Hg	7,590
^{35}Cl	4,172	^{203}Tl	24,33
^{51}V	11,19	^{207}Pb	8,907
^{55}Mn	10,50	^{209}Bi	6,841
^{59}Co	10,05		

Use the Larmour relationship and the gyromagnetic ratios of various nuclei shown in table 1 to complete table 2. Check your results in the simulation by setting the appropriate frequencies and main magnet field, take a screenshot of the nuclei emitting energy to include in the report. Try to find the last nuclei (????) by playing with the simulation and register the frequency at two different magnetic fields.

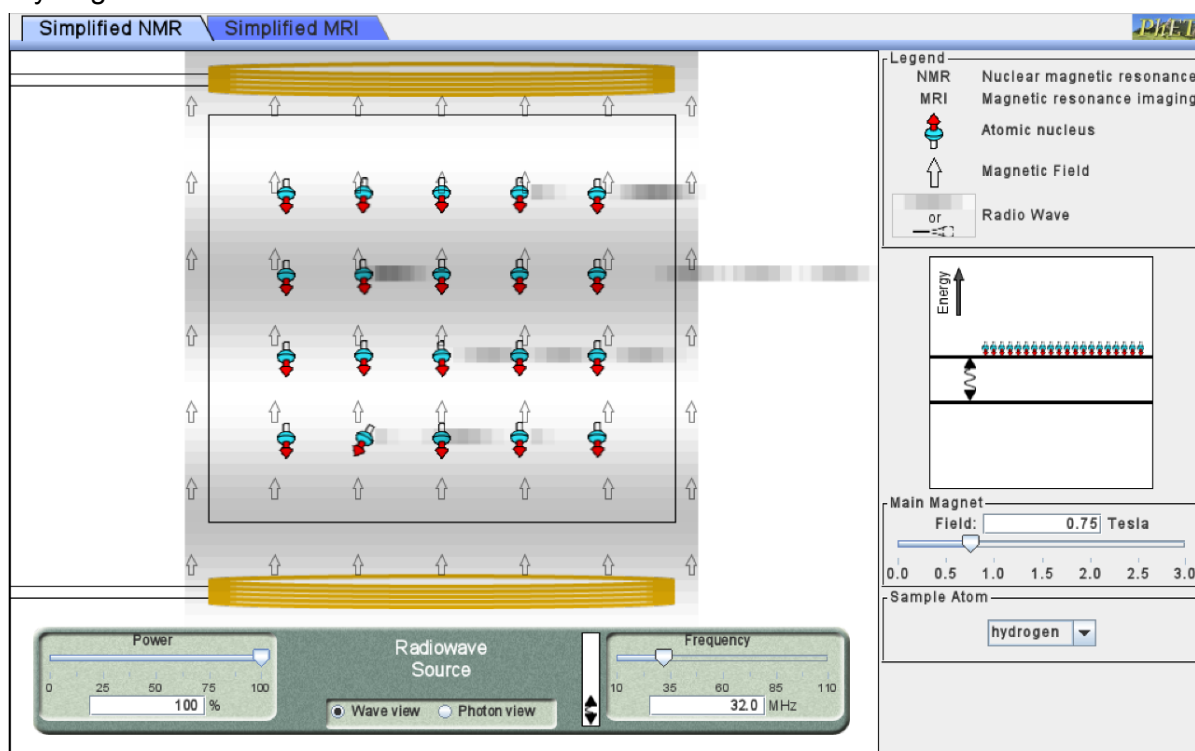
Table 2. Different settings to achieve energy emission.

Nuclei	Magnetic Field	Resonant Frequency	Magnetic Field	Resonant Frequency

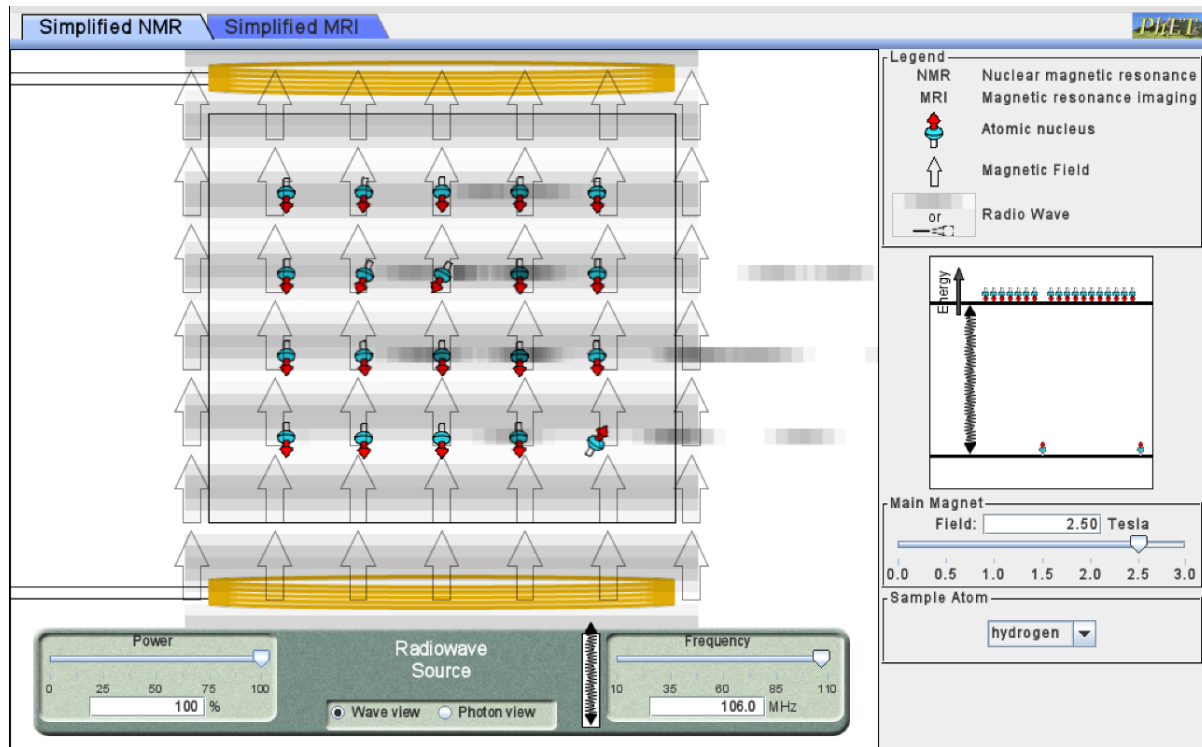
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Hydrogen	0.75	32	2.5	106.45
Nitrogen	2.5	10	-	-
Sodium	1.5	17	2.75	31
Carbon-13	1.75	18	2.5	26
Oxygen	2.0	11	3.0	17
Sulfur	3.0	11	-	-
????	1.5	18	2.75	33

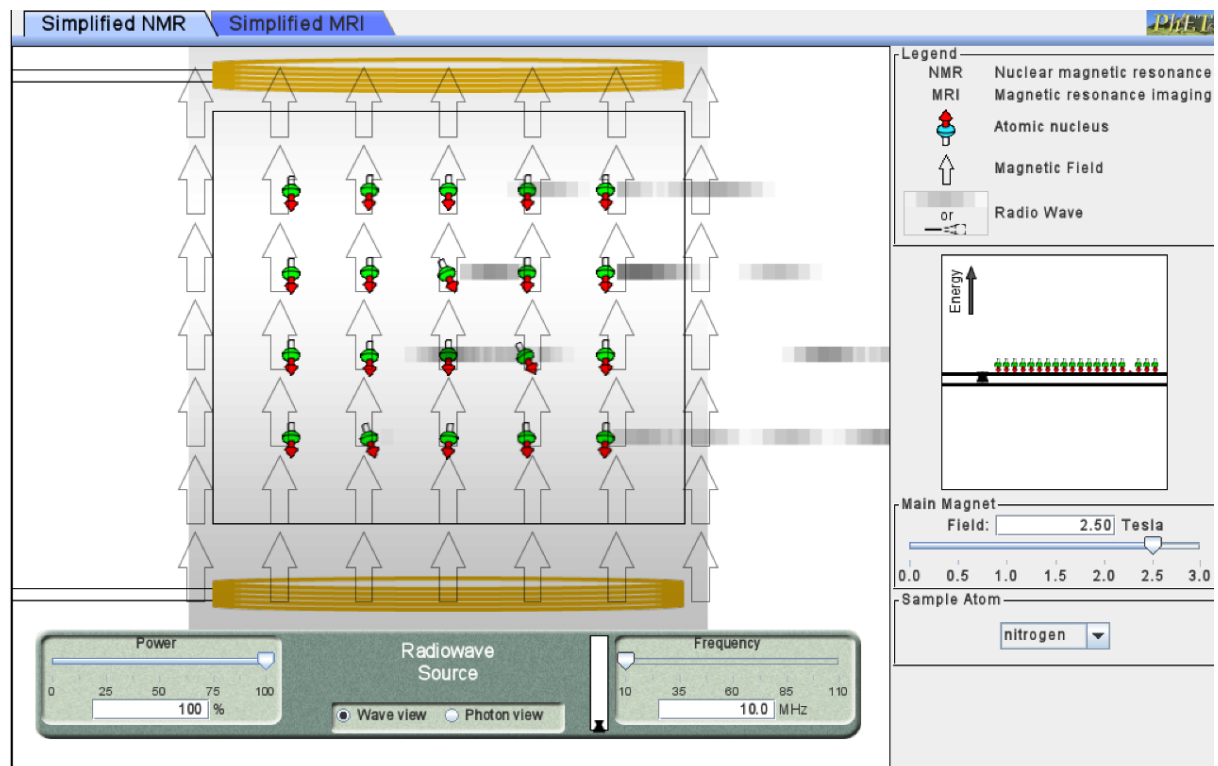
Hydrogen



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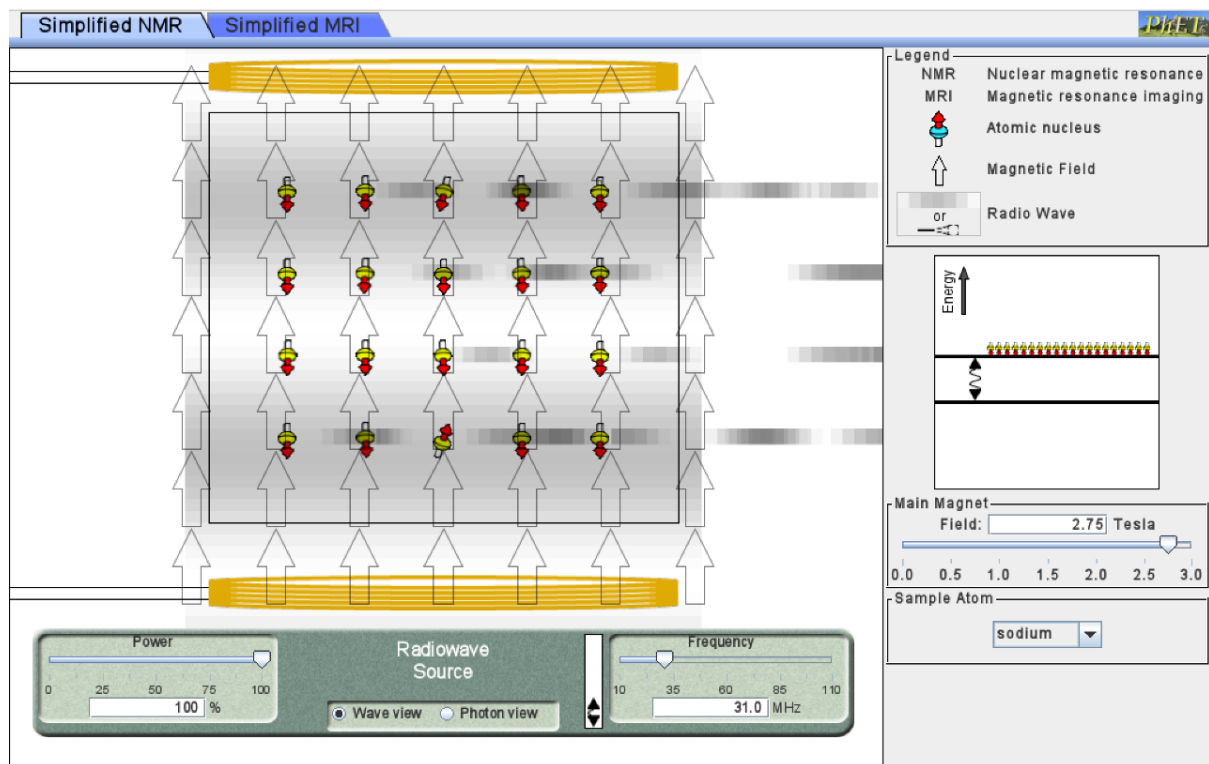
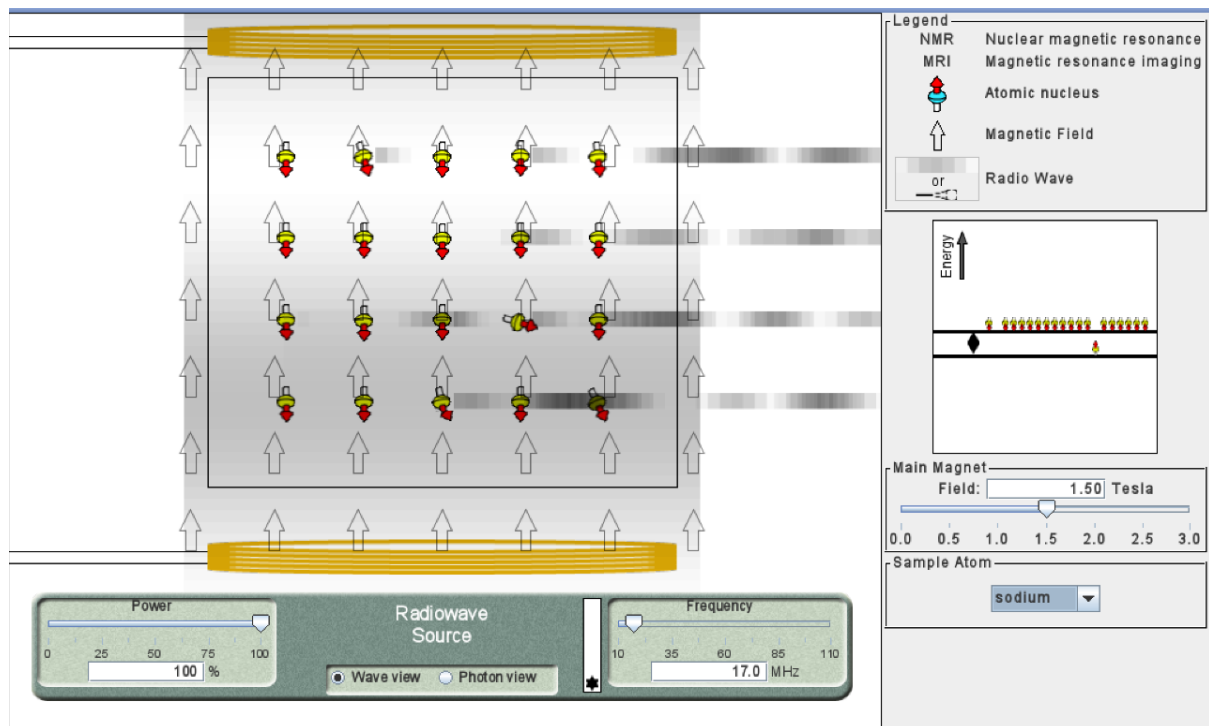


Nitrogen



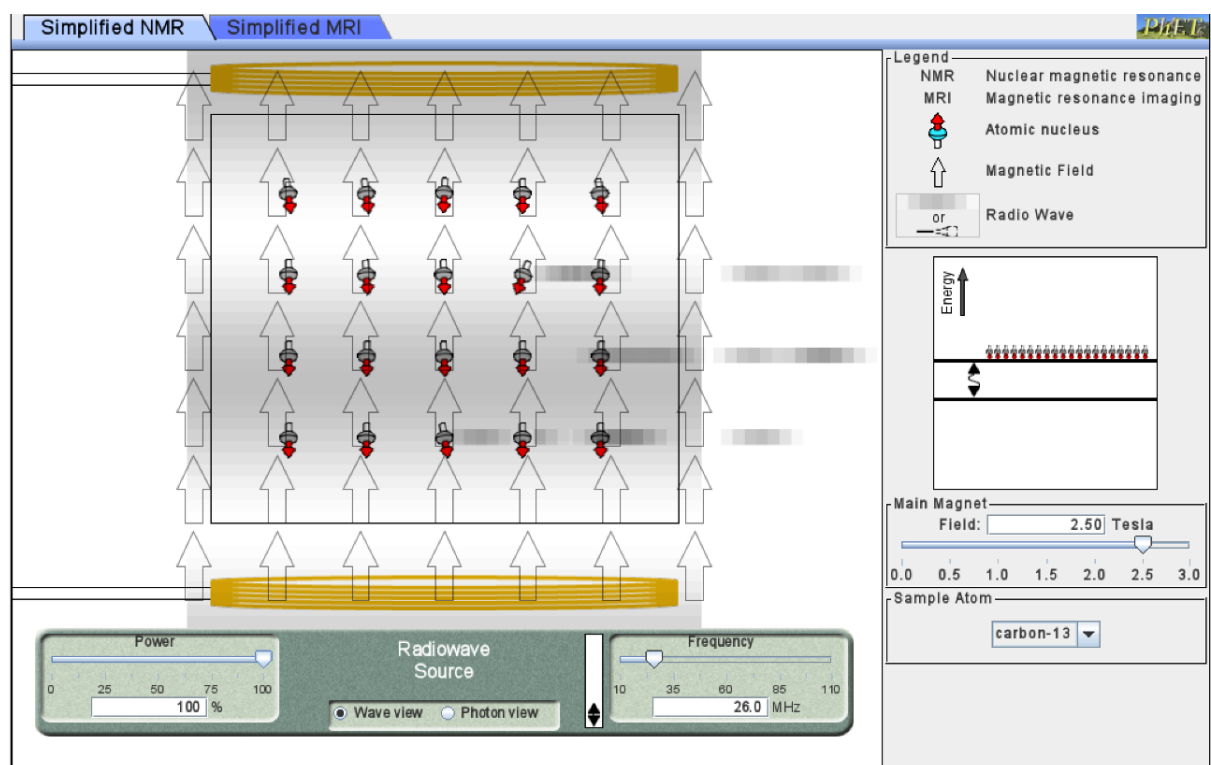
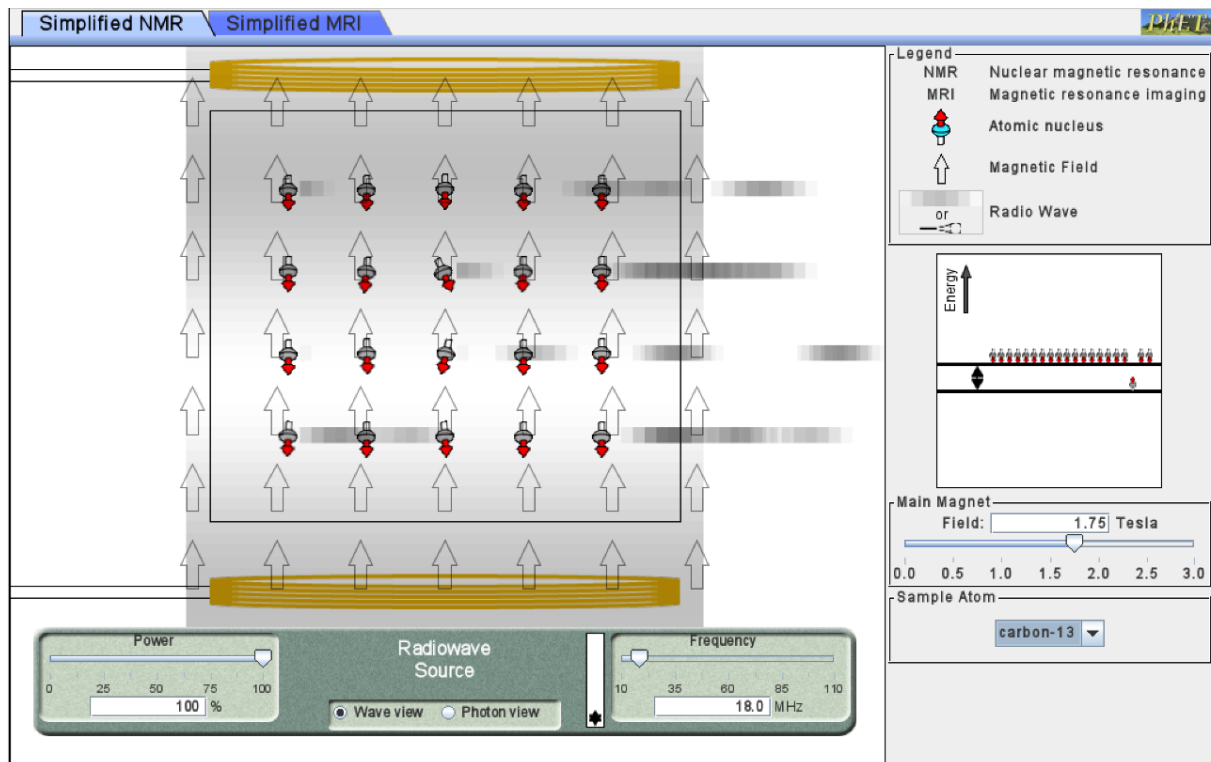
Sodium

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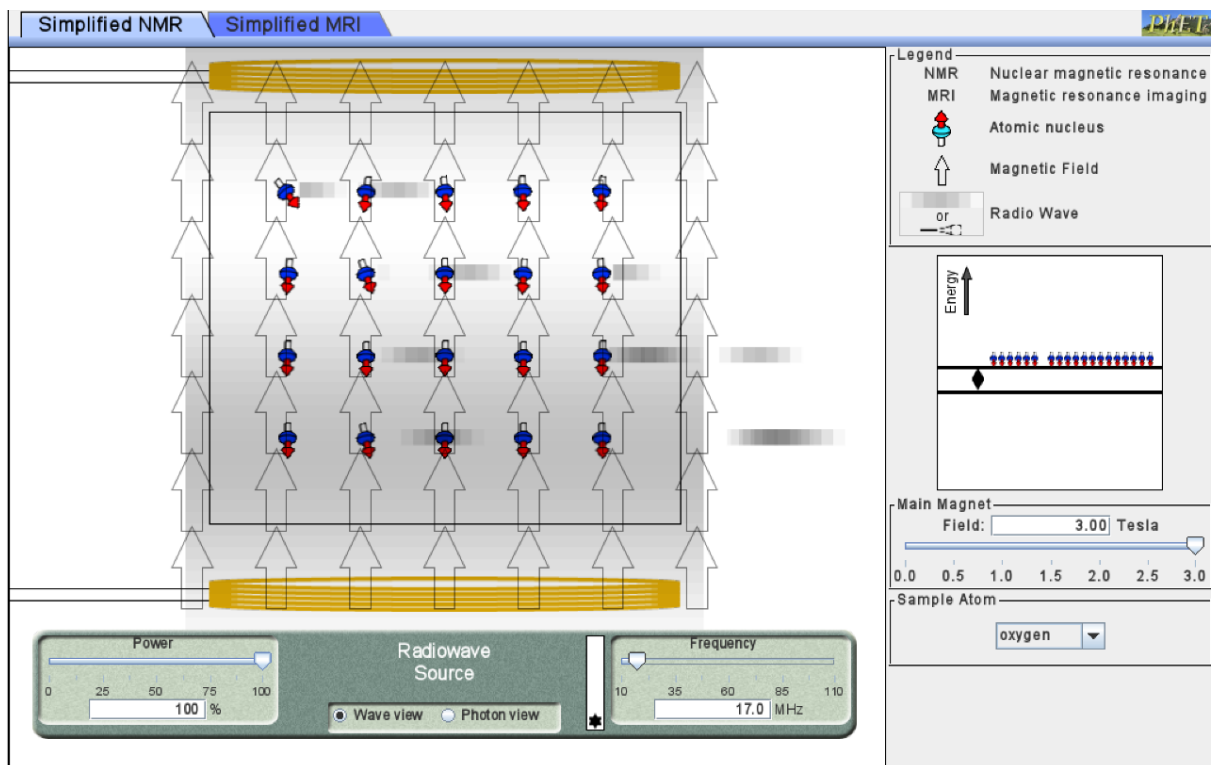
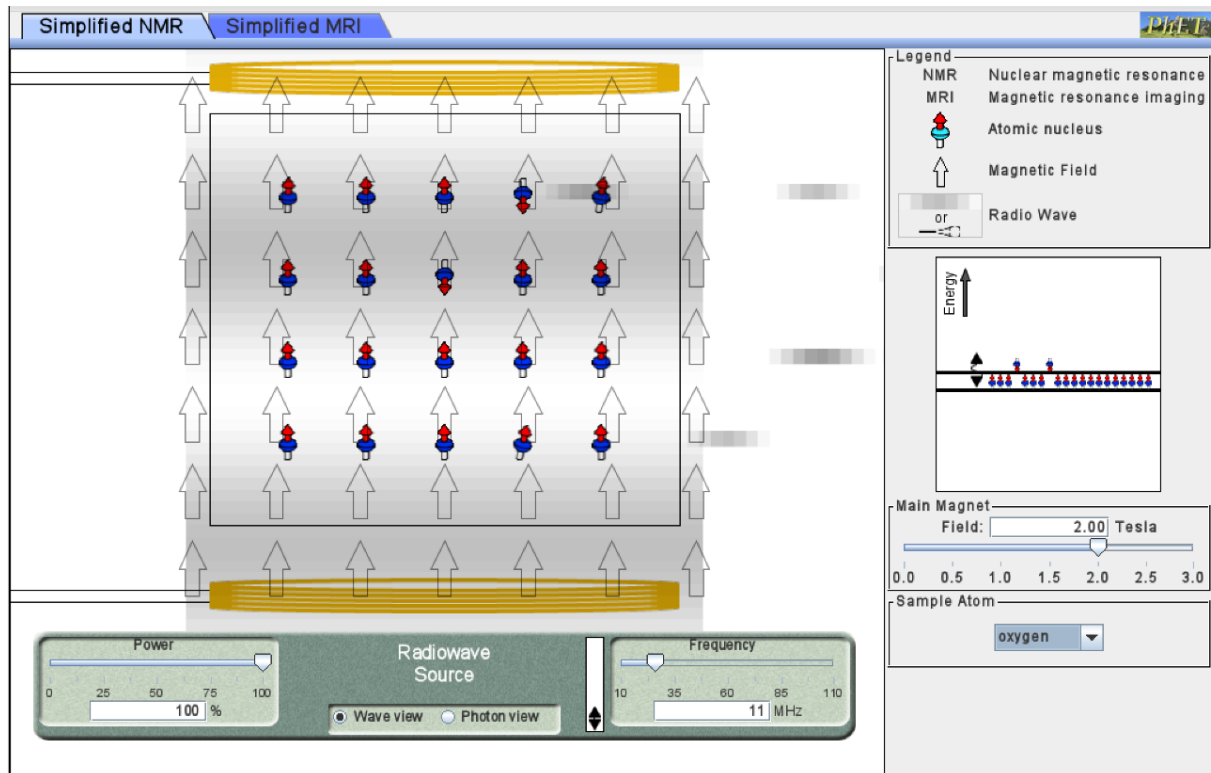
Carbon-13

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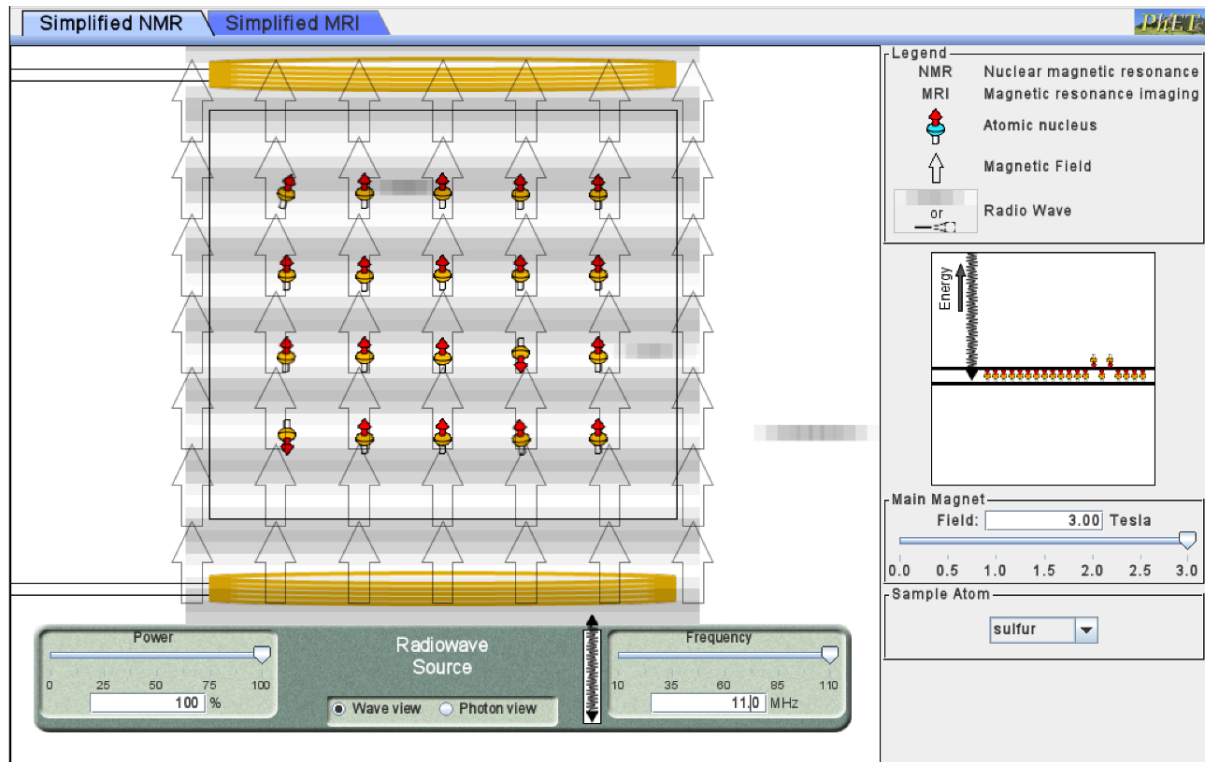
Oxygen

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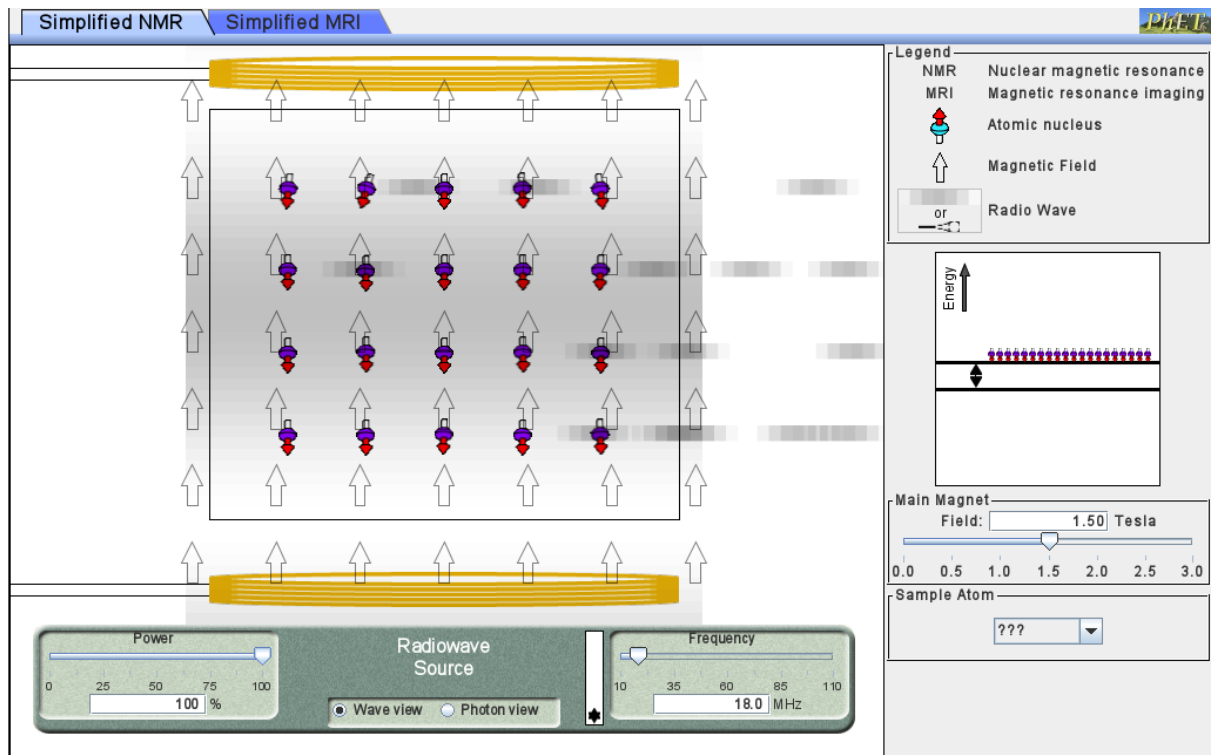


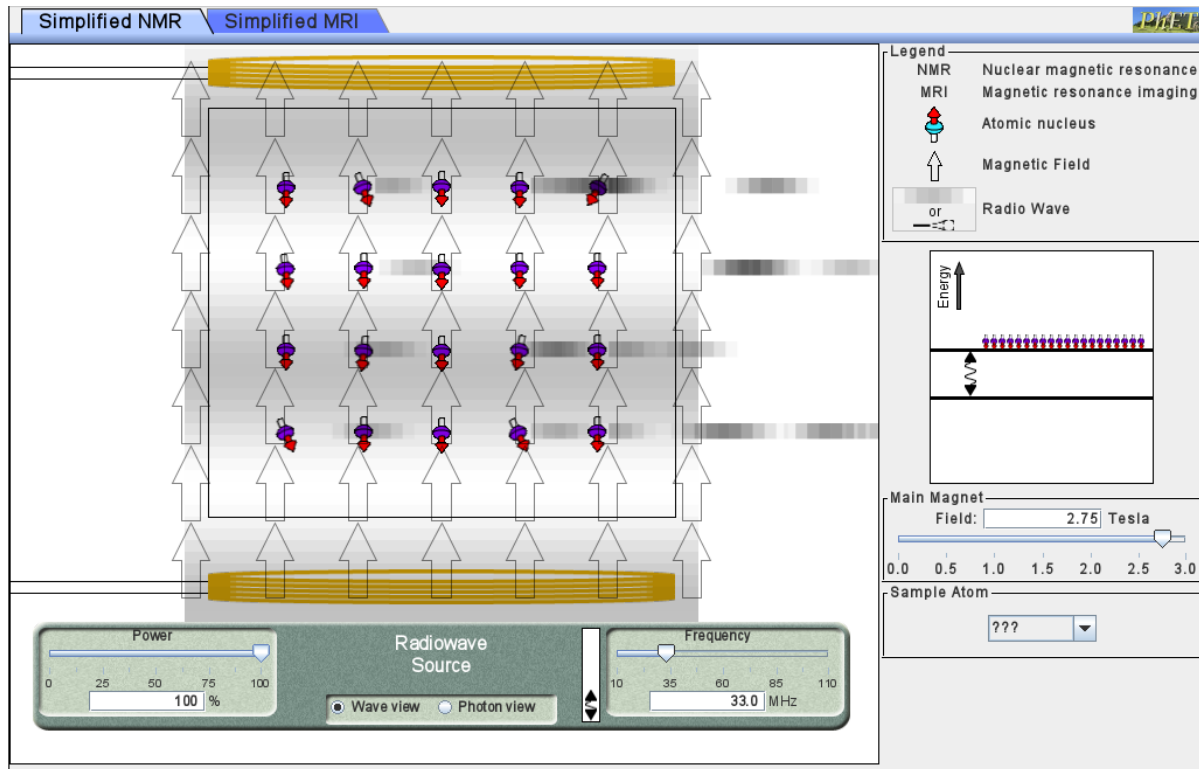
Sulfur

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Desconocido



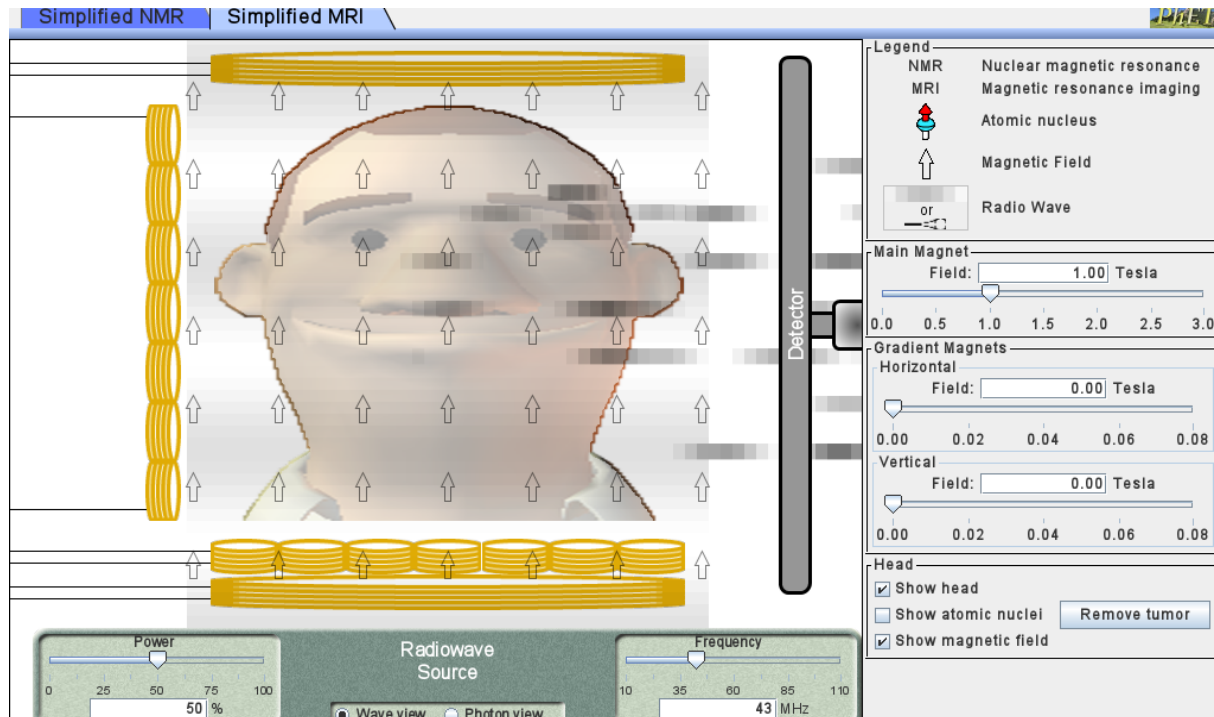


2. MRI

Move to the *Simplified MRI* tab

1. Set the *main magnet field* to 1.0 Tesla, leave the *gradient magnets* in zeros, activate only *show head*, and *show magnetic field* (be sure that *show atomic nuclei* is deactivated), set the frequency in 43 MHz. Finally set the *power* to 50% and observe the flow and distribution of the emissions. After a while observing the emissions, click on *add tumor*, wait for around 7 seconds so the flow distribution stabilizes, look at how the emission changed and try to guess where the tumor is located.

Explain how the emission allowed you to find the correct location: La mayoría de las ondas nacían del lado derecho de la cara del paciente sobre todo en el área del ojo y ceja derecha



2. Play with the main magnet field, frequency, and gradient magnets (both, horizontal and vertical) to try to obtain an emission focused mainly in the zone of the tumor (register your best guess, it doesn't need to be perfect). Answer the following questions.

El tumor se encuentra en la parte derecha de la cara del paciente a la altura de la mandíbula y la comisura del labio.

Best guess: main magnet: 1.05 horizontal gradient: 0.06 vertical gradient: 0.04 frequency: 51.8

What happens when the horizontal gradient increases its magnitude? How does it affect the emissions? las emisiones se hacen mas constantes y son lanzadas con un poco mas de velocidad

What about vertical gradient? No se miran muy afectadas las ondas emitidas, sin embargo al aumentar el grandiente más fotones som emitidos a través del paciente

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