a Cross Curriculum Journey of the James Webb Telescope for Concert Band

### Joni Greene

Carina Nebula Jets (NIRCam Narrowband Filters Compass Image), https://webbtelescope.org/contents/media/ images/2022/057/01GKMKC1AF19PVC0X5JF6BH5X0

## SUSPENDED IN A SUNBEAM

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Rentication of the second seco

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#### INSTRUMENTATION

Piccolo Flute 1 Flute 2 Oboe Bb Clarinet 1 Bb Clarinet 2 **Bb** Clarinet 3 **B**<sup>b</sup> Bass Clarinet Bassoon Eb Alto Saxophone 1 Eb Alto Saxophone 2 J.C **B**<sup>b</sup> Tenor Saxophone Eb Baritone Saxophone Bb Trumpet 1 Bb Trumpet 2 F Horn 1/3 F Horn 2/4 Trombone 1 Trombone 2 **Bass Trombone** Euphonium Tuba Piano Timpani Percussion 1 Percussion 5 Paper Bag (paper grocery size) Bass Drum (can share with Percussion 6) Claves Metal Pipes (4) optional Crotales (C5-C6) with bow (bow can share with Percussion 3) High Suspended Cymbal Splash Cymbal Large Suspended Cymbal

> Percussion 2 Glockenspiel

#### Percussion 6

Bass Drumhead Large Suspended Cymbal Cabasa (can share with Percussion 4) Crotales (C4-C5) *with bow* Chimes Toms (4) Bongos (2) Bass Drum (can share with Percussion 5)

Percussion 3

Paper Bag (paper grocery size) Vibraphone *with bow* (bow can share with Percussion 1)

#### Percussion 4

Paper Bag (paper grocery size) Tam-tam Marimba Cabasa (can share with Percussion 6) Xylophone

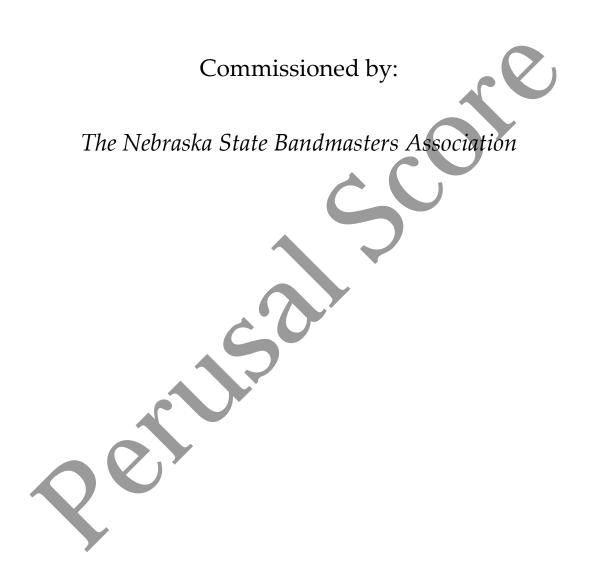
\*One Programmatic Events handout is provided to each section. Additional copies will be available on www.jonigreene.com in December.

Grade 4

Duration = ca 8.30''



ColorWorks Press 166 Diamond Wood Ct. Driftwood, Texas 78619 www.jonigreene.com E-mail: jonigreene@gmail.com Rentication of the second seco



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For Dad, who taught me to be curious and to love the cosmos

"Exploration is in our nature. We began as wanderers, and we are wanderers still. We have lingered long enough on the shores of the cosmic ocean. We are ready at last to set sail for the stars."

– Carl Sagan (Cosmos)

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#### **Cross Curriculum Program and Performance Notes**

Slide show of events for performance available upon request

#### Suspended in a Sunbeam Events

An integrated work of music, astrophysics, and cosmology

"The James Webb Space Telescope will be the premier observatory (telescope) of the next decade, serving thousands of astronomers worldwide. It will study every phase in the history of our Universe, ranging from the first luminous glows after the Big Bang, to the formation of solar systems capable of supporting life on planets like Earth, to the evolution of our own Solar System."\*

#### Leaving the Pale Blue

"Look again at that dot. That's here. That's home. That's us." (Carl Sagan, Pale Blue Dot)

#### 1) The Science:

James Webb Space Telescope (JWST) launch date: December 25, 2021 at Arianespace's ELA-3 launch complex at Europe's Spaceport located near Kourou, French Guiana.

Begin Thrust: Rocket engines begin adding thrust, a mechanical force that pushes the rocket upward once it is greater than the force of gravity.

#### Musical Interpretation:

The intensity of thrust is created with rumbling bass drums and timpani while the build to liftoff accumulates in a textural crescendo (adding of instruments and increased dynamics). Claves begin the ten-second countdown to liftoff in measure 13.

#### 2 The Science:

Liftoff! After liftoff, the rocket provides thrust for approximately 26 minutes allowing the JWST to leave the surface of the Earth. JWST is released from Ariane 5 and is flying on its own.

#### Musical Interpretation:

Bursts of ascending lines culminate with the presentation of the first motive, which will later be featured in the "Lava Planet" section. Immediately following liftoff, floating harmonies illustrate the separation of JWST from the Ariane 5 rocket.

**Deployment Sequence Begins** 

#### (3) The Science:

Escape Velocity (the speed the rocket needs to achieve to leave Earth's atmosphere) reached! 33 *minutes after liftoff*: Solar Array deployed which is made up of five panels that convert sunlight into electricity. These panels will provide enough power for JSWT to make it to its final destination, the Legrange 2 point – 1 million miles from Earth!

#### Musical Interpretation:

JWST begins a lengthy process of unfolding from its packaged rocket formation. A minimalist section begins with changes representing the deployment of different parts of the telescope.

Copper and aluminum pipes are used to create a metallic effect indicative of the mechanical structure of the JWST.

#### (4) The Science:

*1 day:* The Gimbaled Antenna Assembly (GAA) rotates to point back to Earth allowing a path of communication between the telescope and ground control.

#### 5 The Science:

*3 to 4 days:* Sunshields are deployed. They are comprised of five panels made of shiny silver material called Kapton that protect the observatory (telescope side of the JWST) from the extreme heat of the sun. The sunshield spans the width of a tennis court in a kite-like formation. It separates the observatory into a warm, sun facing side withstanding 230° F allowing the telescope side to remain under -370° F.

#### *Musical Interpretation:*

I imagine the sunshield pushing out like a butterfly from a chrysalis, creating the wings of this enchanting observatory. The first melodic motive soars in the woodwinds and horns.

#### 6 The Science:

*11 days:* The secondary mirror emerges. It plays an important role in reflecting the light from the primary mirror. JWST has three mirrors that work together to detect infrared light, the only form of light that can break through the debris of space. Unlike the Hubble Telescope, which could only detect near-ultraviolet, visible, and near-infrared light, the JWST detects infrared light creating the potential to see the edge of the known universe.

#### 7) The Science:

*13 days:* Primary mirror segments begin deployment. \*"One of the JWST's science goals is to look back through time to when galaxies were young. JWST will do this by observing galaxies that are very distant, at over 13 billion light years away from us. To see such far-off and faint objects, JWST needs a large mirror. A telescope's sensitivity, or how much detail it can see, is directly related to the size of the mirror area that collects light from the objects being observed." There are 18 gold hexagonal mirror segments that were engineered to collapse into the space of the rocket. Each segment measures 4.3 feet for a total span of 21 feet and 4 inches.

#### (8) The Science:

*13 days*: JWST is fully deployed, but still has another 2 weeks until it reaches its destination at the Legrange 2 (L2) point.

*15-24 days:* Mirror adjustments begin from ground control. It will take 3 months until the 18 segments form one perfect mirror.

*9 The Science*:

*30 days*: JWST arrives at the Legrange 2 point – 1 million miles from Earth! It will take 5 more months of micro maneuvers to prepare JWST for its next stage, 10-20 years of discovery in the cosmos!

#### The following details have not yet been detected by JWST

Trappist-1h "Ice Planet"

Looking into the "Enveloping Cosmic Dark" (Carl Sagan, The Pale Blue Dot)

**10** The Science:

*6 months to 10 years:* One of the most anticipatory discoveries for the JWST is that of the Trappist-1 System. Trappist-1 is a star 40 light years from Earth and was first discovered in 1999. It is orbited by 7 exoplanets. The farthest planet from Trappist-1 is "h," most likely an ice planet.

Musical Interpretation:

This section features brilliant percussion sounds, particularly crotales, glockenspiel, and piano.

Entering Trappist-1e "Earth Planet"

"That white light is made of colors...

the sky is blue for the same reason that the sunset is red" (Carl Sagan, The Pale Blue Dot)

(1) *The Science*:

Three of the interior planets (e, f, and g) in the Trappist-1 System are in the "habitable zone" meaning they could potentially harbor life. Scientists believe there may be liquid water on the surface conducive to conditions found on Earth.

*Musical Interpretation:* 

This section features terraced harmonies creating the idea of warmth and resonance. The goal is a lush atmosphere that features a few solo voices indicating life.

#### Trappist -1b "Lava Planet"

"Somewhere, something incredible is waiting to be known" (Carl Sagan, The Pale Blue Dot)

(12) The Science:

Planet 1b is closest to Trappist-1, thus making it the hottest planet in the system. Cosmologists have guessed that this planet may be a sphere of lava.

Musical Interpretation:

The work's intensity reaches its highest point in this section. A constant groove begins based on the motive from the "liftoff" section propelling the music to its final and largest climax.

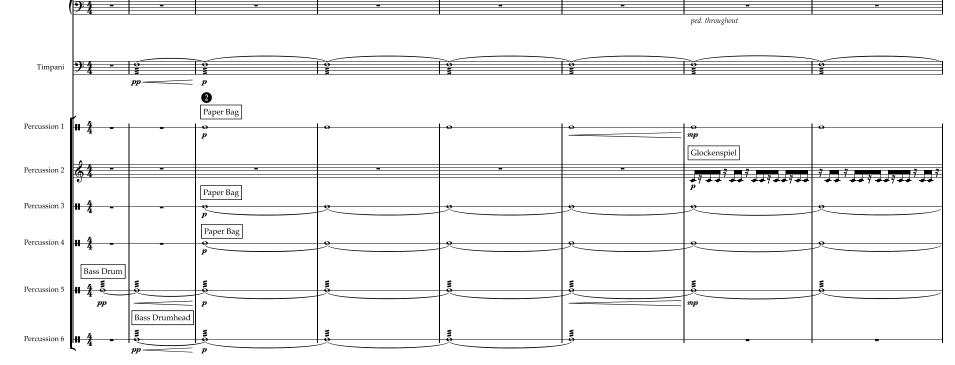


\*Scientific information for this "events page" was largely gathered and paraphrased from jwst.nasa.gov.

#### For Dad and his love of the cosmos

#### **Suspended in a Sunbeam** a Cross Curriculum Journey of the James Webb Telescope

• Leaving The Pale Blue Dot for Concert Band Joni Greene (1)"Look again at that dot. That's here. That's home. That's us." With Anticipation  $\bullet = 120$ 5 4 6 7 64 Piccolo npff ≠≠ ў ≠≠ў≠≠ ŧ Flute 3 4 Flute 2 67 np Oboe 61 \*\*\*\*\* Bb Clarinet 1 6 Bb Clarinet 2 64 Bb Clarinet 3 64 Bb Bass Clarine 64 . p Bassoor 9:4 <del>....</del>f 600 Alto Saxophone 6 i e e e é e e f é Alto Saxophone 2 64 ┍*ᢤ┍╒┊╒╒┊*┍╒<sup>┊</sup>╒╒<sup>┊</sup>╒╒┊╒╒┊╒╒┊┍╒<sup>┊</sup>╒╒┊ • \* • • <del>\*</del> • • <del>\*</del> • • \* • • \* • • \* • • 64 Tenor Saxophon Baritone Say \*\*\*\* 64 Bb Trumpet : Bb Trumpet 2 6 Bb Trumpet 3 6 F Horn 1/3 F Horn 2/4 6 **beee** r r r . . . . . . . . . 111 • • • . . pTrombone 9:4 \*\*\*\*\* 9:4 Trombone 2 Bass Trombone Euphonium 94 ----. . . \* \* \* \* . . . . p Tuba 94 Ð 6 Piano mp



● All quotes by Carl Sagan. "The Pale Blue Dot" is one of his most famous books about our planet.

Use paper grocery bag. Open and close with flat side in one hand and open side in other hand. Repeatedly open and close as fast as possible.

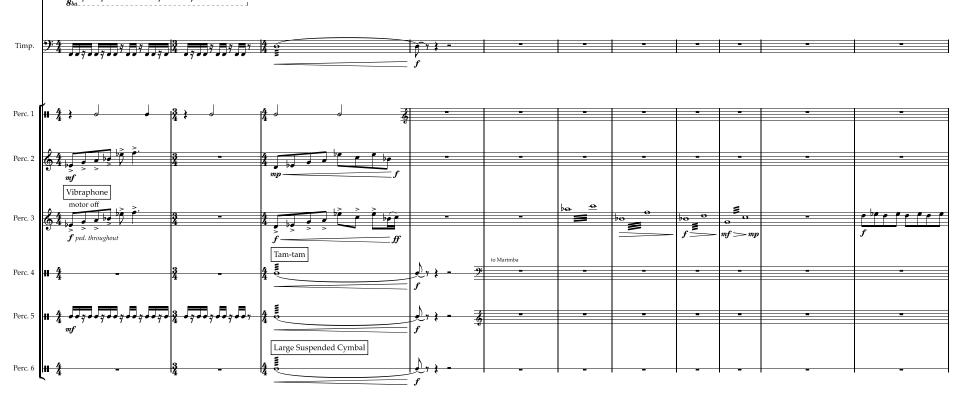
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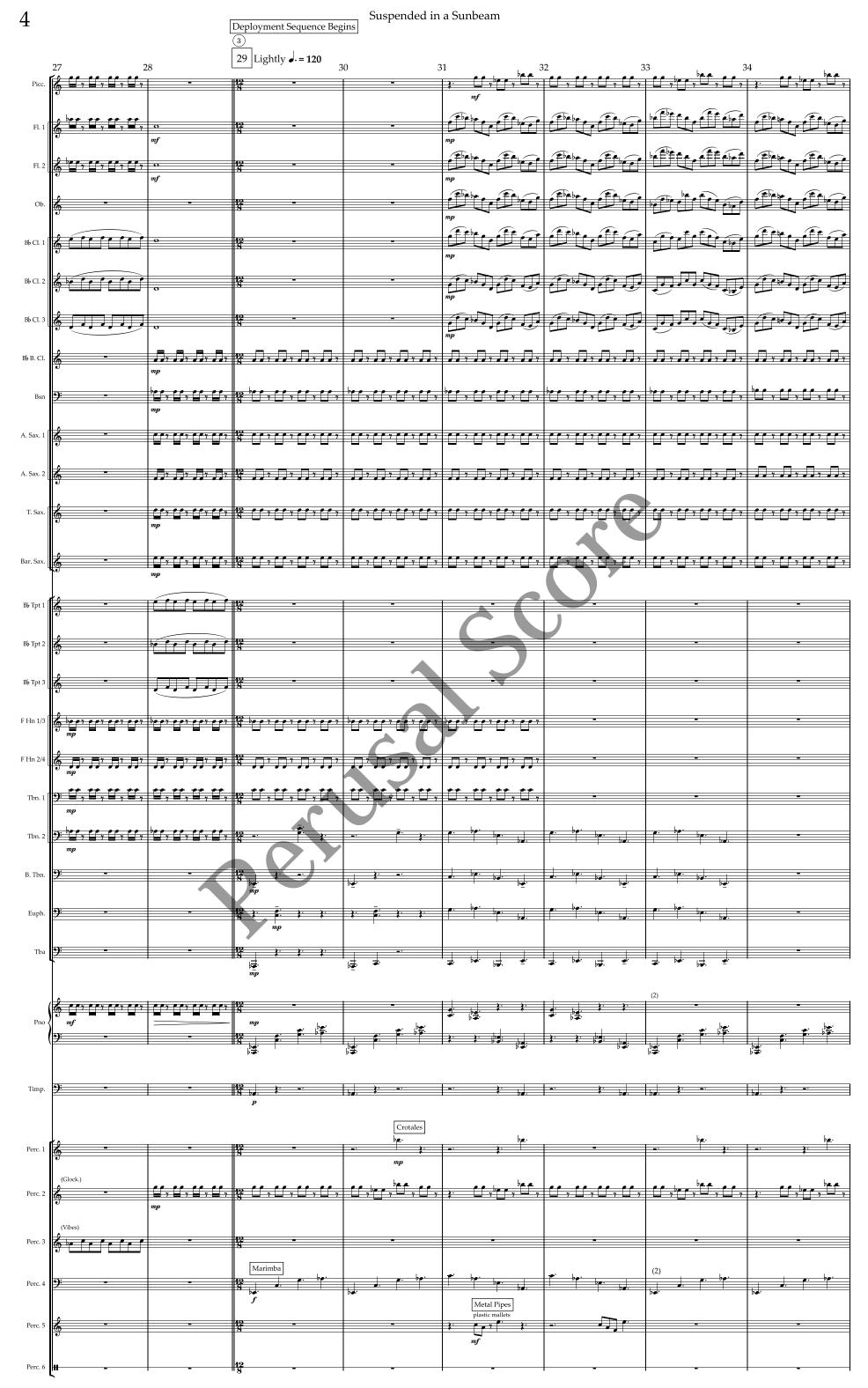
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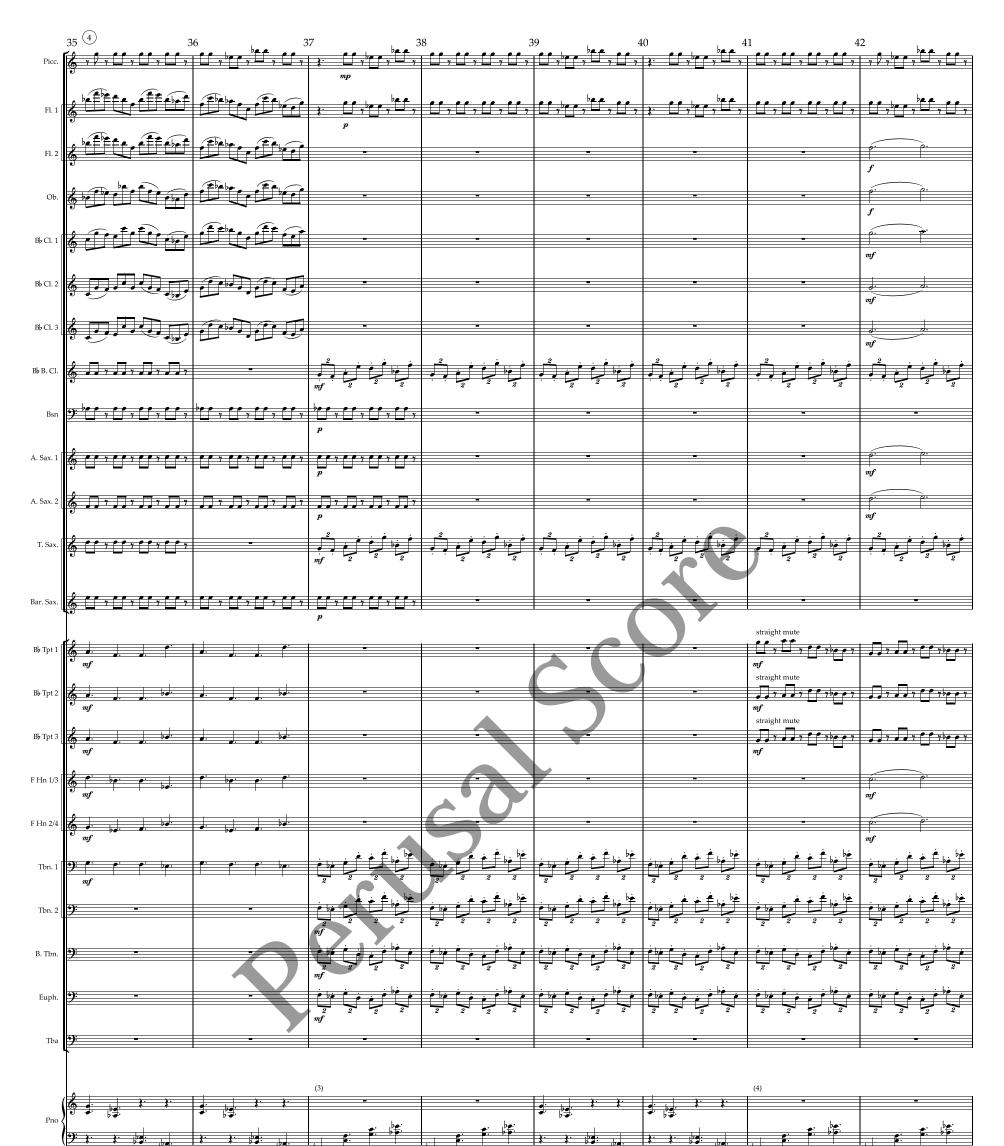


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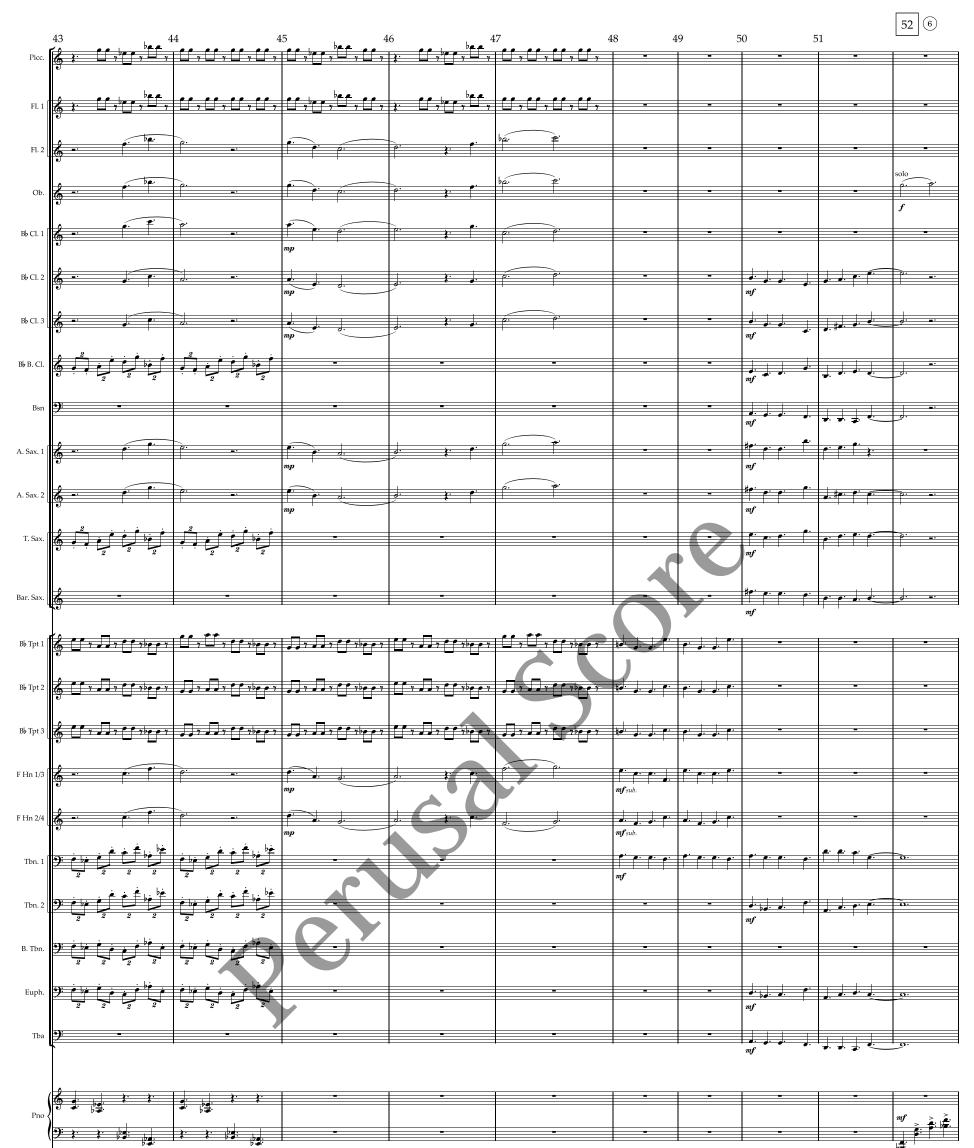
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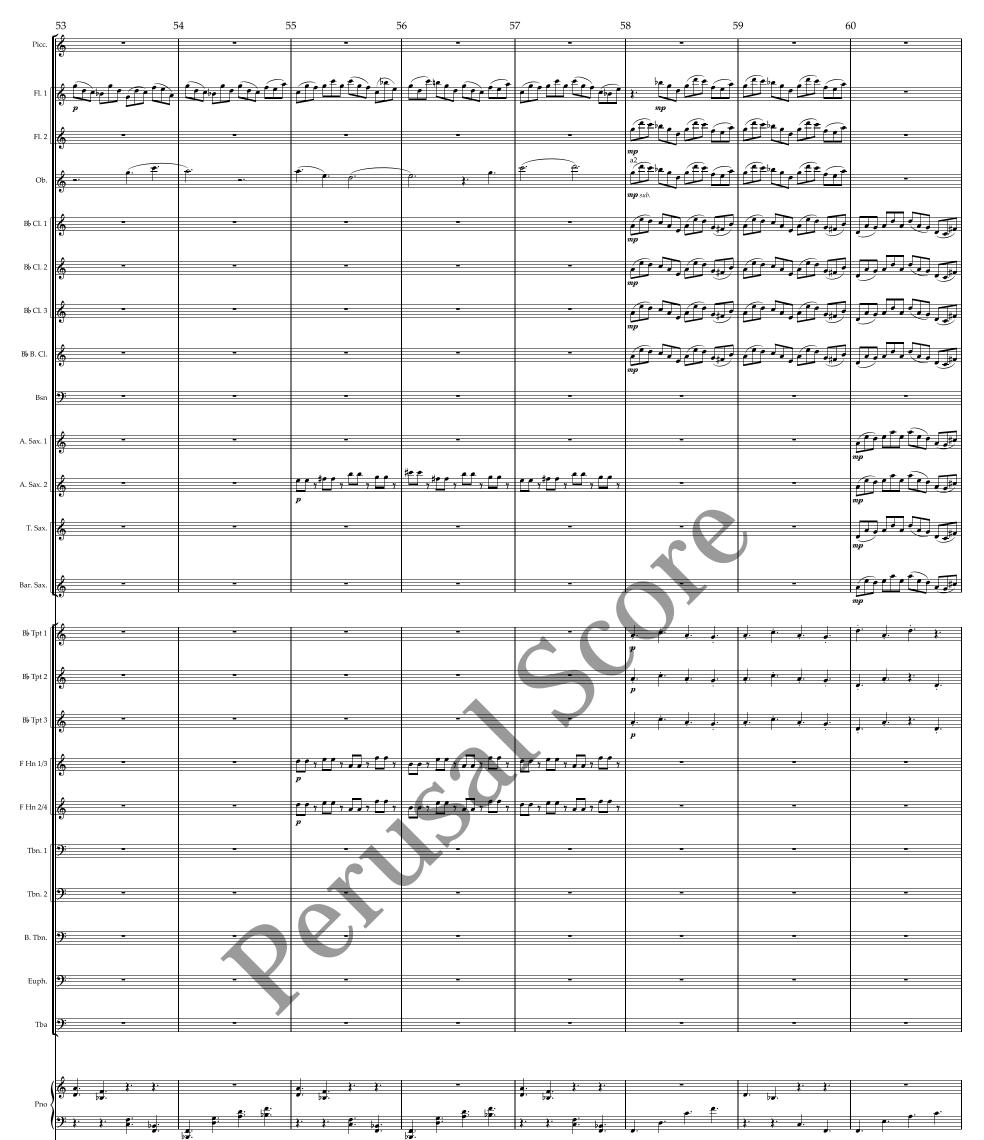






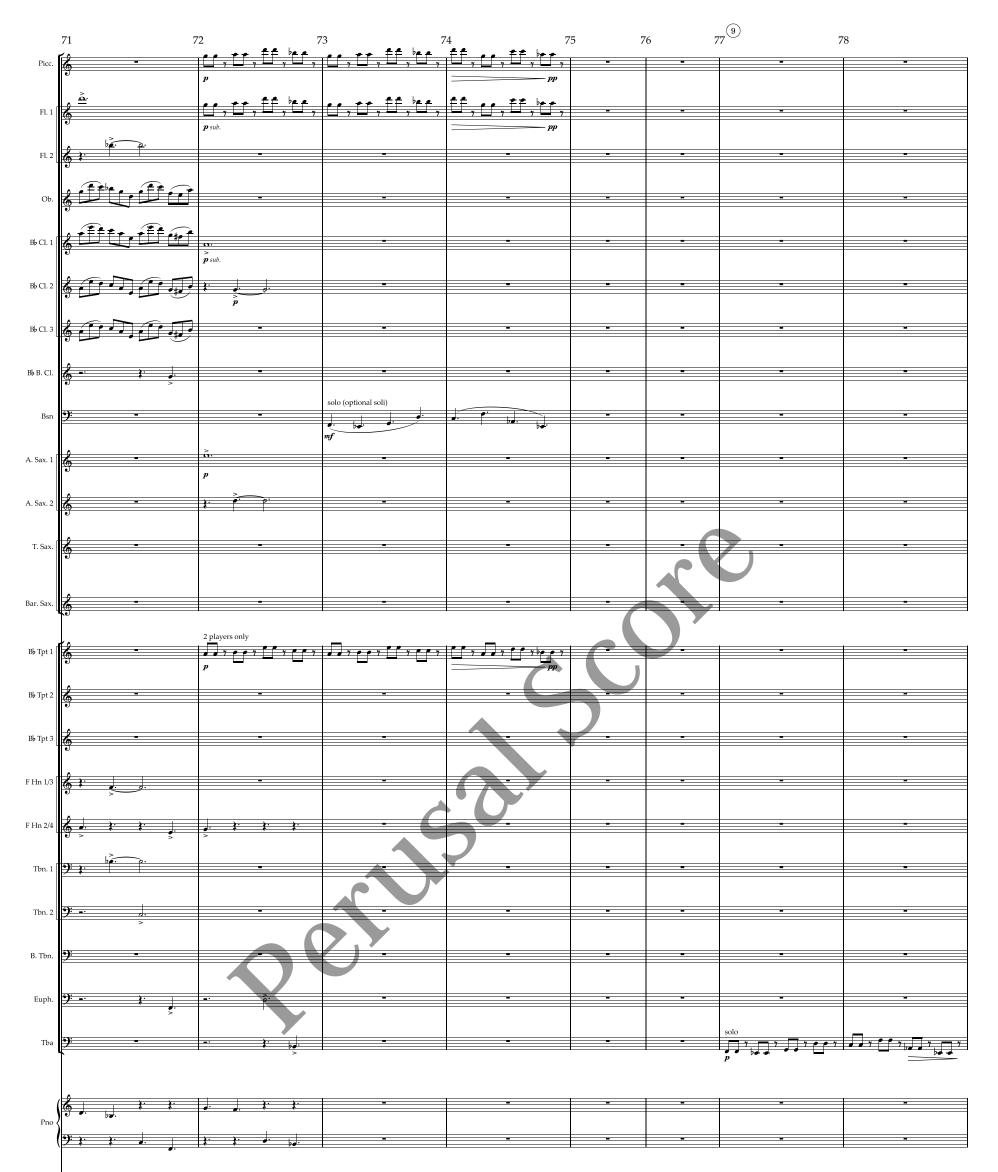


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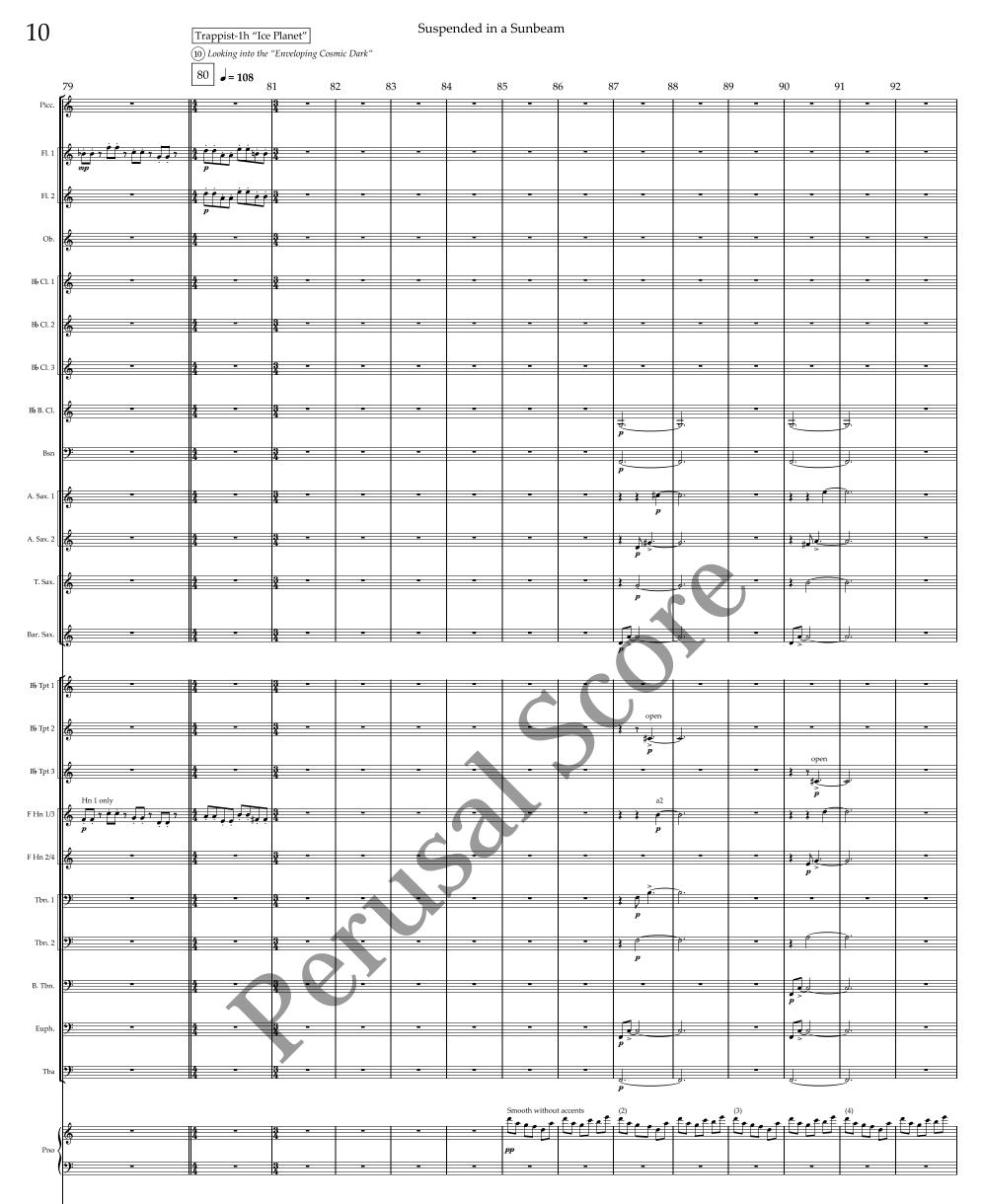




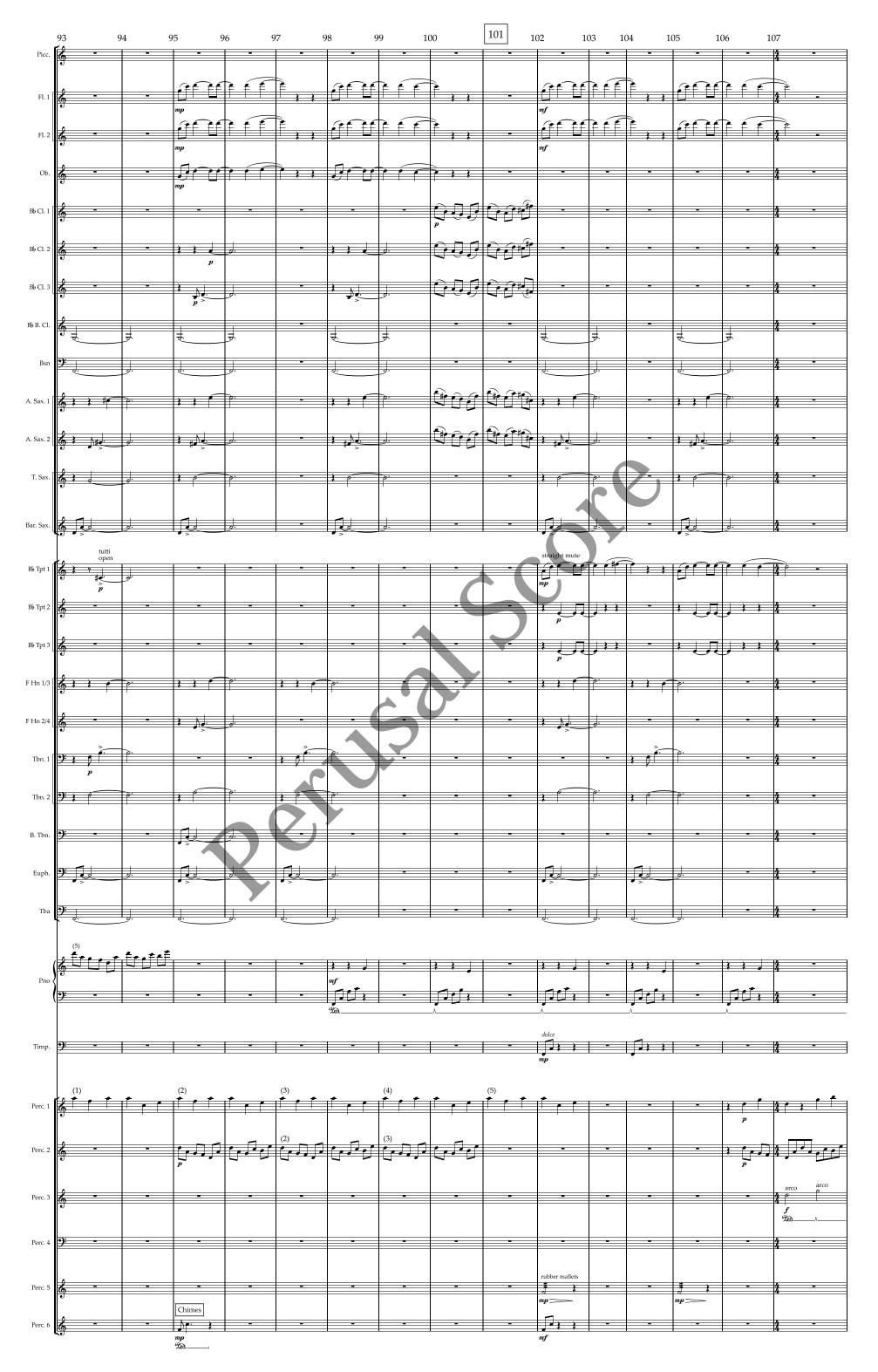






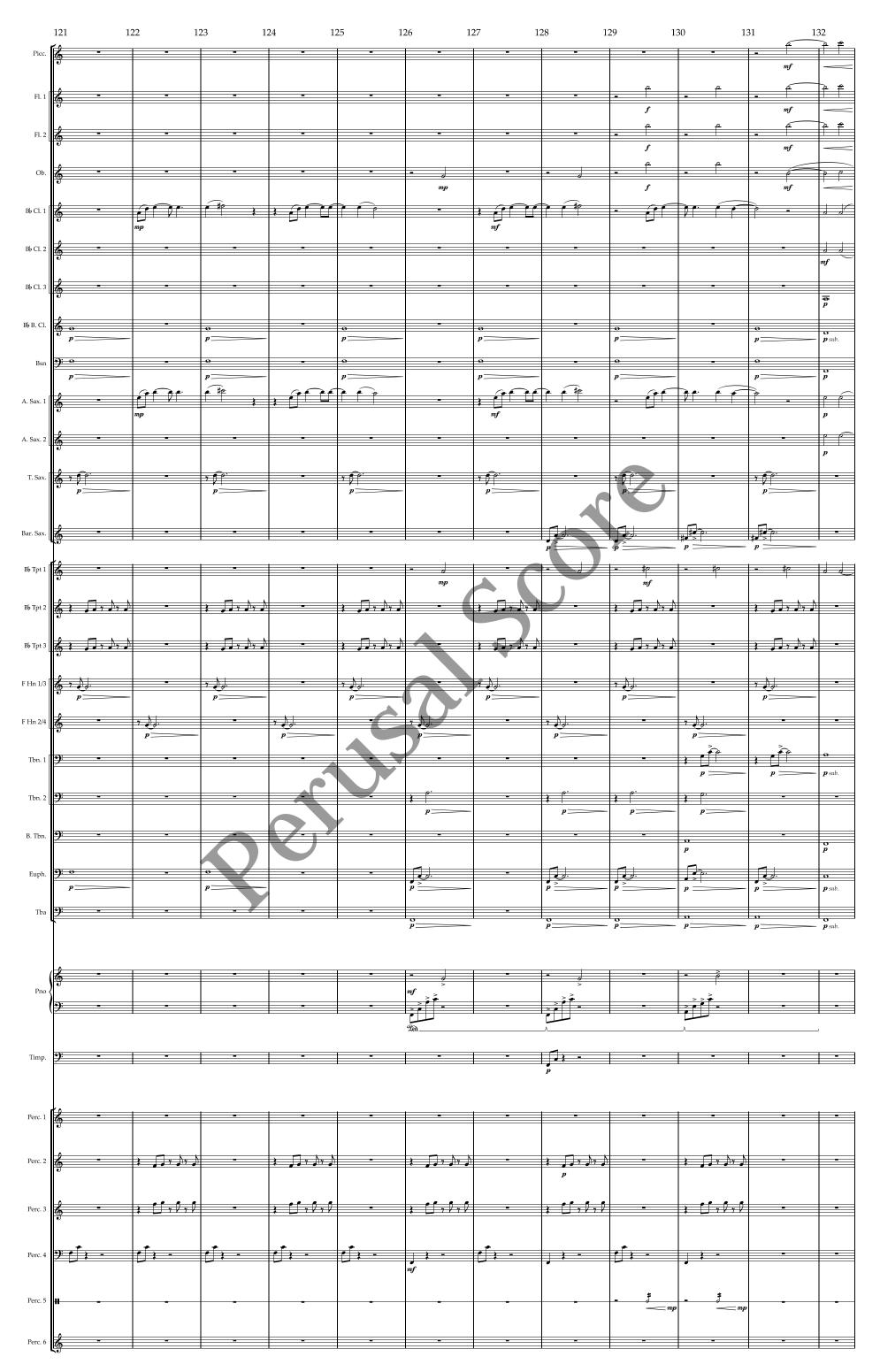


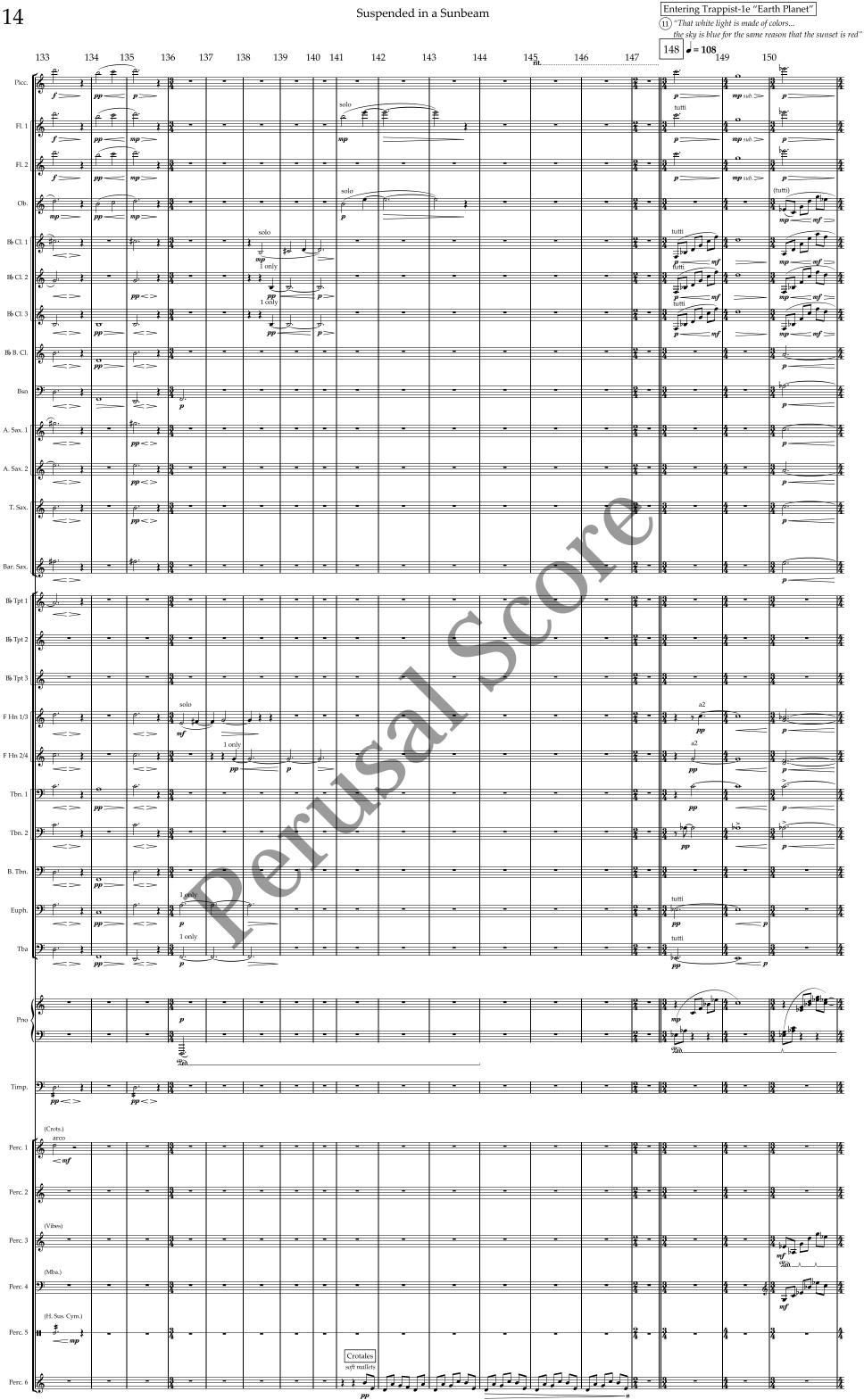




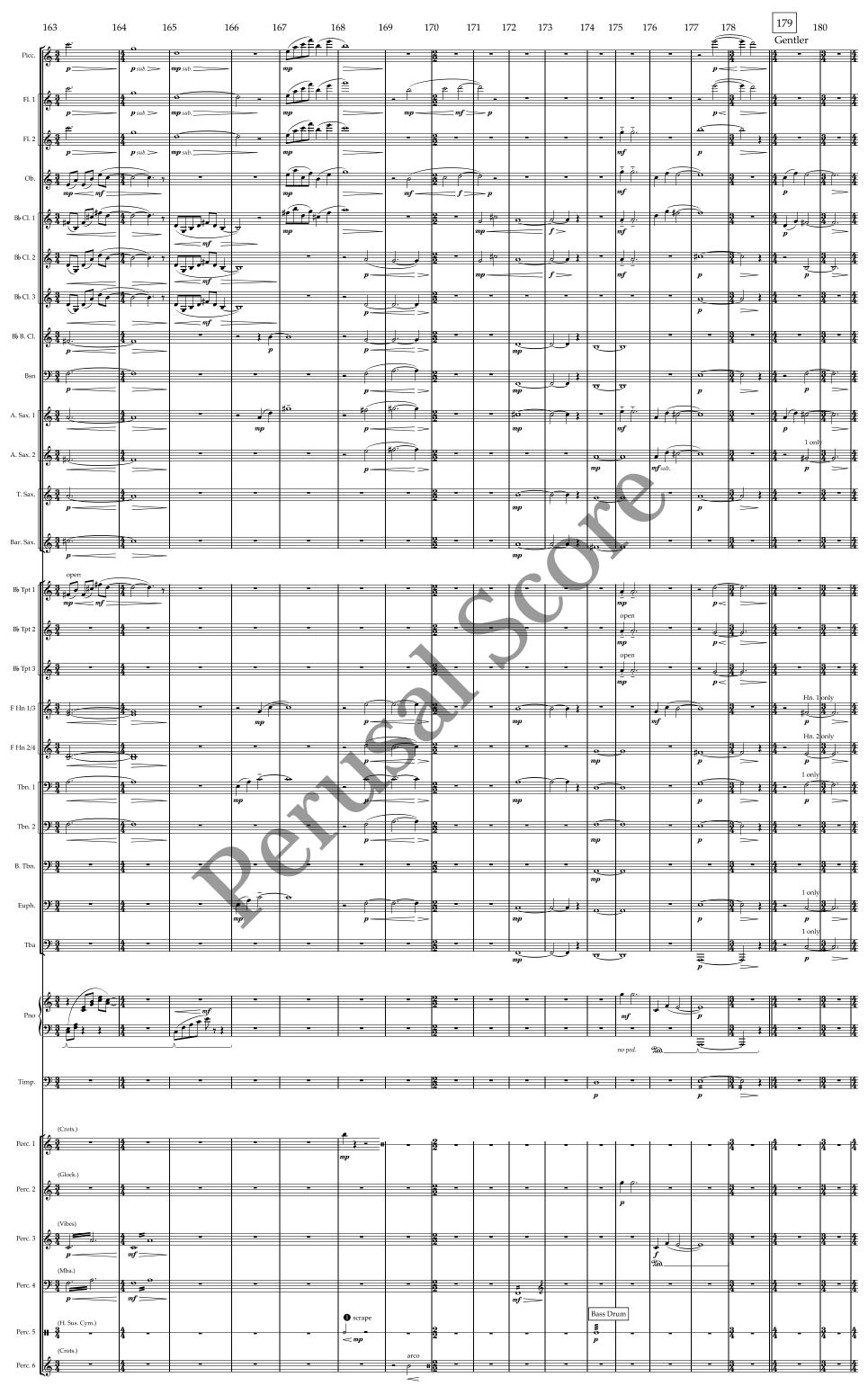


Play pitches in box in a "fluttering" motion at a rapid speed in any order. Only play for one bar.

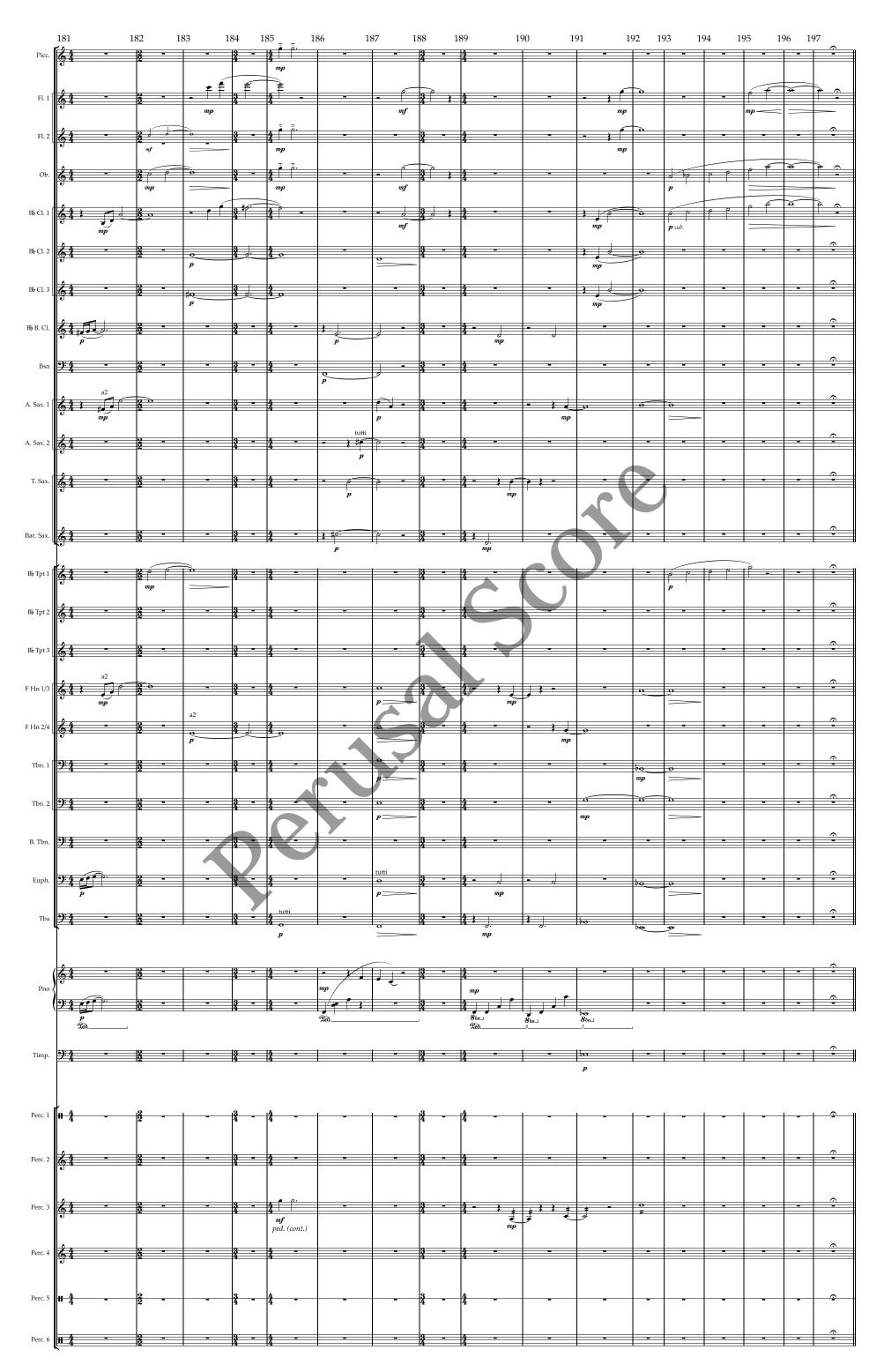


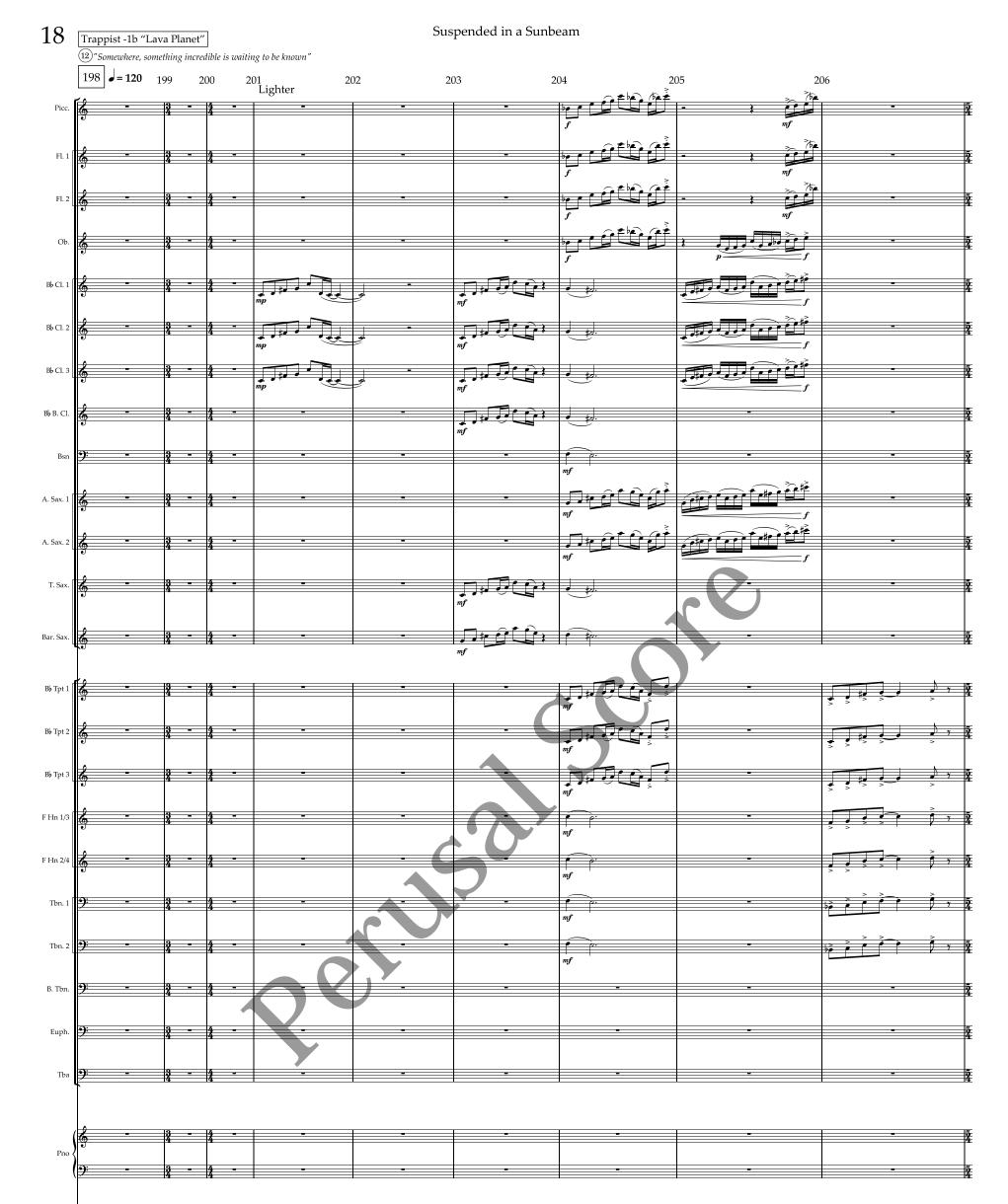






**1** Scrape center of cymbal outwards using triangle mallet.









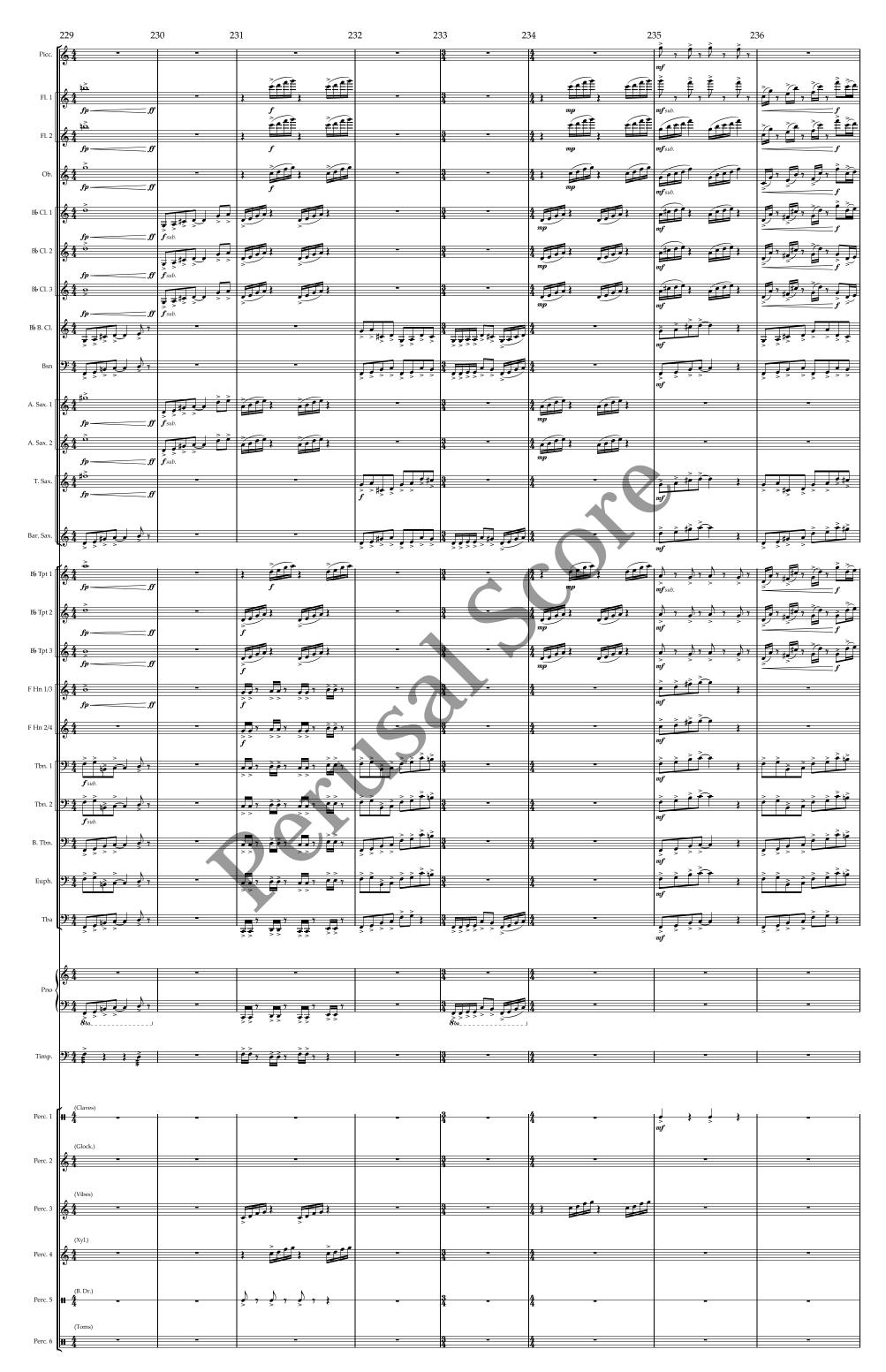
ped. frequently

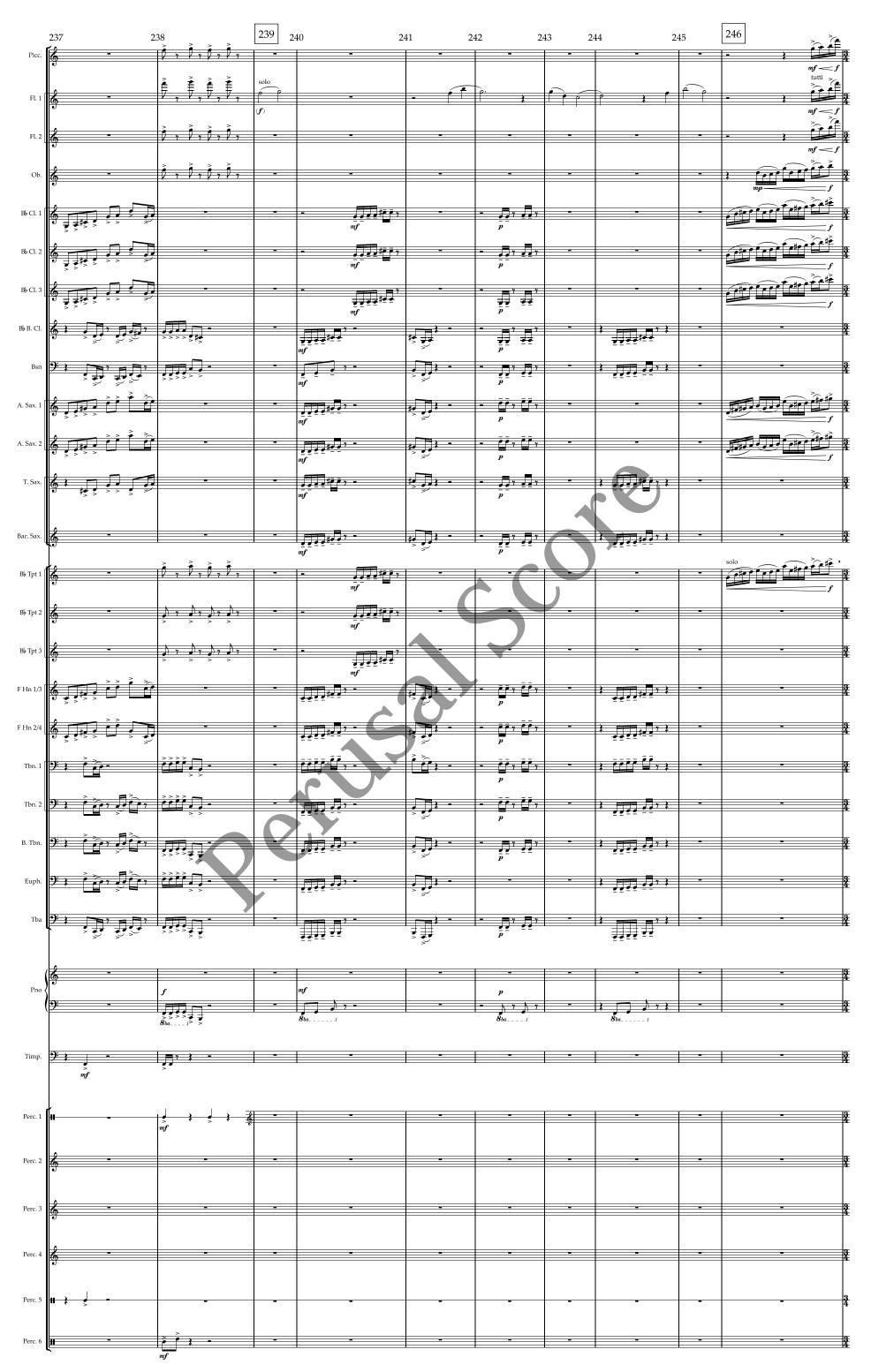




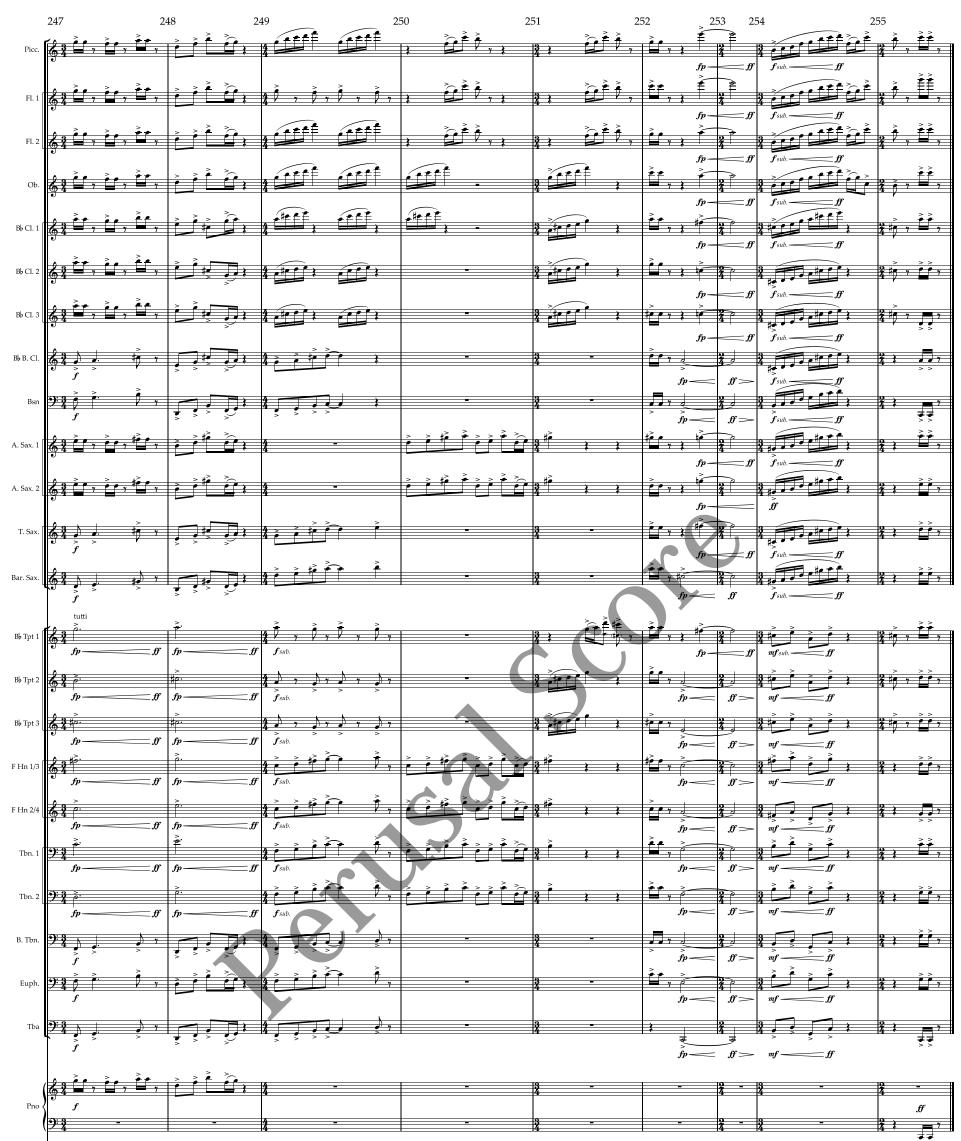








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