LHC Job Matching 2023

03/05/2023

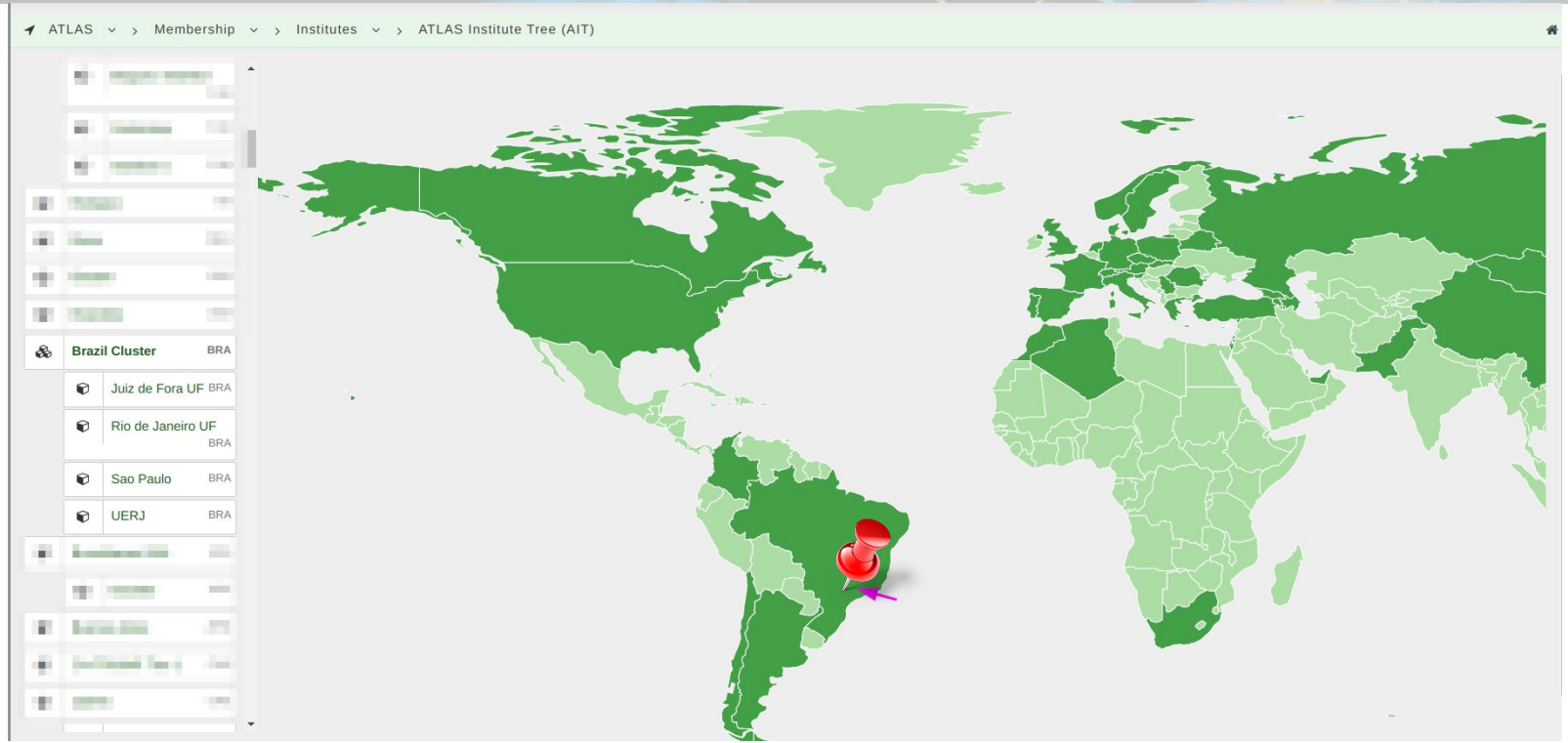
Marco Leite - ATLAS/USP

leite@usp.br

ATLAS EXPERIMENT

Universidade de São Paulo

ATLAS Brazil Cluster



ATLAS Brazil Cluster : We are 4 Institutions in 3 states :

USP (São Paulo), UFRJ and UERJ (Rio de Janeiro), UFJF (Minas Gerais)

69 Members (14 authors)

Universidade de São Paulo (USP) ATLAS Group

The Group :

2 Researchers : Marco Leite, Marisilvia Donadelli
5 Graduate Students (2 starting the PhD in June 2023)
4 Undergraduate students
We host an ATLAS Tier-2 Grid Facility
Lab infrastructure for Instrumentation R&D (ATLAS)
Two long term (5 years) Research Grants for ATLAS/LHC activities

The University :

USP is the largest University in South Hemisphere :

8 Campi (we are in the main campus)
42 Institutes
94.000 Students (30.000 in MsC or PhD)
> 5k academic researchers
> CHF 1.5 Billion budget (does not include research grants)

The City :

São Paulo is a very large and busy metropolitan city, with plenty of options for living

ATLAS : the electroweak sector of the Standard Model

One of the main goals of this project is to explore measurements of the W, Z and H boson production in several kinematic regimes and final state channels using current and future LHC data acquired by the ATLAS experiment in proton-proton collisions at sqrt(s) = 13, 13.6 and 14 TeV.

Precision measurements in SM

- So far, no signs of new physics (SM works pretty well…)
- New physics may be out of the LHC reach by **direct searches** (too heavy, too broad...)
- We need higher precision (model and experiment) ⇒ then hope it breaks somewhere …
- If it breaks, someone needs to come with a fix to the model used in the global fit (new physics)

Study of Higgs self-coupling

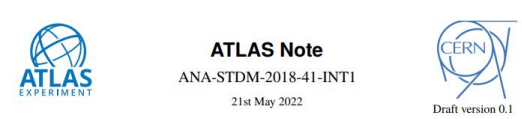
- Probe the scalar sector of SM trough studies of di-Higgs production
- Direct probe of EWK symmetry breaking potential
- The resonant production of HH is a fertile ground for BSM models validation
- Focus on HH→bb$\tau\tau$ channel

Searches for BSM process

- Search for Leptoquarks production

USP ATLAS : Physics Analysis

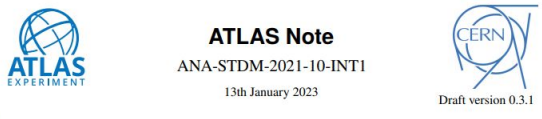
- **Several ongoing physics analysis :**



ATLAS Note
ANA-STDM-2018-41-INT1
21st May 2022
Draft version 0.1

Double-differential charged-current Drell-Yan cross sections at high transverse masses in pp collisions at $\sqrt{s}$ = 13 TeV

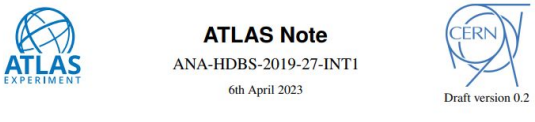
Tim Beumker[a], Christoph Dingel[a], Frank Ellinghaus[a], Alison Elliot[b], Uta Klein[c], Johanna Kraus[a], Marco Leite[d], Jesal Mandalia[b], Michael O'Keefe[c], Eram Rizvi[b], Frederic Schröder[a]



ATLAS Note
ANA-STDM-2021-10-INT1
13th January 2023
Draft version 0.3.1

Measurements of high-mass di-lepton production with at least one τ-lepton and a search for leptoquarks with couplings to third-generation fermions at $\sqrt{s}$ = 13 TeV with the ATLAS detector

Alderweireldt, Sara[c], Bauce, Matteo[d], Butterworth, Jonathan[b], Corradi, Massimo[d], Daumann, Caio Cesar[e], Farrington, Sinead[c], Giagu, Stefano[d], Gutschow, Christian[b], Hamity, Guillermo Nicolas[c], Hays, Chris[a], Hrynova, Tetiana[f], Juzek, Monika Katarzyna[g], Koch, Simon Florian[a], Lisboa Leite, Marco[c], Morodei, Federico[d], Mueller, Roman[h], O'Neill, Aaron Paul[h], Padovano, Giovanni[d], Pleskot, Vojtech[k], Pollard, Chris[a], Richter-Was, Elzbieta[i], Rieck, Patrick[j], Yue, Luzhan[b], Zhu, Yuanda[b]



ATLAS Note
ANA-HDBS-2019-27-INT1
6th April 2023
Draft version 0.2

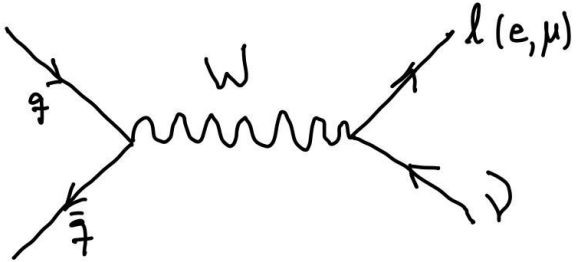
Legacy search for the non-resonant production of Higgs boson pairs via gluon fusion and vector-boson fusion in the $b\bar{b}\tau^+\tau^-$ final state in proton-proton collisions at $\sqrt{s}$ = 13 TeV with the ATLAS detector

Ali, Shahzad[a], An, Shiwen[b], Atashi, Shaghayegh[c], Bellos, Panagiotis[d], Bernardi, Gregorio[e], Betti, Alessandra[f], Buat, Quentin[g], Cairo, Valentina[h], Carquin Lopez, Edson[i], Dao, Valerio[h], Deiana, Allison Mccarn[i], Deutsch, Christopher[j], Dimitriadi, Christina[j], Dingfelder, Jochen Christian[j], Donadelli, Marisilvia[k], Ferrari, Arnaud[l], Fuenzalida Garrido, Sebastian Julio[i], Granados, Kyle Angelo[m], Grimm, Kathryn[m], Guhit, Jem Aizen Mendiola[n], Han, Liangliang[o], Haslbeck, Florian[h, p], Higuchi, Yu Nakahama[b], Karkout, Osama[q], Koeneke, Karsten[r], Lai, Stan[s], Leney, Katharine[i], Lenz, Tatjana[j], Li, Ang[e], Li, Tong[e], Liu, Yanlin[t], Longarini, Iacopo[c], Marchiori, Giovanni[e], Melo, Andres Hugo[s], Moser, Brian[h], Moss, Joshua[m], Nikolopoulos, Konstantinos[d], Ordek, Serhat[u], Pandini, Carlo Enrico[q], Paraskevopoulos, Christos[v], Reynolds, Elliot[w], Sauerburger, Frank[r], Schwarz, Thomas Andrew[n], Taffard, Anyes[c], Togawa, Manabu[b], Varol Mete, Tulin[a], Veatch, Jason Robert[m], Wang, Song-Ming[a], Windischhofer, Philipp[x], Wollrath, Julian[c], Xu, Zifeng[o], Zhang, Lei[o], Zhang, Sijing[j], Zhang, Yulei[c,y]

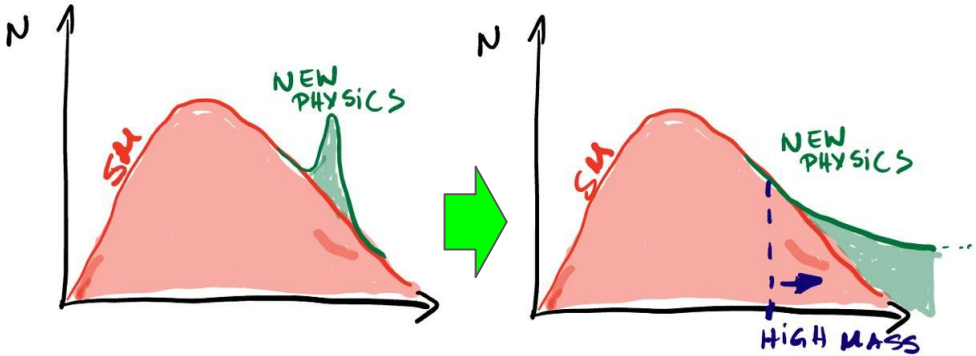
- **Also :**
  - **9 Run-II completed analysis, several internal notes and Editorial Boards**
  - **USP group is very active in ATLAS organization (Executive Board, Chair Advisory Group, Upgrade Speakers Committee, International Computing Board, deputy National Institute Representative)**

Double-differential CCDY cross section in high mT_W

Physics from the tails :



- Constraints to proton PDF
- Checks of lepton universality
- First measurement at this phase space @ LHC
- Phase space interesting for SM EFT interpretations
- Lays the groundwork for ΓW measurement



ATLAS-ANA-STDM-2018-41

ATLAS EXPERIMENT

ATLAS Note

ANA-STDM-2018-41-INT1

21st May 2022

CERN

Draft version 0.1

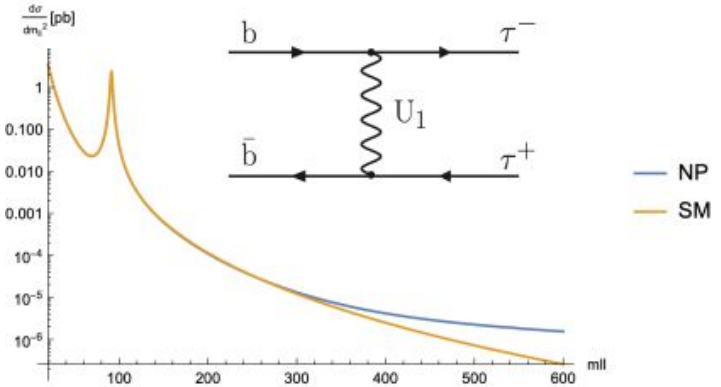
Double-differential charged-current Drell-Yan cross sections at high transverse masses in pp collisions at $\sqrt{s}$ = 13 TeV

Tim Beumker[a], Christoph Dingel[a], Frank Ellinghaus[a], Alison Elliot[b], Uta Klein[c], Johanna Kraus[a], Marco Leite[d], Jesal Mandalia[b], Michael O'Keefe[c], Eram Rizvi[b], Frederic Schröder[a]

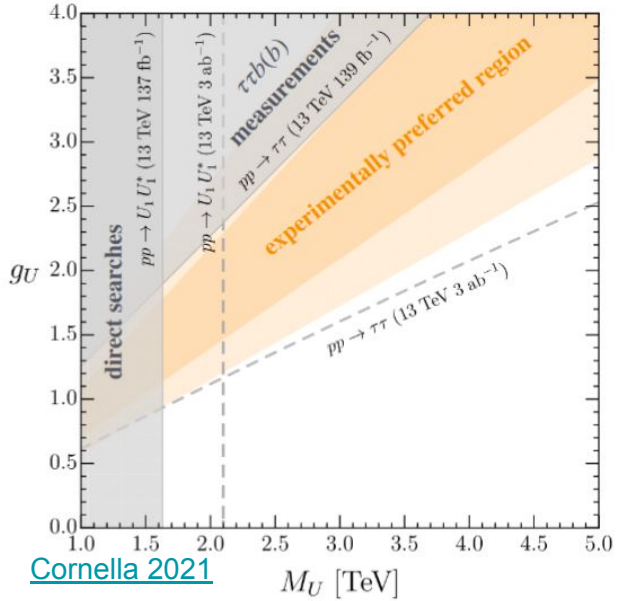
Double-differential NCDY (τ channel) high $m_{\tau\tau}$

ATLAS-ANA-STDM-2021-10

- **Few LHC analysis on 3rd lepton generation,**
  - **but many BSM scenarios sensitive to 3rd generation**
- **High priority for understanding the $b \rightarrow l$ anomalies**
  - **Search for DY processes mediated by a leptoquark**
- Analysis on the pole and high mll mass region (>120 GeV)



F. Wilsch

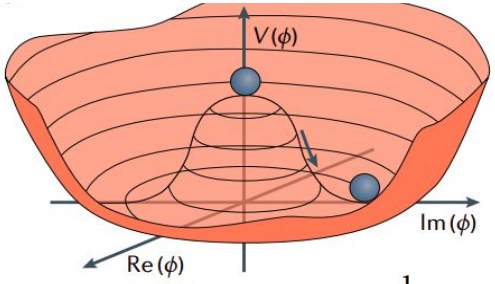


Cornella 2021

- Investigate the production of Leptoquarks as source of Lepton Flavor Universality violation
- Signal generation using Madgraph
- Test and set exclusion limits
- Sensibility in the high mass region of $Z \rightarrow \tau\tau + b$
  - Look for the associated 1(2) b production
- Analysis will also include charge current DY (other next analysis !)
  - $W \rightarrow \tau\nu$
  - $W \rightarrow \tau\nu$+ 1(2)b
- Add 13.6 Run-3 dataset

Search for Higgs boson pair production: HH → bb ττ channel

PhysRevLett.121.191801 JHEP11(2020)163 arxiv:2209.10910



$$V(\phi) = \frac{1}{2}\mu^2\phi^2 + \frac{1}{4}\lambda\phi^4$$

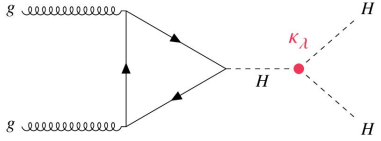
Higgs scalar potential is still largely unconstrained - could give direct insight into the structure of the Higgs potential

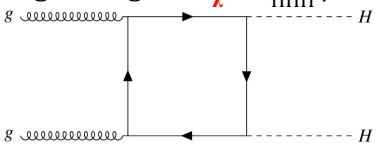
Higgs can interact with itself, producing a pair of Higgs

Known m_H (~ 125 GeV) , SM predicts λ(~ 0.13)

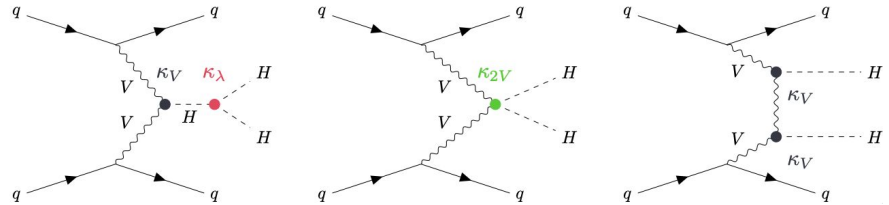
New physics can alter this number!

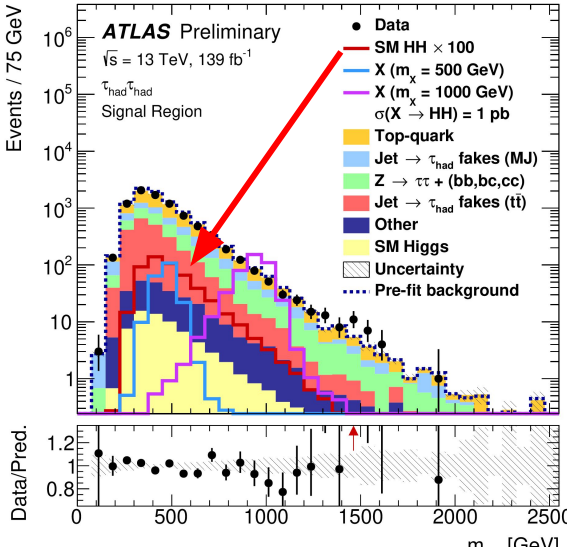
- Gluon-Gluon Fusion (**ggF**)
  - Dominant process at LHC
  - Destructive interference between triangle and box diagram makes the **cross-section tiny (1000 smaller than single Higgs, ~ 30fb)**
  - Anomalous deviations of the coupling strength $\kappa_\lambda = \lambda_{HHH} / \lambda^{SM}_{HHH}$

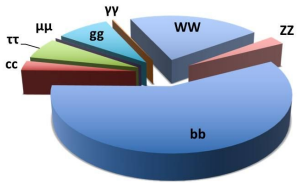




- Vector Boson Fusion (**VBF**)
  - Second most abundant production mode
  - VBF topology provides a clean signature
  - Direct handle to vector boson coupling modifiers κ_{2V} and κ_V





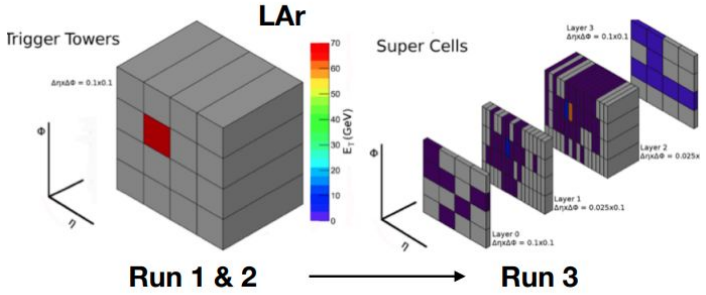


Higgs branching Ratios

USP ATLAS : Upgrades

- **Liquid Argon Phase-I Digital Trigger**

➔ LTDB performance studies
➔ Signal reconstruction and calibration
➔ Data Quality



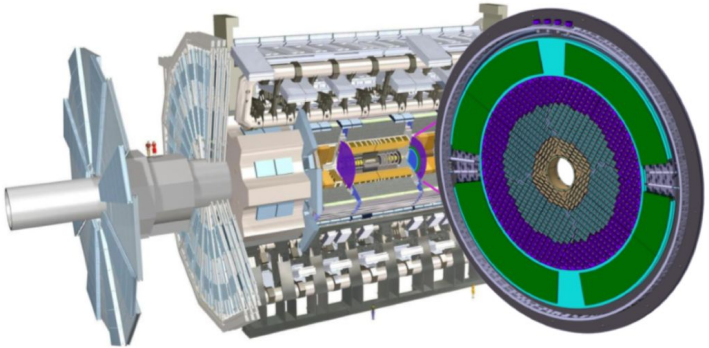
The Phase-I trigger readout electronics upgrade of the ATLAS Liquid Argon calorimeters

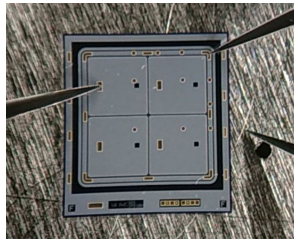
G. Aad,[23] A.V. Akimov,[6,26] K. Al Khoury,[7] M. Aleksa,[6] T. Andeen,[3] C. Anelli,[37] N. Aranzabal,[6] C. Armijo,[2] A. Bagulia,[26] J. Ban,[7] T. Barillari,[27] F. Bellachia,[1] M. Benoit,[5] F. Bernon,[23] A. Berthold,[10] H. Bervas,[32] D. Besin,[32] A. Betti,[9] Y. Bianga,[10] M. Biaut,[23] D. Boline,[33] J. Boudreau,[30] T. Bouedo,[1] N. Braam,[37] M. Cano Bret,[18] G. Brooijmans,[7] H. Cai,[30] C. Camincher,[6,37] A. Camplani,[16,39] S. Cap,[1] A. Carbone,[16] J.W.S. Carter,[35] S.V. Chekulaev,[36,26] H. Chen,[3] K. Chen,[5] N. Chevillot,[1] M. Citterio,[16] B. Cleland,[30,†] M. Constable,[36] S. de Jong,[37] A.M. Deiana,[9] M. Delmastro,[1] B. Deng,[9] H. Deschamps,[32] C. Diaconu,[23] A. Dik,[26] B. Dinkespiler,[23] N. Dumont Dayot,[1] A. Emerman,[7] Y. Enari,[34] P.J. Falke,[1,38] J. Farrell,[5] W. Fielitz,[5] E. Fortin,[23] J. Fragnaud,[1] S. Franchino,[14] L. Gantel,[1] K. Gigliotti,[2] D. Gong,[9] A. Grabas,[32] P. Grohs,[10] N. Guettouche,[23] T. Guillemin,[1] D. Guo,[9] J. Guo,[13] L. Hasley,[9] C. Hayes,[33,40] R. Hentges,[10] L. Hervas,[6] M. Hils,[10] J. Hobbs,[33] A. Hoffman,[5] D. Hoffmann,[23] P. Horn,[10] T. Hryn'ova,[1] L. Iconomidou-Fayard,[15] R. Iguchi,[34] T. James,[9] J. Ye,[9] K. Johns,[2] T. Junkermann,[14] C. Kahra,[22] E.F. Kay,[37] R. Keeler,[37] S. Ketabchi Haghighat,[35] P. Kinget,[8] E. Knoops,[23] A. Kolbasin,[26] P. Krieger,[35] J. Kuppambatti,[8] L.L. Kurchaninov,[36] E. Ladygin,[19] S. Lafrasse,[1] M.P.J. Landon,[21] F. Lanni,[5] S. Latorre,[16] D. Laugier,[23] M. Lazzaroni,[16,17] X. Le,[9] P. Le Bourlout,[32] C.A. Lee,[5] M. Lefebvre,[37] M.A.L. Leite,[20] C. Leroy,[25] X. Li,[9] Z. Li,[23,12] F. Liang,[9] H. Liu,[5] C. Liu,[9] T. Liu,[9] H. Ma,[5] L.L. Ma,[12] D.J. Mahon,[7] U. Mallik,[18] B. Mansoulie,[32] A.L. Maslennikov,[28,29] N. Matsuzawa,[34] R.A. McPherson,[37,a] S. Menke,[27] A. Milic,[35,6] Y. Minami,[34] E. Molina,[32] E. Monnier,[23] N. Morange,[15] L. Morvaj,[6,33] J. Mueller,[30] C. Mwewa,[5] R. Narayan,[9] N. Nikiforou,[3,6] I. Ochoa,[7,41] R. Oishi,[34] D. Oliveira Damazio,[5] R.E. Owen,[31] C. Pancake,[33] D.K. Panchal,[3] G. Perrot,[1] M.-A. Pleier,[5,*] P. Poffenberger,[37,†] R. Porter,[37] S. Quan,[9] J. Rabel,[30] A. Roy,[3] J.P. Rutherfoord,[2] F. Sabatini,[16] F. Salomon,[23] E. Sauvan,[1] A.C. Schaffer,[15] R.D. Schamberger,[33] Ph. Schwemling,[32] C. Secord,[37] L. Selem,[1] K. Sexton,[5,†] E. Shafto,[33] M.V. Silva Oliveira,[6] S. Simion,[15] S. Singh,[35] W. Sippach,[7] A.A. Snesarev,[28] S. Snyder,[5] M. Spalla,[27] S. Stärz,[6,24] A. Straessner,[10] P. Strizenec,[4] R. Stroynowski,[9] V.V. Sulin,[26] J. Tanaka,[34] S. Tang,[5] S. Tapprogge,[22] G.F. Tartarelli,[16] G. Tateno,[34] K. Terashi,[34] S. Tisserant,[23] D. Tompkins,[2] G. Unal,[6] M. Unal,[3] K. Uno,[34] A. Vallier,[6,23] S. Vieira de Souza,[22] R. Walker,[2] Q. Wang,[7] C. Wang,[23,13] R. Wang,[22] M. Wessels,[14] I. Wingerter-Seez,[1] K. Wolniewicz,[5] W. Wu,[5,13] Z. Xiandong,[9] R. Xu,[3] H. Xu,[5] S. Yamamoto,[34] Y. Yang,[34] H. Zaghia,[32] J. Zang,[34] T. Zhang,[34] H.L. Zhu,[5,11] V. Zhulanov,[28,29] E. Zonca[32,†] and G. Zuk[30]

2022 JINST 17 P05024

- **Phase-II High Granularity Timing Detector**

➔ Ultra-fast semiconductor sensor R&D
➔ Test beams at CERN SPS
➔ Detector construction and commissioning at CERN
➔ A new facility for semiconductor sensor at USP is coming up (FAPESP Grant)





The position :

- FAPESP Grant (https://fapesp.br/en)
- Two years (subject to renewal) and includes one year stationed at CERN supported by FAPESP
- We expect the candidate to take a leading role on Run-3 (2) analysis (HH→ bb$\tau\tau$ or Drell-Yan precision measurements)
- Also requires participation on Run-3 dataking (operations in LAr) and some HGTD activities at CERN
- For more details on stipend, projects, conditions etc. please feel free to email me !

Marco Leite
leite@usp.br