EN_52 — Local V1 trial with selectors and CHSH analysis

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1. Purpose and main result

The installed V1 is subjected to two execution branches with a common known input and external selectors. The objective is to check agreement between branches and calculate their correlations using the CHSH criterion.

8,192 paired trials were performed, corresponding to **16,384 V1 executions**, with fresh preparation per machine and trial. The Deutsch answer bit, `q0`, agreed between branches and with the expected answer in every case.

The result was:

$$E_{00} = E_{01} = E_{10} = E_{11} = 1, \qquad S = 2 .$$

No Bell violation was observed. The setup checks agreement between V1 copies and reaches the local CHSH bound for the answer bit.

In that precise sense, the two V1 machines on one computer passed the local checks performed: they agreed on the Deutsch answer and their correlations respected the Bell inequality. No violation was found in the data from this trial. This does not mean exceeding the Bell bound or ruling out any violation in other setups.

The Spain–Italy test is defined to obtain two separate sets of records and compare them afterwards. Its results and compliance with its conditions will be evaluated when it is executed, without anticipating the outcome.

It is not a loophole-free physical trial: two Python processes ran on the same computer, without a Prolog implementation or execution between countries.

2. V1 and the inputs used

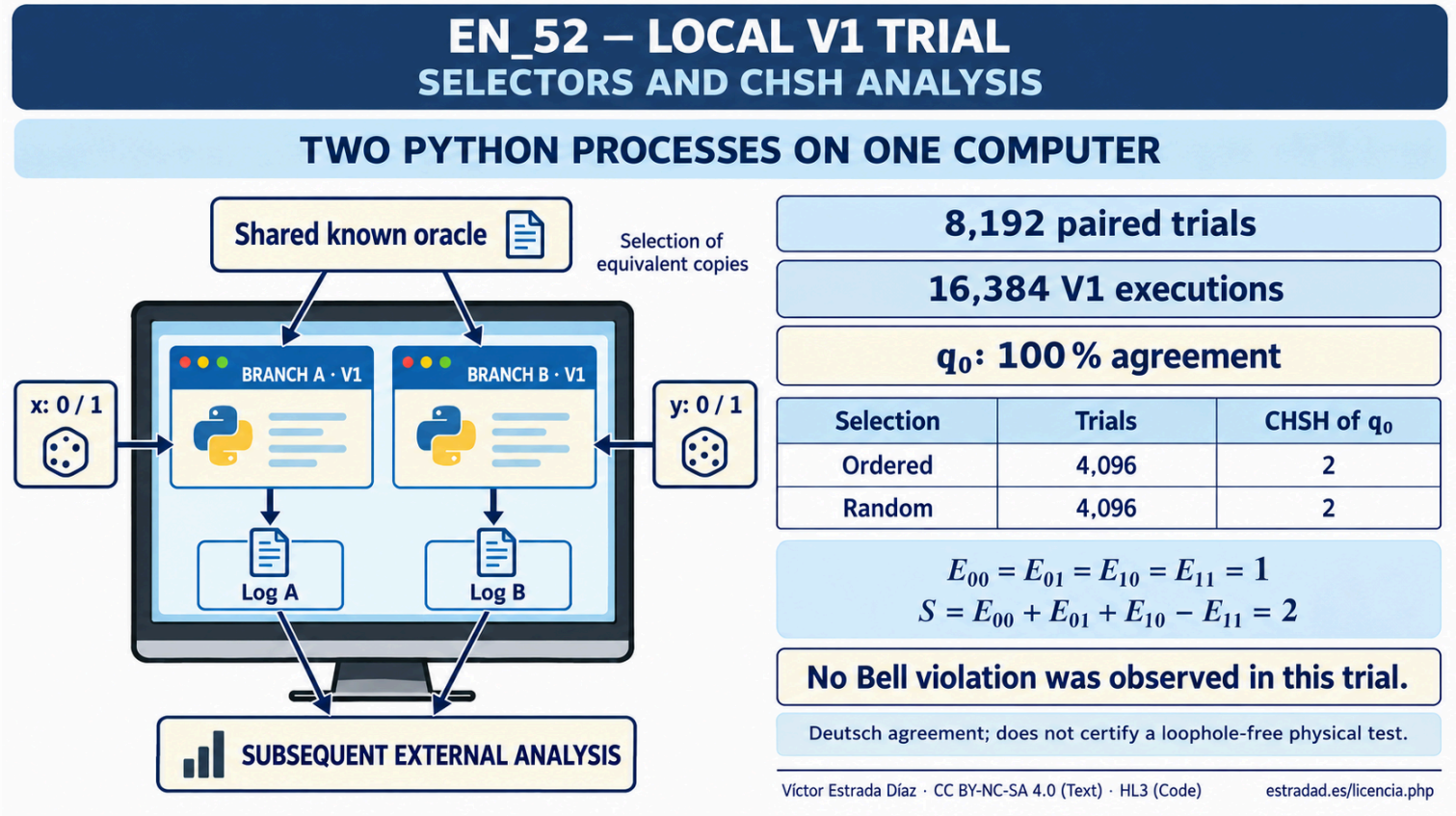


Figure 1. Two Python processes on one computer, subsequent external analysis and q0 results. It summarizes the trial performed, not the proposed Spain–Italy extension.

V1 solves the Deutsch task for a one-input binary function, denoted here by f_o. This notation distinguishes it from the internal function f of the Einstein-VED framework.

The register is prepared with the known values (0, 1). The case input defines a reversible oracle block. The four available cases were used:

Oracle	$f_o(0)$	$f_o(1)$	Deutsch answer q_0
Constant 0	0	0	0
Constant 1	1	1	0
Identity	0	1	1
Inverter	1	0	1

The checked answer satisfies:

$$q_0 = f_o(0) \oplus f_o(1).$$

The table describes the trials' known inputs and the answer checked afterwards. It is not used as a substitute for the V circuit to manufacture its output. Execution imports the installed V1 and its signal implementation; the XOR comparison is external and subsequent.

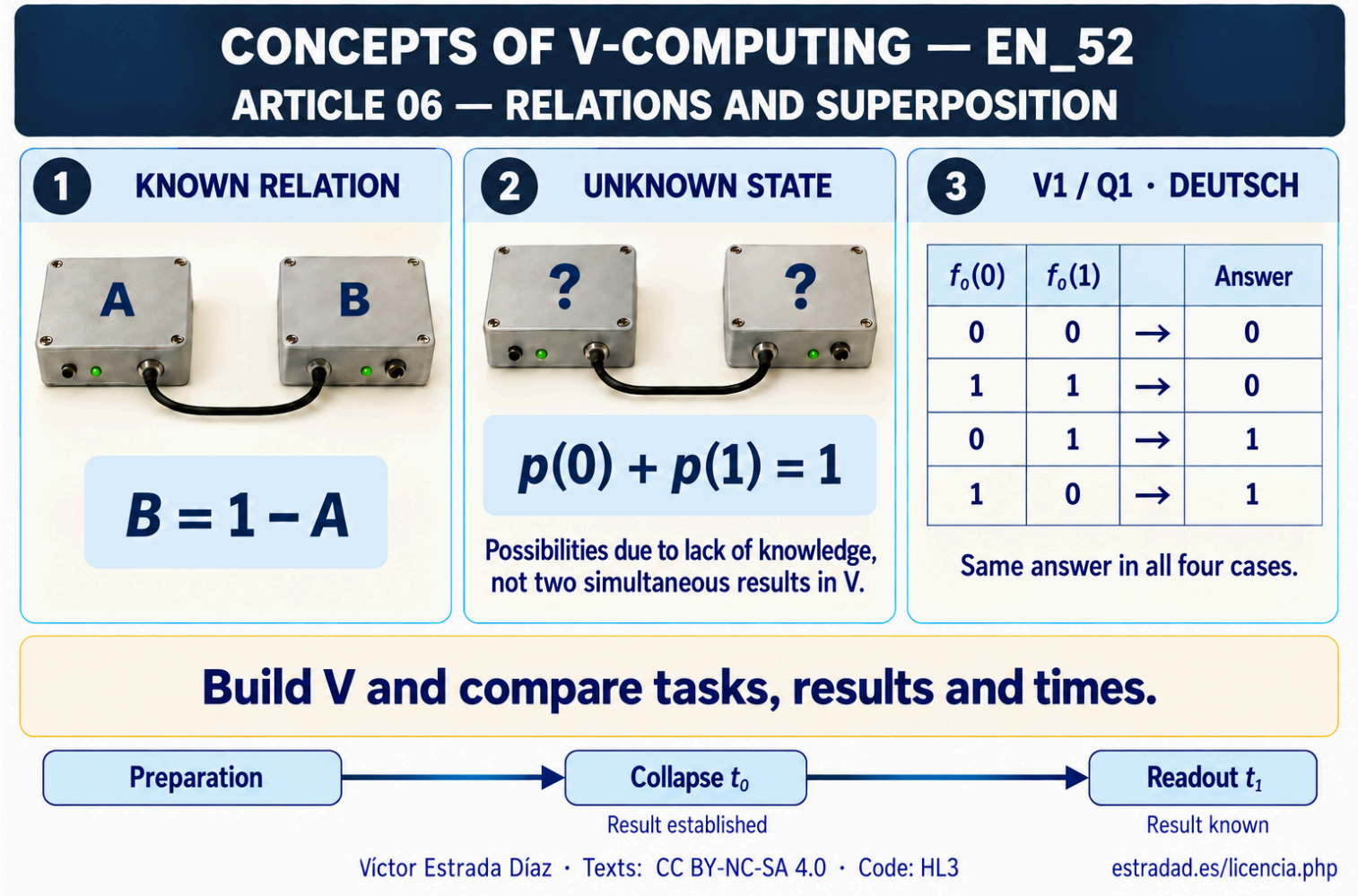


Figure 2. Illustration from article 06 to situate the Deutsch example. It does not represent a Bell trial or a speed measurement against Q hardware.

3. Setup executed

Element	Actual implementation
Branch A	Python process with V1
Branch B	Another Python process with V1
A selector	External bit $x \in \{0, 1\}$
B selector	External bit $y \in \{0, 1\}$
A0/A1 alternatives	Interchangeable copies of the same V1
B0/B1 alternatives	Interchangeable copies of the same V1
Common known input	The same oracle table for both branches
Recorded outputs	Both bits from each execution
Preparation	Fresh in each branch and trial

The A0/A1 and B0/B1 labels **do not change the operation performed by V1**. The selector identifies an equivalent copy. This choice implements the proposed case of machines that should give the same answer to the same problem; it does not, by itself, introduce two different observables per branch.

Each process receives only its own local setting, the trial identifier and the common input. It does not receive the other branch's setting or result before producing its record. The external controller knows both settings and gathers outputs afterwards.

The program does not introduce random draws to generate V's internal states or results. Randomness, when used, belongs exclusively to the external selectors.

Sequence per trial

1. The controller fixes the common oracle input following a predefined cycle independent of random selection.
2. Local labels x and y are selected.
3. Each branch creates and prepares a new V1 with its known input. Changing the label does not execute another measurement operation.
4. Each V1 triggers and returns its capture.
5. The controller collects both outputs and incorporates them into the external record.
6. After executions finish, agreements and correlations are calculated.

In this control implementation, selectors are generated before each new instance is prepared. A physical choice following shared preparation or relativistic separation of events has not been certified.

The series' conceptual notation distinguishes collapse at t_0, which fixes the result, from acquisition completed at t_1. The software record includes trigger instant `t0` and preparation and measurement durations; **it does not record an independent `t1` instant**. These data do not provide a measurement of the physical separation between the events.

4. Correlations and CHSH convention

For each output bit analyzed separately, let $a, b \in \{0, 1\}$ be the results from A and B. They are transformed into signs:

$$A = (-1)^a, \qquad B = (-1)^b .$$

Therefore:

$$AB = \begin{cases} +1, & a = b, \\ -1, & a \neq b . \end{cases}$$

For each selector pair (x, y), with N_{xy} records, we calculate:

$$E_{xy} = \frac{1}{N_{xy}} \sum_{i \in I_{xy}} A_i B_i = \frac{N_{xy}^{\text{equal}} - N_{xy}^{\text{different}}}{N_{xy}} .$$

A single convention is adopted throughout the report:

$$S = E_{00} + E_{01} + E_{10} - E_{11} .$$

The local Bell-model bound, with settings independent of relevant internal variables, is:

$$|S| \leq 2 .$$

Normalization is performed within each setting group; differences in group size are not confused with changes in correlation.

Equivalent CHSH game

The per-trial success criterion is:

$a \oplus b = xy$.

Settings (x, y)	**Success condition**
00	$a = b$
01	$a = b$
10	$a = b$
11	$a \neq b$

With uniform settings and in terms of conditional probabilities:

$P_{\text{success}} = \frac{1}{2} + \frac{S}{8}$.

The local bound for this success criterion is 3 / 4. The raw success fraction of a sample with differently sized groups need not exactly match the average giving each setting equal weight.

5. Results measured in the software trial

5.1. Ordered selection

4,096 paired trials were executed, with 1,024 records of each selector combination.

Bit analyzed	E_{00}	E_{01}	E_{10}	E_{11}	S	**A/B agreement**
q0, Deutsch answer	1	1	1	1	2	100%
q1, second bit	1	1	0.998046875	1	1.998046875	99.9755859375%

For q0 there were 3,072 CHSH-game successes: 75%. For q1 there were 3,071: 74.9755859375%.

Ordered selection is an agreement control with predictable settings. It is not presented as a physical test of setting independence.

5.2. External random selection

Another 4,096 paired trials were executed.

Settings	**Records**
00	981

Settings	Records
01	1,013
10	1,050
11	1,052

For both bits:

$E_{00} = E_{01} = E_{10} = E_{11} = 1, \qquad S = 2 .$

A/B agreement was 100% for both q0 and q1. The raw game-success fraction was:

$\frac{3044}{4096} = 0.7431640625 .$

There is no contradiction between this 74.31640625% and $S = 2$: there were 1,052 selections of 11, precisely those that fail when both outputs always agree. The average giving equal weight to the four pairs still gives 75%.

5.3. Comparison with the Deutsch answer

In all 16,384 executions, q0 agreed with $f_o(0) \oplus f_o(1)$. There were no discrepancies for any of the four oracles.

The most favorable bit was not selected retrospectively: q0 and q1 were retained and analyzed separately. Trials were not discarded according to their results either; no execution failures occurred in this run.

6. External mathematical check

In addition to executing V1, the analyzer enumerated the 16 binary assignments of local responses (a_0, a_1, b_0, b_1). This enumeration is not used inside V and does not generate its states or outputs.

For a fixed assignment of local signs:

$C = A_0 B_0 + A_0 B_1 + A_1 B_0 - A_1 B_1 = A_0 (B_0 + B_1) + A_1 (B_0 - B_1) .$

Since $B_0, B_1 \in \{-1, +1\}$, one parenthesis is zero and the other equals ±2. Hence:

$C \in \{-2, +2\}, \qquad |\langle C \rangle| \leq 2 .$

Enumeration confirmed $|C| = 2$ for all 16 assignments and a maximum 75% success rate with uniform settings. Not knowing the local responses does not change that bound under the stated assumptions.

This mathematical check is distinguished from correlations estimated in a finite sample. No statistical significance test was performed, and no violation is declared from fluctuations.

7. What it demonstrates and what it does not

Demonstrated for the setup executed:

- Complete q0 agreement between the two V1 copies for all four oracles.
- Preservation of that agreement with ordered and external random selectors.
- q0 correlations equal to 1 and CHSH equal to 2.
- Absence of a Bell violation observed in this trial.

Not checked in this trial:

- Equivalence between Python and Prolog implementations: both branches were Python.
- Execution between Spain and Italy or isolation through spacetime separation.
- Absence of side channels or physical independence of settings.
- Independence of the internal deterministic time references of the two implementations.
- Internal unknownness certified merely by using separate processes.
- A quantum-hardware result or a speed comparison with Q.
- A general conclusion about all V constructions.

The controller knows both settings and the branches share a computer. Interface isolation is not equivalent to a loophole-free physical Bell test.

The trial is external verification. V1's construction was not modified and the analyzer introduced no prior measurements of its internal states. This does not, by itself, certify all coherence conditions defined by the author.

8. Interpretation for article 07

In this setup, choosing equivalent copies produces the expected agreement but does not introduce measurement alternatives that change the local answer for the same common input. All four q0 correlations equal 1 and their CHSH combination gives 2.

Studying another setup would require describing the operations distinguishing A0/A1 and B0/B1, shared preparation and each branch's access to information during the trial. Sharing preparation is allowed in Bell; making each response depend on the remote setting is not allowed within the local model being tested.

The result obtained is incorporated into EN_52_07 — Correlations and Bell, PDF. This stage of the exposition ends at 07; later constructions will be presented subsequently.

9. Proposed extension: Spain–Italy

Status: proposed protocol, not yet executed. Its first purpose is to check V1 agreement and correlations between two sites. A loophole-free physical Bell test would require additional isolation, independence and timing controls.

9.1. What is taken to Italy

One installation is placed in Spain, A, and another in Italy, B. An already prepared computer may be physically transported, or a verifiable software copy installed on a computer at the Italian site. It is not

necessary to transport an unknown internal state or preserve an execution in progress during travel.

The V1 code and required modules, a compatible Python environment, the preparation specification and the public trial plan are taken. File versions and SHA-256 hashes are recorded at each site. Future results or internal values of an execution are not copied as substitutes for unknown sources.

The portable arrangement keeps these sibling directories:

```
SRC-VED/
  v-computacion/
    EN_52_EnsayoBellV1.md
    datos/ES_52_EnsayoBellV1/
  UNIHOLOG/
    Traductores_V/
```

The four selection labels are distributed across two sites: A0/A1 in Spain and B0/B1 in Italy. In the first repetition they remain equivalent V1 copies. They may be new instances of the same local application; four computers are not required.

A later Prolog implementation would first be checked against the four Deutsch cases and the preparation and capture contract. It is not declared available or verified by this protocol.

USB variant clarified by the author

The program, execution environment and known configuration are duplicated onto two USB drives before the machines are started. The intention is not to copy a prepared execution in RAM or transport an execution in progress.

One copy is installed in Spain and the other in Italy. Each site starts its own environment and prepares execution locally. Both preparations occur within the agreed start window, without communication between sites during preparation and execution.

The copies share the defined start and known relations. The agreed plan includes no connections between branches or instructions consulting the other environment. There is no requirement to share values that must remain unknown or fix future execution results by duplication.

Records are retained separately and gathered on completion. Inspection and analysis follow the local collapses and acquisitions.

Matching known environments does not invalidate the trial: it constitutes common public preparation. Operational separation thus established is distinguished from statistical independence of local choices, which must be documented if the campaign is interpreted as a Bell trial. An agreed start time does not, by itself, certify section 9.6's spacetime conditions either.

9.2. Public preparation before starting

Both sites agree on a campaign identifier, trial count, trial identifiers, public oracle order and record format. For example, the two original blocks of 4,096 trials may be repeated: an ordered control block and

a block with local random selection.

The bits to be analyzed are fixed before execution: q0 as the Deutsch answer and q1 as an additional output, without choosing the most favorable afterwards. How errors, missing records and delays will be recorded is documented. Cases detrimental to correlation are not removed.

The common plan contains only what is known. In the random block, it does not include future choices of both selectors, a joint seed predetermining them or output results. Each site receives only its local information during the trial.

9.3. How it starts and runs

1. Before the campaign, versions, inputs and hashes are checked. Basic Deutsch cases are run separately as an installation control.
2. The public plan is distributed and a start window fixed. A network signal may coordinate the campaign before local choices; a response from the other site is not used to decide an output.
3. For each identifier, each site prepares a new V1 with that trial's known oracle. Preparation maintains V's internal conditions and does not deliver its unknown values.
4. In the random block, an external local device or controller obtains its selector after instance preparation and before triggering. A receives only x; B receives only y. Selecting equivalent copies does not change their operation, but is recorded. Future choices are not exchanged.
5. Each site locally triggers collapse, records t0 and completes acquisition. Readout completion, obtained bits, selector, trial status and available times are recorded separately.
6. Records remain local until both sites have fixed their results. Missing remote results do not authorize repeating a consumed preparation or choosing another result for the same identifier.

Acquisition does not read internal values before collapse to calculate an answer. Selectors and subsequent analysis belong to the external verification apparatus.

The supplied program reproduces the two-process trial on a single computer. It does not yet implement autonomous branches, choice after preparation or separate recording of readout completion. Execution between sites requires a local controller per branch and a subsequent comparator. Running the complete program in both countries is not sufficient: it would produce two local trials, not one distributed trial.

9.4. Records to retain

Field	Spain, branch A	Italy, branch B
Identification	Campaign and trial identifier	Same campaign and identifier
Common input	Known oracle	Same known oracle
Local selection	x	y
Capture	q0, q1 and acquisition status	q0, q1 and acquisition status

Field	Spain, branch A	Italy, branch B
Times	Local choice, trigger and acquisition end	Local choice, trigger and acquisition end
Provenance	Version, code hash and configuration	Version, code hash and configuration
Incidents	Failures, missing records and clock conditions	Failures, missing records and clock conditions

After closing the block, a hash of the complete local file is calculated. The hash allows subsequent modifications to be detected; it does not, by itself, prove internal independence or the physical instant when each output was fixed.

9.5. How results are gathered and verified

The two closed files are transferred to the external analyzer. This may be done over a network after results are fixed, or using physical media. Subsequent comparison does not require machines to remain connected during the trial.

The analyzer performs these checks:

1. Verifies hashes, versions and matching campaign.
2. Pairs by identifier, never searching afterwards for the pairs that agree most. Checks duplicates, missing records, differing oracles and incidents.
3. Checks each site's q0 against the Deutsch answer and calculates discrepancies between Spain and Italy. This measures functional agreement independently of CHSH.
4. Groups by 00, 01, 10 and 11 and calculates the four correlations and S using this report's formulas. Calculates q0 and q1 separately.
5. Declares a group without data non-estimable. If failures or unpaired trials occur, retains them in the report and applies the agreed treatment; it does not characterize a selection of successful cases as a loophole-free test.
6. Reports sample size and uncertainty. An estimate above 2 requires statistical analysis and an audit of conditions; a violation is not declared automatically.

If q0 always agrees for equivalent copies, the expected result is again:

$$E_{00} = E_{01} = E_{10} = E_{11} = 1, \qquad S = 2 .$$

That would be a geographically distributed agreement result. Distance alone does not turn S = 2 into a Bell violation.

9.6. Isolation and spacetime condition

For computational verification, data exchange between branches during choice and result acquisition is documented and blocked. Network channels, shared files and control services are reviewed. Using Python or Prolog does not, by itself, guarantee that isolation.

To physically close the possibility of communication at or below light speed, the positions and distance D between sites, choice events and result events must be identified, with bounded timing uncertainty.

Let uA and uB be local choice times and vA and vB recorded-result times, expressed in a common time reference. A sufficient criterion, including a conservative uncertainty margin ε, is:

$$v_A - u_B + \varepsilon < \frac{D}{c}, \qquad v_B - u_A + \varepsilon < \frac{D}{c}.$$

The local choice–result ordering must also hold. This criterion checks that the remote setting could not reach the other output through a light-speed or slower signal. Without adequate time metrology, separation between countries and ordinary computer clocks are not sufficient to certify it.

These are external Bell-trial conditions, not new internal V components. A campaign may be valid as a cross-site reliability check without yet satisfying the conditions of a loophole-free physical Bell test.

9.7. Distances used in Q

Cryogenics is not a Bell requirement. It is an operating condition of certain devices. The 2023 superconducting-qubit experiment used as a reference separated its two sites by 30 meters; it was not a Spain–Italy setup.

Quantum experiments at much greater distances also exist: in 2017 photon pairs were distributed from a satellite to ground stations separated by 1,203 km and S = 2.37 ± 0.09 was reported. This is a photonic platform, not two general-purpose quantum computers. Its loophole closure is not equated here with that of the superconducting trial either.

- Superconducting-circuit experiment, 30 m, 2023.
- Authors' paper on photon distribution over 1,203 km, 2017.

Comparison must always identify platform, separation and conditions actually checked, not only a country name or distance.

10. Data and reproduction

The concepts and this report belong to v-computacion, a separate project. ES_52 in UNIHOLOG is the base project. DEMUESTRA will work on the Spanish version of that base project; its construction is not transferred here or modified by this report.

- Summary, correlations and source hashes.
- Complete records of the 8,192 paired trials.
- External trial program, with portable local path.
- Documentary copy of V1 inputs.
- Documentary copy of the V1 structural analysis.
- Documentary copy of the established V1 result.
- ES_52 base project in UNIHOLOG, PDF.
- ES_52 demonstration in DEMUESTRA/Proyectos/ES_52, PDF.

In DEMUESTRA, documentary verification is limited to Spanish `.md` files. Its document is identified as a reference; no new review of all DEMUESTRA has been performed for this report.

The documentary copy of the established result comes from `../UNIHOLOG/Traductores_V/Pruebas_V/resultado_asentado_v1.json` and is retained without changing its content. It is included inside `datos/ES_52_EnsayoBellV1/` so that its link does not depend on UNIHOLOG's web publication. When this project is published, its `datos/` and `img/` directories must accompany the documents, preserving the relative structure.

From this document's directory, to repeat the trial without overwriting original records:

```
python -B ./datos/ES_52_EnsayoBellV1/ensayo_bell_v1.py --output ./datos/ES_52_EnsayoBellV1/repeticion -
```

The portable copy adapts the UNIHOLOG path and adds a small-sample control: if a setting pair is missing in a group, its correlation and CHSH are recorded as `null` and are not estimated. That control does not change the original results, whose groups were complete. The hashes in `resultados.json` correspond to the original execution. A repetition will generate its own hashes, selectors, times and results; identical random counts or q1 values are not expected.

Links and PDF conversion

File links and images use paths relative to this document's directory, with `/` to facilitate use by converters. There are no local `file://` links or user paths in the text.

Reading links point to PDF, not `.md` sources. The concept and report PDFs are in `./pdfs/`; the base project is consulted in `../UNIHOLOG/` and the demonstration in `../DEMUESTRA/Proyectos/ES_52/`. When generating HTML and PDF, `publica.py` adapts paths from their respective output directories without changing the destination format: documents continue to link to PDF. JSON data, the program and images retain their extensions and must accompany the collection to keep their links accessible.

11. Protocol reference

IBM Quantum — CHSH game: rules and local-strategy bound.

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