The Latin American Synchrotron in the Greater Caribbean

Galileo Violini

International Center of Physics, CIF, Bogota

EuPRAXIA_PP ANNUAL MEETING

La Biobola Bay, Elba Island, Italy, September 27, 2024

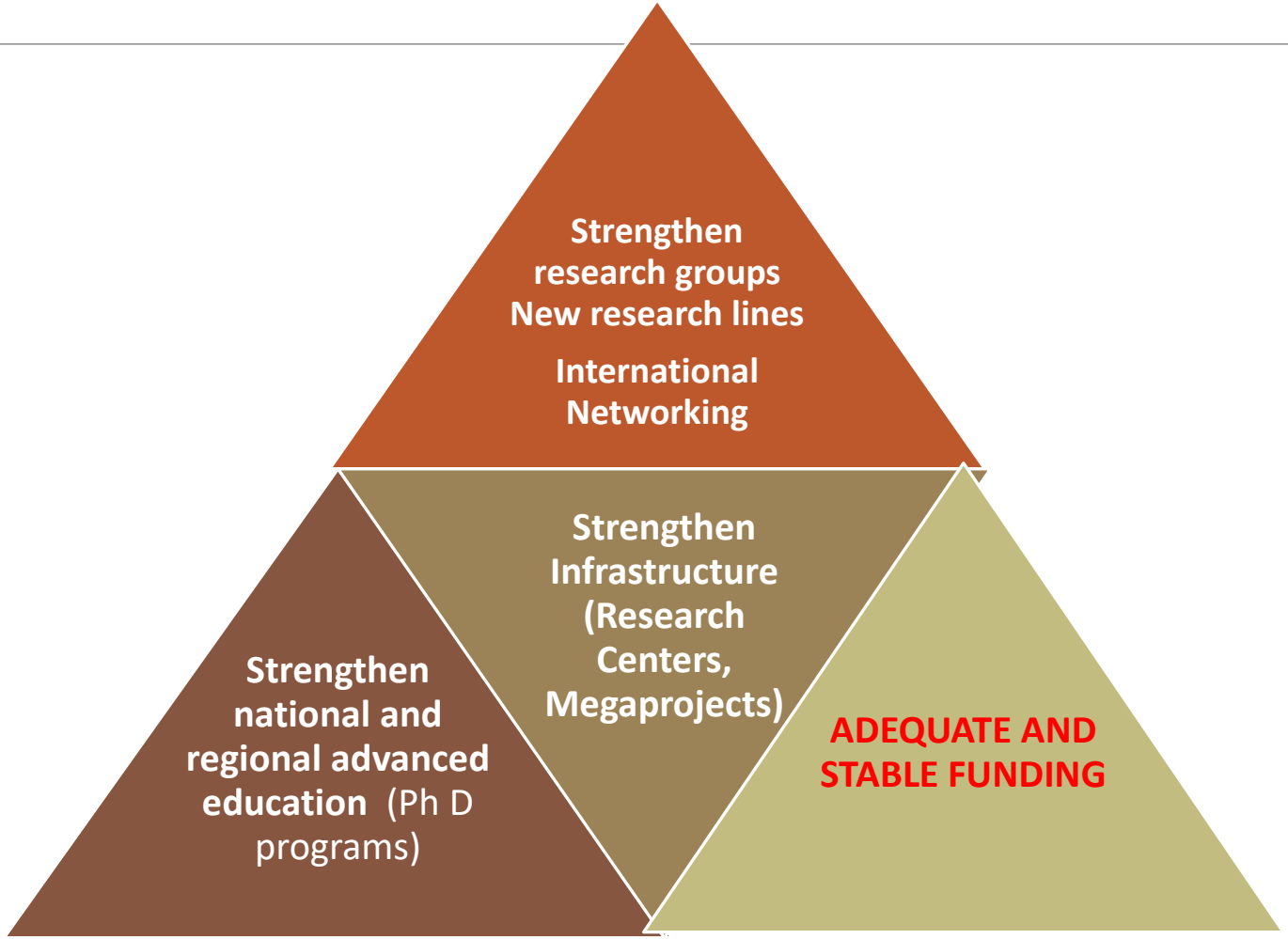
Greater Caribbean

Our project: Mexico, SICA countries (Continental Central America and Dominican Republic), Colombia, Caribbean islands.

Geographically: also Venezuela, Cuba, Puerto Rico

GC + Gulf of Mexico: add South Eastern US, namely Southern Texas, Louisiana, Alabama, Mississippi, and Florida

South Science - Priorities and Needs



The Case for Synchrotrons - SDG

Synchrotron research relevant for 13 out of the 17 UN Sustainable Development Goals

Among the 13 goals, Poverty, Health, Water, Energy, four Is, Climate, especially relevant for GC.

Synchrotrons in the South

In Africa: No synchrotrons. **AfLS** proposal (1990-2015): AfLS may offer guidelines for GC project, and is a potential partner for international lobbying and training programs

In Latin America: LNLS, Campinas: first proposal 1981, VUV (1997), Sirius (2018) - Great impact on scientific and industrial development. Direct (SIRIUS built, 86%, by Brazilian enterprises). Indirect, e.g. pharmaceutical industries, production of radioisotopes.

SESAME, a successful case:

Promoted by international organizations: UNESCO, CERN

Political and diplomatic differences overcome through Science

Big scientific Infrastructure in Latin America: Astronomy and Astrophysics

Chacaltaya Lab in Bolivia, 1947 (pion discovery)

Arecibo (1963) closed August 2023

La Silla (ESO) and Cerro Tololo (Interamerican) Observatories, 1969

Pierre Augier Observatory (Mendoza, Cronin) 1999

Our Proposal

https://arxiv.org/abs/2109.11979

Independent, although not new. **REGIONAL**

Colombia: Bernardo Gómez (2015)

Mexico: first in Morelos (Brenda Valderrama, Víctor del Rio, 2015), then Hidalgo

Cuba: After Obama's visit (2016), Jeremy Rothstein and Fidel Castro Smirnov

Currently: Puerto Rico PULS

Background and Milestones

2021- XVI Week of Dominican Science, **Symposium on postpandemic science in LA** - Arxiv article- Working group

---

2022- XVII Week of Dominican Science- **Symposium on Scientific Megastructures**

- LAAAMP, SESAME. **First contact with Sirius**, ICTP support, World Science Forum- **Alliance with AfLS**

2023- SLAC and LNBL visit. Result: Joining with the national Mexican Project. Formalization of the working group

- XVIII Week of Dominican Science- **Six-country Symposium LAMISTAD**

2024- Nature, https://www.nature.com/articles/d41586-024-005198-4

Some dozens International Presentations (Conferences, Workshops, Symposia, Seminars, Schools, Science Academy Meetings)

Which Kind of Synchrotron?

1- GCS: foreseen operating in the thirties, should be a 4th generation one. (Currently, only MaxIV, ESRF and Sirius are 4th generation, although many 3rd generation facilities are being upgraded and a new one is under construction in China).

2- Energy: complementary to 3 GeV Sirius synchrotron

3- Higher energy? Lower energy? 1.5 GeV interesting for several areas of application relevant for the region (e.g., bio - health), although mining and soil study are also important (case for 6 GeV)

4- MAX IV Example?

Where?

Probably NOT URGENT DECISION – Political and Financial considerations are to be taken into account

Several possibilities

- Mexico – Plans exist. Hidalgo offered land for the Mexican project. Largest GNP in the region. Political complexity (federal structure allows local decisions, but eventual decision by Federal government)

- Colombia – Royalties Law 2056 (Sept.30, 2020). Regional development of Atlantic Coast

- Dominican Republic – Project of a City of Knowledge

Central America? Jointly El Salvador - Guatemala - Honduras? Jamaica?

What else elsewhere?

Wherever established, it must be a Latin American Synchrotron, located WITHIN the Great Caribbean

Possible additional facilities. Compact Light Sources and small accelerators may be more than an intermediate-time option

Regional system of small accelerators? Potential Political NECESSITY

Belonging to a unique institution? If (and probably only if) part of a regional lab., independence of possible national political changes ensured

Feasibility Conditions

Exixtence of scientific demand and technical capacity

Availability of economic interest and financial resources

Social acceptance

Favourable national, regional and international context

Scientific Demand and technical Capacity

Scientific demand and potential users (basin of several thousands needed)

Expected also users from outside the Region

Potentially high availability, especially in sectors where Region's non-scientific demand is high, such as health, food safety, biodiversity, all of socioeconomic importance. Estimated size of this community: tens of thousands potential users.

Little experience. Existing synchrotrons far located. Other research techniques are used. Training necessary, Possible support from e.g. Elettra, Sirius, SESAME, US.

A GC (South?) beamline? Joining a research group at some beamline?

Technical capacity - Engineers, staff and technicians

Vigogorus training program necessary. SESAME experience: It is possible to carry on such a program during the building of the facility

Economic Context - LA Matrix

- Explotation of Natural Resources

- Agriculture

- Tourism
- Trade – Internal economies
- **Import of technological goods**
- Services
- Migrant Remittances

Limited and unequal Industrial development

Options: National High Tech vs. Offshore foreign Medium Tech

Science in the Greater Caribbean

Country	Res/1000 labor force (%) 2018 (year)	HEExp/GNP (2018)	Ph D students (%) (2018)	Publications (2018)	R & D/GNP
Mexico	0.71	1.02	43774 (2018)	23508	0.27- 0.31
Colombia	0.17	1.05	6225 (2018)	11193	0.29-0.24
SICA countries					
Guatemala	0.03	0.41	881 (2017)	269	0.06- 0.03
Belize*					
El Salvador	0.15	0.33	63 (2018)	69	0.16-0.16
Honduras	0.08	0.88	492 (2017)	181	0.06-0.04
Costa Rica	0.79	1.36	2805 (2019)	1053	0.28-0.39
Nicaragua				118	0.11
Panama	0.08	1.1	107 (2016)	727	0.18-0.15
Dominican Rep.				232	0,24

* not considered by UNESCO Science Report becase included in the Caricom section.

Sources: UNESCO Science Report 2021 (Gabriela Dutrénit, Carlos Aguirre, Martín Puchet Mónica Salazar) and Carlos Aguirre, private communiation. CEPAL 2023 Report, Estimate

Structure of S & T Funding

- Low investment: Average 0.6% of GNP, Big asymmetries, two extreme cases: Brasil (1.4%) Guatemala 0.04%)
- GNP Percentage poor indicator for small under 10-15 million population), and/or low per capita income countries.
- **Big national scientific programs impossible**

Funding sources:

- National public (**very little, if any, private**)

- International – Development Banks, (often earmarked, not allowing structural actions)

- Cooperation, often considered as a primary source and not as a complementary one. External-policy priorities may limit and constrain the eligibility of research programs.

Cost – Financing - Governance

Rough estimate: Initial investment: 300 MUS$ spread over 5-6 years. International support possible (Development Banks, International Cooperation ?)

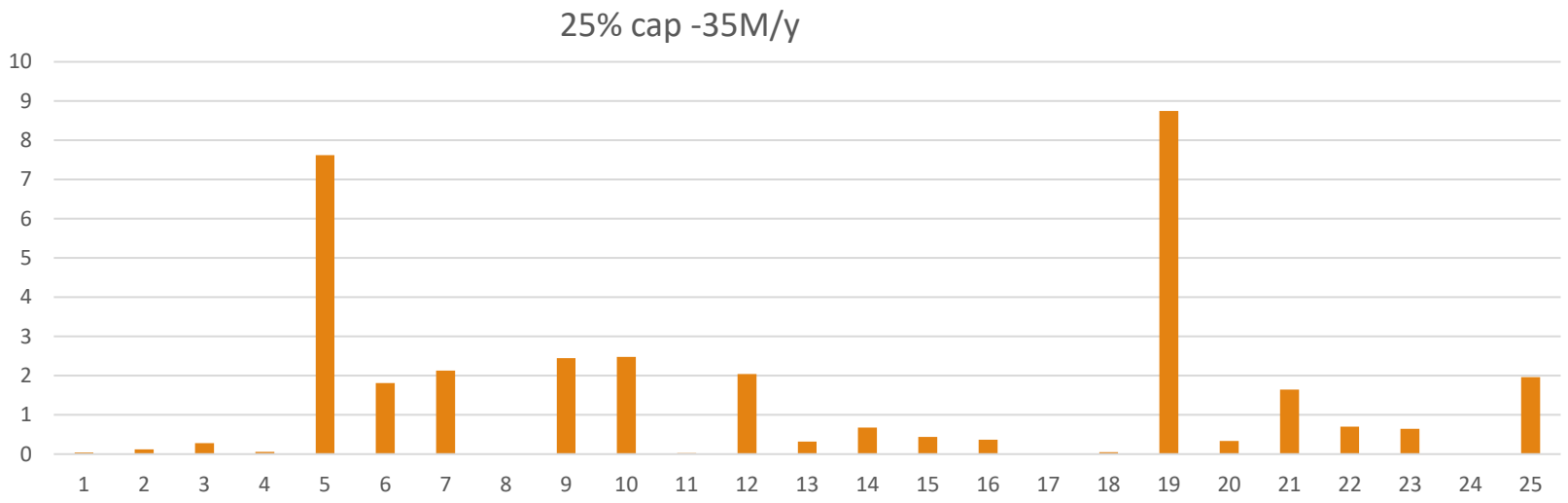
Operational cost: 35 MUS$/year, (although SESAME, until now: 90 MUS$ (full solar-energy electric power) with financing from participating countries

Governance: Intergovernmental (CERN-like), Private-semipublic (Consortium of participants, ESFR-like)

Yearly Cost per Country

No external contribution for operation (35M$/y), Contributions: proportional to GNP, with a 25 % cap for individual countries .

Impact on the choice of host country (Mexico? Colombia?) Compatibility with countries policies



Social Acceptance

Problem: Cost of opportunity, vis à vis social and educational problems of the region. Usueally Science is not real governmental priority

---

However:

Insufficient scientific education and development cause indirect costs

Natural risk, Environment, Food security, Contamination), Agriculture, Health are socially relevant issues

Regional integration, industrial development, Biodiversity are part of political speech

Right of people to develop their capacities (RIGHT TO SCIENCE, not limited to access and use) Ethical, but politically weak argument

Necessary to present the benefit of the project, targeting both the society in general, and the private productive sector

Scientific world support (universities, academies, scientific societies) necessary, but not granted. Personal and sectorial interests may reflect in negative positions

Role of scientific journalism (weak in the region)

Cost of Opportunity?

Education: Argument rarely used to deny financing in this sector (Average LA: 4.6% GNP, against 0.6% Science)

Health: During the pandemic the BCIE (Central American Bank for Economic integration) gave $400 million to the 8 SICA countries

GC Military expenditure (40% of LA one): in 2021: $21.2 Billion, mostly by Mexico and Colombia ($18.9 Billion), but still remaining countries expenditure is $2.3 Billion.

(Sources: Stockholm International Peace Research Institute, D. Lopes Da Silva et al., https://www.macrotrends.net/countries/LCN/latin-america-caribbean-/military-spending-defense-Budget)

A must: Regional Financing
Interesting Proposal: FORCyT

First suggestion: GV, June 2015, CSUCA meeting in Cartagena, presented to Guatemala Government by J.A. Fuentes Soria, then CSUCA 's SG .

Endorsement by Guatemala Government (again J. A. Fuentes Soria, as Vicepresident) at a SICA Meeting, El Salvador, December 2015, 25M$/year during 5 years

CTCAP Meeting in Guatemala (September 28, 2016)

Still waiting for the decision of the Heads of State

Fuentes Soria, J. A. (2017), "Fondo Regional de Ciencia y Tecnología del Sistema de la Integración Centroamericana, FORCYT-SICA" in Lemarchand G., Relevamiento de la investigación y la innovación en la República de Guatemala, Paris, UNESCO

Possibilities of Cooperation: 1- US

House Resolution for SESAME: *Funding is intended to promote scientific excellence in the Middle East region and prevent the loss of scientific expertise that is holding back science education and research in the region.*

Science Diplomacy, Latin America strategically important for US, in particular after the pandemic (Vaccines issue)

A Latin American focused program? A Marshall Plan for Central America? Two years ago, Hispanic Law-makers advocated one - Main motivation: social problems. What about the role of Science for that?

USAID ? DOE ? NSF ? Puerto Rico?

Consortium of institutions having important LA programs?, of synchrotrons? First contacts: SLAC, LBNL, UPR, Cornell

Political opportunities – July 2023, US rejoined UNESCO, key promoter of SESAME

– August 2023, US lifted Venezuela sanctions

Possible technical difficulty: Multilaterality of the project

Possibilities of Cooperation: 2- EU

European Union Association Agreement with Central America.

European Union Program for CELAC Infrastructure

7-year European Union Programs, current one, the ninth: Horizon Europe

Bilateral cooperation. In Italy, intergovernmental: Istituto Italo Latino-Americano. Spain, leading European country. France, Agence Francophonie

Possible form: Matching Funds

Possibilities of Cooperation: 3- Others

Development Funds. Nominally stable (2000—2020) about 1 billion US$, 35% decrease in real terms

Direct Foreign Investiment: About 15 billion US$,

For both: rethinking goals?

IDB Regional Public Goods Program, WB, BCIE. CAF

Commonwealth programs

When?

LNLS, SESAME, AfLS: 10-15 yrs for first idea to decision

LNLS, SESAME: 10 yrs for decision to operation

AfLS: First idea nineties, Interim Steering Committee 2015, First governmental formal declaration of support: 2019 (Ghana's president Akufo Addo), triggering Benin, South Africa, Nigeria and Ivory Coast

Optimistic: This project develops faster than similar projects. Mid thirties

More realistic: End thirties

Expected Results - 1

Scientific development, advanced research, increase of publication number (case of SESAME) integration of groups from different disciplines and sectors, strengthening of internationalization, increased access to international facilities,

Technological and industrial development, Challenges of the construction and maintenance of the facility, and its beamlines, of the data analisis, Sirius example of CERN patents use.

Academic development. Doctorates, broadening of the actual range of advanced teaching, with less scientific inbreeding

Expected Results - 2

Social and economical development Progress in sensible areas, food safety, circular economy, pharmaceutical, health (Cardiology, Neuronal degeneration, production of radioisotopes, medicine from natural products, tomography), biodiversity and molecular structure of plants, nanomaterials for energy, soil analisis, biosensors for agriculture

High-tech industrialization, Possible fostering of new industries, even during and for the construction.

Political development. Regional Integration, in particular between Spanish-speaking and English-speaking Caribbean

Return (Massimo Florio: Cost- Benefit of Big scientific Infrastructure): Tangible, estimate from existing facilities. Intangible, Indirect (industrial development, scientific growth)

Interregional and intercontinental Dimension

AfLS Partnership – link through LAAAMP – Joint presentation at the 2022 World Science Forum in Cape Town, GCLS participation in the AfLS Conference.

Short term - Joint lobbying to get international support. – A case for UNESCO, US and Commonwealth? Role of Brazil for a SESAME-like resolution jointly supporting GCLS, AfLS and SESAME

Yesterday ADG/SC UNESCO speaker in our Workshop at UNGA Science Summit

Interregional coordination group with other South projects (AfLS, ILSF, Uzbekistan, SESAME). Possible goal: coordianted representation, availability of some South dedicated beamline

Long term prospective: South research collaborations.

GCLSI/LAMISTAD Organization

About 60 scientists, 20 countries with 3 national chapters: Colombia, Dominican Republic, Ecuador

Executive Committee: chair GV, deputy chair Abel Moreno, Mexico, members: chairs of 5 committees:

Communications (Carlos Rudamas, El Salvador)

Capacity building (Marvadeen Wilmoth-Singh, Jamaica)

International Relations (Víctor Castaño, Mexico)

Financial Committee (chair to be elected)

Scientific-Technical (Mayra Cuéllar, Mexico)

r

Conclusion: Where we are

Positive feedback from scientific community (SESAME, Sirius, several US and European synchrotrons)

Synergy with the AfLS project

International interest:

- Unique experience of a six – country (Colombia, Spain, Jamaica, Mexico, El Salvador, Dominican Republic), multi-venue Symposium

- Support from Brazil, Kenya and Australia

- Progress on diffusion. Impact of the article on Nature: Russian TV News, Latin American Post

Conclusion: Short & Medium-term Road Map

Creation of an Association (or Foundation) to promote the project, possibly in connection with RCN

Technical detailed article, and feasibility study (with PULS?)

Further diffusion of the project (Civil Society, Press, Private Sector, Politicians)

Strengthen contact with International Organizations (UNESCO, CARICOM, ISC, FAO, OMS)

Immediate short term goal: UNESCO resolution jointly supporting a big program of development of Synchrotrons in the South of the World, including the establishment of GCSL, AfLS, possibly the Uzbekistan synchrotron, and the strengthening of SESAME

Acknowledgments

My deepest thanks to my colleagues of the ArXiv paper, the working group and the GCLS Executive Committee,in particular its previous cochairs, Carolina Santacruz, Victor Castaño, Victor Del Rio and Sekazi Mtingwa and the current Vicechair Abel Moreno

However, without the advice and support of my Science policy mentors, Edoardo Amaldi, Leon Lederman and Abdus Salam, my contribution to this proposal and my half-century activity in Latin America would have never been possible.


thank you
danke
謝謝
gracias
merci
obrigado
dziękuję
bedankt
go raibh maith agat
sukriya
kop khun krap
terima kasih
teşekkür ederim
ngiyabonga
dank je
tapadh leat
mochchakkeram
arigatô
dakujem
grazie
takk
taiku
sagolun
maururu
hvala
dhanyavad
kiitos
dankie
faafetai lava
спасибо
рахмат
Баярлалаа
vinaka
спасибі
blagodaram
mersi
barka
welalin
tack
spas
misaotra
matondo
paldies
grazzi
mahalo
хвала
asante
manana
obrigada
tenki
murakoze
chokrane
mamnun
дякую
djiere dieuf
tau
enkosi
bayarlalaa
gràçie
nanni
nandri
köszönöm
akun
dankon
ačiū
chnorakaloutioun
gratias ago
gràcies
sulpáy
sobodi
děkuji
mèsi
didi madloba
kam sah hamnida
rahmat
najis tuke
ありがとう
tanemirt
rahmet
ευχαριστώ
diolch
dhanyavadagalu
shukriya
merci
мерси
trugarez
তোমাকে ধন্যবাদ
감사합니다
xièxie