# A Simple Nano-Bio Signal Processing Informatics R&D Framework With Machine Learning.

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**ABSTRACT → [ A General Multi-disciplinary Thermal Mapping + Signal Processing System to Probe (Graphene Quantum Dots + Virus ) based Nano-Bio Sensor for COVID-19 BIO-CHEMICAL INFORMATION PROCESSING w.r.t Theory + Algorithms + Experimentation + Machine Learning as an interesting Suggestion ]**

**keywords/index words → You can easily guess.**

## [I] Inspiration + Introduction →

Probing Bio-Chemical Systems & Signals in the Context of COVID-19 Informatics Framework - A Simple Technical Communication Using Graphene QDOTS+Virus+Grobner Bases+Machine Learning based on [ CoCoA Lib + dlib ] C++/Python ImageAI Software Tools/Python-Ising Models/VCSELs/Smart Devices/IoT/HPC – Heterogeneous Systems.

## MAIN IDEA →

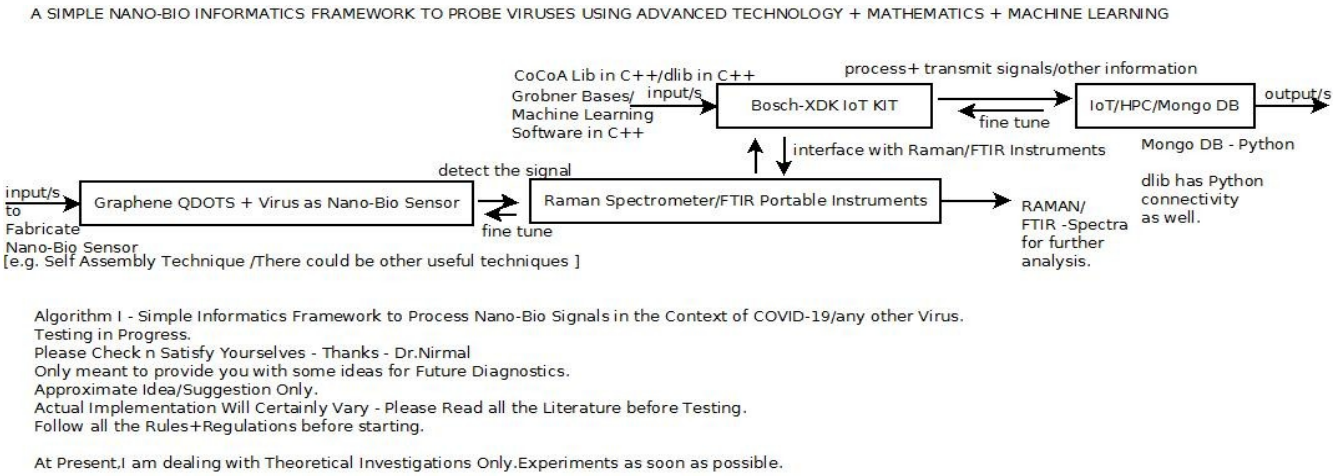
**Let us understand → Underlying Sensors+Instrumentation + Machine Learning + QRNG-Devices/Services + Smart Devices + IoT/HPC R&D Heterogeneous Informatics Framework via Algorithms presented here.**

Corona virus isn't the ONLY Virus Spreading – Remember – In the Future → "We will have to face even more".

Interested in "Understanding the Physics of Using Graphene based QDOTS + Virus" for all Algorithms presented in this Short Technical Communication. Please Make a Note → as there is plenty of information/literature available on Nano-Bio Sensors/Immuno sensors Fabrication+Analysis,we are not presenting them here. Readers are kindly requested to search. Any Graphene based material system could be used to design experiments with supporting theories.

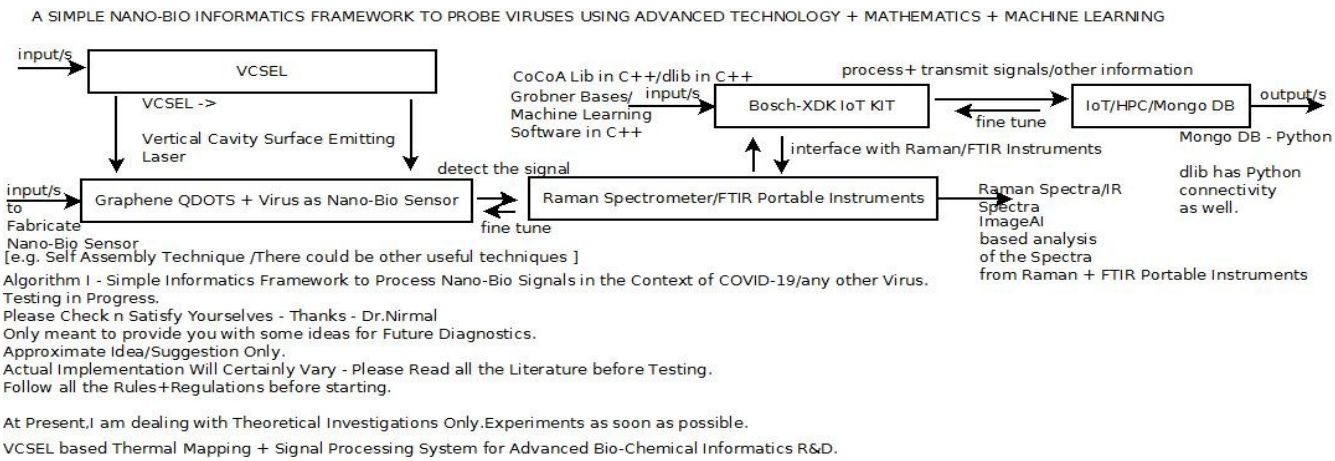
**Why Graphene ? → Most Promising Material for rigorous Theoretical + Experimental R&D approaches.Our own experience with Graphene in fabricating Nano-Bio Sensors based on our PATENTS,**is very much useful in writing this communication.

## [II] Informatics R&D Framework Involving Above Mentioned Software/Hardware →

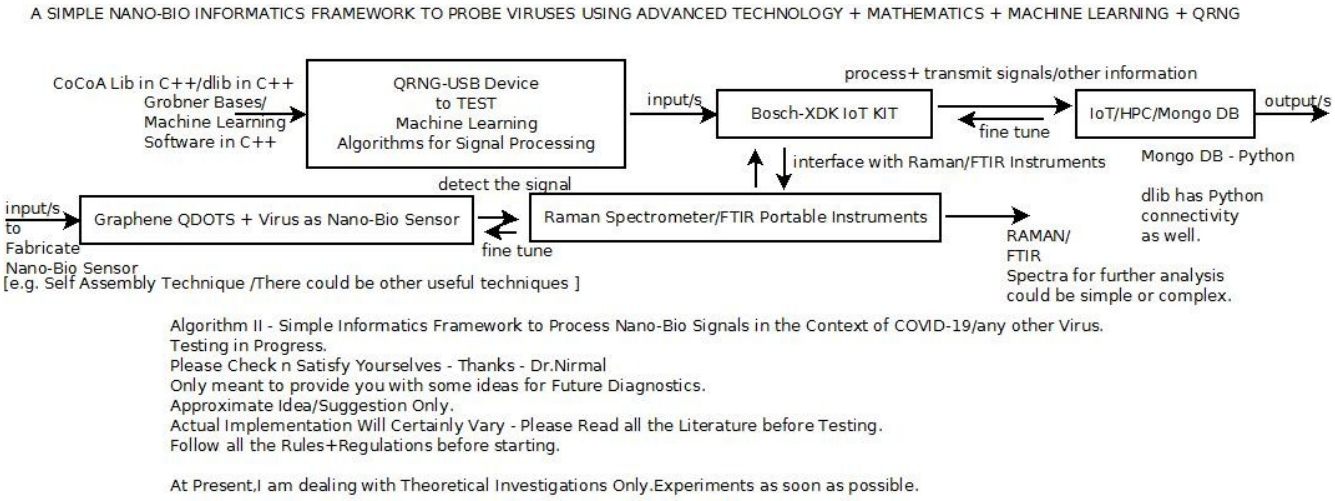



**[ Figure I – Algorithm I – Graphene QDOTS+Virus interfacing with Bosch-XDK IoT KIT to Probe Bio-Informatics Could be useful to deal with any Future Situations also-Thanks ]**

[ Want to study+understand Graphene QDOTS interaction with COVID-19/Virus ]




**[ We are suggesting a Thermal Mapping + Signal Processing System Using VCSELs ]**




**[ Figure II – Algorithm II – Graphene QDOTS+Virus interfacing with Bosch-XDK IoT KIT to Probe Bio-Informatics Could be useful to deal with any Future Situations also-Thanks ]**

[ We Need → A Robust R&D Setup to Rapidly Prototype Nano-Bio Signaling involving Viruses With Machine Learning ]

*https://pubs.acs.org/doi/10.1021/nn506011j* – may be useful in designing some experiments.

*https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3753009* – may be useful in designing some experiments.

* https://www.ophiropt.com/laser--measurement/knowledge-center/article/13743 – Useful info.

**Micro-processes on semiconductor surface and exploitation of novel semiconductor devices** → by Shmavonyan, Gagik & Tej Kumar, Nirmal.

[ ***** **https://ui.adsabs.harvard.edu/abs/2004APS..MARU10015S/abstract** – Gagik & Nirmal – 2004.]

http://oops.uni-oldenburg.de/353/1/383.pdf → Statistical Mechanical Models for Image Processing.

https://arxiv.org/pdf/0906.4745.pdf → A Q-Ising model application for linear-time image segmentation.

https://www.smapip.is.tohoku.ac.jp/~kazu/SMAPIP-KazuKazu/Summary/index-e.htmlhttps:// → Information Processing.

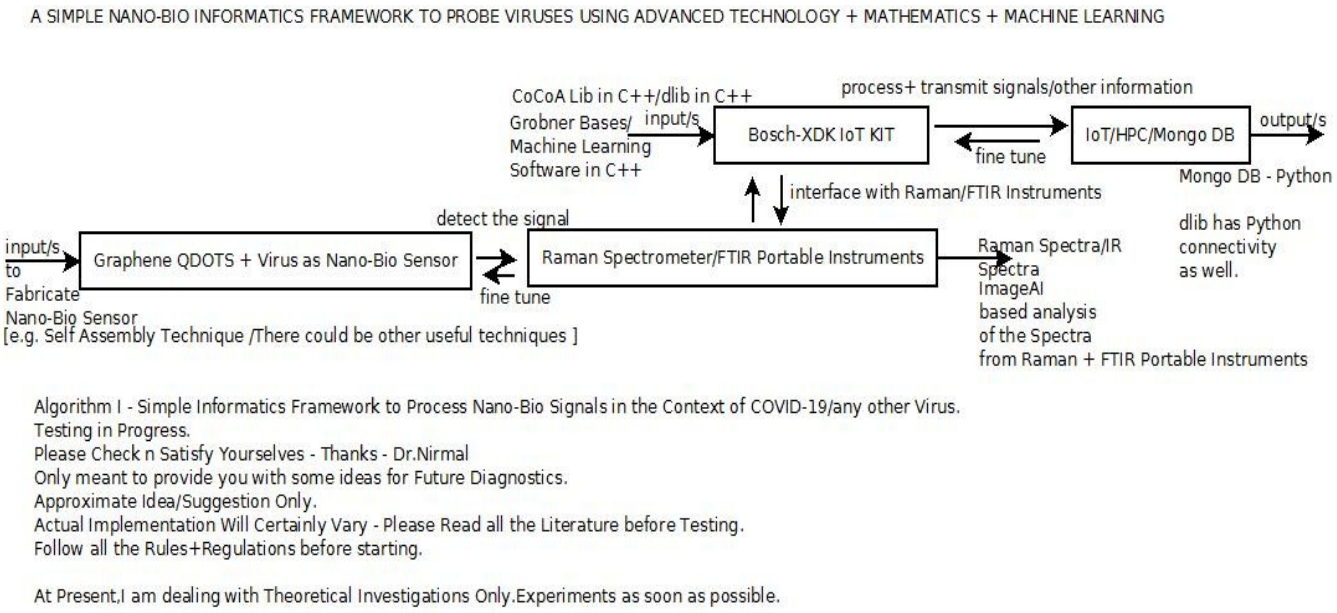
**Publications & Notes on Landauer's effect [ Could be useful ] →**

[a] https://doi.org/10.1016/j.ifacol.2017.08.1162
[b] https://en.wikipedia.org/wiki/Landauer%27s_principle

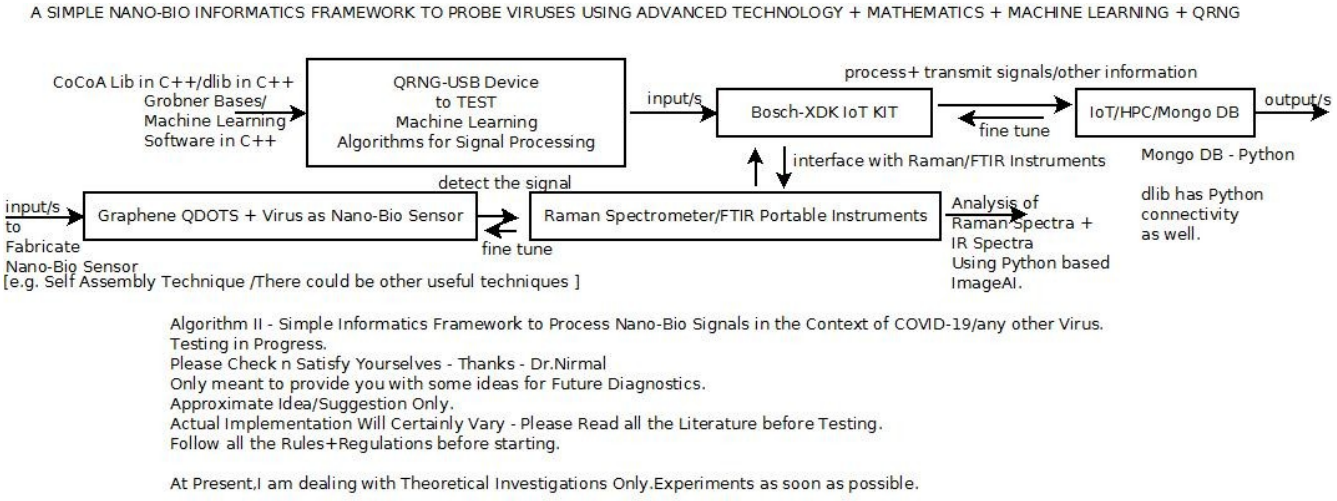
[c] https://cds.cern.ch/record/491908/files/0103108.pdf
[d] https://www.informationphilosopher.com/solutions/scientists/landauer/

[e] https://www.scientificamerican.com/article/the-fundamental-physical-limits-of-computation/

**[III] Algorithm I & Algorithm II Using Python ImageAI to Interpret Raman Spectra/FTIR Spectra →**

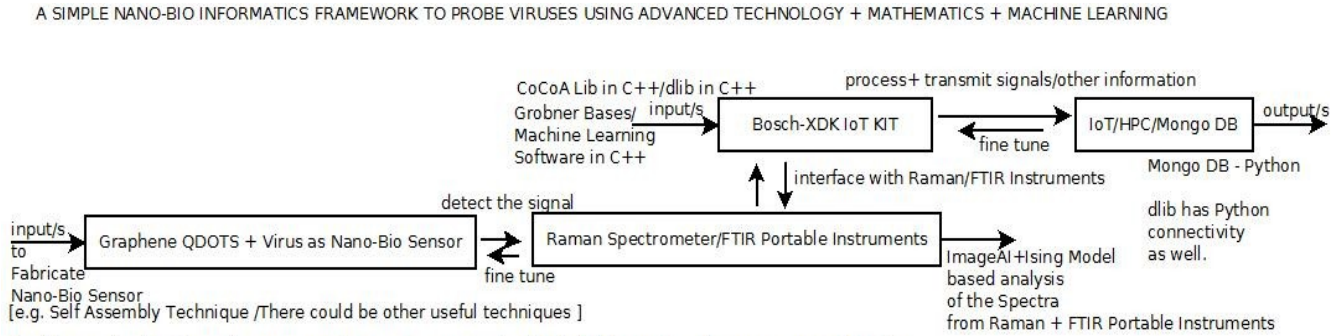



**[ Figure III – Algorithm III - Graphene QDOTS+Virus interfacing with Bosch-XDK IoT KIT to Probe Bio-Informatics ] → Modified Algorithm I.**




**[ Figure IV – Algorithm IV - Graphene QDOTS+Virus interfacing with Bosch-XDK IoT KIT to Probe Bio-Informatics .Could be useful to deal with any Future Situations also-Thanks ] → Modified Algorithm II.**

**[IV] Algorithms I & II Using Python Ising Models + Python ImageAI to Interpret Raman Spectra/FTIR Spectra →**




Algorithm I - Simple Informatics Framework to Process Nano-Bio Signals in the Context of COVID-19/any other Virus.
Testing in Progress.
Please Check n Satisfy Yourselves - Thanks - Dr.Nirmal
Only meant to provide you with some ideas for Future Diagnostics.
Approximate Idea/Suggestion Only.
Actual Implementation Will Certainly Vary - Please Read all the Literature before Testing.
Follow all the Rules+Regulations before starting.

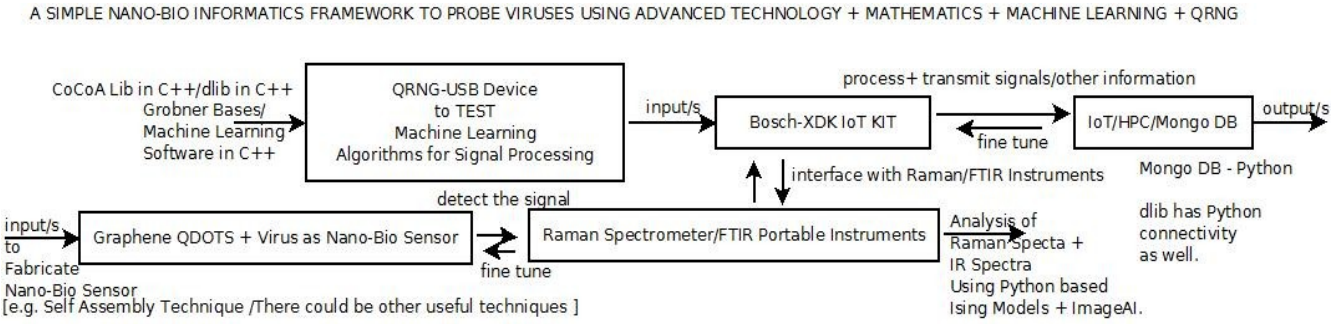
At Present,I am dealing with Theoretical Investigations Only.Experiments as soon as possible.

**[ Figure V – Algorithm V - Graphene QDOTS+Virus interfacing with Bosch-XDK IoT KIT to Probe Bio-Informatics ] → Modified Algorithm I.**

*https://www.nature.com/articles/srep42258 - may be useful in designing some experiments.*
*https://onlinelibrary.wiley.com/doi/full/10.1002/jbm.b.34579* - may be useful in designing some experiments.

https://github.com/GTorlai/IsingRBM – Interesting Information.

**Python – Ising Models** → "Why should we spend so much time talking about the Ising model? 1. It's surprisingly useful for helping us think about all sorts of behaviors relating to phase transitions. For instance: 1. the Ising model exhibits symmetry breaking in low-temperature phase (which we just talked about) 2. it has a special 'critical point' at a well-defined temperature (which we alluded to in the phase diagram of water) 3. other rich features. 2. It's one of few exactly solvable models where we can actually co... " [ Source - http://stanford.edu/~jeffjar/statmech2/intro4.html ]




Algorithm II - Simple Informatics Framework to Process Nano-Bio Signals in the Context of COVID-19/any other Virus.
Testing in Progress.
Please Check n Satisfy Yourselves - Thanks - Dr.Nirmal
Only meant to provide you with some ideas for Future Diagnostics.
Approximate Idea/Suggestion Only.
Actual Implementation Will Certainly Vary - Please Read all the Literature before Testing.
Follow all the Rules+Regulations before starting.

At Present,I am dealing with Theoretical Investigations Only.Experiments as soon as possible.

**[ Figure VI – Algorithm VI - Graphene QDOTS+Virus interfacing with Bosch-XDK IoT KIT to Probe Bio-Informatics ] → Modified Algorithm II.**

*https://pubs.acs.org/doi/10.1021/am302706g* - may be useful in designing some experiments.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1201471/ - some useful information.

**[V] Theoretical Investigations of Thermal Mapping + Signal Processing Concepts Using Mathematics + HOL Theorem Prover →**

**[a] We are using Reaction-Diffusion[R-D] Mechanisms + Cellular Automata[CA] + Grobner Bases[GB] + Deep Learning[DL] + JLV Graphs-[ Jucys/Levinson/Vanagas Graphs ] + Theoretical Atomic Spectroscopy related concepts to understand the Nano-Bio System/s + Bio-Chemical Information Processing + Hardware/Software/Firmware issues in designing our [ Thermal Mapping + Signal Processing] System involving Graphene QDOTS + Bio-materials →**

Algorithm I → as input → HOL-Isabelle Theorem Prover System → Verification+output

Algorithm II → as input → HOL-Isabelle Theorem Prover System → Verification+output

Algorithm III → as input → HOL-Isabelle Theorem Prover System → Verification+output

Algorithm IV → as input → HOL-Isabelle Theorem Prover System → Verification+output

Algorithm V → as input → HOL-Isabelle Theorem Prover System → Verification+output

Algorithm VI → as input → HOL-Isabelle Theorem Prover System → Verification+output

**[b] Instead of HOL-Isabelle System one could also use z3API-Py Theorem Prover to probe the Novel Ideas.**

**[c] Not Possible to describe everything in detail as this is a Short Communication. Please refer to →**

*Article DOI : 10.5958/0975-8089.2015.00010.X

*Article DOI : 10.5958/0975-8089.2014.00013.X

*Article DOI : 10.5958/0975-8089.2018.00004.0

**[d] Useful Information on Isabelle – HOL/Theorem Prover →**

* https://isabelle.in.tum.de – Important Information on Theorem Proving Using Isabelle.

* https://isabelle.in.tum.de/doc/prog-prove.pdf - Programming & Proving Using Isabelle HOL System.

* https://www.it.uu.se/edu/course/homepage/ai/vt05/AI-theorem.html

* https://en.wikipedia.org/wiki/HOL_(proof_assistant)

* https://isabelle.in.tum.de/library/

* https://www21.in.tum.de/local_projects/koselleck.html

* https://www.isa-afp.org/entries/Signature_Groebner.html – Grobner Bases Information.

* https://www.isa-afp.org/entries – You can find all the other related materials here.

**[VI] Some Information on Raman Spectroscopy + FTIR Spectroscopy + cryo-Electron Microscopy(cryo-EM) Related Concepts →**

**[a] Raman Spectroscopy → "Raman spectroscopy** (/ˈrɑːmən/); (named after Indian physicist C. V. Raman) is a spectroscopic technique typically used to determine vibrational modes of molecules, although rotational and other low-frequency modes of systems may also be observed.[1] Raman spectroscopy is commonly used in chemistry to provide a structural fingerprint by which molecules can be identified."

[ Source - https://en.wikipedia.org/wiki/Raman_spectroscopy ]

https://www.azom.com/article.aspx?ArticleID=6271 - "Characterization of Graphene Using Raman Spectroscopy".

**[b] FTIR Spectroscopy → "Fourier-transform infrared spectroscopy** (**FTIR**)[1] is a technique used to obtain an infrared spectrum of absorption or emission of a solid, liquid or gas. An FTIR spectrometer simultaneously collects high-spectral-resolution data over a wide spectral range. This confers a significant advantage over a dispersive spectrometer, which measures intensity over a narrow range of wavelengths at a time.The term *Fourier-transform infrared spectroscopy* originates from the fact that a Fourier transform (a mathematical process) is required to convert the raw data into the actual spectrum."

[ Source - https://en.wikipedia.org/wiki/Fourier-transform_infrared_spectroscopy ]

https://www.azom.com/article.aspx?ArticleID=18949 - "Extraction Lab with FTIR Spectroscopy".

**[c] cryo-EM Image Processing of Nano-Bio Materials →**

https://www.azom.com/article.aspx?ArticleID=18926 - **"** Cryo-EM in the Cloud".
https://www.ncbi.nlm.nih.gov/pubmed/29864529
http://cryoem.berkeley.edu/

http://www.few.vu.nl/~wroos/Virus.html

https://analyticalscience.wiley.com/do/10.1002/was.00020032

*https://factor.niehs.nih.gov/2020/4/feature/3-feature-cryo-em/index.htm*

*https://nihrecord.nih.gov/2020/04/17/niehs-cryo-em-resources-support...*

*https://analyticalscience.wiley.com/do/10.1002/micro.1799*

*coronavirussoftware.com*

*https://www.sciencedirect.com/science/article/pii/S1663542203005 28*

*https://gizmodo.com/scientists-create-snapshot-of-how-the-new-corona*

*https://www.thermofisher.com/uk/en/home/electron-microscopy/life...*

**[VII] Some Useful & Important Information for Theoretical R&D Approaches →**

[a] **http://physicell.org/** → "PhysiCell aims to provide a robust, scalable code for simulating large systems of cells in 3-D tissues on standard desktop computers."

[b] A. Ghaffarizadeh, R. Heiland, S.H. Friedman, S.M. Mumenthaler, and P. Macklin, PhysiCell: an open source physics-based cell simulator for 3-D multicellular systems, PLoS Comput. Biol. 14(2): e1005991, 2018.
DOI: 10.1371/journal.pcbi.1005991.

[c] https://nanohub.org/resources/pc4covid19 → PhysiCell model for COVID19 → Y. Wang et al., Rapid community-driven development of a SARS-CoV-2 tissue simulator. *bioRxiv* 2020.04.02.019075, 2020 **(Preprint)**.
DOI: 10.1101/2020.04.02.019075.

[d] http://PhysiCell.MathCancer.org.
[e] Randy Heiland, Paul Macklin (2020), "PhysiCell model for COVID19," https://nanohub.org/resources/pc4covid19. (DOI: 10.21981/2B1H-GX51).

**[f] https://www.cgal.org → "** CGAL is a software project that provides easy access to efficient and reliable geometric algorithms in the form of a C++ library. CGAL is used in various areas needing geometric computation, such as geographic information systems, computer aided design, molecular biology,medical imaging, computer graphics, and robotics."

**Geometrical Analysis Using CGAL is very much useful in understanding of the following →**

**{ [ COVID-19 Virus + its Polyproteins ] to design → [ Graphene Quantum DOTS + Virus ]→ Nano-Bio sensors ]***
**[ Nano-Bio Materials System for Sensor Design ]***

**[g]** "[ Physicists have a lot of experience in dealing with dynamical systems modeling, differential equations, and computer/ data scientists can analyze the data that is available. COVID-19 R&D effort has to be an interdisciplinary approach and we need people to be talking and on the same platform."."Maybe in the near future, more new research directions can emerge out of this.]".
**[ https://www.weforum.org/agenda/2020/04/indian-scientists-covid19-false-infomation-coronavirus - ]**

**[h]** "The presence of oxygenated functional groups on a Graphene surface provides electrostatic and hydrogen bonding possibilities with proteins, while the aromatic benzene ring structure of neat Graphene provides hydrophobic and π–π interaction to orient hydrophobic residues toward the Graphene surface. "
[https://www.nature.com/articles/s42004-019-0254-9 ]

**[i]** https://pubs.acs.org/doi/10.1021/acsami.9b21841 - Graphene Information.
**[j] https://europepmc.org/article/med/21954945**

**[k] Information on VCSELs →**
**https://www.amazon.de/VCSELs-Fundamentals-Applications-Vertical-Cavity-Surface-Emitting/dp/3642430406**

VCSELs: Fundamentals, Technology and Applications of Vertical-Cavity Surface-Emitting Lasers (Springer Series in Optical Sciences (166), Band 166)(Englisch) Taschenbuch – 9. November 2014 – von **Rainer Michalzik** (Herausgeber).

**[l] http://downloads.hindawi.com/journals/specialissues/317614.pdf – VCSELS information.**

**[m] https://www.ophiropt.com/laser--measurement/applications/vcsel → "**VCSELs were first used in the telecom industry,and today are widely used as light sources in sensing applications. **"**
**https://www.ophiropt.com/laser--measurement/applications/medical – Important Information on VCSELs.**
***** ( From my Experience – With VCSELs we have excellent R&D opportunities – Hence,this suggestion )**

**[n]** Theoretical Atomic Spectroscopy – by Zenonas Rudzikas -Cambridge University Press,26-Jul-2007-Science-424 pages.

**[VIII] DRACO →** (**double-stranded RNA activated caspase oligomerizer**) → What an inspiration !!!!!!

It is useful to read about DRACO – Very much relevant these days in the Context of COVID-19 R&D :

"DRACO (double-stranded RNA activated caspase oligomerizer) is a group of experimental antiviral drugs formerly under development at the Massachusetts Institute of Technology. In cell culture, DRACO was reported to have broad-spectrum efficacy against many infectious viruses, including dengue flavivirus, Amapari and Tacaribe arenavirus, Guama bunyavirus, H1N1 influenza and rhinovirus, and was additionally found effective against influenza *in vivo* in weanling mice. [1] It was reported to induce rapid apoptosis selectively in virus-infected mammalian cells, while leaving uninfected cells unharmed. [1]"

"DRACO is selective for virus-infected cells. Differentiation between infected and healthy cells is made primarily via the length and type of RNA transcription helices present within the cell. Most viruses produce long dsRNA helices during transcription and replication. In contrast, uninfected mammalian cells generally produce dsRNA helices of fewer than 24 base pairs during transcription. Cell death is effected via one of the last steps in the apoptosis pathway in which complexes containing intracellular apoptosis signalling molecules simultaneously bind multiple procaspases. The procaspases transactivate via cleavage, activate additional caspases in the cascade, and cleave a variety of cellular proteins, thereby killing the cell. [1]"

[ **Source – Wikipedia** - https://en.wikipedia.org/wiki/DRACO ] - **An Inspiration for Future Generations**.*****

[a] Rider TH, Zook CE, Boettcher TL, Wick ST, Pancoast JS, Zusman BD (2011). "Broad-spectrum antiviral therapeutics" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3144912). *PLoS ONE*. 6 (7): e22572. Bibcode:2011PLoSO...622572R (https://ui.adsabs.harvard.edu /abs/2011PLoSO...622572R). doi:10.1371/journal.pone.0022572 (https://doi.org /10.1371%2Fjournal.pone.0022572). PMC3144912 (https://www.ncbi.nlm.nih.gov/pmc/articles /PMC3144912). PMID21818340 (https://pubmed.ncbi.nlm.nih.gov/21818340).

[b] "Todd Rider Joins Draper to Continue Antiviral Therapeutics Development" → **(http://www.prweb.com /releases/2014/01/prweb11469349.htm) (Press release). Cambridge, MA.**

**[IX] Information on Scientific Literature (((via))) Vixra.org + Other Sources With Mathematics + Software → [Multi-disciplinary Short Notes ]**

[a] http://www.vixra.org/author/d_n_t_kumar

[b] http://www.vixra.org/author/n_t_kumar

[c] http://www.vixra.org/author/Nirmal

[d] http://www.vixra.org/author/nirmal_tej_kumar

[e] https://www.semanticscholar.org/author/Nirmal-Kumar/12354503/suggest

[f] https://vixra.org/pdf/1901.0133v1.pdf – Nirmal.

**[X] Acknowledgment/s** :

Specially Thank Everyone –> My Mentors+Friends+Collaborators. Non-Profit R&D. Inspire Others Always.

** **Written in Free Style for Rapid Publication.**

**[XI] Conclusion/s With Future Perspectives →**

Understanding & Exploring COVID-19 Using Graphene QDOTS+Mathematics+Machine Learning+Smart Devices/IoT/HPC was attempted.This suggestion was put forward based on my DIRECT HANDS-ON experience in both Academia + Hi-tech Industry in my similar previous projects.Hope,this simple suggestion helps researchers,to start or come up with their own frameworks/ideas to probe → COVID-19 Informatics. We have considered Graphene QDOTS + Thermal Mapping + Signal Processing here as an example.{ **Please Remember to follow all the Rules+Regulations without fail.}**

**Also it is useful to study the following publication/s+ Information →**

"Information on intracellular thermal behavior is of vital importance in understanding the fundamentals governing biological metabolism or other physiological phenomena and in developing effective thermal-based therapy of certain diseases [1]. The complexity of the intracellular environment and much limited spatial resolution represents a challenging task for thermal mapping in a living cell. However, various attempts have been made recently to show the intracellular thermogenesis". [ **Source - DOI: 10.1109/NANOMED.2016.7883481/Publisher: IEEE** ]

Get the facts on COVID-19 from the #Elsevier Information Center The information is constantly updated as the global situation develops. From Elsevier: https://3d4medical.com

https://www.thehindu.com/sci-tech/science/the-covid-19-virus-and-its-polyproteins/article31375823.ece

https://www.thehindu.com/sci-tech/science/understanding-the-physics-of-coronavirus-transmission/article31601794.ece

**[XII] Important References →**


[a] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6982008/

[b] **https://www.ncbi.nlm.nih.gov/pubmed/29941799/**

[c] https://www.ncbi.nlm.nih.gov/pubmed/31444532

[d] https://medium.com/topic/coronavirus

[e] https://www.sciencedirect.com/science/article/pii/S2542364917301358

[f] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6222676/

[g] https://www.prweb.com/releases/2015/10/prweb13018147.htm - DRACO - Dr.Todd Rider - MIT USA.***

[h] (http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0022572).***

[i] https://www.oceaninsight.com/blog/raman-spectroscopy-for-virus-detection/ ***

[j] https://www.graphene-info.com/how-can-graphene-assist-war-coronavirus ***

[k] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6982008/ ***

[l] **Rosetta@home/Folding@home –> Protein Folding Mechanisms –> Also useful in exploring COVID-19.**
**[ Could be useful in hunting Corona Virus Protein/Other Required Information ]**

*https://foldingathome.org/covid19*

*https://www.facebook.com/Foldinghome-136059519794607*

*https://en.wikipedia.org/wiki/Folding@home*

*https://boinc.bakerlab.org/rosetta* ***&&*** *https://en.wikipedia.org/wiki/Rosetta@home*

*https://www.ipd.uw.edu/2020/02/rosettas-role-in-fighting-coronavirus*

*https://www.ipd.uw.edu/2020/03/volunteers-rally-to-rosettahome-to-stop-covid-19*

*https://ralph.bakerlab.org*

**[XIII] COVID-19 is an emerging, rapidly evolving situation/Additional Information →**

* Get the latest public health information from CDC: https://www.coronavirus.gov .

* Get the latest research from NIH: https://www.nih.gov/coronavirus.

* Follow All the Safety Procedures + Read all the Scientific Literature With Care.

* Theoretical Investigations are quite OK but Experimentation has to be done following all the RULES strictly under Expert Supervision ONLY.

* Please get the PRIOR APPROVAL from the Authorities in your Country before Experimenting in your LAB when handling Bio-materials.

**[XIV] Additional Useful Information →**

[a] **http://cocoa.dima.unige.it/cocoalib/** – **John Abbott and Anna Maria Bigatti** → *CoCoALib: a C++ library for doing Computations in Commutative Algebra.*

[b] *www.***dlib***.net* → **Dlib** is a **C++** toolkit containing machine learning algorithms and tools for creating complex software in **C++** to solve real world problems.

[c] *www.idquantique.com/random-number-generation/products/quantis-qrng-chip/*

[d] *https://*xdk.bosch*-connectivity.com*

[e] *https://en.protrustech.com* – portable Raman

[f] *www.agilent.com/en/products/ftir/ftir-compact-portable-systems*

[g] http://stanford.edu/~jeffjar/statmech2/intro5.html – Thermodynamics.

[h] *https://*github.com*/*red-starter/Ising-Model

[i] http://jakevdp.github.io/blog/2017/12/11/live-coding-cython-ising-model/

[j] https://github.com/Patrick-Louden/Ising-Model

[k] https://www.vixra.org/pdf/2004.0190v1.pdf – AI Systems and Movement of Molecules.

[l] "A photothermal experimental system for intracellular thermal mapping is presented,which makes the use of aqueous CdTe/CdS/ZnS quantum dots as the thermal sensors and allows the measurement of temperatures in living cells embedded with the QDs via temperature-dependent photoluminescence (PL)."
[ **Source - DOI: 10.1109/NANOMED.2016.7883481/Publisher: IEEE** ]

[m] **https://forbetterscience.com/2020/06/05/would-lancet-and-nejm-retractions-happen-if-not-for-covid-19-and-chloroquine/** *****

**[XV] An Interesting Final Word →**

{ The next outbreak → We are not ready ? → Bill Gates Message → http://TED.com →
"So, now's the time, Bill Gates suggests, to put all our good ideas into practice, from scenario planning to vaccine research to health worker training. As he says, "There's no need to panic ... but we need to get going." }

**[ THE END ]**