The African Strategy of Fundamental and Applied Physics

Report of the 2020–2024 Community Study on the Future of Fundamental and Applied Physics in Africa

organized through Broad Grassroots Community Consultations

Study Conveners:
Kétévi A. Assamagan, Simon H. Connell, Farida Fassi,
Fairouz Malek, Shaaban I. Khalil

Editorial Committee: ..

International Advisory Committee: ..

Foreword

In this space, the ASFAP Steering Committee will describe their view of the Study, and thank everyone who needs to be thanked.

Executive Summary

The African Strategy of Fundamental and Applied Physics brought together over 600 participants worldwide to develop a strategic vision, with practical recommendations, to enhance physics research and education in Africa.

Contents

1

Summary of the 2020-2024 African Strategy of Fundamental and Applied Physics

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, "Journals", 1820.

[2] A. Beale, "Surgical Writings", 1839.

[3] G. Cuvier, "Le Régne Animal", Imprimerie de A. Belin, Paris, 4 Volumes, 1816.

[4] J. Hunter, Phil. Trans. Royal Soc. **77**, 38 (1787).

[5] G. Lesson, "Mammalia", 1822.

2

Ethics in Physics

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, "Journals", 1820.

[2] A. Beale, "Surgical Writings", 1839.

3

Observers

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ⋯ Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[⋯]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, "Journals", 1820.

[2] A. Beale, "Surgical Writings", 1839.

4

Accelerators Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

5

Astrophysic & Cosmology Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

6

Atomic & Molecular Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

7

Biophysics Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

8

Complex Systems Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

9

Computing Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

10

Earth Science Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

11

Energy Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

12

Fluid and Plasma Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

13

Instrumentation and Detectors Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

14

Light Sources Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

15

Materials Physics Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

16

Medical Physics Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. $\cdots$ Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[$\cdots$]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

17

Nuclear Physics Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

18

Optics and Photonics Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

19

Particle Physics Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

617

20

Community Engagement Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

21

Physics Education Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

677

22

Women in Physics Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

707

23

Young Physicists Working Group

Josephina Thabo, Koffi Tahiri

John Doe, Aisha Koulibali

Already we are boldly launched upon the deep; but soon we shall be lost in its unshored, harbourless immensities. Ere that come to pass; ere the Pequod's weedy hull rolls side by side with the barnacled hulls of the leviathan; at the outset it is but well to attend to a matter almost indispensable to a thorough appreciative understanding of the more special leviathanic revelations and allusions of all sorts which are to follow.

It is some systematized exhibition of the whale in his broad genera, that I would now fain put before you. Yet is it no easy task. The classification of the constituents of a chaos, nothing less is here essayed. Listen to what the best and latest authorities have laid down.

"No branch of Zoology is so much involved as that which is entitled Cetology," says Captain Scoresby, A.D. 1820 [1].

"It is not my intention, were it in my power, to enter into the inquiry as to the true method of dividing the cetacea into groups and families. ··· Utter confusion exists among the historians of this animal" (sperm whale), says Surgeon Beale, A.D. 1839 [2].

"Unfitness to pursue our research in the unfathomable waters." "Impenetrable veil covering our knowledge of the cetacea." "A field strewn with thorns." "All these incomplete indications but serve to torture us naturalists."

Thus speak of the whale, the great Cuvier, and John Hunter, and Lesson, those lights of zoology and anatomy.

[···]

Finally: It was stated at the outset, that this system would not be here, and at once, perfected. You cannot but plainly see that I have kept my word. But I now leave my cetological System standing thus unfinished, even as the great Cathedral of Cologne was left, with the crane still standing upon the top of the uncompleted tower. For small erections may be finished by their first architects; grand ones, true ones, ever leave the copestone to posterity. God keep me from ever completing anything. This whole book is but a draught—nay, but the draught of a draught. Oh, Time, Strength, Cash, and Patience!

Bibliography

[1] J. Scoresby, “Journals”, 1820.

[2] A. Beale, “Surgical Writings”, 1839.

737

24

Conclusions

We are happy and relieved to conclude.

25

Glossary

$0\nu\beta\beta$: Neutrinoless double-beta decay, a nuclear decay process in which two electrons and zero neutrinos are emitted.

$2\nu\beta\beta$: Double-beta decay, a nuclear decay process in which two electrons and two neutrinos are emitted.

2HDM : Two-Higgs-Doublet Model, a model with two Higgs fields, usually with natural flavor conservation in Higgs boson couplings.

AAAS : American Association for the Advancement of Science.

ACTA : Augmented Cherenkov Telescope Array, the next-generation atmospheric Cherenkov telescope project for gamma ray detection.

ADMX : Axion Dark Matter Experiment, an experiment at the University of Washington searching for axions using a large electromagnetic cavity in a static magnetic field.

ADS : Accelerator-Driven Systems, a technology for driving nuclear reactors with particle beams.

AGILE : Astro-Rivelatore Gamma a Immagini Leggero, a space-based X-ray and gamma ray observatory.

AGN : Active Galactic Nucleus.

AIP : American Institute of Physics.

ALCF : Argonne Leadership Computer Facility.

ALICE : A Large Ion Collider Experiment, an experiment at the **LHC** focusing on heavy ion collisions and the quark-gluon plasma.

ALP : Axion-Like Particle.

ALPS, ALPS-II : Any Light Particle Search, a series of experiments at **DESY** searching for **axions** and similar particles using laser light conversion in a strong magnetic field.

AMANDA : Antarctic Muon and Neutrino Detector Array, the first-generation neutrino telescope experiment in Antarctica.

AMR : Adaptive Mesh Refinement.

AMS, AMS-02 : Alpha Magnetic Spectrometer, an antimatter detector located on the International Space Station.

ANITA : Antarctic Transient Antenna, a balloon experiment in Antarctica for detection of radio signals of ultra-high-energy neutrino events.

ANL : Argonne National Laboratory.

ANTARES : Astronomy with a Neutrino Telescope and Abyss environmental RESearch, a neutrino telescope experiment in the Mediterranean Sea.

APEX : A Prime EXperiment, an experiment at **JLab** searching for the production of dark photons using an intense electron beam.

APS : American Physical Society.

ARA : Askaryan Radio Array, a radiofrequency neutrino antenna experiment at the South Pole.

ArgoNeuT : Argon Neutrino Teststand, a small liquid argon **TPC** experiment at **Fermilab**.

ARIANNA : Antarctic Ross Ice-shelf ANtenna Neutrino Array, a radiofrequency neutrino antenna experiment in Antarctica.

ART : An Intensity Frontier software framework developed by the **Fermilab** Scientific Computing Division and used by **NOvA**, **mu2e**, **Muon $g-2$**, **LArSoft** , **DarkSide**, **LArIAT**, and others.

ASIC : Application Specific Integrated Circuit, a silicon chip processor designed for a particular purpose.

ASTA : Advanced Superconducting Test Accelerator, an accelerator test facility at **Fermilab**.

ATCA : Advanced Telecommunications Computing Architechture.

ATF, ATF2 : Accelerator Test Facility, an accelerator test complex at **KEK** built to study beam dynamics issues for the *ILC*.

ATLAS : A Toroidal LHC ApparatuS, a large experiment at the **LHC** optimized for high transverse momentum particle production.

ATR : Advanced Test Reactor, a research reactor at the Idaho National Laboratory.

Auger : Pierre Auger Observatory, experiment in Argentina that detects ultra-high-energy cosmic rays through both fluorescence and surface water Cherekov detectors.

Axion : A hypothetical, very light particle, with couplings to quarks that reverse under **P** transformations. Such particles could make up the dark matter of the Universe.

BaBar : An experiment at **SLAC**, using e^+e^- annihilation at approximately 10 GeV to study rare heavy quark and lepton decays.

Baikal : A neutrino telescope in Lake Baikal in Siberia.

Baksan : An underground laboratory in the Caucasus mountains in Russia.

BAO : Baryon Acoustic Oscillations.

Baseline : In neutrino physics, the distance between the neutrino production point, near an accelerator, and the neutrino detector.

BELLA : Berkeley Lab Laser Accelerator, a facility at **LBNL** for the development of laser-driven accelerators.

Belle : An experiment at **KEK**, using e^+e^- annihilation at approximately 10 GeV to study rare heavy quark and lepton decays.

Belle-II : An experiment at **KEK**, using e^+e^- annihilation at approximately 10 GeV to study rare heavy quark and lepton decays with 50-100 times the data set produced by **BaBar** and **Belle**.

BESIII : An experiment at **IHEP**, using e^+e^- annihilation at approximately 3–4 GeV to study charm quark and tau lepton physics.

BEST : Baksan Experiment on Sterile Transitions, a proposed radioactive source experiment in Russia with a gallium detector.

BINP : Budker Institute for Nuclear Physics, a high-energy physics laboratory in Novosibirsk, Russia.

BNB : Booster Neutrino Beam , a neutrino beamline at **Fermilab** using the Booster.

BNL : Brookhaven National Laboratory.

Borexino : A solar neutrino experiment at **Gran Sasso**.

Boson : A type of elementary particle whose intrinsic spin is an integer (0, 1, 2, ...) multiple of $\hbar$. Such particles can make up a macroscopic force field such as the electromagnetic field.

BOSS : Baryon Oscillation Spectroscopic Survey, a galaxy survey aiming to measure baryon acoustic oscillations.

BR : Branching Ratio, the probability that an unstable particle decays to a particular final state.

BSM : Beyond the Standard Model, a reference to new physics associated with an extension of the **SM**.

C : Charge conjugation, the interchange of particles and antiparticles.

CALICE : CALorimeter for Linear Collider Experiment, an experimental collaboration aimed at improving the technology of hadron calorimeters, especially with the **PFA** method.

Canfranc Underground Laboratory : An underground scientific facility in a former railway tunnel in the Spanish Pyrenees under Monte Tobazo in Canfranc, Spain.

Capability : In computing, refers to high-speed, highly parallel computing that might require a large fraction of a supercomputer.

Capacity : In computing, refers to computing in which many moderately parallel jobs are run alongside one another.

CAPTAIN : Cryogenic Apparatus for Precision Tests of Argon INteractions, a liquid argon R&D detector.

CAST : CERN Axion Solar Telescope, an experiment at **CERN** searching for **axions** radiated from the Sun.

CC : Charged Current weak interactions.

CCD : Charge Coupled Device, a class of pixel silicon detectors.

CDF : Collider Detector at Fermilab, a large experiment at the **Fermilab** Tevatron optimized for high transverse momentum particle production.

CDM : Cold Dark Matter, a class of dark matter models in which the dark matter particles move at nonrelativistic speeds.

CDR : Conceptual Design Report.

Ce-LAND : A ^{144}Ce source to be placed in **KamLAND** to study the reactor neutrino anomaly.

CENNS : Coherent Elastic Neutrino-Nucleus Scattering, an **NC** neutrino process and also a proposed experiment to be sited at the **BNB**.

CE&O : Communication, Education, and Outreach, a topic of one of the "frontiers" in this study.

CERN : Conseil Européen pour la Recherche Nucleaire, the major European high energy physics laboratory, located in Geneva.

CESR : Cornell Electron Storage Ring, an e^+e^- colliding beam accelerator at Cornell University that operated in the energy range 3.5-12 GeV from 1979 to 2008. The accelerator is still in operation as a synchrotron light source (CHESS) and as an accelerator physics testbed.

CesrTA : CESR Test Accelerator, a configuration of **CESR** to study the design of electron damping rings, in particular, for **ILC**.

Chameleon : A new particle that has properties that depend on its environment.

CHIPS : CHerenkov detectors In mine PitS, a proposed experiment to use the **Fermilab** beams and massive Cherenkov detectors in flooded mine pits.

CHOOZ : A first-generation reactor neutrino experiment located in Chooz, France.

CKM : Cabibbo-Kobayashi-Maskawa matrix, the matrix relating the weak interaction and mass eigenstates of quarks.

CL : (Statistical) Confidence Level.

CLEAN : Cryogenic Low Energy Astrophysics with Noble gases, a cryogenic noble liquid experiment for dark matter and solar neutrinos.

CLEO : A general-purpose particle detector at **CESR** studying heavy quark decays and spectroscopy.

CLFV : Charged Lepton Flavor Violation.

CLIC : Compact LInear Collider, a concept for an e^+e^- linear collider, with center of mass energies up to 3 TeV, based on two-beam acceleration.

CM : Center of Mass, the system for viewing a particle collision or decay in which the overall system is at rest.

CMB : Cosmic Microwave Background, the approximately isotropic microwave radiation in the universe created in the original formation of atoms from electrons and ionized protons.

CMS : Compact Muon Spectrometer, a large experiment at the **LHC** optimized for high transverse momentum particle production.

CoGeNT : COherent GErmanium Neutrino Technology, a germanium detector for dark matter and other signals requiring low background.

COMET : An experiment at **J-PARC** searching for muon to electron conversion in the field of a heavy nucleus.

COUPP : Chicagoland Observatory for Underground Particle Physics, a dark matter detector using a bubble chamber, now located in the Sudbury Mine in Sudbury, Ontario.

CP : The combination of a **C** and a **P** transformation, converting particles to antiparticles, plus mirror (left-right) reflection. This is a very accurate, but not perfect, approximate symmetry of nature.

CPAD : Coordinating Panel for Advanced Detectors, an advisory panel on detector technology created by the **APS DPF**.

CPT : The combination of a **C**, and a **P**, and a **T** transformation, converting particles to antiparticles, plus mirror (left-right) reflection, plus reversal of the direction of time. Local quantum field theory predicts this to be a perfect symmetry of nature.

CPU : Central Processing Unit of a computer.

CRADA : Cooperative Research and Development Agreement, an agreement between a government laboratory and a private company to pursue R&D on a technology or project.

CSI : Coherent Scattering Investigations at the SNS, a proposed **CENNS** search experiment for the **SNS**.

CTA : Cherenkov Telescope Array, a planned large-area array of telescopes for high energy gamma rays.

CTF3 : CLIC Test Facilty 3, the most recent in a series of test accelerators for **CLIC** at **CERN**.

CUDA : Compute Unified Device Architecture, which defines a parallel computing architecture for NVIDIA **GPU**s.

CUORE : Cryogenic Underground Observatory for Rare Events, an experiment searching for neutrinoless double beta decay, located at **Gran Sasso**, Italy.

DØ : D-zero, a large experiment at the **Fermilab** Tevatron optimized for high transverse momentum particle production.

DAEδALUS : Decay At rest Experiment for δ_{CP} studies at the Laboratory for Underground Science, a neutrino oscillation experiment based on beams created by cyclotrons.

DAMA : DArk MAtter experiment, a scintillator-based dark matter search experiment at **Gran Sasso**.

DAMIC : DArk Matter In CCD experiment, an experiment at **Fermilab** searching for light dark matter particles.

DANSS : Detector of the reactor AntiNeutrino based on Solid-state plastic Scintillator, a reactor neutrino experiment in Russia.

Dark Light : An experiment at **JLab** searching for dark photons using an **FEL**.

DarkSide : A dark matter search experiment at **Gran Sasso** using a liquid argon detector.

Daya Bay : A reactor neutrino experiment located near Daya Bay, China.

DeepCore : A low-energy extension to the **IceCube** experiment with a high density of photodetectors in a central region of the cube.

DES : Dark Energy Survey.

DESI : Dark Energy Spectroscopic Instrument.

DESY : Deutsches Elektronen SYnchrotron, the major high energy physics laboratory in Germany, located in Hamburg.

DIRC : Detection of Internally Reflected Cherenkov light, a detector using quartz bars for tracking and particle identification.

DIS : Deep Inelastic Scattering, a process of lepton scattering from a nucleon or nucleus with large momentum transfer, especially when only the lepton recoil is observed.

DM : Dark Matter.

DOE : U.S. Department of Energy.

Double Chooz : A reactor neutrino experiment in Chooz, France, utilizing detectors at two distances from the source.

DPF : Division of Particles and Fields, a division of the American Physical Society.

DREAM : Dual REAdout Method, a method for hadron calorimetry that corrects the charge/neutral response ratio by separate measurement of Cherenkov and scintillation light.

Drive beam : A high energy particle beam used to create an electromagnetic field that can then accelerate another beam to high energy.

DSNB : Diffuse Supernova Neutrino Background.

dSphs : dwarf Spheroidal satellite galaxies of the Milky Way.

EAS : Extensive Air Shower, produced by high energy cosmic rays in the Earth's atmosphere.

EBL : Extra-galactic Background Light.

ECHo : Electron Capture ^{163}Ho experiment, a proposed neutrino mass microcalorimeter experiment.

EDM : Electric Dipole Moment.

EFT : Effective Field Theory, a method of quantum field theory in which the effects of new particles or interactions that might be present at high energies are expressed by the addition of more complex operators to the equations of motion of the **SM**.

ESA : European Space Agency.

ESS : European Spallation Source, a future facility in Lund, Sweden.

ESSνSB : European Spallation Source Neutrino Super Beam, a proposal to use the **ESS** proton linac to generate a neutrino superbeam.

$\not\!\!E_T$ **:** Missing Transverse Energy, unobserved momentum in a high-energy particle collision carried away by weakly interacting neutral particles.

Euclid : A dark energy space mission currently under development by the European Space Agency.

EVA : ExaVolt Antenna, a proposed balloon-based neutrino antenna experiment in Antarctica.

EW : ElectroWeak interaction, the unified description of the electromagnetic and weak interactions.

EWSB : ElectroWeak Symmetry Breaking.

Exascale : Of the order of 10^{18}, used in computing to refer to next-generation computation resources in memory or speed.

EXO : Enriched Xenon Observatory, an experiment searching for neutrinoless double beta decay of the isotope Xe^{136}.

FACA : Federal Advisory Committee Act, the legislation that governs questions of openness and transparency for certain Federal committees. The act generally covers grant review panels of the **NSF** but not those of the **DOE**.

FACET : Facility for advanced ACcelerator Experimental Tests, a user facility at **SLAC** for experiments on high-gradient electron accelerator technology.

FCNC : Flavor-Changing Neutral Current.

FEL : Free Electron Laser, an electron accelerator that produces high-intensity coherent synchrotron radiation.

Fermi : Femtometer = 10^{-13}cm.

Fermi-LAT : Fermi Large Area Telescope, a space-based gamma-ray detector.

Fermion : A type of elementary particle whose intrinsic spin is a half-integer ($\frac{1}{2}$, $\frac{3}{2}$, ...) multiple of $\hbar$. Such particles can form rigid structures of matter such as atoms and atomic nuclei.

Fermilab : Fermi National Accelerator Laboration, in Batavia, Illinois.

FFAG : Fixed-Field Alternating Gradient accelerator, an accelerator design concept with time-independent magnetic bending fields and strong focusing.

FPGA : Field Programmable Gate Array, a type of programmable integrated circuit.

FNAL : Fermi National Accelerator Laboratory, or **Fermilab**.

FRIB : Facility for Rare Isotope Beams, a linear accelerator at Michigan State University for isotope production and nuclear structure research.

FrPNC : Francium Parity Non-Conservation, at experiment at **TRIUMF** to measure **P**-violating atomic transitions in francium atoms.

FSR : Final State Radiation, radiation from a lepton, quark, or gluon produced in a high-energy scattering process.

GALLEX : GALLium EXperiment, a radiochemical solar neutrino experiment located at **Gran Sasso**.

GammeV-CHASE : An experiment at **Fermilab** to search for **axions** using a laser beam in a strong magnetic field.

GAPS : General Antiparticle Spectrometer, an experiment to detect anti-matter, especially deuterons, produced by annihilating dark matter particles.

GC : Galactic Center.

GDE : Global Design Effort, the collaboration responsible for the **ILC** Technical Design Report.

GEANT4 : A library of simulation programs describing the passage of high-energy particles through matter.

GEM : Gas Electron Multiplier, a type of **MPGD** ionization detector.

GEMMA : Germanium Experiment for measurement of the Magnetic Moment of Antineutrino, a neutrino magnetic moment experiment at the Kalinin nuclear power plant in Russia.

GERDA : Ge experiment searching for neutrinoless double beta decay.

GeV : Giga-electron Volt (10^9 eV), the energy scale of the proton mass and the subnuclear strong interactions.

GIM : Glashow-Iliopoulos-Maiani mechanism, a method for coupling quarks to the weak interactions that avoid flavor-changing **NC** processes, realized in the **SM**.

GLACIER : Giant Liquid Argon Charge Imaging Experiment, a proposed large liquid argon detector in Europe.

GNO : Gallium Neutrino Observatory, a radiochemical solar neutrino experiment at **Gran Sasso** (successor to **GALLEX**).

GPU : Graphics Processing Unit.

GR : General Relativity, Einstein's theory of gravity.

Gran Sasso : An Italian national laboratory under a mountain of the same name, about 120 km from Rome.

Grid : In computing, a network of distributed computer and storage resources. Typically, it refers to a network in which users need not know at which node the processor or data they are using resides.

GUT : Grand Unified Theory, a unified theory of all microscopic particle interactions.

GZK neutrinos : Greisen-Zatsepin-Kuzmin neutrinos, produced by ultra-high energy cosmic ray protons scattering off **CMB** photons.

HALO : Helium And Lead Observatory, lead-based supernova neutrino detector at **SNOLAB**.

HAWC : High-Altitude Water Cherenkov, a gamma-ray detector currently operating in Mexico.

HE-LHC : High-Energy LHC, a proposed stage of the **LHC** in which the bending magnets are replaced by higher-field magnetics, to create *pp* collisions at center-of-mass energies of 26–33 TeV.

H.E.S.S. : High Energy Stereoscopic System, a telescope for high-energy gamma rays seen as air showers in Cherenkov radiation, located in Namibia.

HEP : High-Energy Physics, the generic term for the areas of research described in this report.

HEPAP : High-Energy Physics Advisory Panel, a panel convened by the U.S. **DOE** and **NSF** to advise the federal government on high-energy physics research.

HERA : Hadron Elektron Ring Anlage, an electron-proton and positron-proton collider at **DESY** that operated from 1990 to 2007.

HETDEX : Hobby-Ebberly Telescope Dark Energy Experiment.

HFIR : High Flux Isotope Reactor, reactor facility at Oak Ridge National Laboratory.

HHCAL : Homogeneous Hadron Calorimeter, a concept for hadron calorimetry based on total absorption of hadrons in large crystals equipped with dual readout (see **DREAM**).

HIGS : High Intensity Gamma-ray Source, a free electron laser at Duke University.

HiRes : High Resolution Fly's Eye cosmic ray experiment in Utah.

HLbL : Hadronic Light-by-Light scattering contributions to the muon anomalous magnetic moment.

HL-LHC : High Luminosity LHC, the highest-luminosity phase of the **LHC** program, with plans to collect 3000 fb^{-1} of data between 2022 and 2030.

HPC : High Performance Computing, such as that done using supercomputers.

HPS : Heavy Photon Search, an experiment at **JLab** searching for the decay of dark photons to e^+e^-.

HSC : Hyper-Suprime Cam, wide-field camera for the Subaru telescope.

HTC : High Throughput Computing, i.e, data-intensive computing.

HTS : High-Temperature Superconductivity.

Hyper-K : Hyper-Kamiokande, a proposed large water Cherenkov detector at Kamioka in Japan.

IACT : imaging Atmospheric Cherenkov Telescope.

IAEA : International Atomic Energy Agency.

IAXO : International Axion Observatory.

IBD : Inverse Beta Decay, usually referring to the reaction $\overline{\nu}_e + p \to e^+ + n$.

ICAL : Iron CALorimeter atmospheric neutrino experiment at **INO**.

ICARUS : Imaging Cosmic And Rare Underground Signals, a liquid argon neutrino detector located at **Gran Sasso**.

IceCube : A neutrino telescope located at the Amundsen–Scott South Pole station in Antarctica.

IceTray : A software framework developed and used by the IceCube experiment for both online and offline processing.

IDS : International Design Study (for the Neutrino Factory).

IHEP : Institute of High Energy Physics of the Chinese Academy of Sciences, the major particle physics laboratory in China, located in Beijing.

ILC : International Linear Collider, an electron-positron linear collider with design **CM** energy 500 GeV.

ILD : International Linear collider Detector, a large detector proposed for **ILC** and **CLIC**.

INO : India-based Neutrino Observatory, a future underground laboratory in Tamil Nadu, India.

IOPS : Input/output Operations Per Second.

IOTA : Integrable Optics Test Accelerator, an electron storage ring to be constructed at **ASTA** to study nonlinear beam optics.

IPPOG : International Particle Physics Outreach Group, a network of science educators and communicators based at **CERN**.

ISIS : Research center at Rutherford Appleton Laboratory near Oxford.

IsoDAR : Isotope Decay At Rest experiment, a proposed cyclotron-based sterile neutrino experiment.

ISR : Initial State Radiation, radiation from a high-energy lepton, quark, or gluon emitted as it scatters from another high-energy particle.

JLab : Thomas Jefferson National Accelerator Facility, in Newport News, Virginia.

J-PARC : Japan Proton Accelerator Research Complex, the laboratory hosting the major Japanese proton accelerator, located in Tokai.

JEM-EUSO : Extreme Universe Space Observatory onboard the Japanese Experiment Module, proposed ultra-high energy cosmic ray detector on the International Space Station.

JUNO : Jiangmen Underground Neutrino Observatory, a proposed large scintillator experiment for reactor neutrino oscillations located in China.

K2K : KEK to Kamioka, the first-generation long-baseline oscillation experiment using beam from **KEK** to **Super-K**.

KamLAND : Kamioka Liquid scintillator ANtineutrino Detector, a reactor neutrino experiment at Kamioka in Japan.

KamLAND-Zen : Zero neutrino double beta decay search, a neutrinolesss double beta decay experiment using a Xe-doped balloon deployed in **KamLAND**.

KATRIN : KArlsruhe TRItium Neutrino experiment, an experiment to measure neutrino mass from the endpoint of the tritium beta decay spectrum.

KEK : Ko-Enerugi Kenkyusho, the major high energy physics laboratory in Japan, located in Tsukuba.

KLOE, KLOE-2 : An experiment at **LNF** studying e^+e^- annihilation at energies near 1 GeV.

KM3NET : Multi-Km^3 Neutrino Telescope, a future deep-sea neutrino telescope in the Mediterranean sea.

KOTO : An experiment at **J-PARC** to study the rare decay $K_L^0 \to \pi^0\nu\overline{\nu}$.

kt : Kilotonne $= 10^6$ kilograms.

ΛCDM : The standard model of cosmology in which the Universe consists of known particles, cold dark matter (CDM), and dark energy (Λ).

***L/E* :** Length (**baseline**) / Energy, a figure of merit for neutrino oscillation experiments.

LAGUNA : Large Apparatus studying Grand Unification and Neutrino Astrophysics, a collaborative project to assess the possibilities for a deep underground neutrino observatory in Europe; includes the **GLACIER** , **MEMPHYS**, and **LENA** concepts.

LANL : Los Alamos National Laboratory.

LANSCE : Los Alamos Neutron Science Center.

LAPPD : Large Area Picosecond Photo-Detectors project, a collaboration working to develop large-area flat-panel photon detectors.

LAr : Liquid argon.

LAr1 : A proposal to add additional liquid argon TPCs to the **Fermilab** Booster neutrino beamline.

LAr1-ND : A proposal to add a liquid argon TPC near detector in the **Fermilab** Booster neutrino beamline.

LArIAT : Liquid Argon In A Testbeam, a liquid argon TPC test beam experiment at **Fermilab**.

LARP : LHC Accelerator Research Program, a collaboration of U.S. national laboratories to develop technology for the current and future stages of the **LHC**.

LBNE : Long Baseline Neutrino Experiment: An experiment to measure neutrino oscillations, with beams from **Fermilab** and a detector at **SURF** in South Dakota.

LBNL : Lawrence Berkeley National Laboratory (formerly LBL, Lawrence Berkeley Laboratory).

LBNO : Long-Baseline Neutrino Oscillation experiment, a proposed accelerator-based neutrino oscillation experiment in Europe.

LCF : Leadership Computing Facility, one of the **DOE**'s high-performance computing centers.

LENA : Low Energy Neutrino Astronomy, a proposed next-generation liquid scintillator detector.

LENS : Low Energy Neutrino Spectroscopy, a low-energy indium-based solar neutrino experiment.

LEP, LEP-2 : The Large Electron-Positron collider at **CERN**, which performed precision studies of the Z meson and searches for new phenomena from 1989 from 2000.

LHC : Large Hadron Collider, a large proton-proton collider at **CERN**, with design **CM** energy 14 TeV.

LHCb : LHCb, an experiment at the Large Hadron Collider specialized to measure the production in the forward direction of hadrons containing heavy quarks.

LHeC : Large Hadron-electron Collider, a proposal for a high-energy electron beam colliding with the proton beam of the **LHC** at **CERN**.

LNF : Laboratori Nazionali di Frascati, the leading particle physics laboratory in Italy, located in Frascati, near Rome.

LO : Leading Order, applied to the level of a quantum field theory calculation (see also **NLO**).

LPA : Laser Plasma Acceleration.

LSND : Liquid Scintillator Neutrino Detector, an experiment at Los Alamos National Laboratory searching for sterile neutrinos.

LSO : Lutetium Silicate (Lu_2SiO_5).

LSST : Large Synoptic Survey Telescope.

LUX : Large Underground Xenon detector, a large dark matter detector using liquid Xenon.

LVD : Large Volume Detector, a neutrino observatory at **Gran Sasso** studying low-energy neutrinos from gravitational stellar collapse.

LXe : Liquid Xenon.

LYSO : Lutetium Yttrium OxyorthoSilicate ($Lu_2(1\text{-}x)Y_2(x)SiO_5$).

LZ : LUX-Zeplin, a next-generation xenon TPC dark matter detector.

MAGIC : Major Atmospheric Gamma-ray Imaging Cherenkov telescope, a telescope for high-energy gamma rays seen as air showers in Cherenkov radiation, located in the Canary Islands.

MAJORANA : An experiment searching for neutrinoless double-beta decay in Ge, located at **SURF**.

MAMI : MAinzer MIcrotron, a low-energy electron accelerator at the University of Mainz.

Many-core : Refers to computer chips that contain many more cores than **multi-core CPU**s, i.e., more than than 16 **CPU**s.

MAPS : Monolithic Active Pixel Sensor.

MCP : Micro-Channel Plate.

MEG : MuEGamma experiment, an experiment at **PSI** searching for the decay $\mu \to e\gamma$.

MEMPHYS : MEgaton Mass PHYSics, a large water Cherenkov detector proposed for **CERN** or **ESS**.

MESA : Mainz Energy-Recovering Superconducting Accelerator, a proposed electron accelerator at the Universithy of Mainz.

MicroBooNE : Liquid argon TPC experiment in the Booster neutrino beamline at **Fermilab**.

MicroMegas : Micro-Mesh gas detector, a type of **MPGD** ionization detector.

Milagro : A water Cherenkov gamma-ray telescope located near **LANL**.

MINERνA : Main Injector Experiment for ν-A, a neutrino scattering experiment in the NuMI beamline at **Fermilab**.

MiniBooNE : A short-baseline neutrino oscillation experiment using a mineral oil-based Cherenkov detector in the Booster neutrino beamline at **Fermilab**.

MIND : Magnetised Iron Neutrino Detector, a proposed neutrino factory detector.

MINOS : Main Injector Neutrino Oscillation Search, a neutrino oscillation experiment located at **Soudan** using the NuMI beamline at **Fermilab**.

MKID : Microwave Kinetic Inductance Detector.

MNS : Maki-Nakagawa-Sakata matrix (see **PMNS**).

MOLLER : An experiment at **JLab** to measure the **P**-violating asymmetry in electron-electron scattering.

MPGD : Micro-Pattern Gas Detector.

MPPC : Multi-Pixel Photon Counter.

$\overline{MS}$: Modified Minimal Subtraction, a prescription for removing divergences commonly used in high-precision quantum field theory calcuations.

MS-DESI : Mid-Scale Dark Energy Spectroscopic Instrument.

MSSM : Minimal Supersymmetric Standard Model, the simplest (though, not very simple) model that extends the **SM** by the addition of **SUSY**.

MSW : Mikheyev-Smirnov-Wolfenstein effect, the modification of the neutrino oscillation probability as neutrinos pass through matter.

Multi-core : Refers to computer chips that contain up to about 16 **CPU**s.

Muon $g-2$: An experiment at **Fermilab** to measure the anomalous magnetic moment of the muon.

mwe : Meters water-equivalent, a measure of the depth of an underground detector.

NA62 : An experiment proposed at **CERN** to measure the rare kaon decay $K^+ \to \pi^+ \nu\overline{\nu}$.

NC : Neutral Current weak interactions.

NERSC : National Energy Research Scientific Computing Center.

NESSiE : Neutrino Experiment with SpectrometerS in Europe, a proposed experiment to search for sterile neutrinos using the **CERN** SPS beam and the **ICARUS** detector.

NEXT : Neutrino Experiment with Xenon TPC, a neutrinoless double beta decay experiment at the **Canfranc Underground Laboratory**.

NF : Neutrino Factory.

NH : Normal Hierarchy.

NIST : National Institute of Standards and Technology.

NLCTA : Next Linear Collider Test Accelerator, an accelerator at **SLAC** now used for tests of advanced accelerator concepts.

NLO, NNLO : Next-to-Leading Order, Next-to-Next-to-Leading Order, terms designating a quantum field theory calculation with two and three terms, respectively, in the power series in the coupling constant.

NLWCP : New, Light, Weakly-Coupled Particles.

NNbarX : An experiment proposed at **Fermilab** to search for neutron-antineutron oscillations.

NOMAD : Neutrino Oscillation MAgnetic Detector, a neutrino oscillation experiment at **CERN**.

NOνA : NuMI Off-Axis electron-neutrino Appearance experiment, a neutrino oscillation experiment in the **NuMI** beamline at **Fermilab**.

NREN : National Research and Education Network, a high performance network designed for large scale data movement.

NSF : U.S. National Science Foundation.

NUFO : National User Facility Organization, the umbrella group for U.S. national user facility users' organizations.

NuMAX : Neutrinos from Muon Accelerators at Project X, a proposed neutrino oscillation experiment using a muon-storage ring as a source of neutrinos.

NuMI : Neutrinos at the Main Injector, a neutrino beamline at **Fermilab** using the Main Injector, extending to **Soudan** and Ash River, Minnesota.

nuSTORM : Neutrinos from STORed Muons, a proposed short-baseline neutrino experiment to study sterile neutrinos using a muon storage ring as a source of neutrinos.

NVRAM : Non-Volatile Random Access Memory.

OHEP : Office of High Energy Physics of the U.S. **DOE**.

OLCF : Oak Ridge Leadership Computing Center.

OPERA : Oscillation Project with Emulsion-tRacking Apparatus, an emulsion- and tracker-based neutrino oscillation experiment at **Gran Sasso**.

ORCA : Oscillation Research with Cosmics in the Abyss, a proposed experiment to measure the neutrino mass hierarchy using the **KM3NeT** neutrino telescope.

ORKA : A proposed **Fermilab** experiment to measure the rate of the decay $K^+ \to \pi^+ \nu\overline{\nu}$.

ORNL : Oak Ridge National Laboratory.

OscSNS : Oscillations at the Spallation Neutrino Source, a proposed sterile neutrino search using the SNS facility.

P : Parity, the inversion of all spatial coordinates.

PAMELA : Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics, space-based anti-matter detector.

PANDA : antiProton ANnihilation at Darmstadt, a proposed experiment at the GSI Helmholtzzentrum in Darmstadt, Germany, studying proton-antiproton annihilation at few-GeV energies.

PandaX : A liquid xenon dark matter experiment to be located in the Jin-Ping Underground Laboratory in Sichuan, China.

PB : PetaByte, equal to 10^{15} bytes of information.

PDF : Parton Distribution Function, a function that describes the internal structure of the proton by giving the momentum distribution of a particular constituent, for example, the up quark or gluon.

PEN : An experiment at **PSI** to measure the ratio of decay rates $\pi^+ \to e^+\nu$ / $\pi^+ \to \mu^+\nu$.

Persistency management : Management of persistent data on disk, tape, or other media. This includes reducing the risk of loss to an appropriate level.

PEP-II : An e^+e^- collider operated at **SLAC** from 1998 to 2008 in the center-of-mass energy region of 10 GeV.

PF : PetaFlop, 10^{15} floating point operations (usually, per second).

PFA : Particle Flow Analysis, a method for hadron calorimetry based on separate measurement of the components of a hadronic shower with charged particles, photons, and neutral hadrons.

PFS : Prime Focus Spectrograph, wide-field multi-object spectrograph for the Subaru telescope.

PIENU : An experiment at **TRIUMF** to measure the ratio of decay rates $\pi^+ \to e^+\nu$ / $\pi^+ \to \mu^+\nu$.

PINGU : Precision IceCube Next Generation Upgrade, a proposed low-energy extension to **IceCube**.

Pipeline computing : Data analysis that proceeds in stages.

pMSSM : phenomenological Minimal Supersymmetric Standard Model, a 19-parameter subspace of the full MSSM.

PMNS : Pontecorvo-Maki-Nakagawa-Sakata matrix, the matrix linking the mass and flavor eigenstates of neutrinos.

PMT : PhotoMultiplier Tube.

Port : To adjust and test a computer program to run on a new architecture, or the result of this process.

PQ : Peccei-Quinn symmetry, an approximate symmetry of quark-Higgs boson interactions, which must also be spontaneously broken, that allows the possible **CP**-violating term in **QCD** to be set to zero. A consequence of this symmetry is the existence of the **axion**.

PREM : Preliminary Reference Earth Model, a model for the Earth's density distribution.

PREP : Physics Research Equipment Pool.

Project 8 : A proposed tritium-based neutrino mass experiment.

Project X : A planned upgrade of the proton accelerator injector complex at **Fermilab**, with a superconducting proton linear accelerator capable of producing multi-megawatt beams.

PROSPECT : Precision Reactor Neutrino Oscillation and Spectrum Experiment, a U.S.-based reactor short-baseline oscillation search experiment.

PSI : Paul Scherrer Institute, a national laboratory and accelerator center in Switzerland.

PTOLEMY : Princeton Tritium Observatory for Light Early-universe Massive neutrino Yield, a proposed relic Big Bang neutrino background experiment.

PWFA : Plasma Wake Field Acceleration.

QCD : Quantum Chromodynamics, the well-established theory describing the strong subnuclear interactions.

QE : Quasi-Elastic scattering. In neutrino physics, a reaction such as $\nu n \to \mu^- p$ in which no mesons are produced. In other contexts, a quasi-elastic reaction on a nucleon can involve production of a low-lying nucleon resonance.

QED : Quantum ElectroDynamics.

Qweak : An experiment at **JLab** to measure Q_{weak}, the charge with which the proton couples to the Z boson at very low momentum transfer.

RADAR : R&D Argon Detector at Ash River, proposal to add a **LAr TPC** to the **NOνA** far detector building in Ash River, Minnesota.

RAT : A simulation and analysis package for optical detectors developed for the Braidwood project and now used within **SNO+**, **MiniClean**, and **DEAP**.

REAPR : Resonantly Enhance Axion Photon Regeneration, an experiment at **Fermilab** to search for **axions** using a laser beam in a strong magnetic field, the successor to **GammeV-CHASE**.

RENO : Reactor Experiment for Neutrino Oscillations, a reactor neutrino experiment in South Korea.

RENO-50 : A proposed reactor-based experiment with **baseline** ~ 50 km to measure the neutrino mass hierarchy with a large scintillator detector.

RF : Radio Frequency.

RHIC : Relativistic Heavy Ion Collider, a colliding beam acclerator for protons and heavy ions at **BNL**.

RICE : Radio Ice Cherenkov Experiment, neutrino detector in Antarctica.

RICOCHET : A proposed bolometric sterile neutrino search using **CENNS**.

RICH : Ring Imaging CHerenkov detector.

RIKEN : Rikaguka Kenkyujo, a major Japanese research institute covering physics, chemistry, and engineering, operating multiple research groups in Japan and one in the U.S. at **BNL**.

ROI : Region Of Interest. In neutrino physics, the region of a measured energy spectrum where the signal (typically a peak or dip from an oscillation) lies. In collider physics, a region of a detector whose data is used in trigger calculations.

RPC : Resistive Plate Chamber, a type of particle tracking detector.

SAGE : Soviet American Gallium Experiment, a solar neutrino experiment in the **Baksan** Neutrino Observatory in Russia.

SBIR : Small Business Innovation Research, a grant category of the **DOE** for collaboration of small businesses with experimental projects.

SciDAC : Scientific Discovery through Advanced Computation, a program of the **DOE**.

Science DMZ : A portion of a computer network designed for high-performance scientific applications rather than general-purpose computing such as web browsing.

SciNOνA : A proposed neutrino scattering experiment adding a fine-grained scintillator detector at the **NOνA** near detector site.

SDSS : Sloan Digital Sky Survey, a survey of more than a quarter of the sky using the 2.5-meter telescope at Apache Point Observatory, New Mexico.

SiD : Silicon Detector, a detector with silicon tracking proposed for **ILC** and **CLIC**.

SIMD : Single Instruction Multiple Data style of parallel programming.

SiPM : Silicon PhotoMultiplier, a silicon-based photodetector operated in Geiger mode.

SKA : Square Kilometer Array radio telescope.

SLAC : Stanford Linear Accelerator Center, a U.S. national laboratory in Menlo Park, California, featuring a 3 km electron linear accelerator.

SLC : SLAC Linear Collider, an electron-positron collider operated at **SLAC** from 1989 to 1998 to study the Z boson and develop the technology of linear colliders.

SM : Standard Model of particle physics, which describes the strong, electromagnetic, and weak interactions as mediated by vector fields.

SNO : Sudbury Neutrino Observatory, a solar neutrino experiment located in Sudbury, Ontario, Canada.

SNO+ : A successor to the **SNO** experiment aimed at the measurement of neutrinoless double-beta decay of tellurium.

SNOLAB : Underground science laboratory in the Vale Creighton Mine located near Sudbury, Ontario.

SNS : Spallation Neutron Source, at Oak Ridge National Laboratory.

Soudan : An underground laboratory in northern Minnesota, housing **MINOS** and low-background experiments.

SOX : A chromium and/or cesium source used with the **Borexino** detector to study the reactor neutrino anomaly.

SRF : Superconducting Radio Frequency (**RF**) cavities and associated technology.

STTR : Small business Technology TRansfer, a **DOE** program for this purpose.

STAR : Solenoidal Tracker at RHIC, a relativistic heavy ion collider experiment at Brookhaven.

STEM : Science, Technology, Engineering, and Mathematics, typically describing a domain of education.

STEREO : Search for Sterile Neutrinos at ILL reactor, a reactor short-baseline oscillation search in France.

SPS : Super Proton Synchotron at **CERN**.

Subaru : An optical/infrared telescope on Mauna Kea operated by the National Observatory of Japan.

Super-K : Super-Kamiokande experiment, water Cherenkov detector in the Kamiokande mine in Japan studying proton decay as well as solar, atmospheric, and accelerator-produced neutrinos.

SuperKEKB : A high-luminosity electron-positron collider, with **CM** energy about 10 GeV, at **KEK**.

Super-NEMO : Super Neutrino Ettore Majorana Observatory, a neutrinoless double beta decay experiment in the Fréjus underground laboratory in France.

SURF : Sanford Underground Research Facility: An underground laboratory in the former Homestake Mine in Lead, South Dakota.

SUSY : SUperSYmmetry, a symmetry that links together **fermions** and **bosons**. In any realistic theory, supersymmetry requires a new space-time structure extending and generalizing that of relativity.

T : Time reversal, the transformation of reversing the direction of time.

T2K : Tokai to Kamiokande experiment, a neutrino oscillation experiment in Japan, using the **J-PARC** neutrino beam and the **Super-K** detector.

TA : Telescope Array, ultra-high-energy cosmic ray detector in Utah.

TCA : Telecommunications Computing Architechture.

TeV : Tera-electron Volt (10^{12} eV), the order-of-magnitude energy scale of Higgs boson physics.

TDR : Technical Design Report.

TES : Transition Edge Sensor, a cryogenic sensor based on the very small amount of energy needed to destroy superconductivity in a thin film painted on the surface of a detector.

TLEP : Triple Large Electron-Positron collider, a proposed e^+e^- collider in a large circular tunnel, with **CM** energies from 90 to 350 GeV.

TPC : Time Projection Chamber, a type of particle detector in which ionization from a track flows to a wall of a detector and the arrival time and location are measured, producing a 3-dimensional image of the track.

TREK : Time Reversal Experiment with Kaons, an experiment at **J-PARC** to search for **T**-violating muon polarization in the decay $K^+ \to \pi^0\mu^+\nu$.

TRIUMF : TRI-University Meson Facility, the national accelerator laboratory of Canada, located in Vancouver. It is now operated by a consortium of 15 universities.

UHE : Ultra High Energy, typically applied to cosmic rays with energies $> 10^{18}$ eV.

VCSEL : Vertical Cavity Surface Emitting Laser.

VEPP : One of a series of electron-positron colliders at the Budker Institute of Nuclear Physics in Novosibirsk, Russia.

VERITAS : Very Energetic Radiation Imagine Telescope Array System, a telescope for high energy gamma rays seen as air showers in Cherenkov radiation, located in Arizona.

Vev : Vacuum expectation value, the value of a condensed field, such as the Higgs field, at every point in space.

VLHC : Very Large Hadron Collider, a concept for a proton-proton collider with center of mass energy approximately 100 TeV.

Volunteer computing : A distributed computing effort in which computer resources are donated by the owner, for example, the SETI At Home project.

Wakefield : The electromagnetic field trailing a bunch of high-energy particles in an accelerating structure.

WATCHMAN : WATer CHerenkov Monitoring of Anti-Neutrinos, a collaboration of U.S.-based universities and laboratories conducting a site search for an advanced water Cherenkov demonstration detector.

WFIRST-AFTA : Wide-Field InfraRed Survey Telescope-Astrophysics Focused Telescope Assets

WIMP : Weakly Interacting Massless Particle, a category of particle that might make up the dark matter of the universe.

WIPP : Waste Isolation Pilot Plant, an underground facility located in New Mexico.

YBCO : Yttrium Barium Copper Oxide, $YBa_2Cu_3O_{7-x}$, one of the first high-temperature superconductors.