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CERN Large Hadron Collider (LHC) Radiation Source for Magnetic Resonance Biospectroscopy in Metabolic and Molecular Imaging and Diagnosis of Cancer

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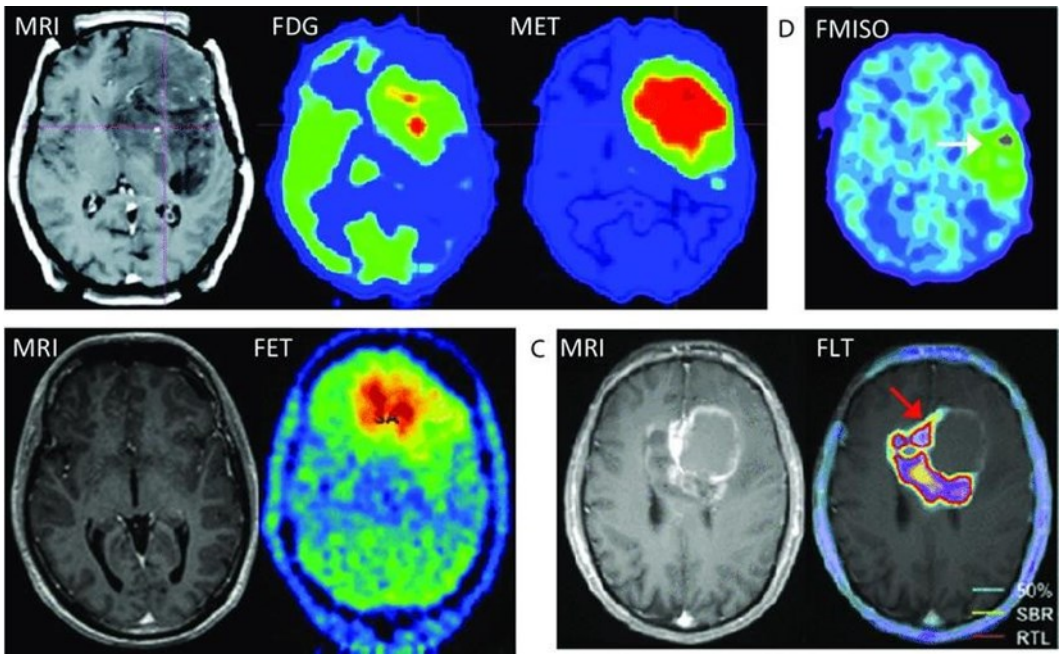
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Abstract

Molecular imaging is a new method in examining physiological studies in molecular dimensions. Among the various methods that have been introduced for this purpose, the magnetic resonance spectroscopy (MRS) method has made it possible to more accurately study the activities of the brain region as well as tumors in different parts of the body. MRS imaging is a type of non– invasive imaging technique that is used to study metabolic changes in the brain, stroke, seizure disorders, Alzheimer's disease, depression and also metabolic changes in other parts of the body such as muscles. In fact, since metabolic changes in the human body appear faster than anatomical and physiological changes, the use of this method can play an important role in the early detection and diagnosis of cancers, infections, metabolic changes and many other diseases. (Graphical Abstract)

Introduction

MRI (MR) imaging is primarily related to the production of anatomical images, while in the MRS method, instead of an image, we will have a spectrum of the range of MR signals according to their intensity frequency (in Hertz or ppm) [1–38]. The signals recorded by MRI are mainly from protons in water and



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fat. In MRS studies other than hydrogen nucleus, other nuclei such as 31P, 7Li, 19F, 23Na and 13C have been used, which contain physiological information. By comparison, MRS aims to analyze the chemical composition of tissues in a very small number of much larger voxels [39–76]. The signal–to–noise ratio in MRS is lower than in MRI, therefore, the volume of selected voxels is considered larger for MRS. MRI removes chemical shift information, while the purpose of MRS is to enhance this information qualitatively and quantitatively [77–114].

For cancer treatment, it is critical to be able to identify key biomolecules and molecular changes associated with cancer and harmful things, as well as to monitor the medically beneficial results against these targets. People who work to find information and doctors now have new tools to improve most aspects of cancer care thanks to recent developments in molecular imaging based on magnet–based (MR) methods. The broad definition of molecular imaging is "imaging techniques for detecting molecular signatures at the cellular and expression (tiny chemical assembly instruction inside of living things) levels. “This article discusses the (possible power or ability within/possibility of) these ways of doing things in improving medicine–based cancer care and reviews both established and newly appearing molecular MR methods in cancer–related medical care. It also talks about how molecular MR, as well as other ways of doing things with functional MR imaging (related to what holds something together and makes it strong), paves the way for custom–designed cancer treatment (success plans/ways to reach goals) [115–152].

Breast cancer is a common disease that affects women. It is the second leading factor in women's cancer–related deaths. Related to food processing and use), reprogramming takes place during the growth of cancer, sudden, unwanted entry into a location, and disease spread throughout the body. Body–structure–related and molecular processes have shown (possibility of/possibility of happening of) illustrating body–structure–related and molecular processes changes before (related to body structure) visible signs on ordinary MR imaging, as shown by functional magnet–based (MR) methods containing/making up an organized row of ways to do things. One of these is in vivo proton (1H) MR spectroscopy (MRS), which is widely

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used to distinguish breast cancer from other diseases by measuring compounds that contain more choline. In addition, the understanding of glucose and phospholipid (chemically processing and using food) was enhanced by the utilization of hyperpolarized 13C and 31P MRS. In vitro bright and sharp NMR spectroscopy and bright and sharp magic angle spectroscopy (HRMAS) can also be used to closely examine medical samples and examples (unharmed and in one piece tissues, tissue extracts, and various biofluids such as blood, urine, nipple breathes/inhales, and fine needle breathes/inhales) to gather information about the (related to processing and using food) body functions of living things. In addition to providing a deeper understanding of cancer (study of living things/qualities of living things) and chemically processing and using food, such studies can provide information on more metabolites than seen by in vivo MRS. The tumor subtypes were classified after a large number of NMR data sets related to ghosts or rainbow colors were analyzed using multivariate methods related to studying numbers. It demonstrated significant (possible greatness or power) progress in the creation of novel medically beneficial strategies. By putting into numbers (related to what holds something together and makes it strong), vasculature, diffusion, perfusion, and (related to processing and using food) (things that are different from what is usually expected) in vivo, multiparametric MRI approaches were found to be helpful in explaining how a disease works, particularly cancer. This review focuses on how NMR, MRS, and MRI can be used to understand breast cancer (study of living things and their qualities), identify a disease or problem or its cause, and monitor breast cancer in a way that is helpful to medicine [153–183].

Results and Discussion

MR spectroscopy analyzes molecules such as hydrogen ions or protons. Proton spectroscopy is more common. There are several metabolites or metabolic products that can be measured to differentiate between tumor types: Lactate or Lac N–acetyl aspartate or NAA Choline or Cho Creatine or Cr Myo–inositol or Myo Glutamate and Glutamine or Glx Lipid. The abundance of these metabolites is measured in units called parts per million (ppm) and plotted as peaks of different heights on the graph. The horizontal axis of the spectrum indicates the amount of chemical shift of each of these materials and the vertical axis indicates the amount of this chemical shift, which is the same signal resulting from the magnetic intensification of the core. By measuring the PPM of each of the mentioned metabolites and comparing them with normal brain tissue, neurologists can determine the type of tissue present. MR spectroscopy can be used to determine the type of tumor and whether it is malignant or benign, etc. Simultaneously with the discovery of MRI, the chemical shift effect was also identified. Chemical shift (chemical shift) is the basis of MRS. The origin of this effect is the response of the electrons of a molecule to the magnetic field [115–152]. In the MRI discussion, the nucleus or proton is affected by an external field with intensity B0 and therefore rotates around the field with the Larmor frequency, but the electrons themselves also create a protective effect or shield around the proton or nucleus, which is called the shielding constant. we say. The greater the electron cloud and the number and characteristics of the electronegativity, the greater this protection is, and therefore the nucleus does not see the actual external value of the field, so we expect hydrogens that are in tissues with less electron shielding to see a greater external magnetic field and according to the Larmor relation They rotate faster around the external field, while for tissues such as fat, where hydrogen protons have stronger bonds with carbons and electron shields, they rotate slower with the Larmor frequency [153–183]. In fact, different metabolites have different hydrogen bonds and considering that the chemical shift in them differs according to what was mentioned, we can use it in Spectroscopy. In general, two different approaches are used in proton spectroscopy: Single voxel method that uses a sequence of STEAM or PRESS pulses and spectroscopic imaging methods that are also known as chemical shift imaging or CSI. In the first attempts to perform spectroscopic imaging, which is also referred to

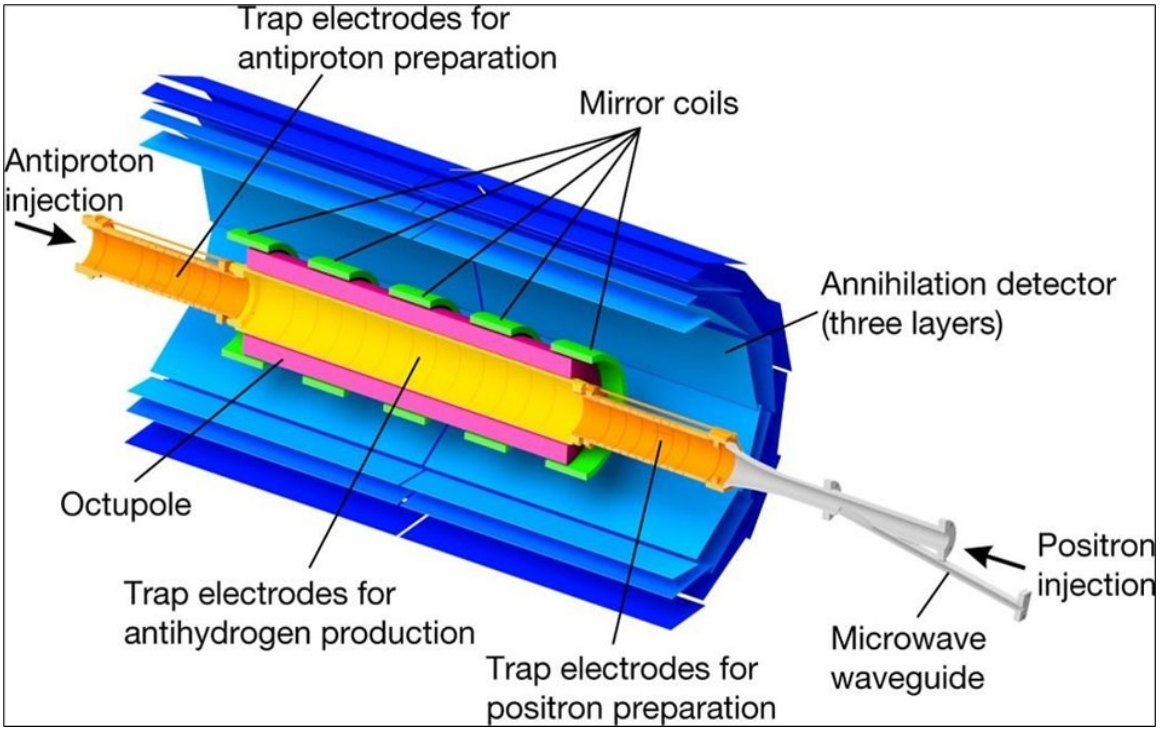


Figure 1. The phase methods in two directions were extended to two dimensions and subsequently

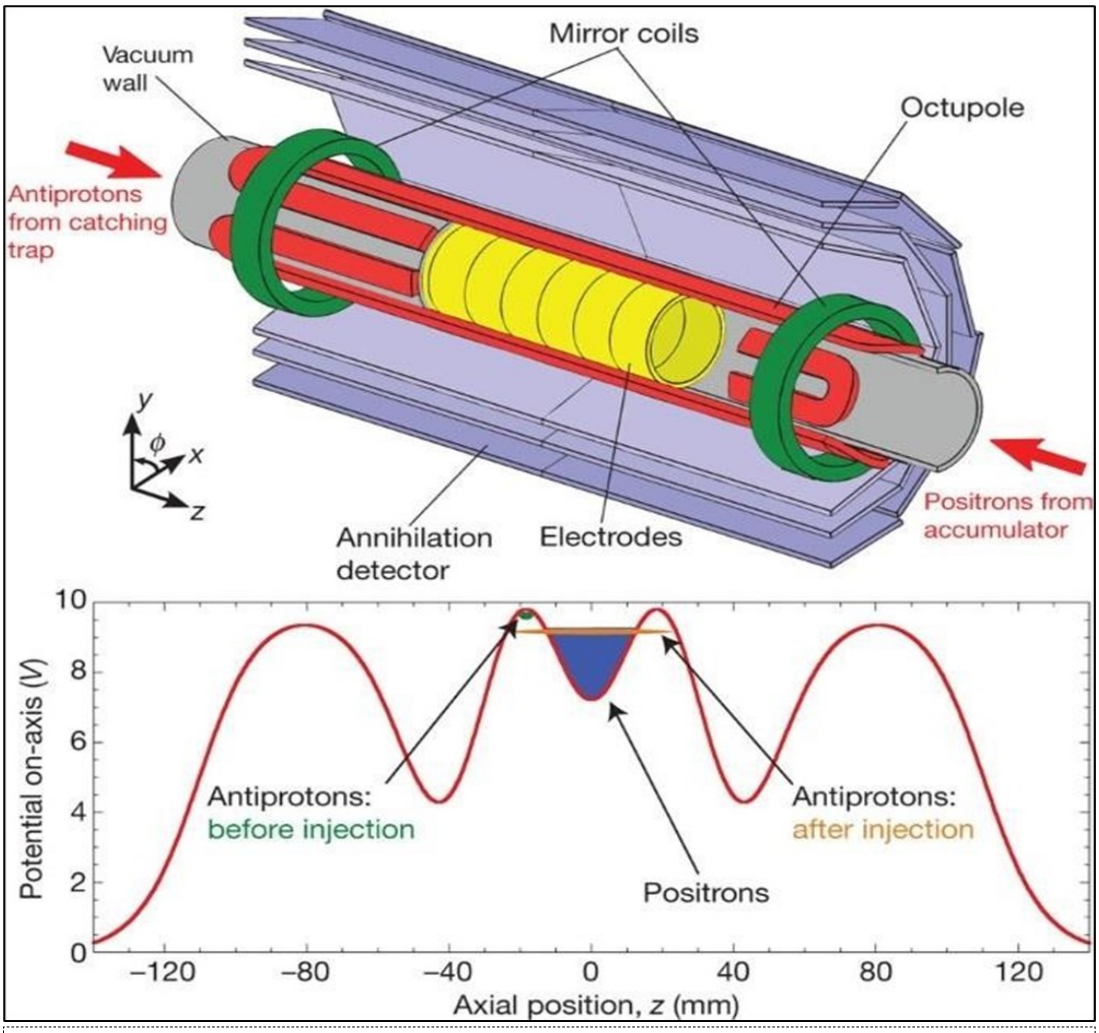


Figure 2. Schematic of single voxel spectroscopy method.

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as MRS, the one– dimensional method was performed using phase coding in one direction. By using MRSI coding gradients, the phase methods in two directions were extended to two dimensions and subsequently to three dimensions with three–dimensional coding, which are called chemical shift imaging (Figure 1).

While most single voxel studies are performed in short TEs. MRSI studies are performed in long TEs. Low TE spectra contain the signal of a greater number of compounds and as a result better SNR, but their contamination with water and fat is also more. In contrast, high TE spectra have lower SNR, less visible compounds and different T2–weight values, but they have spectra with more separated resonances and a smoother background. The choice of method depends on the information needed in a specific medical or research application. For example, if spectroscopy is used to find the location of a stroke or seizure center in the brain, the microscopic extent of tumors and the intensity of tumor invasion in the prostate and brain, the CSI method is preferable because it is able to create a map of the amount of metabolites in order to diagnose lesions. Scattered to be used in different places. But if the tissue is studied in order to check the composition change at a specific point, the single voxel spectroscopy method will be the chosen method (Figure 2).

It is a non–invasive method. It can be used to monitor the chemical changes of tissues. We can simultaneously evaluate several metabolites. Two examples of where MRS is very helpful in the brain: The invasion of the tumor (Glioblastoma multiform (GBM) into the surrounding tissues, which is not clear in normal T2 images, but can be determined by MRS. By MRS, it is possible to distinguish two types of lesions that look similar to each other in normal MRI images (such as tumor recurrence and tumor necrosis after radiotherapy). MRS imaging has found wide applications in the field of cancer diagnosis. Among the fields of clinical application of MRS, we can mention the diagnosis (between normal and cancerous tissue, different types of cancer and neoplastic from non–neoplastic), designing the best treatment regimens for each patient, and monitoring the patient after treatment. MRS in tumors: In brain tumors, spectroscopy can determine the degree of malignancy. As malignancy increases, NAA and creatine decrease and choline, lactate and fat increase. Fat is seen in the necrotic parts of the tumor. Lactate concentration increases in rapidly growing tumors due to anaerobic glycolysis. Diagnosing tumor recurrence from the effects of radiotherapy: Increased choline is a marker for tumor recurrence. Changes due to radiotherapy usually decrease NAA, creatine and choline. If necrosis has occurred as a result of radiotherapy, fat and lactate can also be seen in the spectrum. Molecular imaging using spectroscopy Cerebral ischemia and infarction: When the brain suffers from ischemia, anaerobic respiration of glucose is used and lactate increases. Choline increases and NAA and creatine decrease. If it happens after ischemia, the fat signal is also seen. trauma: It is a useful method to assess the degree of nerve damage and predict the results. The clinical consequences are opposite to the NAA/Cr ratio, and the observation of lactate and fat indicates the seriousness of the condition. infectious diseases: decrease naa Inside the abscess, lactate, alanine, cytosolic acid and acetate increase. Alzheimer: In the advanced stages of Alzheimer's, NAA decreases and myo–inositol increases. MS: The increase of choline and lactate has shown that the increase of choline can be due to the increase of phospholipid as a result of breaking the myelin of the cell and the increase of lactate is due to the increase of the anaerobic respiration of the cell due to the increase of the cell metabolism. In addition, there is evidence of increased lipids, and most importantly, decreased NAA, which is caused by nerve damage. And recently, it has been found that glutamate and myoinositol levels increase in acute MS lesions. Parkinson: In most studies in Parkinson's disease, no changes in metabolites have been observed, only when Parkinson's has caused brain atrophy, a decrease in NAA in the basal ganglia has been observed (Figures 3–6).

Conclusion, Summary, Outlook and Future Directions

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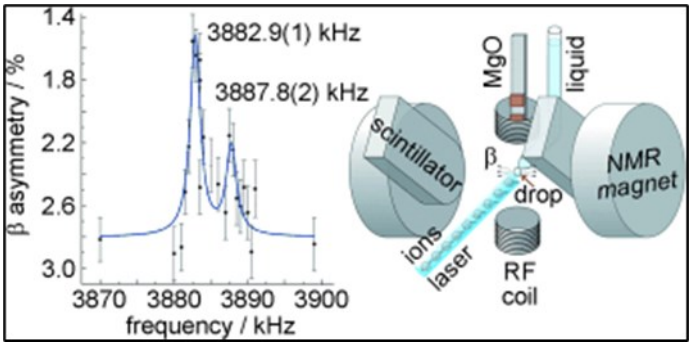


Figure 3. Different spectra metabolites in different areas of the human body.

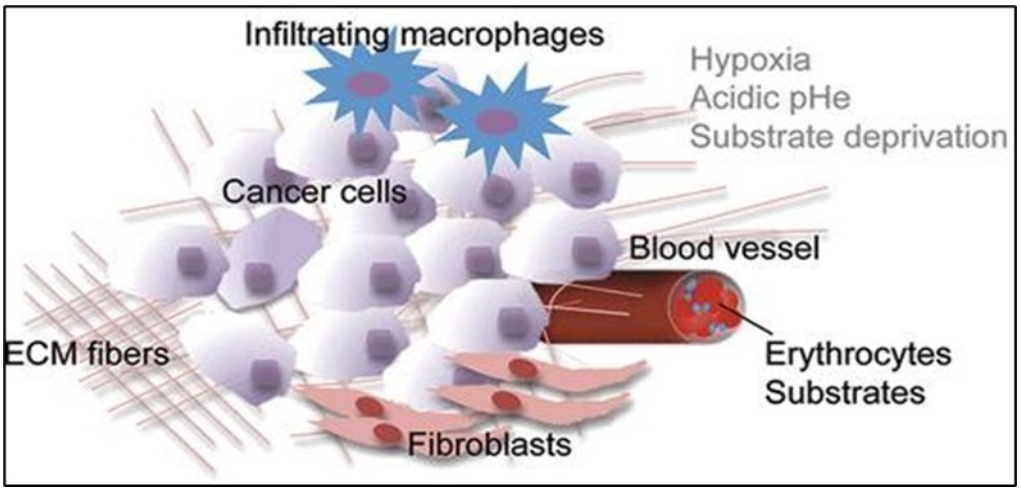


Figure 4. Infiltrating macrophages of cancer cells in interaction with hypoxia acidic pHe substrate deprivation.

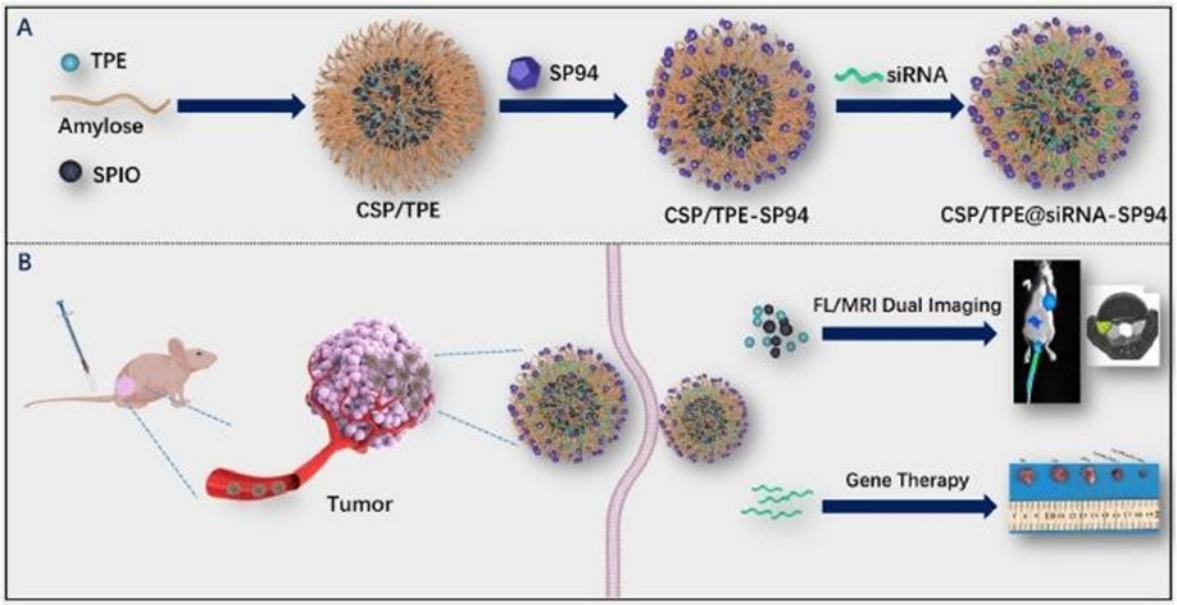


Figure 5. Schematic of different steps of CERN Large Hadron Collider (LHC) radiation source for magnetic resonance biospectroscopy in metabolic and molecular imaging and diagnosis of cancer.

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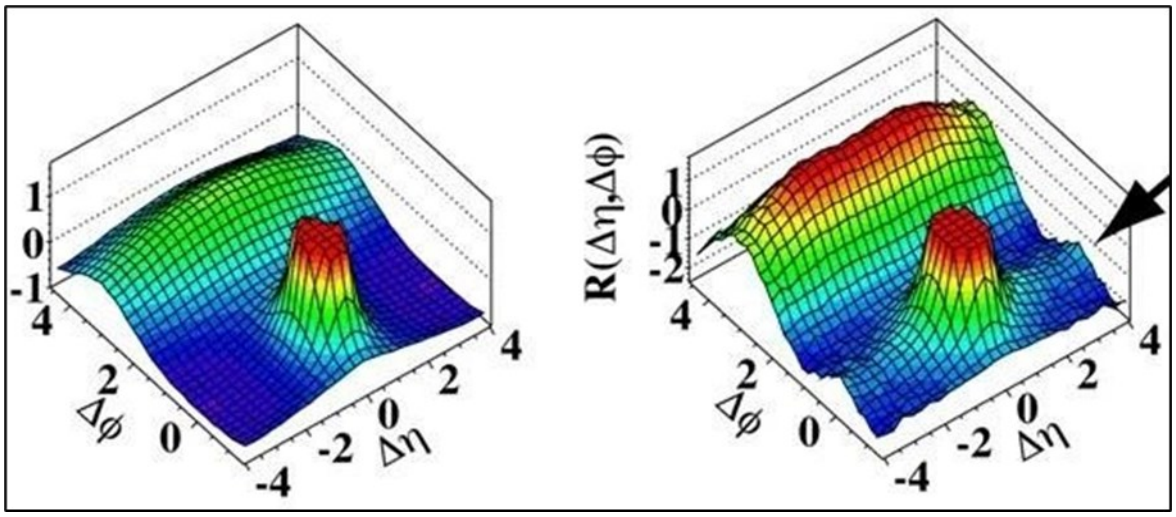


Figure 6. Simulation of CERN Large Hadron Collider (LHC) radiation source for magnetic resonance biospectroscopy in metabolic (left) and molecular (right) imaging and diagnosis of cancer.

MRS imaging method is a new method in molecular imaging that can be used in different types of differential diagnoses. Among the areas of clinical application of MRS, we can mention the diagnosis (between normal and cancerous tissue, different types of cancer and neoplastic from non–neoplastic), designing the best treatment regimens for each patient, and monitoring the patient after treatment. This method can solve the lack of ability of MRI method in examining pathology.

Measurements of molecular and cellular processes, such as the chemical processing and use of food, cell death, cell growth and spread, and biosynthetic pathways of various metabolites in vivo in cancer, can be made using molecular MR imaging. Every aspect of cancer–related medical care, including early disease detection, identification of a disease or problem or its cause, staging, personalized treatment, and treatment monitoring/supervision, can benefit from molecular imaging. Ovarian, lung, and male reproductive gland cancer are just a few of the many types of cancer for which molecular imaging had a significant impact on patient care. Detecting and curing disease in its most treatable phase, as well as saving a large number of lives, may be possible with molecular imaging's ability to detect (things that are different from what is usually expected) very early in the (development or increase over time/series of events or things) of disease. This could shift medicine away from causing reactions from other people or chemicals and toward preventing problems before they occur. In clinical arrangement, sub–atomic X–ray will make ready toward a major improvement in early discovery of illness, treatment arranging and watching/ overseeing the restoratively supportive outcomes.

This survey momentarily introduced the (conceivable power or capacity inside/probability of) X–ray and MRS–based techniques in figuring out bosom malignant growth (investigation of living things/ characteristics of living things) and the job of various MR biomarkers in illness (recognizable proof of a sickness or issue, or its goal), (proclamation about a potential future occasion), (looking at and testing so a choice can be made), medicinally supportive watching/managing, and cancer (rehashing occasion).Numerous metabolites were found in breast cancer patients through in vitro bright and sharp NMR studies of tissue extracts, nodes, serum, and blood plasma samples. More than two, but not many, metabolites, membrane metabolites like tCho and GPC, and amino acids like Ala, Glu, Gln, Lys, His, Gly, Ser, and Tau, as well as legal and law–based machines, methods, and ways, were shown to have changed in response to the changes. In addition, these metabolites could be used as disease–specific and prediction– related biomarkers in the treatment of breast cancer.

The molecular mixed–up nature of tumors was

also connected to the mixed–up nature of tumors, which was related to food processing and use. However, a comprehensive and thorough description of the mixed–up nature of breast cancer (damage to body parts) is required in relation to food processing and use. X–ray and MRS are currently being utilized as (partner/helping) approaches to getting things done to clinical bosom tests, histology, and alternate approaches to getting things done. Information on tumor cellularity, perfusion, and stiffness are provided by MRI, which combines them to produce something superior. RI has emerged as an important tool for (determining the value, quantity, or quality of) the population of women at high risk over the past few years.

The use of MRI in the detection of cancers that are occult on a mammogram has been demonstrated in numerous studies. However, due to its technical difficulties, breast MRS is still not performed regularly. MRS's sensitivity is also constrained by a number of technical factors. However, recent computer and scientific advancements, like improving the design and sensitivity of breast coils and high–field MR systems, may be able to enhance the breast MRS's quality of being very close to the truth or true number. Even though the methods of MRI and MRS showed or told about a lot of biomarkers as potential candidates, they are only used in research labs at this time for (more than two, but not a lot of) reasons like technical difficulties and higher costs for procedures, equipment not being available, etc. For these markers to be used in clinics to provide decorated (with a personal touch) health care, they need to be developed with greater reproducibility.

Using MR techniques, it is necessary to demonstrate various histological types of breast cancer for a comprehensive understanding of its mixed nature. The ability of these methods to identify diseases may improve as a result of this. In addition, there is a requirement for simple, automated acquisition, learning, and post–processing sets of computer instructions that can be visualized (in your mind) and converted into numbers for Cho in tumors of a small size. The cost of MR procedures for more applications should be the primary focus of future research. Additionally, multi–center studies on the application of MRI and MRS strategies in medicine–based settings are required to "combine" them into a single unit. NMR spectroscopy of biofluids in women at risk for (related to things you get from your parents' genes) is also necessary to (figure out the worth, amount, or quality of). This is a potential area for future research that could aid in the classification of women at high risk for cancer and provide an early indication of the vulnerable population. In addition, it is crucial to carry out metabolomics studies in a well–organized manner in order to discover robust and healthy biomarkers for the (identification of a disease or problem, or its cause), as well as the outlook for the disease. The results of metabolomics research ought to be translated into the development of overly straightforward methods that could be easily implemented in medicine–based settings with low–cost effects, recommendations, and results. Long/big multi–center (acts of asking questions and attempting to find the truth about something) is required by recent methods like MR elastography. Utilizations of radiomics need to be thoroughly investigated, and X–ray practitioners need to gain a better understanding of the fundamental concepts, the creation of reproducible (done or made to look the same every time) sets of computer instructions, and the sharing of data for medicine–based applications.

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References

1. A. Heidari, *"Different High–Resolution Simulations of Medical, Medicinal, Clinical, Pharmaceutical and*

Therapeutics Oncology of Human Lung Cancer Translational Anti–Cancer Nano Drugs Delivery Treatment Process under Synchrotron and X–Ray Radiations", J Med Oncol. Vol. 1 No. 1: 1, 2017.

2. A. Heidari, *"A Modern Ethnomedicinal Technique for Transformation, Prevention and Treatment of Human Malignant Gliomas Tumors into Human Benign Gliomas Tumors under Synchrotron Radiation", Am J Ethnomed, Vol. 4 No. 1: 10, 2017.*
3. A. Heidari, *"Active Targeted Nanoparticles for Anti–Cancer Nano Drugs Delivery across the Blood–Brain Barrier for Human Brain Cancer Treatment, Multiple Sclerosis (MS) and Alzheimer's Diseases Using Chemical Modifications of Anti–Cancer Nano Drugs or Drug– Nanoparticles through Zika Virus (ZIKV) Nanocarriers under Synchrotron Radiation", J Med Chem Toxicol, 2 (3): 1–5, 2017.*
4. A. Heidari, *"Investigation of Medical, Medicinal, Clinical and Pharmaceutical Applications of Estradiol, Mestranol (Norlutin), Norethindrone (NET), Norethisterone Acetate (NETA), Norethisterone Enanthate (NETE) and Testosterone Nanoparticles as Biological Imaging, Cell Labeling, Anti–Microbial Agents and Anti–Cancer Nano Drugs in Nanomedicines Based Drug Delivery Systems for Anti–Cancer Targeting and Treatment", Parana Journal of Science and Education (PJSE)–v.3, n.4, (10–19) October 12, 2017.*
5. A. Heidari, *"A Comparative Computational and Experimental Study on Different Vibrational Biospectroscopy Methods, Techniques and Applications for Human Cancer Cells in Tumor Tissues Simulation, Modeling, Research, Diagnosis and Treatment", Open J Anal Bioanal Chem 1 (1): 014–020, 2017.*
6. A. Heidari, *"Combination of DNA/RNA Ligands and Linear/Non–Linear Visible– Synchrotron Radiation–Driven N–Doped Ordered Mesoporous Cadmium Oxide (CdO) Nanoparticles Photocatalysts Channels Resulted in an Interesting Synergistic Effect Enhancing Catalytic Anti–Cancer Activity", Enz Eng 6: 1, 2017.*
7. A. Heidari, *"Modern Approaches in Designing Ferritin, Ferritin Light Chain, Transferrin, Beta–2 Transferrin and Bacterioferritin–Based Anti–Cancer Nano Drugs Encapsulating Nanosphere as DNA–Binding Proteins from Starved Cells (DPS)", Mod Appro Drug Des. 1 (1). MADD.000504. 2017.*
8. A. Heidari, *"Potency of Human Interferon β–1a and Human Interferon β–1b in Enzymotherapy, Immuno-therapy, Chemotherapy, Radiotherapy, Hormone Therapy and Targeted Therapy of Encephalomyelitis Disseminate/Multiple Sclerosis (MS) and Hepatitis A, B, C, D, E, F and G Virus Enter and Targets Liver Cells", J Proteomics Enzymol 6: 1, 2017.*
9. A. Heidari, *"Transport Therapeutic Active Targeting of Human Brain Tumors Enable Anti– Cancer Nanodrugs Delivery across the Blood–Brain Barrier (BBB) to Treat Brain Diseases Using Nanoparticles and Nanocarriers under Synchrotron Radiation", J Pharm Pharmaceutics 4 (2): 1–5, 2017.*
10. A. Heidari, C. Brown, *"Combinatorial Therapeutic Approaches to DNA/RNA and Benzylpenicillin (Penicillin G), Fluoxetine Hydrochloride (Prozac and Sarafem), Propofol (Diprivan), Acetylsalicylic Acid (ASA) (Aspirin), Naproxen Sodium (Aleve and Naprosyn) and Dextromethamphetamine Nanocapsules with Surface Conjugated DNA/RNA to Targeted Nano Drugs for Enhanced Anti–Cancer Efficacy and Targeted Cancer Therapy Using Nano Drugs Delivery Systems", Ann Adv Chem. 1 (2): 061–069, 2017.*
11. A. Heidari, *"High–Resolution Simulations of Human Brain Cancer Translational Nano Drugs Delivery Treatment Process under Synchrotron Radiation", J Transl Res. 1 (1): 1–3, 2017.*
12. A. Heidari, *"Investigation of Anti–Cancer Nano Drugs' Effects' Trend on Human Pancreas Cancer Cells and Tissues Prevention, Diagnosis and Treatment Process under Synchrotron and X–Ray Radiations with the Passage of Time Using Mathematica", Current Trends Anal Bioanal Chem, 1 (1): 36–41, 2017.*

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13. A. Heidari, *"Pros and Cons Controversy on Molecular Imaging and Dynamics of Double– Standard DNA/RNA of Human Preserving Stem Cells–Binding Nano Molecules with Androgens/Anabolic Steroids (AAS) or Testosterone Derivatives through Tracking of Helium–4 Nucleus (Alpha Particle) Using Synchrotron Radiation", Arch Biotechnol Biomed. 1 (1): 067– 0100, 2017.*

14. A. Heidari, *"Visualizing Metabolic Changes in Probing Human Cancer Cells and Tissues Metabolism Using Vivo ^{1}H or Proton NMR, ^{13}C NMR, ^{15}N NMR and ^{31}P NMR Spectroscopy and Self–Organizing Maps under Synchrotron Radiation", SOJ Mater Sci Eng 5 (2): 1–6, 2017.*

15. A. Heidari, *"Cavity Ring–Down Spectroscopy (CRDS), Circular Dichroism Spectroscopy, Cold Vapour Atomic Fluorescence Spectroscopy and Correlation Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Enliven: Challenges Cancer Detect Ther 4 (2): e001, 2017.*

16. A. Heidari, *"Laser Spectroscopy, Laser–Induced Breakdown Spectroscopy and Laser– Induced Plasma Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Int J Hepatol Gastroenterol, 3 (4): 079–084, 2017.*

17. A. Heidari, *"Time–Resolved Spectroscopy and Time–Stretch Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Enliven: Pharmacovigilance and Drug Safety 4 (2): e001, 2017.*

18. A. Heidari, *"Overview of the Role of Vitamins in Reducing Negative Effect of Decapeptyl (Triptorelin Acetate or Pamoate Salts) on Prostate Cancer Cells and Tissues in Prostate Cancer Treatment Process through Transformation of Malignant Prostate Tumors into Benign Prostate Tumors under Synchrotron Radiation", Open J Anal Bioanal Chem 1 (1): 021–026, 2017.*

19. A. Heidari, *"Electron Phenomenological Spectroscopy, Electron Paramagnetic Resonance (EPR) Spectroscopy and Electron Spin Resonance (ESR) Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Austin J Anal Pharm Chem. 4 (3): 1091, 2017.*

20. A. Heidari, *"Therapeutic Nanomedicine Different High–Resolution Experimental Images and Computational Simulations for Human Brain Cancer Cells and Tissues Using Nanocarriers Deliver DNA/RNA to Brain Tumors under Synchrotron Radiation with the Passage of Time Using Mathematica and MATLAB", Madridge J Nano Tech. Sci. 2 (2): 77–83, 2017.*

21. A. Heidari, *"A Consensus and Prospective Study on Restoring Cadmium Oxide (CdO) Nanoparticles Sensitivity in Recurrent Ovarian Cancer by Extending the Cadmium Oxide (CdO) Nanoparticles–Free Interval Using Synchrotron Radiation Therapy as Antibody–Drug Conjugate for the Treatment of Limited–Stage Small Cell Diverse Epithelial Cancers", Cancer Clin Res Rep, 1: 2, e001, 2017.*

22. A. Heidari, *"A Novel and Modern Experimental Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under White Synchrotron Radiation", Cancer Sci Res Open Access 4 (2): 1–8, 2017.*

23. A. Heidari, *"Different High–Resolution Simulations of Medical, Medicinal, Clinical, Pharmaceutical and Therapeutics Oncology of Human Breast Cancer Translational Nano Drugs Delivery Treatment Process under Synchrotron and X–Ray Radiations", J Oral Cancer Res 1 (1): 12–17, 2017.*

24. A. Heidari, *"Vibrational Decihertz (dHz), Centihertz (cHz), Millihertz (mHz), Microhertz (μHz), Nanohertz (nHz), Picohertz (pHz), Femtohertz (fHz), Attohertz (aHz), Zeptohertz (zHz) and Yoctohertz (yHz) Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", International Journal of*

Citation: Alireza Heidari, Zahra Torfeh, Sophia Iorgulescu, Olivia Robinson, Lin Hu et al. (2022) CERN Large Hadron Collider (LHC) Radiation Source for Magnetic Resonance Biospectroscopy in Metabolic and Molecular Imaging and Diagnosis of Cancer. Journal of New Developments in Chemistry - 3(4):29-30. https://doi.org/10.14302/issn.2377-2549.jndc-22-4351

Biomedicine, 7 (4), 335–340, 2017.

25. A. Heidari, *"Force Spectroscopy and Fluorescence Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", EC Cancer, 2 (5), 239–246, 2017.*
26. A. Heidari, *"Photoacoustic Spectroscopy, Photoemission Spectroscopy and Photothermal Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", BAOJ Cancer Res Ther, 3: 3, 045–052, 2017.*
27. A. Heidari, *"J–Spectroscopy, Exchange Spectroscopy (EXSY), Nuclear Overhauser Effect Spectroscopy (NOESY) and Total Correlation Spectroscopy (TOCSY) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", EMS Eng Sci J, 1 (2): 006–013, 2017.*
28. A. Heidari, *"Neutron Spin Echo Spectroscopy and Spin Noise Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Int J Biopharm Sci, 1: 103–107, 2017.*
29. A. Heidari, *"Vibrational Decahertz (daHz), Hectohertz (hHz), Kilohertz (kHz), Megahertz (MHz), Gigahertz (GHz), Terahertz (THz), Petahertz (PHz), Exahertz (EHz), Zettahertz (ZHz)and Yottahertz (YHz) Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Madridge J Anal Sci Instrum, 2 (1): 41–46, 2017.*
30. A. Heidari, *"Two–Dimensional Infrared Correlation Spectroscopy, Linear Two– Dimensional Infrared Spectroscopy and Non–Linear Two–Dimensional Infrared Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", J Mater Sci Nanotechnol 6 (1): 101, 2018.*
31. A. Heidari, *"Fourier Transform Infrared (FTIR) Spectroscopy, Near–Infrared Spectroscopy (NIRS) and Mid–Infrared Spectroscopy (MIRS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", Int J Nanotechnol Nanomed, Volume 3, Issue 1, Pages 1–6, 2018.*
32. A. Heidari, *"Infrared Photo Dissociation Spectroscopy and Infrared Correlation Table Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", Austin Pharmacol Pharm, 3 (1): 1011, 2018.*
33. A. Heidari, *"Novel and Transcendental Prevention, Diagnosis and Treatment Strategies for Investigation of Interaction among Human Blood Cancer Cells, Tissues, Tumors and Metastases with Synchrotron Radiation under Anti–Cancer Nano Drugs Delivery Efficacy Using MATLAB Modeling and Simulation", Madridge J Nov Drug Res, 1 (1): 18–24, 2017.*
34. A. Heidari, *"Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Open Access J Trans Med Res, 2 (1): 00026–00032, 2018.*
35. M. R. R. Gobato, R. Gobato, A. Heidari, *"Planting of Jaboticaba Trees for Landscape Repair of Degraded Area", Landscape Architecture and Regional Planning, Vol. 3, No. 1, Pages 1–9, 2018.*
36. A. Heidari, *"Fluorescence Spectroscopy, Phosphorescence Spectroscopy and Luminescence Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", SM J Clin. Med. Imaging, 4 (1): 1018, 2018.*
37. A. Heidari, *"Nuclear Inelastic Scattering Spectroscopy (NISS) and Nuclear Inelastic Absorption Spectroscopy (NIAS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Int J Pharm Sci, 2 (1): 1–14, 2018.*
38. A. Heidari, *"X–Ray Diffraction (XRD), Powder X–Ray*

Diffraction (PXRD) and Energy– Dispersive X–Ray Diffraction (EDXRD) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", J Oncol Res; 2 (1): 1–14, 2018.

39. A. Heidari, *"Correlation Two–Dimensional Nuclear Magnetic Resonance (NMR) (2D– NMR) (COSY) Imaging and Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", EMS Can Sci, 1–1–001, 2018.*
40. A. Heidari, *"Thermal Spectroscopy, Photothermal Spectroscopy, Thermal Microspectroscopy, Photothermal Microspectroscopy, Thermal Macrospectroscopy and Photothermal Macrospectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", SM J Biometrics Biostat, 3 (1): 1024, 2018.*
41. A. Heidari, *"A Modern and Comprehensive Experimental Biospectroscopic Comparative Study on Human Common Cancers' Cells, Tissues and Tumors before and after Synchrotron Radiation Therapy", Open Acc J Oncol Med. 1 (1), 2018.*
42. A. Heidari, *"Heteronuclear Correlation Experiments Such as Heteronuclear Single– Quantum Correlation Spectroscopy (HSQC), Heteronuclear Multiple–Quantum Correlation Spectroscopy (HMQC) and Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC) Comparative Study on Malignant and Benign Human Endocrinology and Thyroid Cancer Cells and Tissues under Synchrotron Radiation", J Endocrinol Thyroid Res, 3 (1): 555603, 2018.*
43. A. Heidari, *"Nuclear Resonance Vibrational Spectroscopy (NRVS), Nuclear Inelastic Scattering Spectroscopy (NISS), Nuclear Inelastic Absorption Spectroscopy (NIAS) and Nuclear Resonant Inelastic X–Ray Scattering Spectroscopy (NRIXSS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Int J Bioorg Chem Mol Biol. 6 (1e): 1–5, 2018.*
44. A. Heidari, *"A Novel and Modern Experimental Approach to Vibrational Circular Dichroism Spectroscopy and Video Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under White and Monochromatic Synchrotron Radiation", Glob J Endocrinol Metab. 1 (3). GJEM. 000514–000519, 2018.*
45. A. Heidari, *"Pros and Cons Controversy on Heteronuclear Correlation Experiments Such as Heteronuclear Single–Quantum Correlation Spectroscopy (HSQC), Heteronuclear Multiple– Quantum Correlation Spectroscopy (HMQC) and Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", EMS Pharma J. 1 (1): 002–008, 2018.*
46. A. Heidari, *"A Modern Comparative and Comprehensive Experimental Biospectroscopic Study on Different Types of Infrared Spectroscopy of Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation"*, J Analyt Molecul Tech. 3 (1): 8, 2018.
47. A. Heidari, *"Investigation of Cancer Types Using Synchrotron Technology for Proton Beam Therapy: An Experimental Biospectroscopic Comparative Study", European Modern Studies Journal, Vol. 2, No. 1, 13–29, 2018.*
48. A. Heidari, *"Saturated Spectroscopy and Unsaturated Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Imaging J Clin Medical Sci. 5 (1): 001–007, 2018.*
49. A. Heidari, *"Small–Angle Neutron Scattering (SANS) and Wide–Angle X–Ray Diffraction (WAXD) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Int J Bioorg Chem Mol Biol. 6 (2e): 1–6, 2018.*

Citation: Alireza Heidari, Zahra Torfeh, Sophia Iorgulescu, Olivia Robinson, Lin Hu et al. (2022) CERN Large Hadron Collider (LHC) Radiation Source for Magnetic Resonance Biospectroscopy in Metabolic and Molecular Imaging and Diagnosis of Cancer. Journal of New Developments in Chemistry - 3(4):29-30. https://doi.org/10.14302/issn.2377-2549.jndc-22-4351

50. A. Heidari, *"Investigation of Bladder Cancer, Breast Cancer, Colorectal Cancer, Endometrial Cancer, Kidney Cancer, Leukemia, Liver, Lung Cancer, Melanoma, Non–Hodgkin Lymphoma, Pancreatic Cancer, Prostate Cancer, Thyroid Cancer and Non–Melanoma Skin Cancer Using Synchrotron Technology for Proton Beam Therapy: An Experimental Biospectroscopic Comparative Study", Ther Res Skin Dis 1 (1), 2018.*

51. A. Heidari, *"Attenuated Total Reflectance Fourier Transform Infrared (ATR–FTIR) Spectroscopy, Micro–Attenuated Total Reflectance Fourier Transform Infrared (Micro–ATR– FTIR) Spectroscopy and Macro–Attenuated Total Reflectance Fourier Transform Infrared (Macro–ATR–FTIR) Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", International Journal of Chemistry Papers, 2 (1): 1–12, 2018.*

52. A. Heidari, *"Mössbauer Spectroscopy, Mössbauer Emission Spectroscopy and ^{57}Fe Mössbauer Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Acta Scientific Cancer Biology 2.3: 17–20, 2018.*

53. A. Heidari, *"Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", Organic & Medicinal Chem IJ. 6 (1): 555676, 2018.*

54. A. Heidari, *"Correlation Spectroscopy, Exclusive Correlation Spectroscopy and Total Correlation Spectroscopy Comparative Study on Malignant and Benign Human AIDS–Related Cancers Cells and Tissues with the Passage of Time under Synchrotron Radiation", Int J Bioanal Biomed. 2 (1): 001–007, 2018.*

55. A. Heidari, *"Biomedical Instrumentation and Applications of Biospectroscopic Methods and Techniques in Malignant and Benign Human Cancer Cells and Tissues Studies under Synchrotron Radiation and Anti–Cancer Nano Drugs Delivery", Am J Nanotechnol Nanomed. 1 (1): 001–009, 2018.*

56. A. Heidari, *"Vivo ^{1}H or Proton NMR, ^{13}C NMR, ^{15}N NMR and ^{31}P NMR Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Ann Biomet Biostat. 1 (1): 1001, 2018.*

57. A. Heidari, *"Grazing–Incidence Small–Angle Neutron Scattering (GISANS) and Grazing– Incidence X–Ray Diffraction (GIXD) Comparative Study on Malignant and Benign Human Cancer Cells, Tissues and Tumors under Synchrotron Radiation", Ann Cardiovasc Surg. 1 (2): 1006, 2018.*

58. A. Heidari, *"Adsorption Isotherms and Kinetics of Multi –Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a– BNNTs) and Hexagonal Boron Nitride Nanotubes (h–BNNTs) for Eliminating Carcinoma, Sarcoma, Lymphoma, Leukemia, Germ Cell Tumor and Blastoma Cancer Cells and Tissues", Clin Med Rev Case Rep 5: 201, 2018.*

59. A. Heidari, *"Correlation Spectroscopy (COSY), Exclusive Correlation Spectroscopy (ECOSY), Total Correlation Spectroscopy (TOCSY), Incredible Natural–Abundance Double– Quantum Transfer Experiment (INADEQUATE), Heteronuclear Single–Quantum Correlation Spectroscopy (HSQC), Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC), Nuclear Overhauser Effect Spectroscopy (NOESY) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESY) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Acta Scientific Pharmaceutical Sciences 2.5: 30–35, 2018.*

60. A. Heidari, *"Small–Angle X–Ray Scattering (SAXS), Ultra–Small Angle X–Ray Scattering (USAXS), Fluctuation X–Ray Scattering (FXS), Wide–Angle X–Ray Scattering (WAXS), Grazing–Incidence Small–Angle X–Ray Scattering (GISAXS), Grazing–Incidence Wide–Angle X–Ray Scattering (GIWAXS), Small–Angle Neutron Scattering (SANS), Grazing–Incidence Small–*

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Angle Neutron Scattering (GISANS), X–Ray Diffraction (XRD), Powder X–Ray Diffraction (PXRD), Wide–Angle X –Ray Diffraction (WAXD), Grazing–Incidence X–Ray Diffraction (GIXD) and Energy–Dispersive X–Ray Diffraction (EDXRD) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Oncol Res Rev, Volume 1 (1): 1 –10, 2018.

61. A. Heidari, *"Pump–Probe Spectroscopy and Transient Grating Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Adv Material Sci Engg, Volume 2, Issue 1, Pages 1–7, 2018.*
62. A. Heidari, *"Grazing–Incidence Small–Angle X–Ray Scattering (GISAXS) and Grazing– Incidence Wide–Angle X–Ray Scattering (GIWAXS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Insights Pharmacol Pharm Sci 1 (1): 1–8, 2018.*
63. A. Heidari, *"Acoustic Spectroscopy, Acoustic Resonance Spectroscopy and Auger Spectroscopy Comparative Study on Anti–Cancer Nano Drugs Delivery in Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Nanosci Technol 5 (1): 1–9, 2018.*
64. A. Heidari, *"Niobium, Technetium, Ruthenium, Rhodium, Hafnium, Rhenium, Osmium and Iridium Ions Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocyclotron Radiations", Nanomed Nanotechnol, 3 (2): 000138, 2018.*
65. A. Heidari, *"Homonuclear Correlation Experiments Such as Homonuclear Single–Quantum Correlation Spectroscopy (HSQC), Homonuclear Multiple–Quantum Correlation Spectroscopy (HMQC) and Homonuclear Multiple–Bond Correlation Spectroscopy (HMBC) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Austin J Proteomics Bioinform & Genomics. 5 (1): 1024, 2018.*
66. A. Heidari, *"Atomic Force Microscopy Based Infrared (AFM–IR) Spectroscopy and Nuclear Resonance Vibrational Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", J Appl Biotechnol Bioeng. 5 (3): 142–148, 2018.*
67. A. Heidari, *"Time–Dependent Vibrational Spectral Analysis of Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", J Cancer Oncol, 2 (2): 000124, 2018.*
68. A. Heidari, *"Palauamine and Olympiadane Nano Molecules Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocyclotron Radiations", Arc Org Inorg Chem Sci 3 (1), 2018.*
69. R. Gobato, A. Heidari, *"Infrared Spectrum and Sites of Action of Sanguinarine by Molecular Mechanics and Ab Initio Methods", International Journal of Atmospheric and Oceanic Sciences. Vol. 2, No. 1, pp. 1–9, 2018.*
70. A. Heidari, *"Angelic Acid, Diabolic Acids, Draculin and Miraculin Nano Molecules Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocyclotron Radiations", Med & Analy Chem Int J, 2 (1): 000111, 2018.*
71. A. Heidari, *"Gamma Linolenic Methyl Ester, 5–Heptadeca–5,8,11–Trienyl 1,3,4– Oxadiazole–2–Thiol, Sulphoquinovosyl Diacyl Glycerol, Ruscogenin, Nocturnoside B, Protodioscine B, Parquisoside–B, Leiocarposide, Narangenin, 7–Methoxy Hespertin, Lupeol, Rosemariquinone, Rosmanol and Rosemadiol Nano Molecules Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocy-*

clotron Radiations", Int J Pharma Anal Acta, 2 (1): 007 –014, 2018.

72. A. Heidari, *"Fourier Transform Infrared (FTIR) Spectroscopy, Attenuated Total Reflectance Fourier Transform Infrared (ATR–FTIR) Spectroscopy, Micro–Attenuated Total Reflectance Fourier Transform Infrared (Micro–ATR–FTIR) Spectroscopy, Macro–Attenuated Total Reflectance Fourier Transform Infrared (Macro–ATR–FTIR) Spectroscopy, Two–Dimensional Infrared Correlation Spectroscopy, Linear Two–Dimensional Infrared Spectroscopy, Non–Linear Two–Dimensional Infrared Spectroscopy, Atomic Force Microscopy Based Infrared (AFM–IR) Spectroscopy, Infrared Photodissociation Spectroscopy, Infrared Correlation Table Spectroscopy, Near–Infrared Spectroscopy (NIRS), Mid–Infrared Spectroscopy (MIRS), Nuclear Resonance Vibrational Spectroscopy, Thermal Infrared Spectroscopy and Photothermal Infrared Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", Glob Imaging Insights, Volume 3 (2): 1–14, 2018.*

73. A. Heidari, *"Heteronuclear Single–Quantum Correlation Spectroscopy (HSQC) and Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC) Comparative Study on Malignant and Benign Human Cancer Cells, Tissues and Tumors under Synchrotron and Synchrocyclotron Radiations", Chronicle of Medicine and Surgery 2.3: 144 –156, 2018.*

74. A. Heidari, *"Tetrakis [3, 5–bis (Trifluoromethyl) Phenyl] Borate (BARF)–Enhanced Precatalyst Preparation Stabilization and Initiation (EPPSI) Nano Molecules", Medical Research and Clinical Case Reports 2.1: 113–126, 2018.*

75. A. Heidari, *"Sydnone, Münchnone, Montréalone, Mogone, Montelukast, Quebecol and Palau'amine–Enhanced Precatalyst Preparation Stabilization and Initiation (EPPSI) Nano Molecules", Sur Cas Stud Op Acc J. 1 (3), 2018.*

76. A. Heidari, *"Fornacite, Orotic Acid, Rhamnetin, Sodium Ethyl Xanthate (SEX) and Spermine (Spermidine or Polyamine) Nanomolecules Incorporation into the Nanopolymeric Matrix (NPM)", International Journal of Biochemistry and Biomolecules, Vol. 4: Issue 1, Pages 1–19, 2018.*

77. A. Heidari, R. Gobato, *"Putrescine, Cadaverine, Spermine and Spermidine–Enhanced Precatalyst Preparation Stabilization and Initiation (EPPSI) Nano Molecules", Parana Journal of Science and Education (PJSE)–v.4, n.5, (1–14) July 1, 2018.*

78. A. Heidari, *"Cadaverine (1,5–Pentanediamine or Pentamethylenediamine), Diethyl Azodicarboxylate (DEAD or DEADCAT) and Putrescine (Tetramethylenediamine) Nano Molecules Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocyclotron Radiations", Hiv and Sexual Health Open Access Open Journal. 1 (1): 4–11, 2018.*

79. A. Heidari, *"Improving the Performance of Nano–Endofullerenes in Polyaniline Nanostructure–Based Biosensors by Covering Californium Colloidal Nanoparticles with Multi– Walled Carbon Nanotubes", Journal of Advances in Nanomaterials, Vol. 3, No. 1, Pages 1–28, 2018.*

80. R. Gobato, A. Heidari, *"Molecular Mechanics and Quantum Chemical Study on Sites of Action of Sanguinarine Using Vibrational Spectroscopy Based on Molecular Mechanics and Quantum Chemical Calculations", Malaysian Journal of Chemistry, Vol. 20 (1), 1–23, 2018.*

81. A. Heidari, *"Vibrational Biospectroscopic Studies on Anti–Cancer Nanopharmaceuticals (Part I)", Malaysian Journal of Chemistry, Vol. 20 (1), 33–73, 2018.*

82. A. Heidari, *"Vibrational Biospectroscopic Studies on Anti–Cancer Nanopharmaceuticals (Part II)", Malaysian Journal of Chemistry, Vol. 20 (1), 74–117, 2018.*

Citation: Alireza Heidari, Zahra Torfeh, Sophia Iorgulescu, Olivia Robinson, Lin Hu et al. (2022) CERN Large Hadron Collider (LHC) Radiation Source for Magnetic Resonance Biospectroscopy in Metabolic and Molecular Imaging and Diagnosis of Cancer. Journal of New Developments in Chemistry - 3(4):29-30. https://doi.org/10.14302/issn.2377-2549.jndc-22-4351

83. A. Heidari, *"Uranocene (U(C8H8)2) and Bis(Cyclooctatetraene)Iron (Fe(C8H8)2 or Fe(COT)2)–Enhanced Precatalyst Preparation Stabilization and Initiation (EPPSI) Nano Molecules", Chemistry Reports, Vol. 1, Iss. 2, Pages 1 –16, 2018.*

84. A. Heidari, *"Biomedical Systematic and Emerging Technological Study on Human Malignant and Benign Cancer Cells and Tissues Biospectroscopic Analysis under Synchrotron Radiation", Glob Imaging Insights, Volume 3 (3): 1–7, 2018.*

85. A. Heidari, *"Deep–Level Transient Spectroscopy and X–Ray Photoelectron Spectroscopy (XPS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Res Dev Material Sci. 7(2). RDMS.000659, 2018.*

86. A. Heidari, *"C70–Carboxyfullerenes Nano Molecules Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocyclotron Radiations", Glob Imaging Insights, Volume 3 (3): 1– 7, 2018.*

87. A. Heidari, *"The Effect of Temperature on Cadmium Oxide (CdO) Nanoparticles Produced by Synchrotron Radiation in the Human Cancer Cells, Tissues and Tumors", International Journal of Advanced Chemistry, 6 (2) 140–156, 2018.*

88. A. Heidari, *"A Clinical and Molecular Pathology Investigation of Correlation Spectroscopy (COSY), Exclusive Correlation Spectroscopy (ECOSY), Total Correlation Spectroscopy (TOCSY), Heteronuclear Single–Quantum Correlation Spectroscopy (HSQC) and Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC) Comparative Study on Malignant and Benign Human Cancer Cells, Tissues and Tumors under Synchrotron and Synchrocyclotron Radiations Using Cyclotron versus Synchrotron, Synchrocyclotron and the Large Hadron Collider (LHC) for Delivery of Proton and Helium Ion (Charged Particle) Beams for Oncology Radiotherapy", European Journal of Advances in Engineering and Technology, 5 (7): 414–426, 2018.*

89. A. Heidari, *"Nano Molecules Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocyclotron Radiations", J Oncol Res; 1 (1): 1–20, 2018.*

90. A. Heidari, *"Use of Molecular Enzymes in the Treatment of Chronic Disorders", Canc Oncol Open Access J. 1 (1): 12–15, 2018.*

91. A. Heidari, *"Vibrational Biospectroscopic Study and Chemical Structure Analysis of Unsaturated Polyamides Nanoparticles as Anti–Cancer Polymeric Nanomedicines Using Synchrotron Radiation", International Journal of Advanced Chemistry, 6 (2) 167–189, 2018.*

92. A. Heidari, *"Adamantane, Irene, Naftazone and Pyridine –Enhanced Precatalyst Preparation Stabilization and Initiation (PEPPSI) Nano Molecules", Madridge J Nov Drug Res. 2 (1): 61–67, 2018.*

93. A. Heidari, *"Heteronuclear Single–Quantum Correlation Spectroscopy (HSQC) and Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Madridge J Nov Drug Res, 2 (1): 68–74, 2018.*

94. A. Heidari, R. Gobato, *"A Novel Approach to Reduce Toxicities and to Improve Bioavailabilities of DNA/RNA of Human Cancer Cells–Containing Cocaine (Coke), Lysergide (Lysergic Acid Diethyl Amide or LSD), Δ^9–Tetrahydrocannabinol (THC) [(–)–trans–Δ^9–Tetrahydrocannabinol], Theobromine (Xantheose), Caffeine, Aspartame (APM) (NutraSweet) and Zidovudine (ZDV) [Azidothymidine (AZT)] as Anti–Cancer Nano Drugs by Coassembly of Dual Anti–Cancer Nano Drugs to Inhibit DNA/RNA of Human Cancer Cells Drug Resistance", Parana Journal of Science and Education (PJSE), v. 4, n. 6, pp. 1–17, 2018.*

95. A. Heidari, R. Gobato, *"Ultraviolet Photoelectron*

Spectroscopy (UPS) and Ultraviolet– Visible (UV–Vis) Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Parana Journal of Science and Education (PJSE), v. 4, n. 6, pp. 18 –33, 2018.

96. R. Gobato, A. Heidari, A. Mitra, *"The Creation of $C_{13}H_{20}BeLi_2SeSi$. The Proposal of a Bio–Inorganic Molecule, Using Ab Initio Methods for the Genesis of a Nano Membrane", Arc Org Inorg Chem Sci 3 (4). AOICS.MS.ID.000167, 2018.*

97. R. Gobato, A. Heidari, *"Using the Quantum Chemistry for Genesis of a Nano Biomembrane with a Combination of the Elements Be, Li, Se, Si, C and H", J Nanomed Res.7 (4): 241–252, 2018.*

98. A. Heidari, *"Bastadins and Bastaranes–Enhanced Precatalyst Preparation Stabilization and Initiation (EPPSI) Nano Molecules", Glob Imaging Insights, Volume 3 (4): 1–7, 2018.*

99. A. Heidari, *"Fucitol, Pterodactyladiene, DEAD or DEADCAT (DiEthyl AzoDiCArboxylaTe), Skatole, the NanoPutians, Thebacon, Pikachurin, Tie Fighter, Spermidine and Mirasorvone Nano Molecules Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocyclotron Radiations", Glob Imaging Insights, Volume 3 (4): 1–8, 2018.*

100. E. Dadvar, A. Heidari, *"A Review on Separation Techniques of Graphene Oxide (GO)/Base on Hybrid Polymer Membranes for Eradication of Dyes and Oil Compounds: Recent Progress in Graphene Oxide (GO)/ Base on Polymer Membranes–Related Nanotechnologies", Clin Med Rev Case Rep 5: 228, 2018.*

101. A. Heidari, R. Gobato, *"First–Time Simulation of Deoxyuridine Monophosphate (dUMP) (Deoxyuridylic Acid or Deoxyuridylate) and Vomitoxin (Deoxynivalenol (DON)) ((3α,7α)– 3,7,15–Trihydroxy–12,13–Epoxytrichothec–9–En–8–One)–Enhanced Precatalyst Preparation Stabilization and Initiation (EPPSI) Nano Molecules Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocyclotron Radiations", Parana Journal of Science and Education (PJSE), Vol. 4, No. 6, pp. 46–67, 2018.*

102. A. Heidari, *"Buckminsterfullerene (Fullerene), Bullvalene, Dickite and Josiphos Ligands Nano Molecules Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Hematology and Thromboembolic Diseases Prevention, Diagnosis and Treatment under Synchrotron and Synchrocyclotron Radiations", Glob Imaging Insights, Volume 3 (4): 1–7, 2018.*

103. A. Heidari, *"Fluctuation X–Ray Scattering (FXS) and Wide–Angle X–Ray Scattering (WAXS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Glob Imaging Insights, Volume 3 (4): 1–7, 2018.*

104. A. Heidari, *"A Novel Approach to Correlation Spectroscopy (COSY), Exclusive Correlation Spectroscopy (ECOSY), Total Correlation Spectroscopy (TOCSY), Incredible Natural–Abundance Double–Quantum Transfer Experiment (INADEQUATE), Heteronuclear Single–Quantum Correlation Spectroscopy (HSQC), Heteronuclear Multiple–Bond Correlation Spectroscopy (HMBC), Nuclear Overhauser Effect Spectroscopy (NOESY) and Rotating Frame Nuclear Overhauser Effect Spectroscopy (ROESY) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Glob Imaging Insights, Volume 3 (5): 1–9, 2018.*

105. A. Heidari, *"Terphenyl–Based Reversible Receptor with Rhodamine, Rhodamine–Based Molecular Probe, Rhodamine–Based Using the Spirolactam Ring Opening, Rhodamine B with Ferrocene Substituent, Calix[4]Arene –Based Receptor, Thioether + Aniline–Derived Ligand Framework Linked to a Fluorescein Platform,*

Mercuryfluor–1 (Flourescent Probe), N,N'– Dibenzyl–1,4,10,13–Tetraraoxa–7,16–Diazacyclooctadecane and Terphenyl–Based Reversible Receptor with Pyrene and Quinoline as the Fluorophores–Enhanced Precatalyst Preparation Stabilization and Initiation (EPPSI) Nano Molecules", Glob Imaging Insights, Volume 3 (5): 1– 9, 2018.

106. A. Heidari, *"Small–Angle X–Ray Scattering (SAXS), Ultra–Small Angle X–Ray Scattering (USAXS), Fluctuation X–Ray Scattering (FXS), Wide–Angle X–Ray Scattering (WAXS), Grazing–Incidence Small–Angle X–Ray Scattering (GISAXS), Grazing–Incidence Wide–Angle X–Ray Scattering (GIWAXS), Small–Angle Neutron Scattering (SANS), Grazing–Incidence Small–Angle Neutron Scattering (GISANS), X–Ray Diffraction (XRD), Powder X–Ray Diffraction (PXRD), Wide–Angle X –Ray Diffraction (WAXD), Grazing– Incidence X–Ray Diffraction (GIXD) and Energy–Dispersive X–Ray Diffraction (EDXRD) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation"*, Glob Imaging Insights, Volume 3 (5): 1–10, 2018.

107. A. Heidari, *"Nuclear Resonant Inelastic X–Ray Scattering Spectroscopy (NRIXSS) and Nuclear Resonance Vibrational Spectroscopy (NRVS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Glob Imaging Insights, Volume 3 (5): 1–7, 2018.*

108. A. Heidari, *"Small–Angle X–Ray Scattering (SAXS) and Ultra–Small Angle X–Ray Scattering (USAXS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation", Glob Imaging Insights, Volume 3 (5): 1–7, 2018.*

109. *A. Heidari, "Curious Chloride (CmCl3) and Titanic Chloride (TiCl4)–Enhanced Precatalyst Preparation Stabilization and Initiation (EPPSI) Nano Molecules for Cancer Treatment and Cellular Therapeutics", J. Cancer Research and Therapeutic Interventions, Volume 1, Issue 1, Pages 01–10, 2018.*

110. R. Gobato, M. R. R. Gobato, A. Heidari, A. Mitra, *"Spectroscopy and Dipole Moment of the Molecule $^{C}13^{H}20^{BeLi}2^{SeSi}$ via Quantum Chemistry Using Ab Initio, Hartree–Fock Method in the Base Set CC–pVTZ and 6–311G**(3df, 3pd)", Arc Org Inorg Chem Sci 3 (5), Pages 402– 409, 2018.*

111. A. Heidari, *"$^{C}60$ and $^{C}70$–Encapsulating Carbon Nanotubes Incorporation into the Nano Polymeric Matrix (NPM) by Immersion of the Nano Polymeric Modified Electrode (NPME) as Molecular Enzymes and Drug Targets for Human Cancer Cells, Tissues and Tumors Treatment under Synchrotron and Synchrocyclotron Radiations", Integr Mol Med, Volume 5 (3): 1–8, 2018.*

112. A. Heidari, *"Two–Dimensional (2D) ^{1}H or Proton NMR, ^{13}C NMR, ^{15}N NMR and ^{31}P NMR Spectroscopy Comparative Study on Malignant and Benign Human Cancer Cells and Tissues under Synchrotron Radiation with the Passage of Time", Glob Imaging Insights, Volume 3 (6): 1–8, 2018.*

113. A. Heidari, *"FT–Raman Spectroscopy, Coherent Anti–Stokes Raman Spectroscopy (CARS) and Raman Optical Activity Spectroscopy (ROAS) Comparative Study on Malignant and Benign Human Cancer Cells and Tissues with the Passage of Time under Synchrotron Radiation", Glob Imaging Insights, Volume 3 (6): 1–8, 2018.*

114. A. Heidari, *"A Modern and Comprehensive Investigation of Inelastic Electron Tunneling Spectroscopy (IETS) and Scanning Tunneling Spectroscopy on Malignant and Benign Human Cancer Cells, Tissues and Tumors through Optimizing Synchrotron Microbeam Radiotherapy for Human Cancer Treatments and Diagnostics: An Experimental Biospectroscopic Comparative Study", Glob Imaging Insights, Volume 3 (6): 1–8, 2018.*

115. Aramini JM, Vorobiev SM, Tuberty LM, Janjua H, Campbell ET, Seetharaman J, et al. Montelione GT Structure. 2015; 23(8): 1382–1393.

116. Banerji U, Camidge DR, Verheul HM, Agarwal R, Sarker D, Kaye SB, et al. The first–in– human study of the hydrogen sulfate (Hyd–sulfate) capsule of the MEK1/2 inhibitor AZD6244 (ARRY–142886): a phase I open–label multicenter trial in patients with advanced cancer. Clin Cancer Res. 2010; 16: 1613–

Citation: Alireza Heidari, Zahra Torfeh, Sophia Iorgulescu, Olivia Robinson, Lin Hu et al. (2022) CERN Large Hadron Collider (LHC) Radiation Source for Magnetic Resonance Biospectroscopy in Metabolic and Molecular Imaging and Diagnosis of Cancer. Journal of New Developments in Chemistry - 3(4):29-30. https://doi.org/10.14302/issn.2377-2549.jndc-22-4351

1623.

117.Bowyer S, Lee R, Fusi A, Lorigan P. Dabrafenib and its use in the treatment of metastatic melanoma. Melanoma Manag. 2015; 2(3): 199–208.

118.Capozzi M, De Divitiis C, Ottaiano A, von Arx C, Scala S, Tatangelo F, et al. Lenvatinib, a molecule with versatile application: from preclinical evidence to future development in anti– cancer treatment. Cancer Manag Res. 2019; 11: 3847–3860.

119.Chakravarty D, Santos E, Ryder M, Knauf JA, Liao XH, West BL, et al. Small–molecule MAPK inhibitors restore radioiodine incorporation in mouse thyroid cancers with conditional BRAF activation. J Clin Invest. 2011; 121: 4700–4711.

120.Cho M, Gong J, Frankel P, Synold TW, Lim D, Chung V, et al. A phase I clinical trial of binimetinib in combination with FOLFOX in patients with advanced metastatic colorectal cancer who failed prior standard therapy. Oncotarget. 2017; 8(45): 79750–79760.

121.Corrigan KL, Williamson H, Elliott Range D, Niedzwiecki D, Brizel DM, Mowery YM. Treatment Outcomes in Anaplastic Thyroid Cancer. J Thyroid Res. 2019; 2019: 8218949.

122.Croce L, Coperchini F, Magri F, Chiovato L, Rotondi M. The multifaceted anti–cancer effects of BRAF–inhibitors. Oncotarget. 2019; 10(61): 6623–6640.

123.Glaser SM, Mandish SF, Gill BS, Balasubramani GK, Clump DA, Beriwal S. Anaplastic thyroid cancer: prognostic factors, patterns of care, and overall survival. Head Neck. 2016; 38: E2083–E2090.

124.Davies H, Bignell GR, Cox C, Stephens P, Edkins S, Clegg S, Teague J, Woffendin H, Garnett MJ, Bottomley W, Davis N, Dicks E, Ewing R, et al. Mutations of the BRAF gene in human cancer. Nature. 2002; 417: 949–954.

125.da Rocha Dias S, Salmonson T, van Zwieten–Boot B, Jonsson B, Marchetti S, Schellens JHM, et al. The European Medicines Agency review of vemurafenib (Zelboraf®) for the treatment of adult patients with BRAF V600 mutation–positive unresectable or metastatic melanoma: summary of the scientific assessment of the Committee for Medicinal Products for Human Use. Eur J Cancer. 2013; 49(7): 1654–1661.

126.Degirmenci U, Wang M, Hu J. Targeting Aberrant RAS/RAF/MEK/ERK Signaling for Cancer Therapy. Cells. 2020; 9(1): 198.

127.Dhomen N, Marais R. New insight into BRAF mutations in cancer. Curr Opin Genet Dev. 2007; 17: 31–39.

128.ElMokh O, Taelman V, Radojewski P, Roelli MA, Stoss A, Dumont RA, et al. MEK Inhibition Induces Therapeutic Iodine Uptake in a Murine Model of Anaplastic Thyroid Cancer. J Nucl Med. 2019; 60(7): 917–923.

129.Fagin JA, Wells SAJ. Biologic and clinical perspectives on thyroid Cancer. N Engl J Med. 2016; 375(11): 1054 –1067.

130.Fala L. Lenvima (Lenvatinib), a Multireceptor Tyrosine Kinase Inhibitor, Approved by the FDA for the Treatment of Patients with Differentiated Thyroid Cancer. Am Health Drug Benefits. 2015; 8(Spec Feature): 176–179.

131.Falchook GS, Lewis KD, Infante JR, Gordon MS, Vogelzang NJ, DeMarini DJ, et al. Activity of the oral MEK inhibitor trametinib in patients with advanced melanoma: a phase 1 dose–escalation trial. Lancet Oncol. 2012; 13: 782–789.

132.Ferrari SM, Elia G, Ragusa F, et al. Novel treatments for anaplastic thyroid carcinoma. Gland Surg. 2020; 9 (Suppl 1): S28–S42.

133.Flaherty KT, Robert C, Hersey P, Nathan P, Garbe C, Milhem M, et al. Improved survival with MEK inhibition in BRAF–mutated melanoma. N Engl J Med. 2012; 367: 107–114.

134.Green P, Schwartz RH, Shell J, Allgauer M, Chong D, Kebebew E. Exceptional response to vemurafenib and cobimetinib in anaplastic thyroid cancer 40 years after treatment for papillary thyroid cancer. Int. J. Endo. Oncol. 2017; 4(4)159–165.

135.Hauschild A, Grob J–J, Demidov LV, Jouary T, Gutzmer

R, Millward M, et al. Dabrafenib in BRAF–mutated metastatic melanoma: a multicentre, open–label, Phase III randomised controlled trial. Lancet. 2012; 380(9839): 358–365.

136.Heidorn SJ, Milagre C, Whittaker S, Nourry A, Niculescu–Duvas I, Dhomen N, et al. Kinase–dead BRAF and oncogenic RAS cooperate to drive tumor progression through CRAF. Cell. 2010; 140(2): 209–221.

137.Ho AL, Grewal RK, Leboeuf R, Sherman EJ, Pfister DG, Deandreis D, et al. Selumetinib– enhanced radioiodine uptake in advanced thyroid cancer. N Engl J Med. 2013; 368: 623–632.

138.Hoeflich KP, Merchant M, Orr C, Chan J, Den Otter D, Berry L, et al. Intermittent administration of MEK inhibitor GDC–0973 plus PI3K inhibitor GDC–0941 triggers robust apoptosis and tumor growth inhibition. Cancer Res. 2012; 72(1): 210–9.

139.Hussain MR, Baig M, Mohamoud HS, et al. BRAF gene: From human cancers to developmental syndromes. Saudi J Biol Sci. 2015; 22(4): 359–373.

140.Hunt JL, Tometsko M, LiVolsi VA, et al. Molecular evidence of anaplastic transformation in coexisting well–differentiated and anaplastic carcinomas of the thyroid. Am J Surg Pathol 2003; 27: 1559–64.

141.Kadota M, Tamaki Y, Sekimoto M, et al. Loss of heterozygosity on chromosome 16p and 18q in anaplastic thyroid carcinoma. Oncol Rep 2003; 10: 35 –8.

142.Keutgen XM, Sadowski SM, Kebebew E. Management of anaplastic thyroid cancer. Gland Surg. 2015; 4(1): 44–51.

143.King AJ, Arnone MR, Bleam MR, Moss KG, Yang J, Fedorowicz KE, et al. Dabrafenib; preclinical characterization, increased efficacy when combined with trametinib, while BRAF/MEK tool combination reduced skin lesions. PLoS ONE. 2013; 8(7): e67583.

144.Kim A, Cohen MS. The discovery of vemurafenib for the treatment of BRAF–mutated metastatic melanoma. Expert Opin Drug Discov. 2016; 11(9): 907–916.

145.Kitamura Y, Shimizu K, Tanaka S, et al. Allelotyping of anaplastic thyroid carcinoma: frequent allelic losses on 1q, 9p, 11, 17, 19p, and 22q. Genes Chromosomes Cancer 2000; 27: 244–51.

146.Kurata K, Onoda N, Noda S, Kashiwagi S, Asano Y, Hirakawa K, et al. Growth arrest by activated BRAF and MEK inhibition in human anaplastic thyroid cancer cells. Int J Oncol 2016; 49: 2303–8.

147.Lee PA, Wallace E, Marlow A, Yeh T, Marsh V, Anderson D, et al. Preclinical development of ARRY–162, a potent and selective MEK 1/2 inhibitor. Cancer Res. 2010; 70: 2515.

148.Liu F, Yang X, Geng M, Huang M. Targeting ERK, an Achilles' Heel of the MAPK pathway, in cancer therapy. Acta Pharm Sin B. 2018; 8(4): 552–562.

149.Li Z, Zhang Y, Wang R, Zou K, Zou L. Genetic alterations in anaplastic thyroid carcinoma and targeted therapies. Exp Ther Med. 2019; 18(4): 2369–2377.

150.Long GV, Stroyakovskiy D, Gogas H, de Braud F, Larkin J, Garbe C, et al. Combined BRAF and MEK Inhibition versus BRAF Inhibition Alone in Melanoma. N Engl J Med 2014; 371: 1877–88.

151.McCubrey JA, Steelman LS, Chappell WH, Abrams SL, Wong EW, Chang F, et al. Roles of the Raf/MEK/ERK pathway in cell growth, malignant transformation and drug resistance. Biochim Biophys Acta. 2007; 1773 (8): 1263–84.

152.Marten KA, Gudena VK. Use of vemurafenib in anaplastic thyroid carcinoma: a case report. Cancer Biol Ther. 2015; 16(10): 1430–1433.

153.Mazieres J, Cropet C, Montané L, Barlesi F, Souquet PJ, Quantin X, et al. Vemurafenib in non–small–cell lung cancer patients with BRAFV600 and BRAFnonV600 mutations. Ann Oncol. 2020; 31(2): 289–294.

154.Merchant M, Chan J, Orr C, Cheng J, Wang X, Hunsaker T, et al. Combination of the ERK inhibitor GDC–0994 with the MEK inhibitor cobimetinib significantly enhances anti–tumor activity in KRAS and BRAF mutant tumor models. 26 EORTC–NCI–AACR

Citation: Alireza Heidari, Zahra Torfeh, Sophia Iorgulescu, Olivia Robinson, Lin Hu et al. (2022) CERN Large Hadron Collider (LHC) Radiation Source for Magnetic Resonance Biospectroscopy in Metabolic and Molecular Imaging and Diagnosis of Cancer. Journal of New Developments in Chemistry - 3(4):29-30. https://doi.org/10.14302/issn.2377-2549.jndc-22-4351

Symposium on Molecular Targets and Cancer Therapeutics; 2014 Nov 18–21; Barcelona, Spain. Eur J Cancer 2014; 50 (Suppl 6): Abstract 387.

155.Molinaro E, Romei C, Biagini A, Sabini E, Agate L, Mazzeo S, Materazzi G, Sellari– Franceschini S, Ribechini A, Torregrossa L, Basolo F, Vitti P, Elisei R. Nat Rev Endocrinol. 2017; 13(11): 644–660.

156.Nagaiah G, Hossain A, Mooney CJ, Parmentier J, Remick SC. Anaplastic thyroid cancer: a review of epidemiology, pathogenesis, and treatment. J Oncol. 2011; 2011: 542358.

157.O'Neill JP, Shaha AR. Anaplastic thyroid cancer. Oral Oncol 2013; 49: 702–6.

158.Podolski A, Castellucci E, Halmos B. Precision medicine: BRAF mutations in thyroid cancer. Precis Cancer Med 2019; 2: 29.

159.Ottaviano M, Giunta EF, Tortora M, Curvietto M, Attademo L, Bosso D, Cardalesi C, Rosanova M, De Placido P, Pietroluongo E, Riccio V, Mucci B, Parola S, Vitale MG, Palmieri G, Daniele B, Simeone E, On Behalf Of Scito Youth. BRAF Gene and Melanoma: Back to the Future. Int J Mol Sci. 2021; 22(7): 3474.

160.Park E, Rawson S, Li K, Kim BW, Ficarro SB, Pino GG, et al. Architecture of autoinhibited and active BRAF–MEK1–14–3–3 complexes. Nature. 2019; 575(7783): 545–550.

161.Rahmani M, Davis EM, Bauer C, Dent P, Grant S. Apoptosis induced by the kinase inhibitor BAY 43–9006 in human leukemia cells involves down–regulation of Mcl–1 through inhibition of translation. J Biol Chem. 2005; 280: 35217–35227.

162.Ragazzi M, Ciarrocchi A, Sancisi V, Gandolfi G, Bisagni A, Piana S. Update on anaplastic thyroid carcinoma: morphological, molecular, and genetic features of the Most aggressive thyroid Cancer. Int J Endocrinol. 2014; 2014: 790834.

163.Rashid M, Agarwal A, Pradhan R, et al. Genetic Alterations in Anaplastic Thyroid Carcinoma. Indian J Endocrinol Metab. 2019; 23(4): 480–485.

164.Reddi H, Kumar A, Kulstad R. Anaplastic thyroid cancer – an overview of genetic variations and treatment modalities. Advances in Genomics and Genetics. 2015; 5: 43–52.

165.Ramos JW. The regulation of extracellular signal–regulated kinase (ERK) in mammalian cells. Int J Biochem Cell Biol. 2008; 40: 2707–2719.

166.Saini S, Tulla K, Maker AV, Burman KD, Prabhakar BS. Therapeutic advances in anaplastic thyroid cancer: a current perspective. Mol Cancer. 2018; 17(1): 154.

167.Sanchez JN, Wang T, Cohen MS. BRAF and MEK Inhibitors: Use and Resistance in BRAF–Mutated Cancers. Drugs. 2018; 78(5): 549–566.

168.Sarkisian S, Davar D. MEK inhibitors for the treatment of NRAS mutant melanoma. Drug Des Devel Ther. 2018; 12: 2553–2565.

169.Scheible H, Kraetzer F, Marx A, Johne A, Wimmer E. Metabolism of the MEK1/2 Inhibitor Pimasertib Involves a Novel Conjugation with Phosphoethanolamine in Patients with Solid Tumors. Drug Metab Dispos. 2017; 45(2): 174–182.

170. Seghers AC, Wilgenhof S, Lebbé C, Neyns B. Successful rechallenge in two patients with BRAF–V600–mutant melanoma who experienced previous progression during treatment with a selective BRAF inhibitor. Melanoma Res. 2012; 22: 466–472.

171.Sherman SI. Targeted therapies for thyroid tumors. Mod Pathol. 2011; 24 Suppl 2: S44– S52.

172.Shin MH, Kim J, Lim SA, Kim J, Lee KM. Current Insights into Combination Therapies with MAPK Inhibitors and Immune Checkpoint Blockade. Int J Mol Sci. 2020; 21(7): 2531.

173.Simões–Pereira J, Capitão R, Limbert E, Leite V. Anaplastic Thyroid Cancer: Clinical Picture of the Last Two Decades at a Single Oncology Referral Centre and Novel Therapeutic Options. Cancers (Basel). 2019; 11 (8): 1188.

174.Smallridge RC, Ain KB, Asa SL, et al. American Thyroid Association guidelines for management of patients

with anaplastic thyroid cancer. Thyroid 2012; 22: 1104–39.

175.Subbiah V, Baik C, Kirkwood JM. Clinical Development of BRAF plus MEK Inhibitor Combinations. Trends Cancer. 2020; 6(9): 797–810.

176.Subbiah V, Kreitman RJ, Wainberg ZA, Yong Cho J, Schellens JHM, Soria JC, et al. Dabrafenib and Trametinib Treatment in Patients with Locally Advanced or Metastatic BRAF V600–Mutant Anaplastic Thyroid Cancer. J Clin Oncol. 2018; 36(1): 7 –13.

177.Tahara M, Kiyota N, Yamazaki T, Chayahara N, Nakano K, Inagaki L, et al. Lenvatinib for Anaplastic Thyroid Cancer. Front Oncol. 2017; 7: 25.

178.Tiedje V, Stuschke M, Weber F, Dralle H, Moss L, Führer D. Anaplastic thyroid carcinoma: review of treatment protocols. Endocr Relat Cancer. 2018; 25 (3): R153–R161.

179.von Richter O, Massimini G, Scheible H, Udvaros I, Johne A. Pimasertib, a selective oral MEK1/2 inhibitor: absolute bioavailability, mass balance, elimination route, and metabolite profile in cancer patients. Br J Clin Pharmacol. 2016; 82(6): 1498–1508.

180.Wang L, Leite de Oliveira R, Huijberts S, Bosdriesz E, Pencheva N, Brunen D, et al. An Acquired Vulnerability of Drug–Resistant Melanoma with Therapeutic Potential. Cell. 2018; 173: 1413–1425.

181.Wiseman SM, Masoudi H, Niblock P, et al. Anaplastic thyroid carcinoma: expression profile of targets for therapy offers new insights for disease treatment. Ann Surg Oncol. 2007; 14: 719–729.

182. Zhao Y, Adjei A. The clinical development of MEK inhibitors. Nat Rev Clin Oncol. 2014; 11: 385–400.

183.Ziogas IA, Tsoulfas G. Evolving role of Sorafenib in the management of hepatocellular carcinoma. World J Clin Oncol. 2017; 8(3): 203–213.

Citation: Alireza Heidari, Zahra Torfeh, Sophia Iorgulescu, Olivia Robinson, Lin Hu et al. (2022) CERN Large Hadron Collider (LHC) Radiation Source for Magnetic Resonance Biospectroscopy in Metabolic and Molecular Imaging and Diagnosis of Cancer. Journal of New Developments in Chemistry - 3(4):29-30. https://doi.org/10.14302/issn.2377-2549.jndc-22-4351