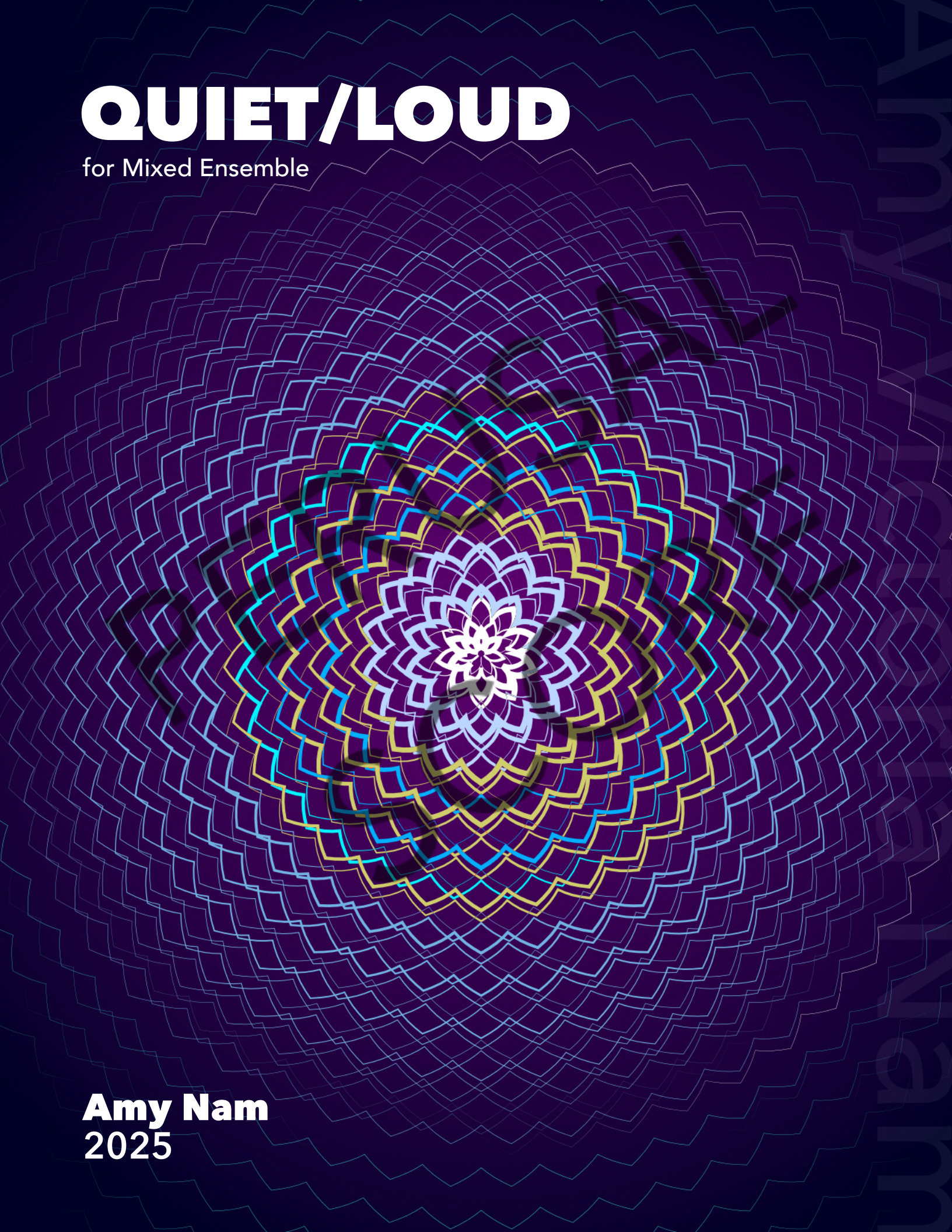
QUIET/LOUD

for Mixed Ensemble



Amy Nam

2025

Duration

7:20

Instrumentation

Flute
Clarinet in B-flat
Piano
Electric Guitar
Double Bass
(with C extension)
Live electronics

Performance notes for electronics

All instruments should be mic'ed and routed (except for the electric guitar, which can be directly routed) through a central interface/laptop for processing before being amplified. They will not require separate processing and can be bussed through one channel.

The electronic part can be performed using any DAW with a reverb effect and pitch shifter effect that can be adjusted live. It is necessary to gradually adjust two parameters at once, so a midi device with knob controllers is recommended. The score indicates a section of music that is to be recorded and played back on loop with processing later on in the piece. This section could either be recorded in advance of the performance or could be recorded live.

The Electronics cue line includes both descriptions of the intended sound and specifications for what effects to use if the electronics are operated with Logic, including specific parameter values. Please use your judgement and adjust the parameter values as suits the performance space in order to achieve the described sound, even if that means setting a parameter value at a very different level than the one indicated.

Program notes

At first glance, the subatomic world seems wild with chaos. Wave functions governing the energy and potential of quantum states combine and separate in polyrhythmic interference. Electrons bop from orbital to atomic orbital without bothering to traverse the intervening space. Ever-present environmental entropy rudely interferes with particles that are somehow occupying multiple places simultaneously.

At first glance, the subatomic world seems chaotic. And yet—it's not. Not quite.

QUIET (Quantum Underground Instrumentation Experimental Testbed) and LOUD are the names of a pair of labs at Fermi National Accelerator Laboratory, or Fermilab, the United States' premier particle accelerator lab, located in Batavia, Illinois. LOUD sits on the earth's surface while QUIET nestles underground beneath 100 meters of rock that shields the lab from most of the high-energy cosmic rays that constantly rain down from outer space to invisibly bombard our planet. Together, these labs carry out controlled experiments measuring the effect of cosmic rays on qubits.

Qubits, or quantum bits, perform calculations in quantum computers. They are similar to "traditional" bits in "normal," classical computers, in that they can, in theory, be designed in a variety of possible mediums, so long as they properly store information to allow for the performance of logical operations. However, unlike classical bits, which can only be in one state at a time (either off or on, 0 or 1), quantum bits can be in a "superposition" of states. This means qubits can occupy both states (0 *and* 1) at the same time, allowing multiple mathematical operations to be carried out simultaneously.

Through conversation with the amazing scientists at Fermilab, I learned about the exciting process that ensues when qubits are put into action.

First, scientists initialize several qubits (an "array" of qubits) to their desired superposition states. For a brief moment of time, the qubits remain in their superpositions and are able to perform calculations as intended. The state of the qubits at this moment can be imagined as a complex system of many simultaneous waves, each with a different amplitude and period that correlates with the qubit's probability of possessing a particular potential energy. The composition of these waves fluctuates as the qubits undergo algorithmic operations that alter the probability of their states of potential energy.

However, this moment doesn't last for long. *Very* quickly (within microseconds!) the qubits begin to "decohere" from their superposition states. Each qubit returns to being in just one state, its "ground state," the state of lowest possible potential energy. Within an array of qubits, the decoherence of each qubit usually happens out of sync from the others. This decoherence happens "naturally," simply because the qubits are affected by the "noise" of their subatomic environment, such as minuscule temperature fluctuations or tiny amounts of radioactive decay from nearby materials. In addition to this naturally-occurring decoherence, and of special interest to the QUIET/LOUD labs, more drastic (but also less frequent) decoherence is caused by cosmic rays, such as the X-rays that emanate from the sun's solar corona. A cosmic ray can add a huge amount of energy to a qubit, suddenly knocking the qubit, or possibly several qubits, out of superposition back to the ground state or even to an entirely different value. Inside a quantum computer, a qubit that has undergone decoherence would immediately be detected and re-initialized to its previous superposition state.

In *QUIET/LOUD,* these quantum processes find musical analogy in three ways. First, I employ a fabric of spinning gestures that continually, asynchronously, wind down before immediately "rebooting," expressing the constant process of decoherence. Additionally, musical melodies and motives echo around the ensemble at different rates, enacting constructive and deconstructive interference patterns that evoke the complex wave function describing a qubit array's fluctuating quantum states. And as a final analogy, a cosmic ray strikes in the form a moment of extreme energy, bringing the music to its state of lowest energy. Taken together, these music processes offer a sonic impression of what might be experienced on the quantum level: complexity that looks chaotic at first, but is in fact highly organized until disturbed.

QUIET/LOUD was commissioned by fivebyfive for premiere in their October 2025 season concert "Subatomic Mysteries" and was written during my residence as the 2025 Fermi Forward Discovery Group Guest Composer.

I give my heartfelt thanks to Fermilab scientists Doğa Kürkçüoğlu and Silvia Zorzetti for their time, generosity, expertise, and conversation; to Natalie Johnson, Head of the Office of Education and Public Engagement at Fermilab; and to Georgia Schwender, Visual Arts Coordinator and founder of the Fermilab artist-in-residence program. My warmest gratitude extends to Laura Lentz, Artistic Director of fivebyfive, for her creative vision and execution in commissioning this piece and its companions, all inspired by our amazing subatomic world.

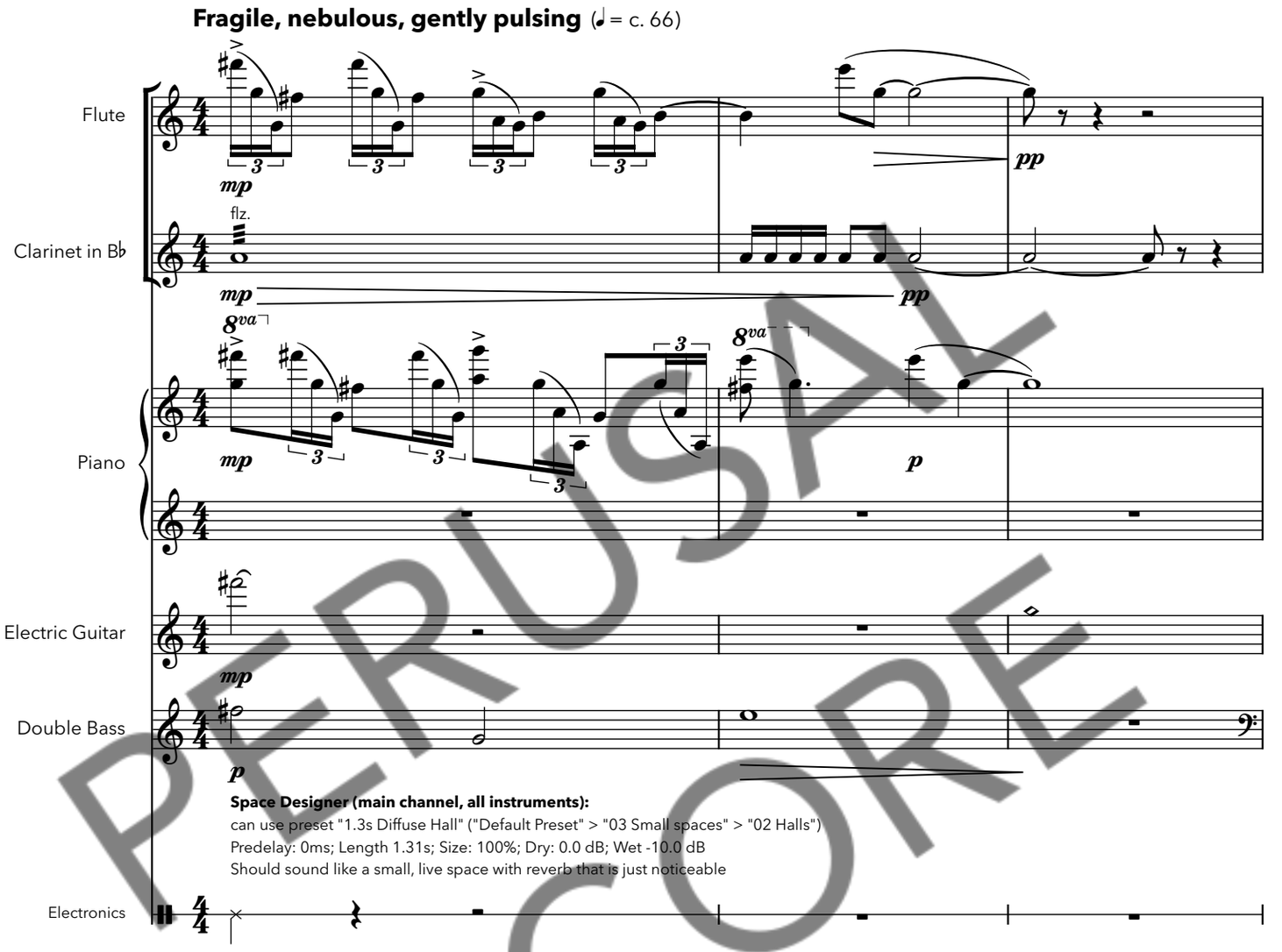
—Amy Nam (b. 1994)

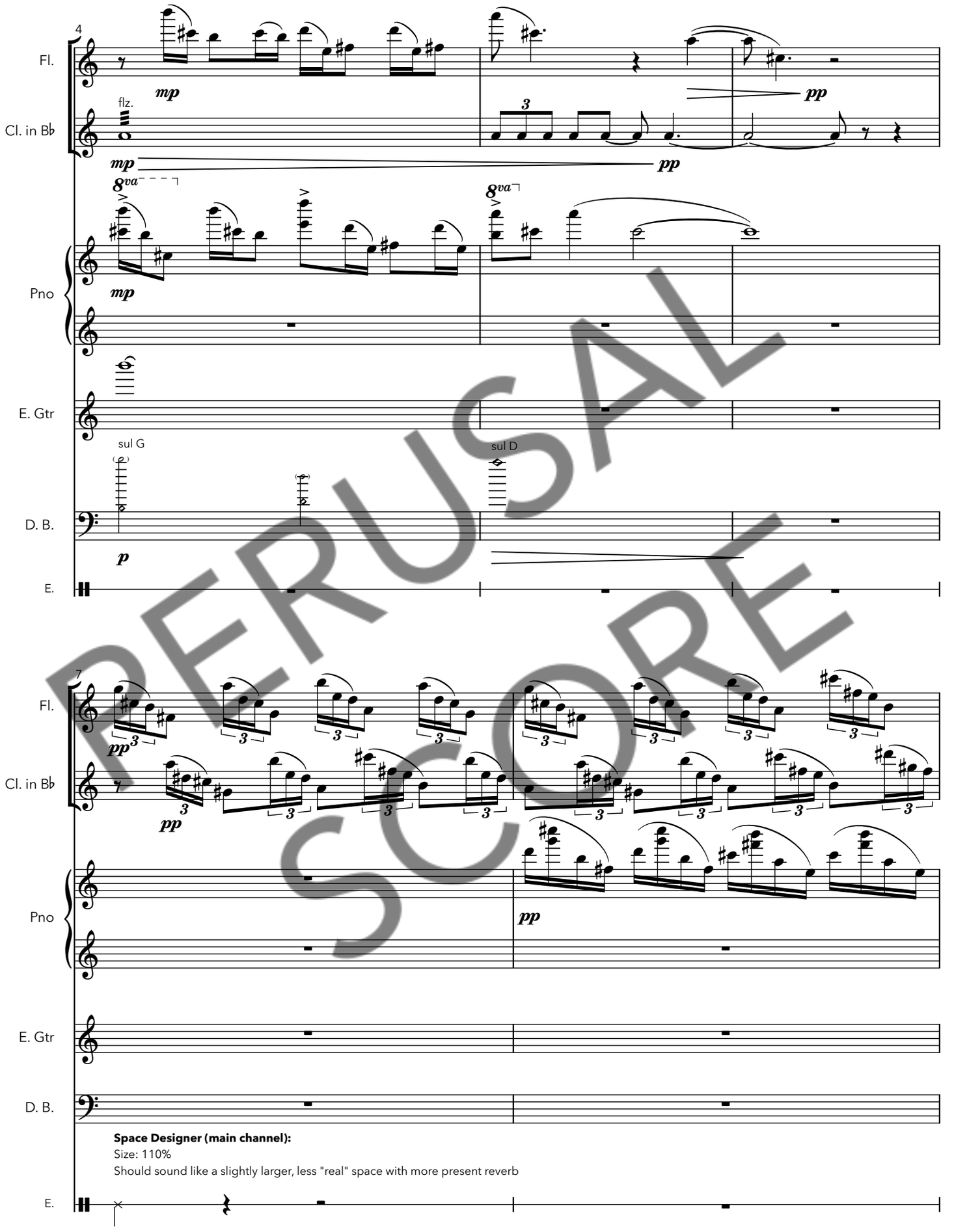
transposed score

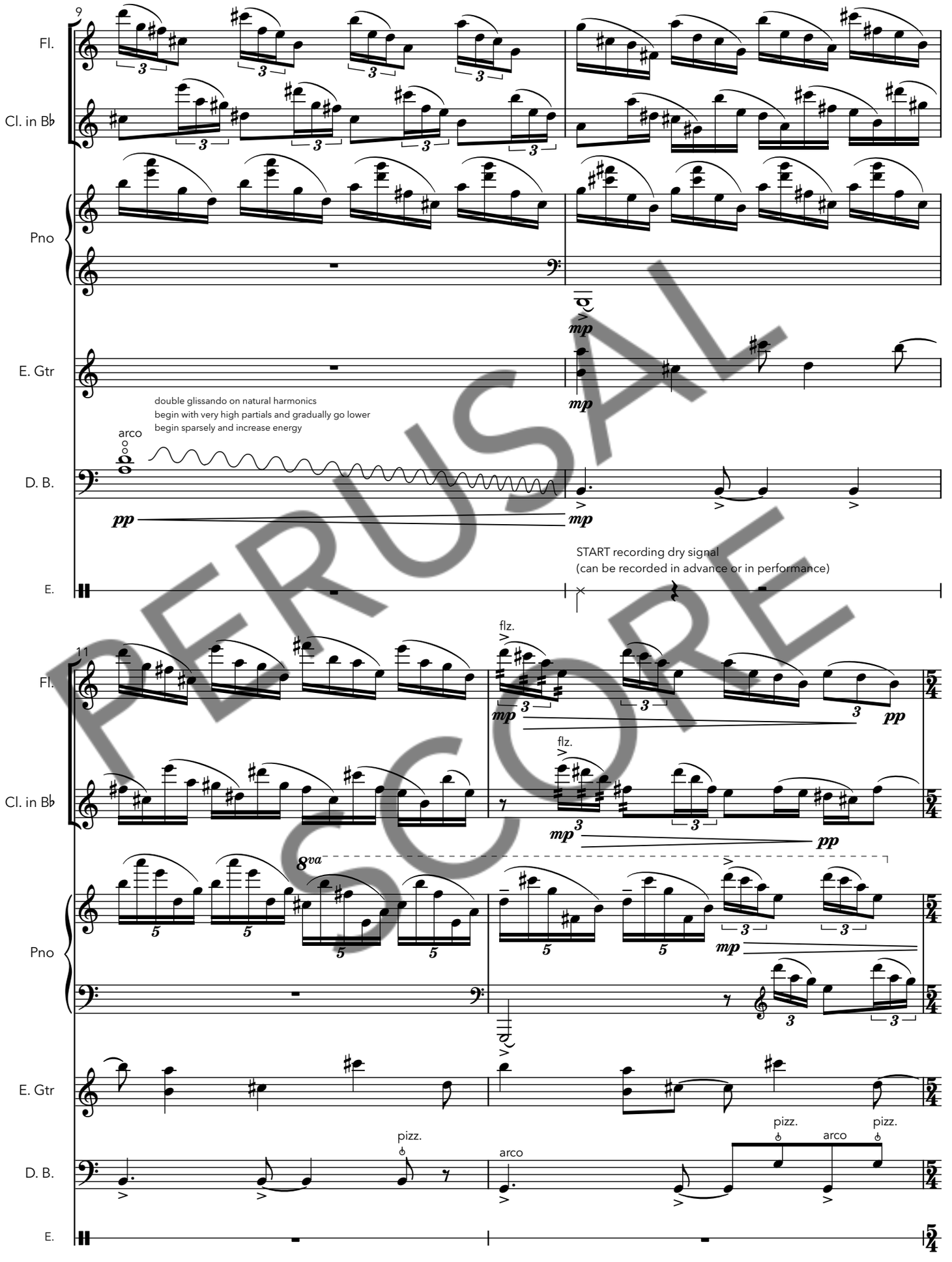
QUIET/LOUD

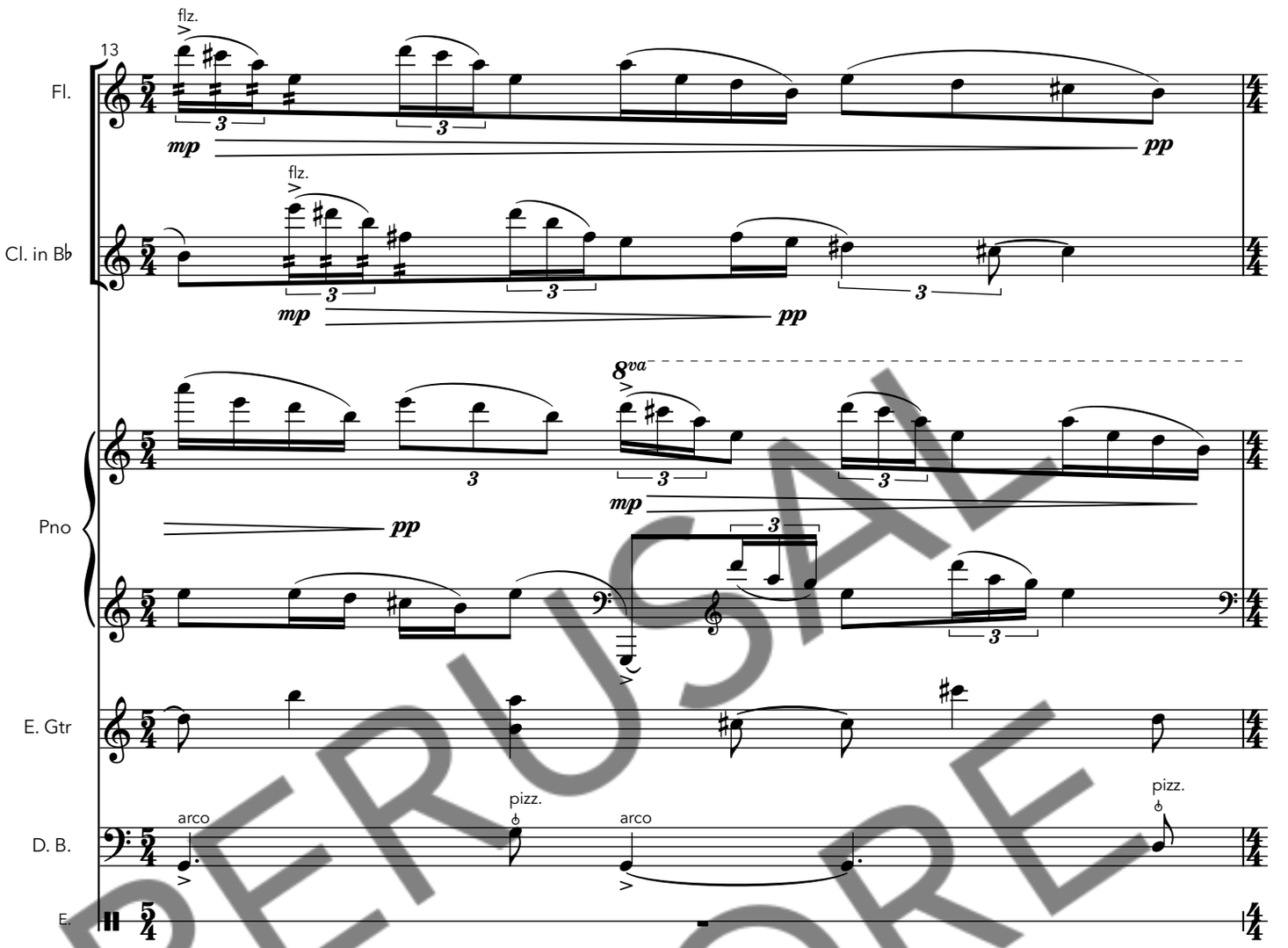
(for fivebyfive)

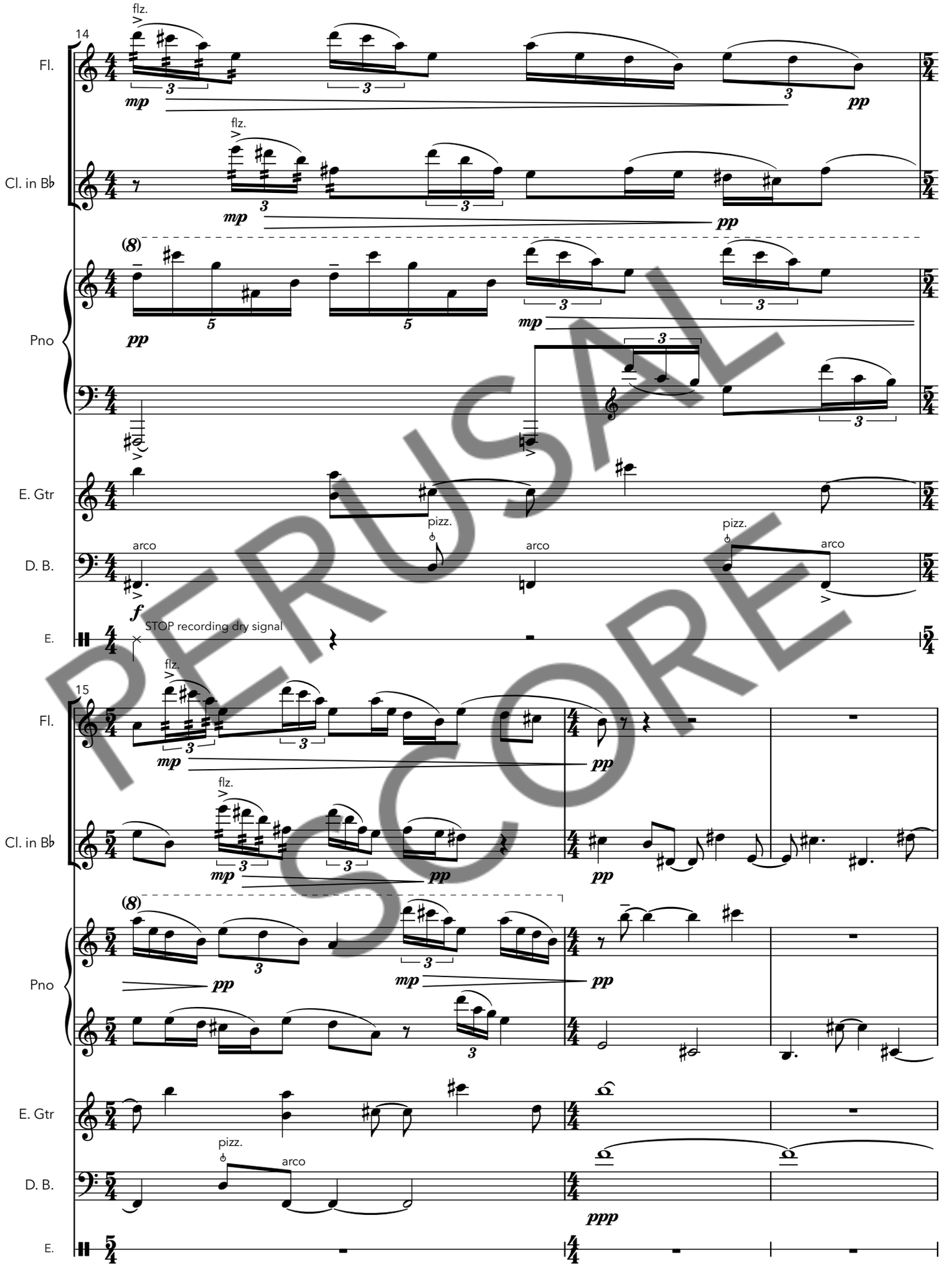
Amy Nam

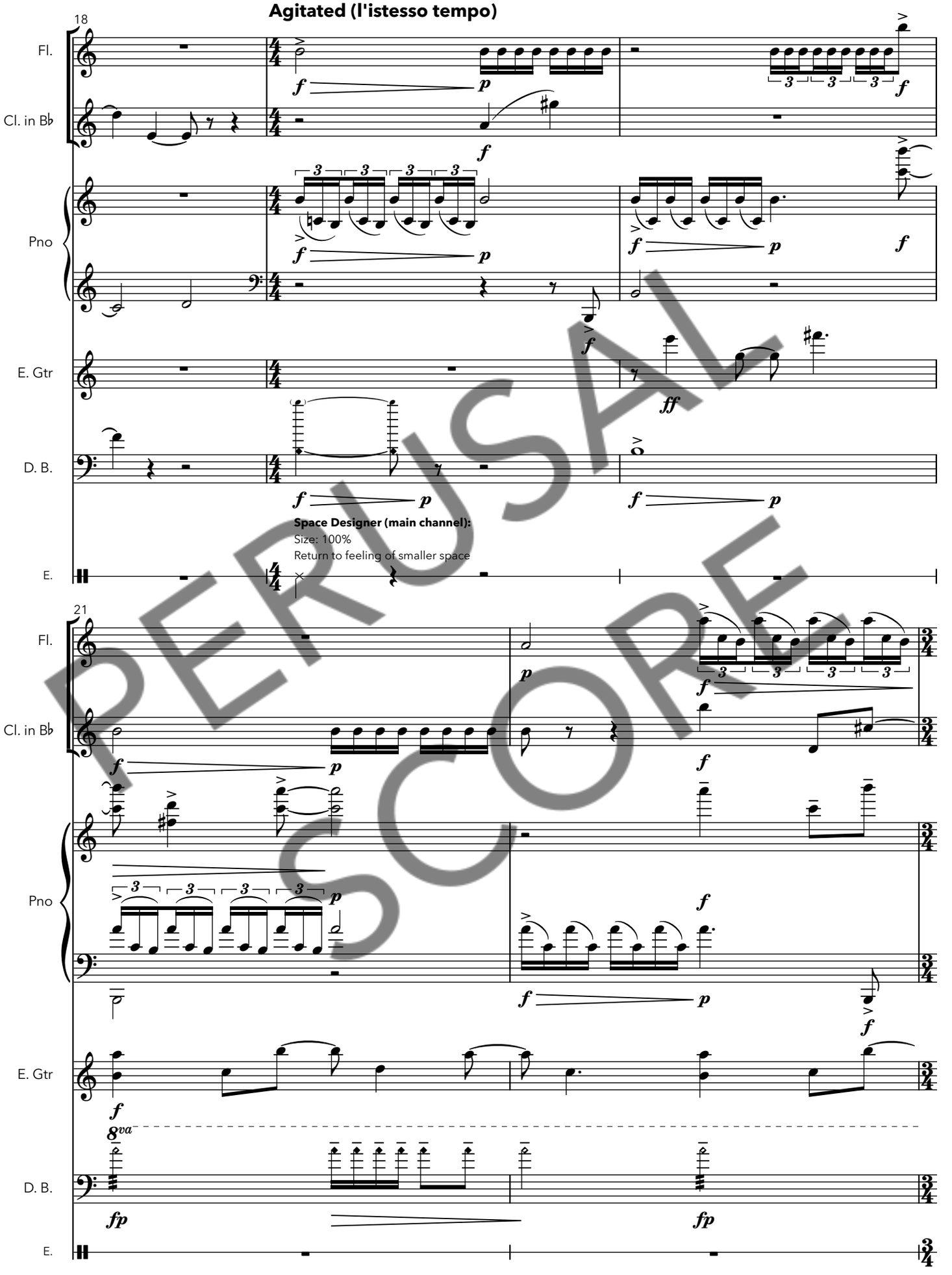


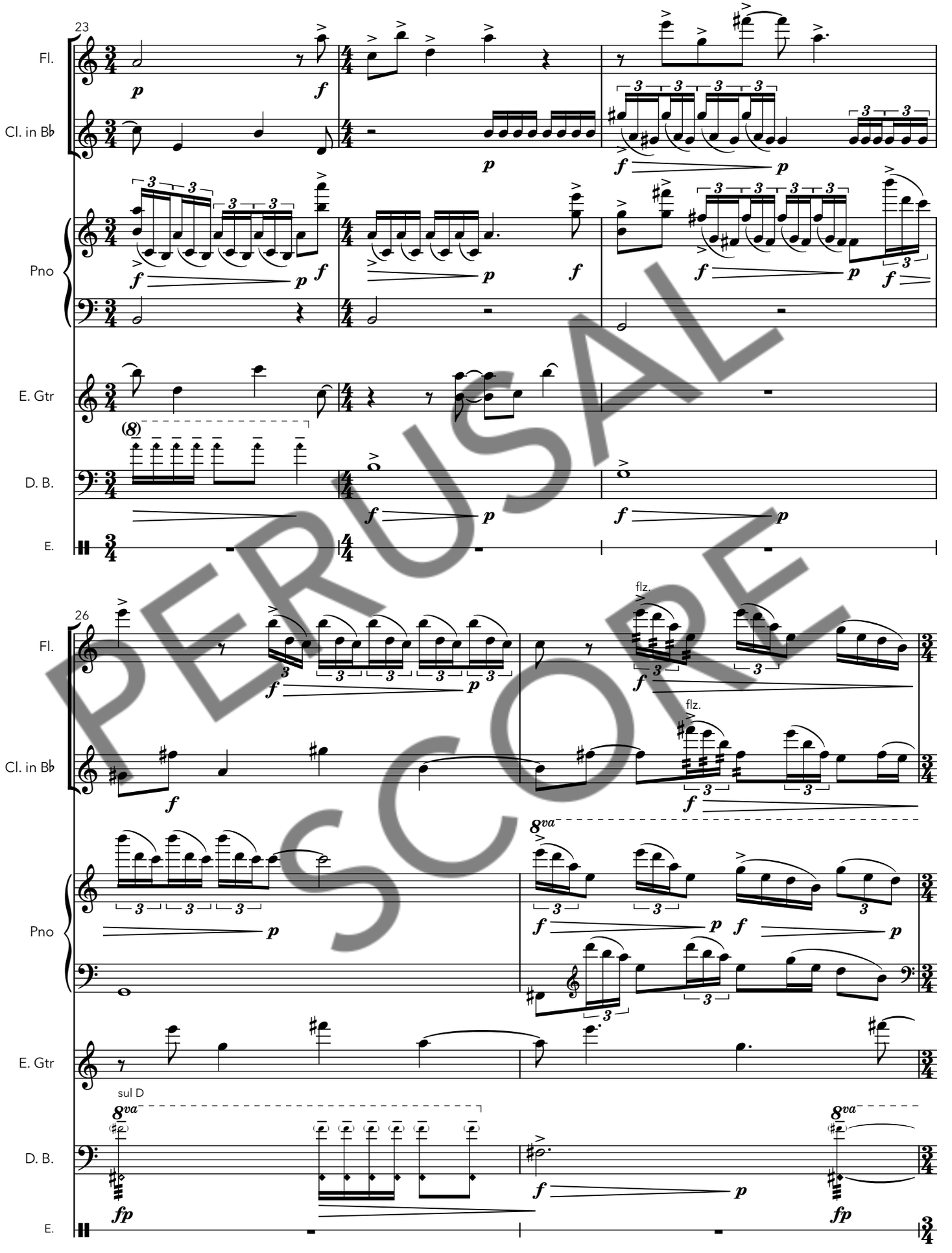


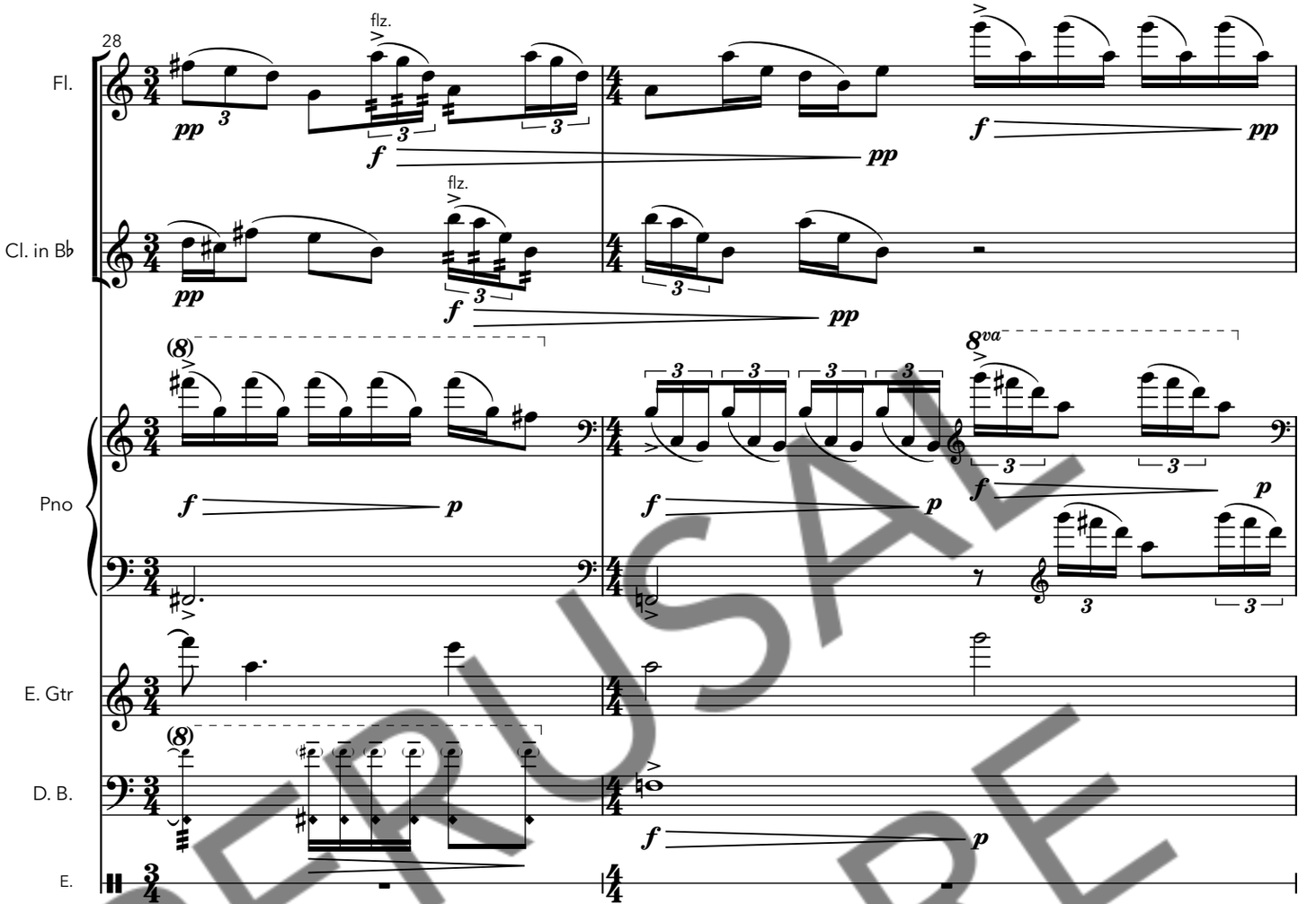


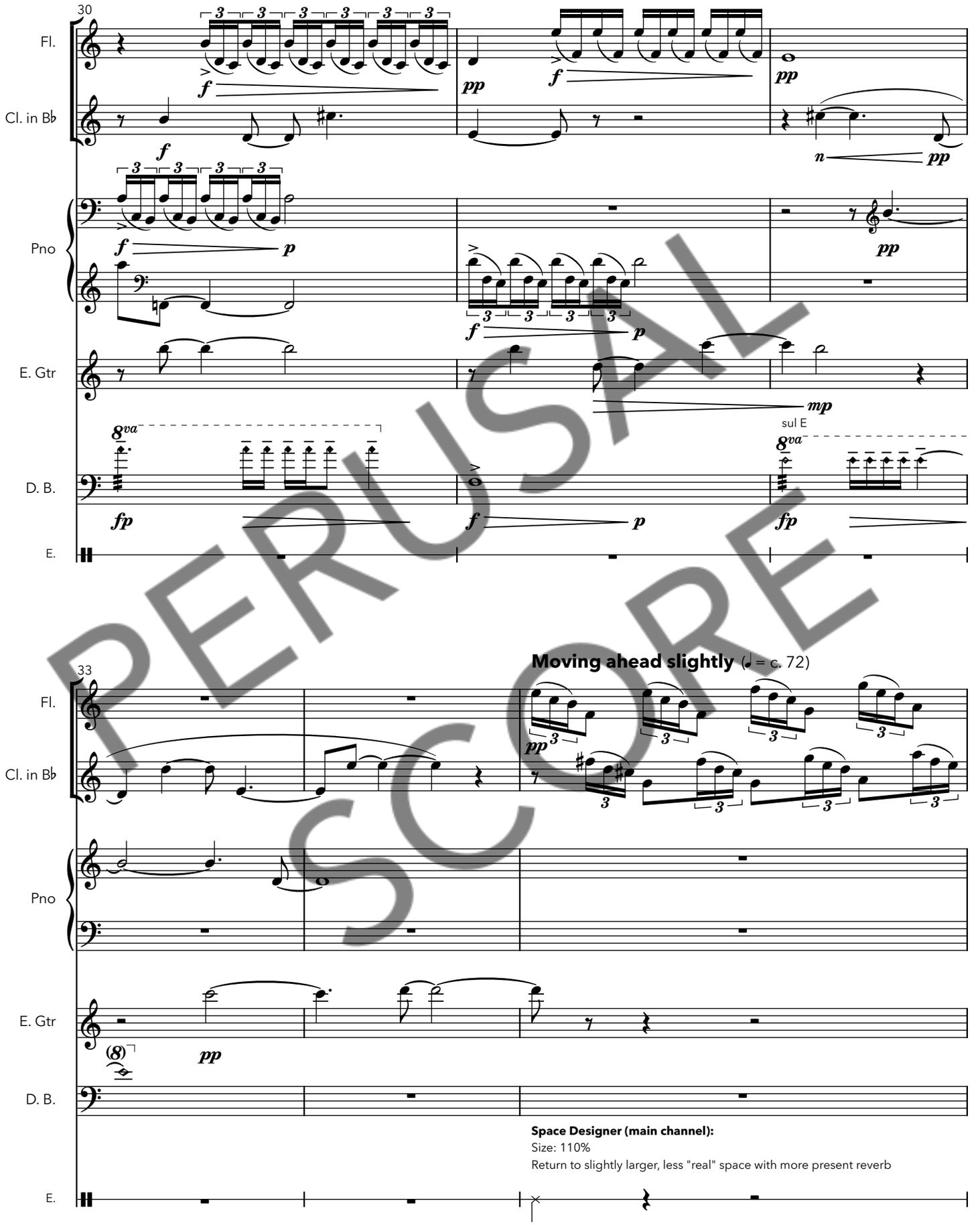


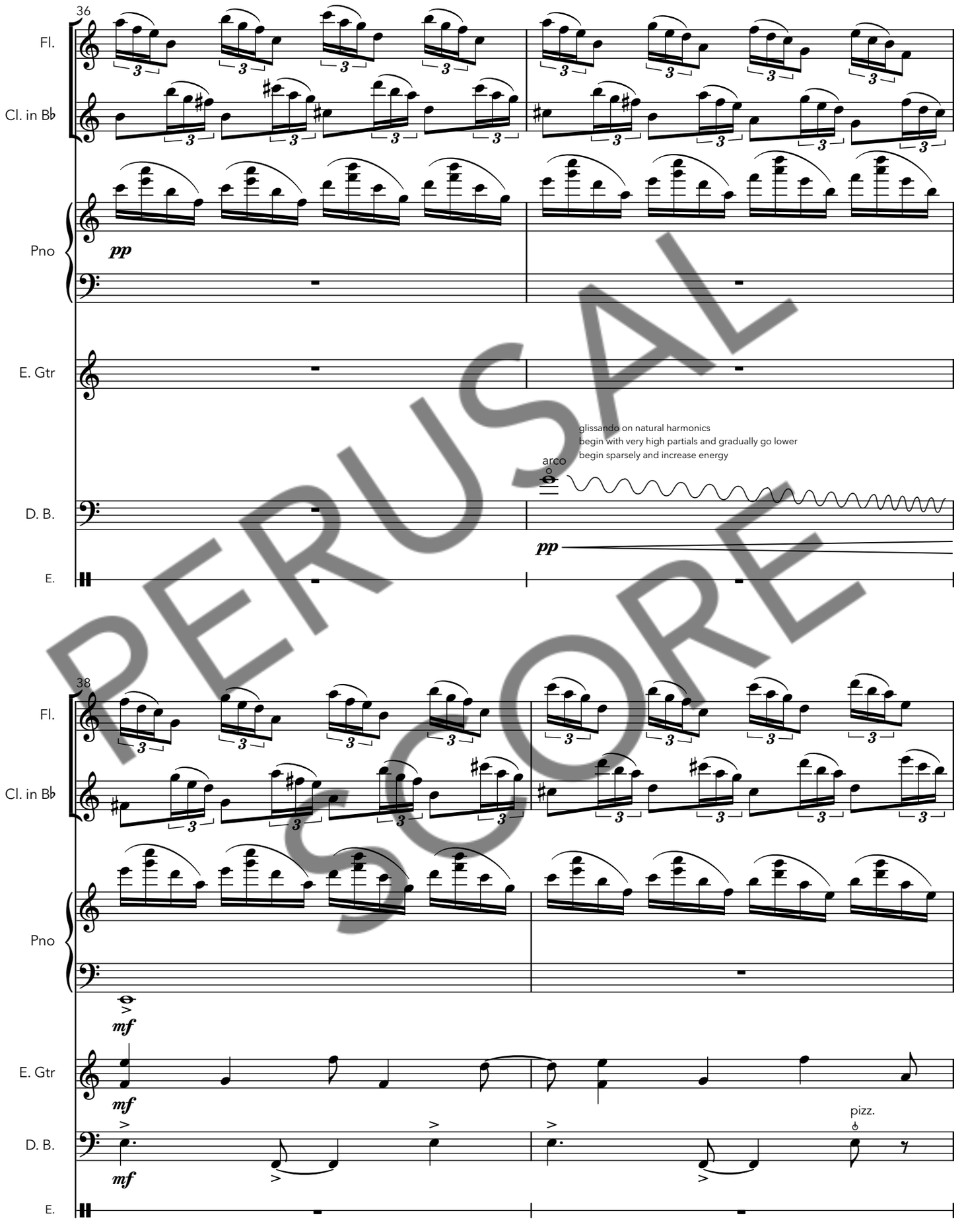


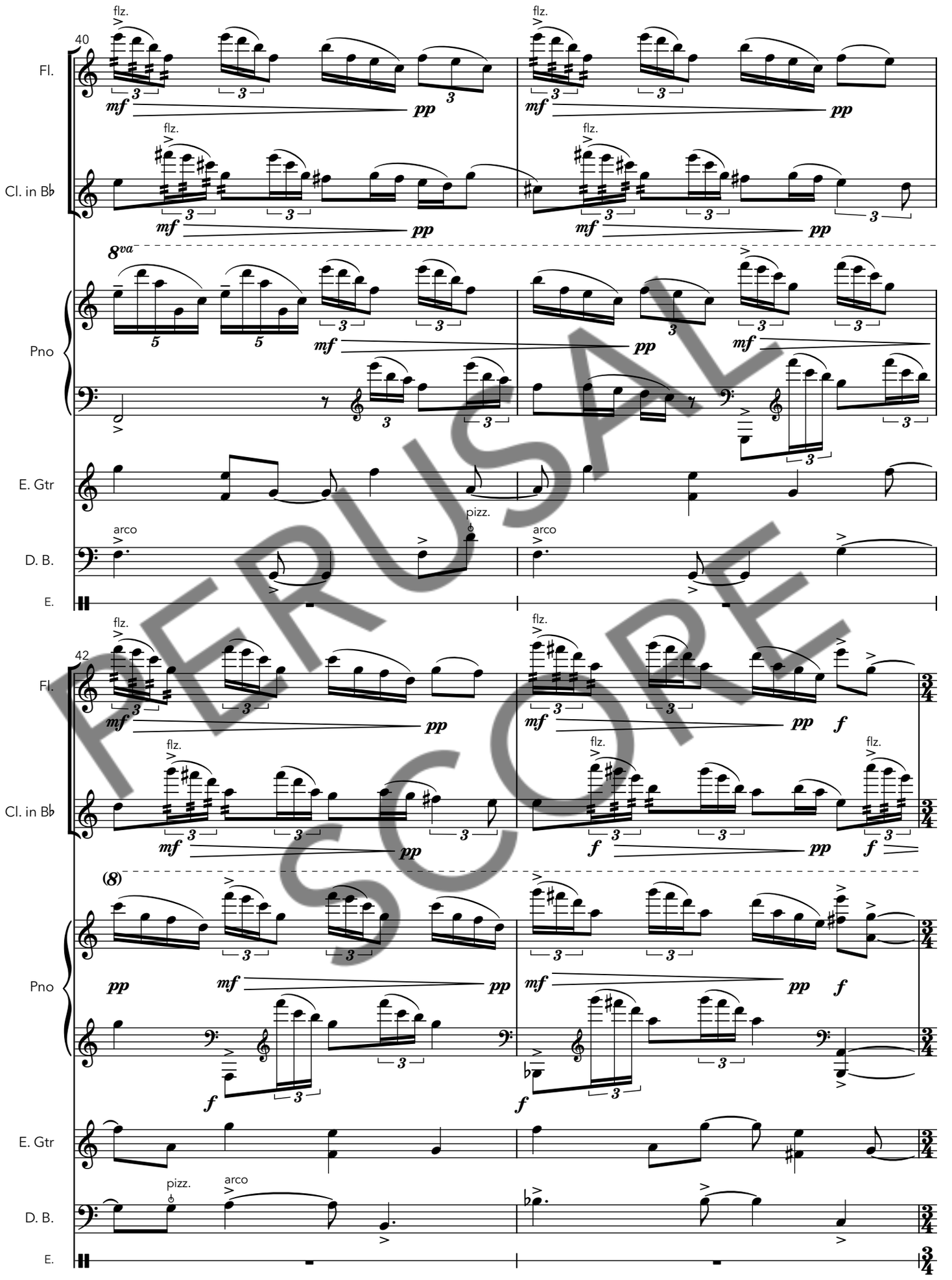


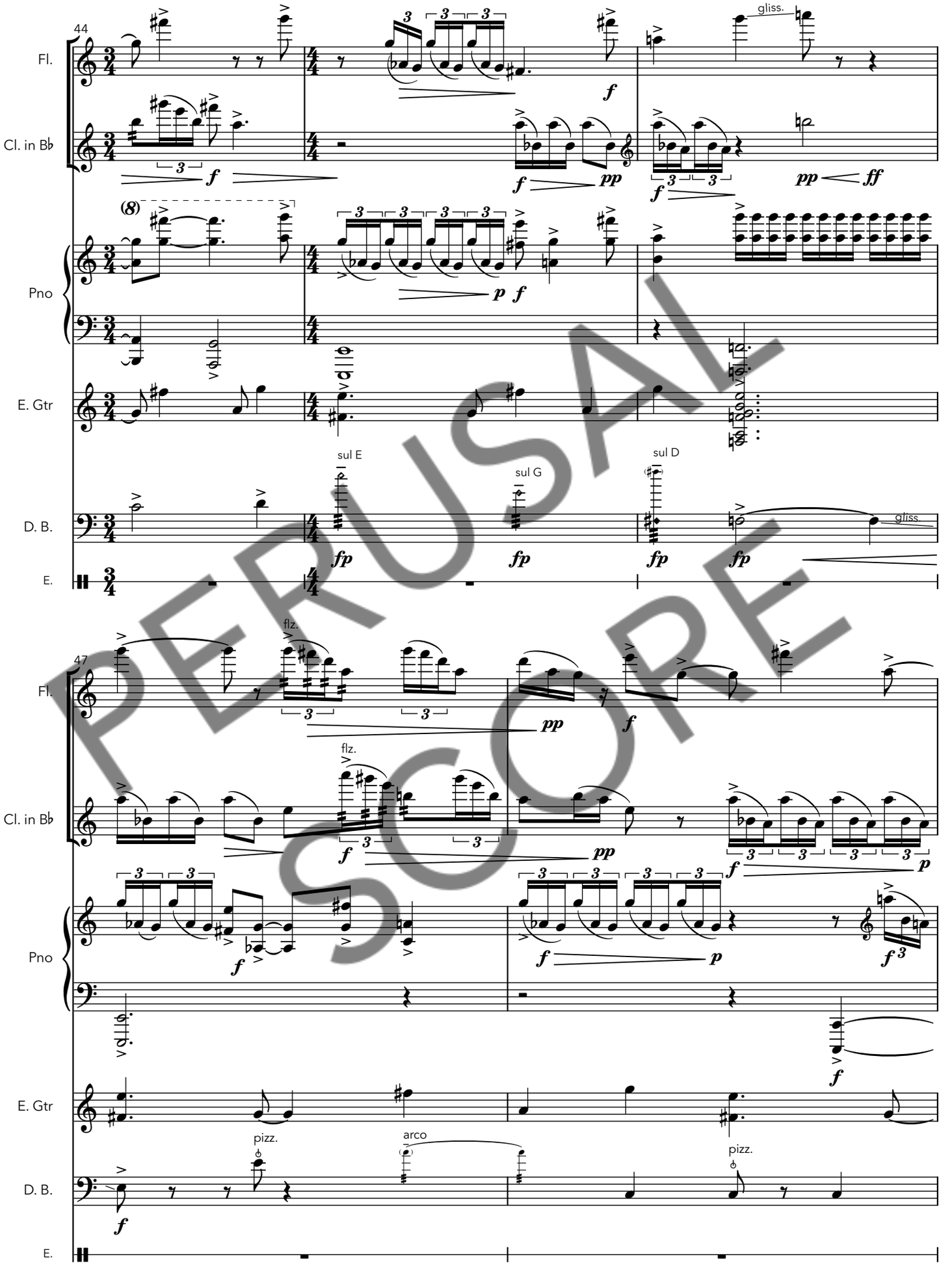


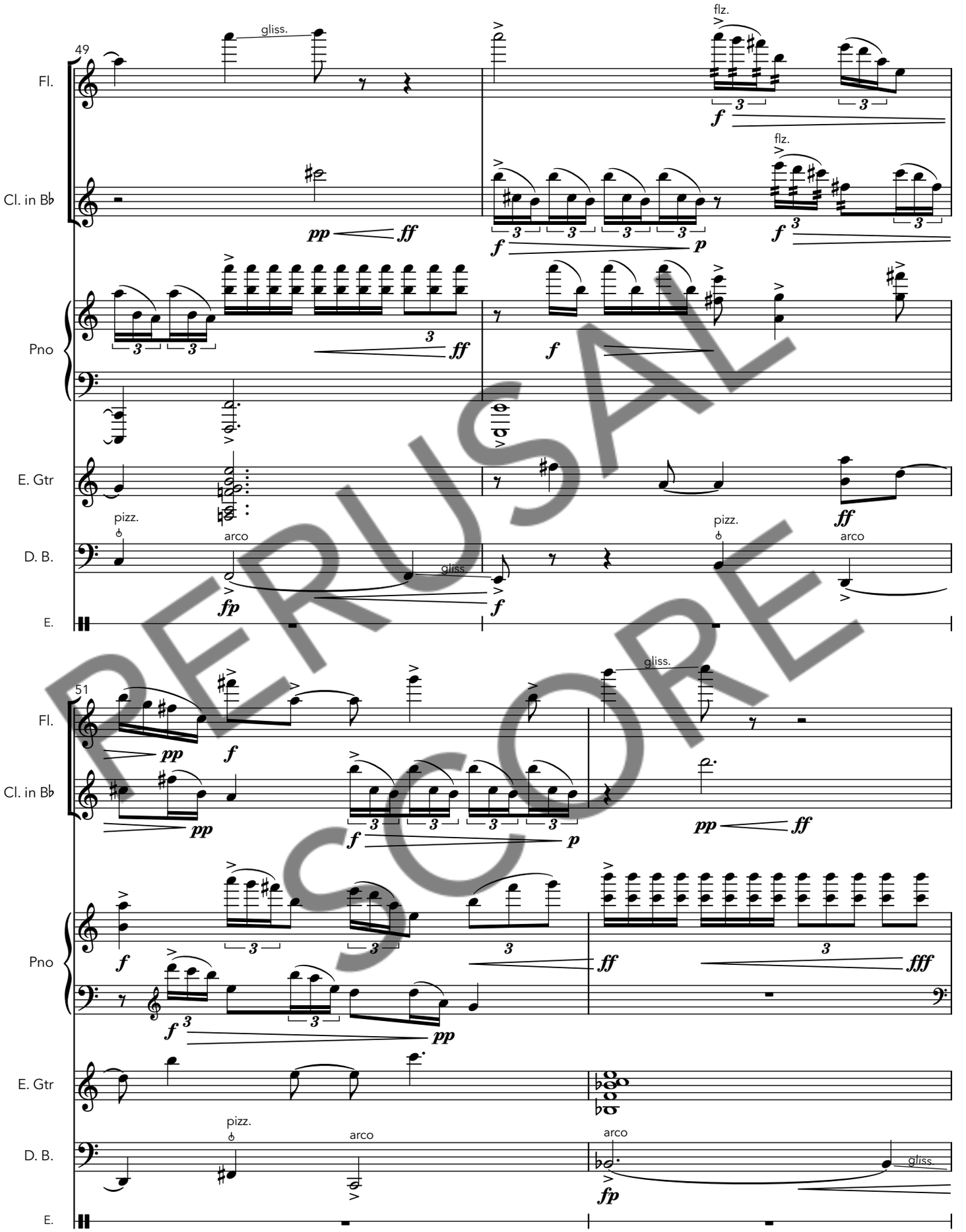


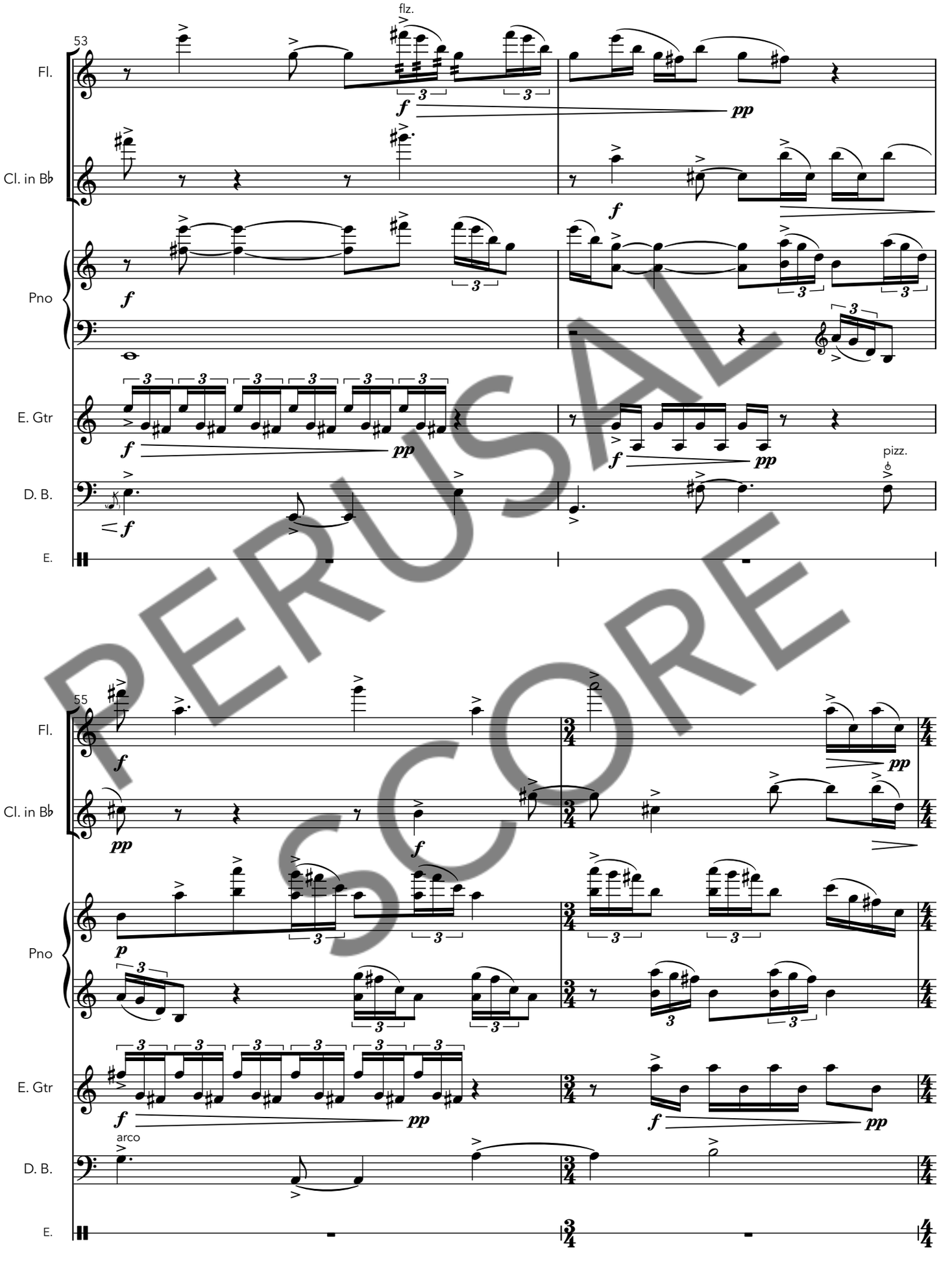


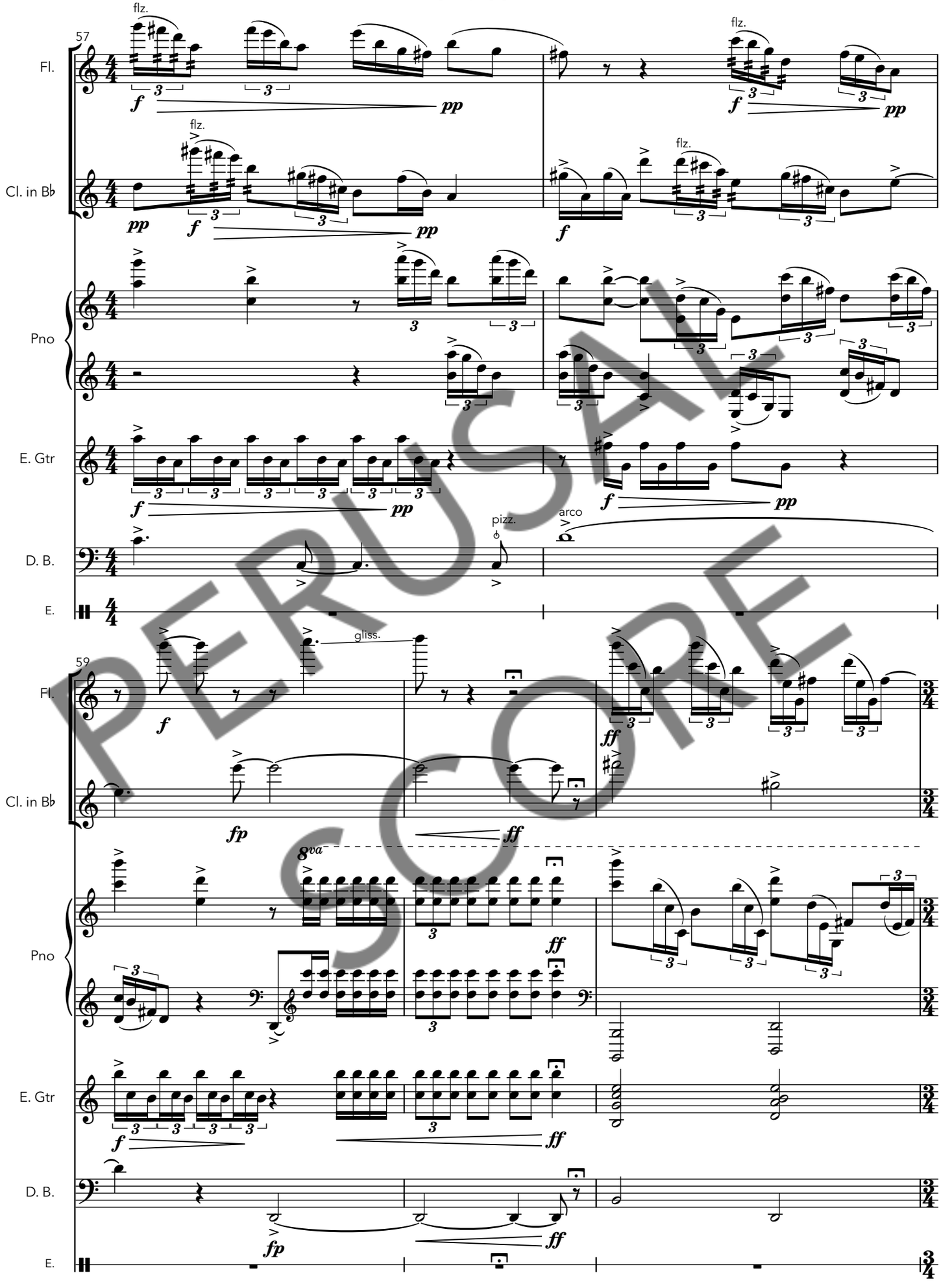


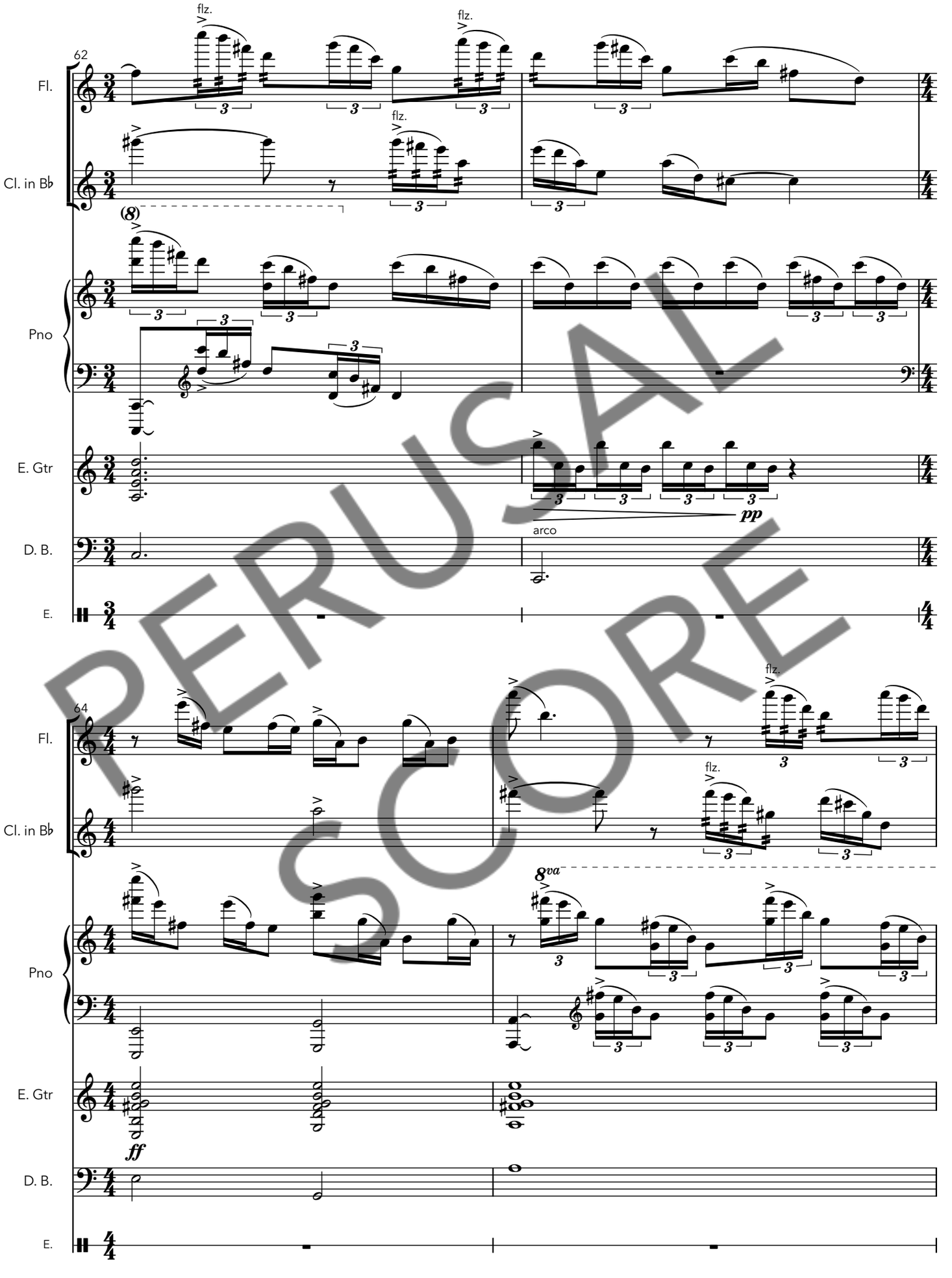


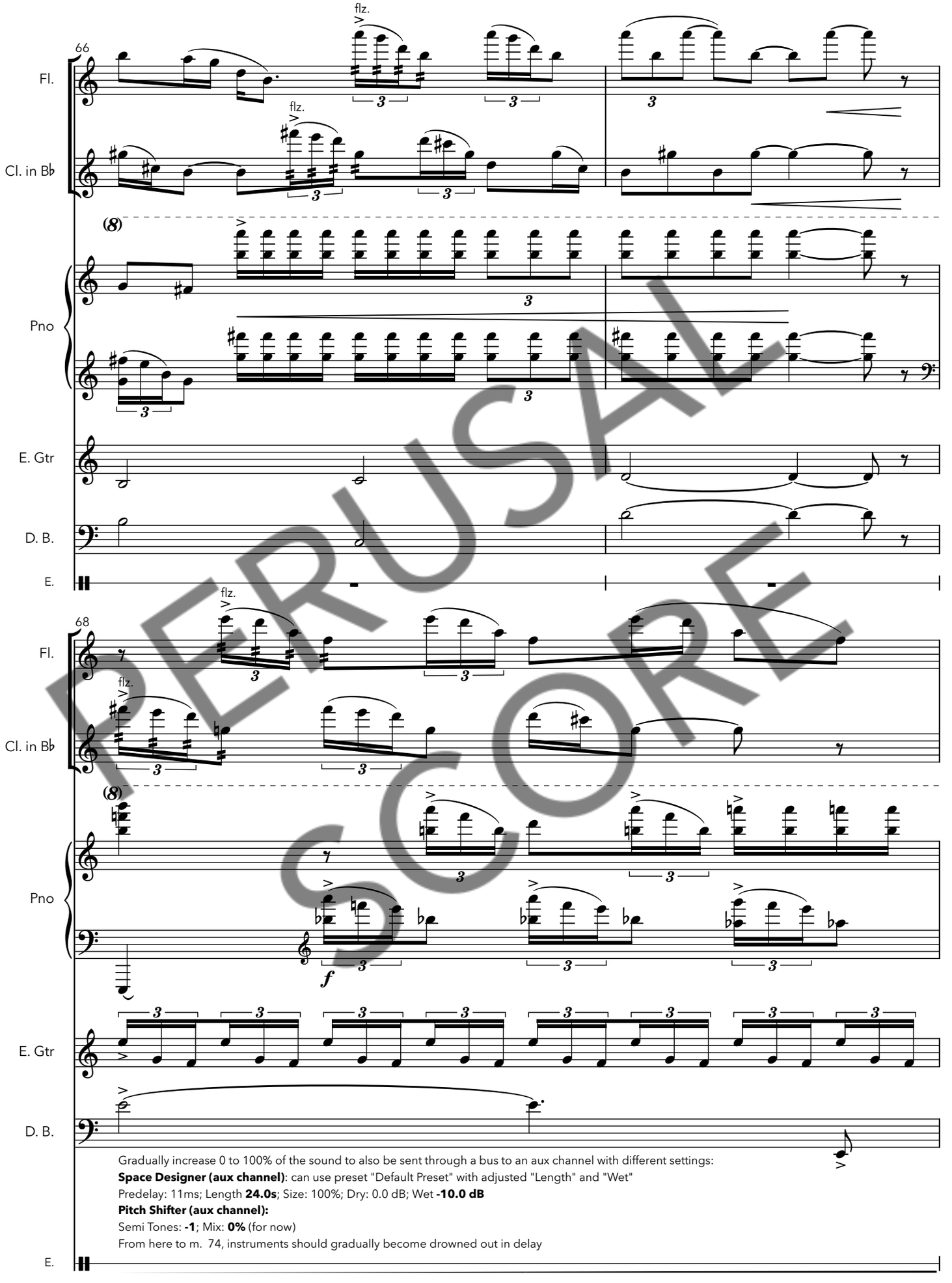












Gradually increase 0 to 100% of the sound to also be sent through a bus to an aux channel with different settings:
Space Designer (aux channel): can use preset "Default Preset" with adjusted "Length" and "Wet"
Predelay: 11ms; Length **24.0s**; Size: 100%; Dry: 0.0 dB; Wet **-10.0 dB**
Pitch Shifter (aux channel):
Semi Tones: **-1**; Mix: **0%** (for now)
From here to m. 74, instruments should gradually become drowned out in delay