Explore the Lifetime Frontier with MATHUSLA

Cristiano Alpigiani

on behalf of the MATHUSLA Collaboration

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CERN
All LHC experiments are doing a wonderful job in the search for LLPs

- But LHC detector searches are limited by large backgrounds
  - Large QCD jet production
  - Pile-up problems
  - Beam halo issues
  - Cosmic background

- At the HL-LHC one of the best possible sensitivity is coming from ATLAS displaced vertex search in the muon spectrometer (shielded and able to trigger on LLP at L1), but searches (arXiv:1605.02742) suggest that various backgrounds (punch through, cosmics, etc) is of the order 100 fb

- In addition, strong dependence on the sub-detectors of ATLAS, CMS and LHCb
- Boost of LLP determines opening angle(s) and that affects trigger efficiencies

Need a clean environment with similar acceptance to main detector!
MATHUSLA

MATHUSLA detector ➔ MAssive Timing Hodoscope for Ultra Stable neutrA L pArticles

- Dedicated detector sensitive to neutral long-lived particles that have lifetime up to the Big Bang Nucleosynthesis (BBN) limit ($10^7 - 10^8$ m) for the HL-LHC
- Proposed a large area surface detector located above CMS or ATLAS

- Need robust tracking
- Need excellent background rejection

- For tracker/floor detector RPCs are an attractive choice (good space and time resolution for vertex reconstruction and cosmic ray rejection), scintillators maybe be an alternative

$\sigma_{LLP} \propto 1/\text{area}$
MATHUSLA - Backgrounds

No LHC QCD background, BUT...

- Cosmic muon rate of about 10 MHz (200 m²) → rejected with timing information (~1 ns timing resolution)

- LHC collision backgrounds
  - LHC muons about 10 Hz
    → Rejected with timing and entrance hit position
  - LHC neutrinos (subdominant background) → during HL-LHC data taking MATHUSLA should observe 0.1 events from high energy neutrinos (W, Z, top, b), ~1 events from low energy neutrinos (pions an kaons)

- Upward atmospheric neutrinos that interact in air decay volume
  - Estimate low rate ~ 70 events per year above 300 MeV
  - Mostly “decay” to low momentum proton → reject with time of flight from one tracker plane to another

Goal is a background-free MATHUSLA!
Geometry discussed in LoI submitted to LHCC (July 2018, arXiv:1811.00927)

Benchmark considered for engineering studies is 100x100x25 m³
- 20 m decay volume
- 5 layers of tracking chambers (RPCs or scintillators) separated by 1 m
- Bottom tracking layer not operated as a veto

Different geometries under studies would reach sensitivities close to MATHUSLA200

Area that is owned by CERN and no plans to occupy it in the future!
MATHUSLA Alternative Layouts

MATHUSLA 100x100 m² closer to CMS

Same 100x100 m² footprint as MATHUSLA100 benchmark from LOI
If decay volume is partially buried, it is ~30 m closer vertically and ~25 m closer horizontally to the IP than MATHUSLA100

In contact with civil engineers about excavating 10 to 20 meters in the CMS site

- **Advantages:**
  - Slightly improvement in solid angle (acceptance)
  - Less obstructive structure
  - Might help with thermal stability

- **No major problems seen**
  - even if, excavating in this area might hold some surprises...
Where MATHUSLA Could Be Located?

MATHUSLA 100x100 m² closer to CMS

- Purely geometric, assume 100% efficiency in decay volume

- MATHUSLA 100x100 side+forward (< half the surface area of MAHUSLA200) is almost as good as MATHUSLA200, and only uses part of available land near CMS!

- These studies show the power of an optimised geometry

- Not final design!
Modular Concept

- The MATHUSLA100 baseline envisages 10x10x25 m³ units with
  - 10x10x4 m³ comprised of tracking stations at the top and a tracking layer at the bottom
  - 10x10x20 m³ decay volume
- Easy to adapt to site specific conditions (non square geometries)
- Allows for modular construction, staged installation of modules and incremental ramp-up

- Option to make detector volume weather tight or install modules in a large building
- Trigger unit: 3x3 modules is current baseline (choice based on largest inclination angle for 200x200 m² detector and very safe for 100x100 m² detector
Cosmic ray studies with MATHUSLA
MATHUSLA - Cosmic Rays - EAS

- KASCADE is currently a leading experiment in this energy range
  - Has larger area than MATHUSLA100 (40,000 m² vs 10,000 m²) but ~100 % detector coverage in MATHUSLA vs < 2 % in KASCADE

- MATHUSLA has better time, spatial and angular resolution, and five detector planes

MATHUSLA standalone

- Measurements of arrival times, number of charged particles, their spatial distributions → allow for reconstruction of the core, the direction of the shower (zenith and azimuthal angles), slope of the radii distribution of particle densities, total number of charged particles (core shape is not well studied → MATHUSLA could provide new information)

MATHUSLA+CMS/ATLAS

- Uniquely able to analyse muon bundles going through both detectors. This is a powerful probe of heavy primary cosmic ray spectra and astrophysical acceleration

- Lot of time to connect MATHUSLA with CMS/ATLAS bunch crossing (at HL-LHC trigger has ~12 microsecond latency)

Guaranteed return on the investment!
Several structures in the current measurements

- Good measurements in the energy range $10^{15}$-$10^{17}$ eV is crucial to understand the transition from galactic to extragalactic cosmic rays.
- Understanding the knee may be the main open problem in cosmic ray physics (requires high statistic and good measurements to establish the components of source and distribution of incident particles).
- The full coverage of MATHUSLA100 will allow a lower energy threshold ($\sim 100$ GeV) than KASCADE ($\sim 1$ PeV).
  - Lower threshold allows comparison with satellite measurements (CREAM, Calet, HERD).
- With the ability to measure several different parameters it should be possible to separate with decent statistics $p+He$, intermediate mass nuclei and Fe up to $10^{16}$ eV.
- MATHUSLA multiple tracking layers may help to understand the energy spectrum.
- Extending the linearity of analog measurements by a factor of 10 greater than ARGO-YBJ, MATHUSLA may be able to measure shower energies above a PeV ($\sim 10^{17}$ eV).

Guaranteed return on the investment!
MC background simulations need data with LHC colliding protons and also when the beam is off.
The MATHUSLA Test Stand

3 layers of RPCs provided by University of Tor Vergata (Rome) by Rinaldo Santonico (from Argo-YBJ Experiment)

Top and bottom scintillator layers from Tevatron DØ provided by Dmitri Denisov

Active area ~ 2.5 x 2.5 x 6.0 m³
Installation in ATLAS P1

- Cosmic background (~) well understood
- Need to quantify the background from ATLAS
- Test stand installed in the (Buffer Zone) on the surface area above ATLAS (exactly above IP) in November 2017 (during ATLAS operations this space is empty)

✓ Perform measurements with beam on and off
MATHUSLA Tracking

- Simple tracking strategy based on straight track least squares fit (position+time)
  - Uses information from both RPC and scintillators
  - Bad hit removal

Event recorded during high-intensity ATLAS pp collisions

Example of track hitting all detector layers
MATHUSLA Tracking: Upward and Downward

- **Dominant** rate from downward particles
- True *upward* expected to be **small**
- Fake are not necessarily a small contribution and they are not trivial to reject with 3 layer of RPCs
- None of the test stand sensors or their geometry/coverage/etc are optimized for use in a MATHUSLA-like detector

Velocity distribution from 1 run (~ 1 hour) during high-intensity ATLAS p-p collisions

- Rate scales with luminosity
- Test stand fake rate cannot be directly extrapolated to the full detector
Summary & Conclusions

- We are studying the feasibility of a large scale detector to measure LLPs with very long lifetimes.
- A test module was installed on the ATLAS surface area in November 2017 and it took data with different beam conditions.
  - Empirical information of potential backgrounds coming from LHC as well as from cosmic rays.
- A Letter of Intent has been submitted to LHCC in July 2018 and focused on MATHUSLA100 layout.
- Cosmic ray physics is the secondary MATHUSLA goal (guaranteed return on the investment).
  - Good measurements in the energy range $10^{15}-10^{17}$ eV might improve the knowledge of EAS and the knee.
- Plan to build a $\sim 10 \times 10 \times 5$ m$^3$ demonstrator to test various options and define fabrication and assembly processes.
- Our tests are aimed to define technologies and procedures to keep the cost of MATHUSLA detector below 100M CHF.

For more info:
- mathusla.experiment@cern.ch
- http://mathusla.web.cern.ch/mathusla/ (under construction)
Some of the MATHUSLA people at work...
BACKUP
The Hidden Sector

- The Standard Model (SM) is in amazing agreement with the experimental data, but **still some problems remain unsolved:** dark matter, neutrinos masses, hierarchy, matter-antimatter asymmetry...

- Many extensions of the SM (Hidden Valley, Stealth SUSY, 2HDM, baryogenesis models, etc) include particles that are **neutral, weakly coupled,** and **long-lived** that can decay to final states containing several hadronic jets

- Long-lived particles (LLPs) occur naturally in **coupling to a hidden sector (HS)** via small scalar (Higgs) or vector ($\gamma, Z$) portal couplings

  - Wide range of possible lifetimes from $\mathcal{O}(mm)$ up to $\mathcal{O}(m/km)$

The mixing of Higgs with HS results in a Higgs like particle decaying into LLPs:

**small coupling $\Rightarrow$ long lifetimes** [Phys. Lett. B6512 374-379, 2007]

$\sim 10^8$ Higgs boson @ HL-LHC
Signature Space of Displaced Vertex Searches

- Detector signature depends on production and decay operators of a given model
  - Production determines cross section and number and characteristics of associated objects
  - Decay operator coupling determines life time, which is effectively a free parameter

- Common Production modes
  - Production of single object - with No associated objects (AOs)
    - Higgs-like scalar $\Phi$ that decays to a pair of long-lived scalars, $ss$, that each in turn decay to quark pairs – Hidden Valley, Neutral Naturalness, ...
    - Vector ($\gamma_{\text{dark}}, Z'$) mixing with SM gauge bosons – kinetic mixing
  - Production of a single object $P$ with an AO – Many SUSY models
    - AO jets if results from decay of a colored object
    - AO leptons if LLP produced via EW interactions with SM

- Common detector signatures $\Rightarrow$ generic searches
Neutral Long-lived Particles

- Neutral LLPs lead to displaced decays with no track connecting to the IP, a distinguishing signature
  - SM particles predominantly yield prompt decays (good news)
  - SM cross sections very large (eg. QCD jets) (bad news)
- To reduce SM backgrounds many Run 1 ATLAS searches required two identified displaced vertices or one displaced vertex with an associated object
  - Resulted in good rejection of rare SM backgrounds
  - BUT limited the kinematic region and/or lifetime reach
- None the less, these Run 1 searches were able to probe a broad range of the LLP parameter space (LLP-mass, LLP-\(c\tau\))
- ATLAS search strategy for displaced decays - based on signature driven triggers that are detector dependent
MATHUSLA detector \(\rightarrow\) MAssive Timing Hodoscope for Ultra Stable neutral particles

- Dedicated detector sensitive to neutral long-lived particles that have lifetime up to the Big Bang Nucleosynthesis (BBN) limit \((10^7 - 10^8 \text{ m})\) for the HL-LHC

- Large-volume, air filled detector located on the surface above and somewhat displaced from ATLAS or CMS interaction points

- HL-LHC \(\rightarrow\) order of \(N_h = 1.5 \times 10^8\) Higgs boson produced

- Observed decays:

\[
N_{\text{obs}} \sim N_h \cdot \text{Br}(h \rightarrow \text{ULLP} \rightarrow \text{SM}) \cdot \epsilon_{\text{geometric}} \cdot \frac{L}{b\epsilon c\tau}
\]

\(\epsilon = \) geometrical acceptance along ULLP

\(L = \) size of the detector along ULLP direction

\[b \sim m_h /(n \cdot m_X) \leq 3\] for Higgs boson decaying to \(n = 2\), \(m_X \geq 20\) GeV

- To collect a few ULLP decays with \(c\tau \sim 10^7\) m requires a 20 m detector along direction of travel of ULLP and about 10% geometrical acceptance
MATHUSLA – LHC Neutrinos Background

No LHC Background, BUT...

- Neutrino from LHC interactions (subdominant background)

MATHUSLA should observe a few events during HL-LHC data taking period
MATHUSLA – signal reconstruction example

Hadronic decay of a LLP

- $\Delta t$ between tracking layers $\sim 3.5$ ns

J-P Chou, D. Curtin, H. Lubatti
arXiv 1606.06298

Tracks are reconstructed in 3D and with detailed **timing** information at each layer, the DV is really a **4D DV**

More difficult to fake $\rightarrow$ all tracks have to pass veto requirements

From D. Curtin
With the current detector design muons and electrons are undistinguishable, while photons are invisible

- **New idea:** insert a layer of iron few cm thick between the first and the second tracking layer
  - Provide 1-2 $X_0$ to convert electron and photons generating visible electromagnetic showers

No energy or momentum measurements, but allows to qualitatively distinguish the various particle types

Angle of the charged tracks w.r.t. tracking plane can be known with a precision of $\sim 2$ mrad

Details about location, material, thickness, etc. still under investigation
Simulated muons coming from LHC and passing 100 m of rocks made of 45.3m of sandstone, 18.25m of marl (calcium and clay), 36.45m mix (marl and quartz)

Minimum energy ~ 70 GeV

What a muon can do inside the detector?

- **Pass through** → detected as a single upwards track
- **Decay** → entirely to e\(\nu\nu\) (single e deflected wrt muon direction), but also to e\(e\nu\nu\) with BR ~ 3x10\(^{-5}\) (looks like a genuine DV decay, but rejected through floor layer veto or main trigger muon trigger)
- **Inelastic scattering** → off the air or the support structure (rejected using floor layer veto)

Over the entire HL-LHC run expected ~ 10\(^6\) muons pass through MATHUSLA, corresponding to ~ 0.1 Hz

- 3000 muons decaying to e\(\nu\nu\) (electron deflected from original muon trajectory by angle ~1/muon boost (~ 5-10 degrees))
- 0.1 muons decaying to e\(e\nu\nu\)
- < 1 muon scattering off air

Looking at these results probably the floor veto is not needed
MATHUSLA – Any other “crazy” background?

Are we really taking into account all backgrounds?

- We are looking at very rare events, so we are very sensitive to less obvious backgrounds!

  • Horizontal cosmic rays hitting atoms below MATHUSLA in floor
  
  • Single $K_L$ or neutron traveling upwards, decaying in MATHUSLA (exactly a LLP signal!)

    ✓ Rate estimated to be very small, but...

    • Cosmic rays hitting material in detector, either floor or walls or support structures? and creating $K_L$ or neutron?

    • ???

We are working on precisely estimating (and simulating, if possible) all these rare backgrounds!
Modular Concept = Flexible Concept

- In the limit where funding is not a consideration, we could **add detector modules to fill available site** to extend our sensitivity.
Demonstrator Unit

- For **tracking layers** evaluating both RPCs and **extruded scintillators bars** with wavelength shifting fibers coupled to SiPM that operates with order 60 V bias
  
  ✓ Extruded scintillator bars used in Belle-II muon detector
  
  ✓ Extrusion facilities at **FNAL** are capable of producing **200 tons of extruded bars per year** with two-shift operation (a commercial factory in Illinois is also available)
  
  ✓ Scintillators remove need for a gas system, high voltages and are relatively insensitive to temperature and pressure variations

- Investigating **low cost front-end electronics** that could work with either scintillators or RPCs
  
  ✓ Low rate environment (biggest rate are from cosmic rays) allows for the possibility of low-cost front-end electronics

- **Plan to build a ~10x10x5 m³ demonstrator unit of the tracking volume to test various options and define fabrication and assembly processes tailored to large unit volume production**
  
  ✓ For RPC intend to work on developing new fabrication techniques to reduce the costs
  
  ✓ Preparing request for funds to build demonstrator unit
Some preliminary detector cost estimate

Scintillators

Top and bottom are = $2 \times 200 \, \text{m}^2 = 80 \, 000 \, \text{m}^2$ + sides = $4 \times 200 \times 20 \, \text{m}^2 = 16 \, 000 \, \text{m}^2$

$\Rightarrow$ Total area = $96 \, 000 \, \text{m}^2$

- Assume thickness = 1 cm, density = 1 gm/m$^3$
- Assume 3 USD / kg (low end of NO$
u$A estimates) excluding electronics

$\Rightarrow$ Total cost $\sim$ 3M USD

RPCs

- Resistive electrode of high pressure laminate based on phenolic resin $\Rightarrow$ 80 E/m$^2$
- Gas gap construction and procurement of all materials excluded the electrode laminate $\Rightarrow$ 160 E/m$^2$
- Signal read out panels $\Rightarrow$ 60 E/m$^2$
- Mechanical support panels (could be optimised, should be cheaper) $\Rightarrow$ 200 E/m$^2$
- Front end electronics $\Rightarrow$ 150 E/m$^2$

Total/m$^2$ $\Rightarrow$ 650 E/m$^2$

$\Rightarrow$ Total for $10^5 \, \text{m}^2$ $\Rightarrow$ 65M E

Not included: mounting of the FE electronics over the strip panels; power system (LV and HV); gas system; trigger and DAQ; cabling and piping.
Some preliminary building cost estimate

- Building 947 (FLEX building) is about the same footprint as MATHUSLA (90 m x 110 m), and ~10 m high. It costs ~10 MCHF.

- MATHUSLA sized building is plausible for 16 MCHF: twice the height and probably more support columns. This assumes a surface building.

- As another point of reference, Building 887 (neutrino platform) is smaller (roughly 70 m x 50 m) but involves a pit requiring excavation and lining. It costs 6 MCHF + 3M for metal shell over the pit.

- Building 947 has two rows of support columns in addition to the side walls to support the roof. These two rows of columns support two bridge cranes in addition to the roof. A similar design may work for MATHUSLA.
A recent paper [A. Fradette and M. Pospelov, arXiv:1706.01920v1] examines the BBN lifetime bound on lifetimes of long-lived particles in the context of constraints on a scalar model coupled through the Higgs portal, where the production occurs via $h \rightarrow ss$, where the decay is induced by the small mixing angle of the Higgs field h and scalar s.

- For $m_s > m_\pi$ the lifetime $\tau < 0.1$ s.

- Conclusion does not depend strongly on $\text{BR}(h \rightarrow ss)$.
MATHUSLA – SHiP Comparison

- SHiP is better for shorter lifetimes and lower masses
- MATHUSLA high-energy LHC collisions can probe LLPs at GeV to TeV scale
- MATHUSLA is better or competitive for mass scale above ~ 5 GeV, and for lifetime >> 100 m even at low masses
- SHiP is limited by lower $\sqrt{s}$ to probing masses of order a few GeV which limits new physics reach to low mass LLPs

“Heavy Neutral Leptons”
MATHUSLA has higher sensitivity for long lifetime
**Test Stand Scintillator Details**

**Top** - 31 scintillators

**Bottom** - 28 scintillators

D0 forward MUON trigger scintillator: 12.8-mm-thick BICRON 404A of trapezoidal shape + WLS bars for light collection
Small stereo rotation angle between the 3 tracking planes to reduce ambiguity and ghost hits
Test Stand RPC Details

- 12 RPCs from the prototype of ARGO YBJ cosmic ray shower experiment in Tibet

- Operating in streamer mode
- Ar + ATLAS RPC gas ($C_2H_2F_4$/Iso-$C_4H_{10}$/SF$_6$ (94.7/5/0.3))

Chamber size: 1.25 x 2.80 m$^2$

- 10 Pads (55.6 x 61.8 cm$^2$) for each RPC
- 8 Strips (6.75 x 61.8 cm$^2$) for each Pad
Test Stand DAQ and Trigger

Test module DAQ

- **Scintillators**
  PMTs interfaced with a VME CAEN module

- **RPCs: Argo Experiment Local Station**
  (from Lecce, Italy). Data from each RPC acquired from a Receiver Card which reads out and digitises the space and time information from 10 pick-up pads and gives out the pad multiplicity for trigger purposes. On trigger occurrence the Local Station sends the collected data to the PC

Test module trigger

Two possible triggers: top and bottom scintillators in coincidence, with:

1. **Timing appropriate for downward going particle** (cosmic ray events can be used for space and time alignment)
2. **Timing appropriate for upward going particle**
RPC Performance vs Environmental Conditions

- Environmental conditions

- Monitoring system (realised with an Arduino and a Bosch BME280) installed in ATLAS SX1 building

...modify the RPC behavior/performance

[Operational features, monitoring and control for the RPCs in the Argo-YBJ experiment - P. Camarri, JINST 8 T03002]

Clear dependence of the currents absorbed by the chambers on the temperature (and also pressure)
RPC HV Tuning

- The HV of each RPC depends on the **instantaneous pressure** and on the **1 hour delayed temperature**

\[
V_{\text{eff}} = V_{\text{app}} \frac{T}{T_0} \frac{p_0}{p}
\]

We want to obtain a constant effective voltage

\[
V_{\text{app}}(t) = V_0 \frac{T_0}{p_0} \frac{p(t)}{T(t-1\text{h})}
\]


- Implemented an **automatic control system** that monitors temperature and pressure in SX1 and changes the HV of each chamber accordingly
RPC Front-End Readout Tuning

- Front end electronics based on GaAs custom chip consisting of eight discriminator channels each with an output of single-ended ECL level
- Front end discriminator threshold need to be tuned
  ✓ A too low threshold will increase the number of noisy (fake) hits

On average, expected to have ~5 hits per event
Scintillators Timing Corrections

- Signal propagation time from the scintillators to the TDC input channel is not zero.
- Time is different from counter to counter and it depends on HV setting, counter size, etc...
- Delay is calculated for each scintillator (Gaussian fit of the distribution).
  - Time is corrected at hardware level w.r.t. a reference counter.

Very good calibration!

...but still margin for improvements.
Installation in ATLAS P1 (2)

Henry L. putting the last bolt

P1 data-taking lasted < 2 weeks
MATHUSLA - Background Simulations

**Effort underway to develop simulations of all the sources of backgrounds**

- Current plan to deal with **muons** and **neutrinos traveling upwards** is to create a “gun” that shoots particles into MATHUSLA
- Cosmic ray showers simulated using **CORSIKA** (work is well advance!)
- Atmospheric neutrinos simulated using **GENIE**

... but simulation need to be anchored to real data!
Long-Lived Particles at the Energy Frontier: 
The MATHUSLA Physics Case

1806.07396

Cristiano Alpigiani, Antonio Ball, Liron Barak, James Beacham, Yan Benhammou, Tingting Cao, Paolo Camarri, Roberto Cardarelli, Mario Rodriguez-Cahuantzi, John Paul Chou, David Curtin, Miriam Diamond, Giuseppe Di Sciascio, Marco Drewes, Sarah C. Eno, Erez Etzion, Rouven Esiig, Jared Evans, Oliver Fischer, Stefano Giagu, Brandon Gomes, Andy Haas, Yuekun Heng, Giuseppe Iaselli, Ken Johns, Muge Karagoz, Luke Kasper, Audrey Kvam, Dragoslav Lazic, Liang Li, Barbara Liberti, Zhen Liu, Henry Lubatti, Giovanni Marsella, Matthew McCullough, David McKee, Patrick Meade, Gilad Mizrahi, David Morrissey, Meny Raviv Moshe, Karen Salomé Caballero-Mora, Piter A. Paye Mamani, Antonio Policicchio, Mason Proffitt, Marina Reggiani-Guzzo, Joe Rothberg, Rinaldo Santonico, Marco Schlippa, Jessie Shelton, Brian Shuve, Martin A. Subieta Vasquez, Daniel Stolarski, Albert de Roeck, Arturo Fernández Téllez, Guillermo Tejeda Muñoz, Mario Iván Martínez Hernández, Yiftah Silver, Steffie Ann Thayil, Emma Torro, Yuhsin Tsai, Juan Carlos Arteaga-Velázquez, Gordon Watts, Charles Young, Jose Zurita,

CERN-LHCC-2018-025

A Letter of Intent for MATHUSLA: a dedicated displaced vertex detector above ATLAS or CMS

Cristiano Alpigiani, Austin Ball, Liron Barak, James Beacham, Yan Benhammou, Tingting Cao, Paolo Camarri, Roberto Cardarelli, Mario Rodriguez-Cahuantzi, John Paul Chou, David Curtin, Miriam Diamond, Giuseppe Di Sciascio, Marco Drewes, Sarah C. Eno, Erez Etzion, Rouven Esiig, Jared Evans, Oliver Fischer, Stefano Giagu, Brandon Gomes, Andy Haas, Yuekun Heng, Giuseppe Iaselli, Ken Johns, Muge Karagoz, Luke Kasper, Audrey Kvam, Dragoslav Lazic, Liang Li, Barbara Liberti, Zhen Liu, Henry Lubatti, Giovanni Marsella, Matthew McCullough, David McKee, Patrick Meade, Gilad Mizrahi, David Morrissey, Meny Raviv Moshe, Karen Salomé Caballero-Mora, Piter A. Paye Mamani, Antonio Policicchio, Mason Proffitt, Marina Reggiani-Guzzo, Joe Rothberg, Rinaldo Santonico, Marco Schlippa, Jessie Shelton, Brian Shuve, Martin A. Subieta Vasquez, Daniel Stolarski, Albert de Roeck, Arturo Fernández Téllez, Guillermo Tejeda Muñoz, Mario Iván Martínez Hernández, Yiftah Silver, Steffie Ann Thayil, Emma Torro, Yuhsin Tsai, Juan Carlos Arteaga-Velázquez, Gordon Watts, Charles Young, Jose Zurita,