

GLAST Prelude for brass quintet, Op.12

A Detailed Discussion by the Composer

(In the form of an interview by NASA Journalist Bill Steigerwald)

Shortly after the completion of the *GLAST Prelude* music video, NASA journalist Bill Steigerwald contacted me with regard to creating a dedicated Web feature on the work (forthcoming soon). To get our conversation started, Bill emailed me a set of questions, which I found quite provocative, and a perfect excuse to go into some detail on the origins and aesthetic, etc. of the composition. This should provide anyone interested with more than enough info on what is behind the *GLAST Prelude*.

STEIGERWALD: How did you interpret the mission and science of GLAST musically?

GASSER: I am a musician and not at all trained in science. In many ways, the GLAST musical project has awakened in me a previously unknown love of science that nowadays borders on obsession. I am constantly reading books, magazines, and web postings on physics, cosmology, and astronomy, and enthralled at how the pieces are slowly coming together in my mind; it's nice to know that at age 43 one can find a whole new "world" to inspire and engage.

This newfound dedication to amateur science began, however, with a much more practical mindset: having received a commission to compose a work for the launch and mission of the GLAST space telescope, I naturally felt obliged to learn something about it. My research included a lot of reading on the topics of GLAST, gamma rays, the electro-magnetic spectrum, particle physics, the history of astronomy and the telescope, etc. This was then richly aided by two special elements: first is the close cooperation and support of Peter Michelson, one of the progenitors of GLAST and the Principal Investigator of the LAT instrument, who initially conceived the idea of celebrating the mission with music; second, was a trip – with Peter and our dear friend Pierre R. Schwob (more on him below) – to the Goddard Space Flight Center. At Goddard I met with Steve Ritz, the GLAST Project Scientist, as well as Neil Gehrels, the GLAST Deputy Scientist, and several members of the Goddard video and animation team, and learned valuable insights on the history, mission, and expectations of GLAST.

Thus armed with ample knowledge and inspiration, I returned home to begin the compositional process. For historical and sonic reasons, the medium of the brass quintet (two trumpets, French horn, tenor trombone, and bass trombone or tuba) was decided upon as an ideal musical consort to celebrate such a noble endeavor as GLAST; thanks to Pierre's connections, we were able to engage the outstanding American Brass Quintet to perform the work – the recording of which would then be used as the basis for a "music video" to be premiered in conjunction with the launch (given the vicissitudes of a launch schedule – something borne out in reality – a live performance was deemed impractical).

My approach to the composition of the *GLAST Prelude*, distinct from many purely instrumental works, was to first conceive a detailed program or "narrative". I knew that I wanted to musically "depict" various aspects of the mission and the science involved in GLAST – both practical and aesthetic – and a finely programmed storyline seemed the best approach. After some consideration, I came up with the following:

Formal Structure of the *GLAST Prelude, for brass quintet, Op.12*

- I. An opening “fanfare” celebrating, in general terms, the overall mission of GLAST.
- II. The preparation for launch, as GLAST is readied upon the Delta II rocket, and countdown is begun on the launch pad at Cape Canaveral.
- III. An interruption – in the midst of the countdown – as if entering a “dream sequence” (*in media res*) in order to answer the question “How did we get here?” before launch can proceed.
- IV. A GLAST Dream Sequence – in 5 Parts
 - a. Part I: A Brief History of Astronomy – one that permits the eventual launch of GLAST: from an early Geo-centric orientation through the Copernican and Galilean revolutions, and on through the later advancements in science, astronomy, and physics that leads us to the present day.
 - b. Part II: A Brief Tour of the Electro-Magnetic Spectrum – a temporal, pitch, and intensity progression from the lowest (radio) through the highest (gamma ray) parts of the EM spectrum – culminating in an actual gamma-ray burst.
 - c. Part III: A GLAST Interlude – a musical “portrait” of GLAST, conducting its mission in the beauty of its earthly orbit – which then leads to:
 - d. Part IV: The Instruments: a musical “depiction” of the two instruments aboard GLAST, the LAT (Large Area Telescope) and the GBM (Gamma Burst Monitor) and a bit of the science involved therein.
 - e. Part V: A Celebration of the Multi-National Cooperation of GLAST – a musical acknowledgement of five nations involved in bringing GLAST to life: the US, France, Germany, Italy, Japan, and Sweden.
- V. A return to the launch pad, and a resumption of the countdown.
- VI. Lift-off and the ascent of GLAST aboard the Delta II – through the atmosphere and its push into orbit, the opening of its solar panels, and the beginning of its work as NASA’s latest and greatest space telescope.

To at last get to your question, here is how I musically interpreted at least a few aspects of the GLAST mission and science – as unveiled via my musical narrative:

Dream Sequence, Part I: A Brief History of Astronomy: to depict a Geo-centric orientation, I identified the Earth with the French Horn, at the center of the tonal range of the quintet; after a meandering solo cadenza (suggesting the wandering notion of Earth’s identity in the consciousness of early man), the Earth-Horn settles to a single tone (d), which it repeats in a static, pulse-like manner – suggesting an unmoving center. “Circling” around the Earth-Horn are two pairs of instruments (Trumpet 1 and Trombone; Trumpet 2 and Bass Trombone) moving in parallel invertible counterpoint, equidistant from the Horn’s central pitch – to suggest the uniform rotation of the heavenly bodies around the Earth. At a certain point, however, the precise symmetry of the invertible counterpoint pairs is broken – suggesting cracks in the Geo-centric framework ushered in by Copernicus; as the counterpoint becomes even less stable, the Earth-Horn loses its bearing and moves away from its static pitch, winding sinuously toward the note f (a 3rd from the former center d). This coincides with a musical nod to the early Baroque composer Giovanni Gabrieli – a contemporary of Galileo (whose father Vincenzo, incidentally, was a prominent composer in Florence); the musical acknowledgement is stylistic only, as no actual quotation is made. While beginning in a rather strict early-Baroque style, the music gradually becomes more chromatic and “modern” – suggesting a chronological progression from the early 17th through the 20th centuries, and the chief scientists who figure in that history: Newton, Hubble, Haley, Einstein, Fermi (the likely future dedicatee of GLAST), etc.

Dream Sequence Part II: A Brief Tour of the Electro-Magnetic Spectrum: to effect both the identity and the progression of the EM spectrum from radio to gamma rays, my solution was to divide the quintet into two parts – the two lowest instruments (a tenor and bass trombone in this recording) constitute the actual and steadily-changing EM waves, effected by a constant flow of low glissandi in contrary (or mirror) motion— much as electric and magnetic waves are themselves mirrors of one another; the upper instruments, then, are free to impressionistically “depict” various images and manifestations of the varying spectrum types, in my mind both the telescopes that search the skies at these wavelengths and the beautiful cosmic images they reveal.

One obvious challenge was how precisely to musically effect the change from radio to microwave, from microwave to infrared, etc. My solution was first to carefully map out the progression of the wavelengths as a sequence of mirror-gliss patterns in ever-decreasing note values – creating the effect of gradually but continually speeding up. The result is not only that the speed of the mirror-gliss increases through the course of the spectrum but also that the length of time dedicated to each wave type decreases through the spectrum: for example, the radio waves are represented by mirror-glisses of whole notes and dotted-half notes tied to eights and endure for 30 beats, whereas the X-rays are represented by mirror-glisses of sixteenth notes and endure for only 8 beats, etc.

Similarly, the upper horns gradually progress from low pitches (at the bottom of the trumpet and horn ranges) and relatively slow note-values to very high notes (at the top of these ranges) in fast and ever-more frenetic rhythms – though unlike the trombones, they are not bound to any particular notes or note patterns. This allowed me to write more aesthetic-oriented passages, and periodically to create specific “tone-painting” effects – such as during the microwave section, where the three instruments exchange similar but slightly varied iterations of a single melodic figure, representing the slight temperature variations in the Cosmic Microwave Background, as revealed in images from the COBE and WMAP telescopes. Again, as the trombones intensify toward the x-ray and gamma-ray portions of the spectrum, the upper horns become increasingly intense – higher and faster - in their utterances, leading to a chaotic flurry that culminates in a fiery chord in all voices – a gamma-ray burst!

Dream Sequence, Part IV: The Instruments: perhaps the greatest challenge was devising a manner to musically “depict” the two main instruments aboard GLAST, the Large Area Telescope (LAT) and the Gamma Burst Monitor (GBM). Beyond reading numerous articles and web postings, whereby I was able to gain at least a cursory understanding of the science behind the instruments, quite useful was viewing a short GLAST video (made back in 2001, produced by Mike Zeko), that includes discussion and some animation of the two instruments. Particularly striking was the animation representing the creation of particle pair splits (electrons and positrons) from the interaction of gamma rays with matter – which the LAT then interprets and tracks back to the source of the incoming energy.

I was thus able to musically portray the LAT in action: first I aligned the incoming gamma rays with the two trumpets, speeding toward the LAT in fast, chromatically harmonized 16th notes; the trombones then represent the particle pair split – moving in short 16th-note bursts in contrary (i.e., “oppositely charged”) motion; the more static French horn represents the medium of matter (LAT’s silicon-strip detectors) through which the action takes place. After two such general exchanges, a more specific musical interaction takes place: a gamma ray enters the LAT and interacts with its 16 identical towers – represented by a burst of 16 rapid-fire chords in the upper four horns – at which point the two trumpets ascend upwards, gradually diminishing in volume, thus “depicting” LAT’s critical process of pointing back to the distant gamma-ray source.

Representing the GBM was in fact a bit easier: I simply divided the consort into two roles – the forceful and abrupt gamma-ray bursts (GRBs) are depicted in the lower three horns with loud, percussive chords; the response of the GBM is depicted by figuration in the 2 trumpets – specifically a rapid 14-note figure, representing the 14 crystals (12 circular NaI crystal discs and 2 cylindrical BGO crystals) within the GBM that allow for the detection and positioning of GRBs from ~10 keV to ~25 MeV. Several iterations of this back-and-forth steadily intensify and lead into the next, and final section of the “dream sequence.” It is perhaps worth noting here that throughout the work, I have musically aligned the identity of gamma rays (and thus GRBs) with the notes c and c#, oriented as half-steps, major 7ths, minor 9ths, etc. – thus providing a suitably intense intervallic relationship for these intense and highly energetic wave frequencies. While not obvious to most listeners, this periodic intervallic link to gamma rays provides a subtle way of providing aesthetic cohesion to the *GLAST Prelude* – much as gamma rays themselves underlie so much of the mission and science of GLAST.

Dream Sequence, Part V: A Celebration of the Multi-National Cooperation of GLAST: an early inspiration on how to handle this vital aspect of the GLAST mission came from Pierre Schwob – who suggested that the work somehow feature the national anthems of the various nations involved. An interesting idea, but how to realize it? After some reflection, I realized that the simplest (and shortest) way to do this was to create a sort of contrapuntal medley of the six national anthems – or at least the opening phrase of each. After learning those I previously didn’t know, I realized that trying to present all six anthems at once would be too taxing on me and the listener, and thus I opted for dividing them into two parts of three anthems each – where the other two horns would provide a kind of harmonic pedal. As such, the medley section presents first the anthems for the United States (French Horn), France (Trumpet 1), and Germany (Trombone) in counterpoint; and then the anthems for Italy (Bass Trombone), Japan (Trumpet 2), and Sweden (French Horn). To better distinguish the themes, I utilized a technique I’ve used in several earlier works, one adapted from the so-called “mensuration canon” used by High Renaissance composers like Ockeghem and Josquin des Prés: where the different melodies are presented in different tempi, each with a different note value as the beat or “tactus”. In addition, the melodies are presented in different, though closely related keys (F, C, G), which likewise helps to distinguish them to the ear. The net result, I believe, is that each anthem’s opening phrase can be well discerned, with each being given equal weight and presence within the section – in the spirit of international cooperation that marks the GLAST mission.

These are some of the more unique and easily explained ways in which I interpreted aspects of the GLAST science and mission. Other, more general techniques include creating an aesthetically warm and loving theme to “depict” GLAST in elegant orbit around the earth; a sequence of steady trumpet calls to signal the countdown at launch (which dissolves at five, prior to the “dream sequence”); a continually cycling ascent in the trombones to “depict” the ascent of the Delta II rocket through the atmosphere; and a sequence of quick, antiphonal utterances in the trumpets to “depict” the jettisoning of the six solid rocket boosters. In all, of course, the goal is not simply to present a series of distinct musical “portraits”, but to create a total and unified artistic statement that moves the listener in an overarching musical narrative throughout the work’s nine minutes – much, one can say, as GLAST will reveal more than a series of distinct data results, but will help yield a more comprehensive picture of the gamma-ray sky and the Universe as a whole. At least that’s the goal.

STEIGERWALD: How was the experience different from traditional composition?

GASSER: As you might gather from the preceding discussion, there are many aspects of the experience of composing the *GLAST Prelude* that have differed from that of previous or more “traditional” works, but yet likewise many aspects that are quite similar. Nearly all of my serious or “art” works involve some degree of research – whether it is the study of a particular non-musical topic (as in my orchestral oratorio, *American Festivals*) or the study of a particular musical repertoire (as in my *Cello Concerto*). Similarly, I often work with some kind of constructed narrative in my mind – even in purely instrumental works – though rarely if ever with the degree of specificity as in the *GLAST Prelude*. Most unique here, not surprisingly, has been the complexity of the non-musical background, and thus the difficulty in gaining a sufficient degree to confidence that I have the *right* to proceed; but at the same time, rarely if ever have I been so consumed emotionally and spiritually with a non-musical topic as I prepare to compose – whereby the topic itself forms such a passionate source of inspiration. In the end, though, to compose music is all about finding the right notes, the right rhythms, melodies, and harmonies, and placing them all together in a coherent way that any music lover can find engaging and enjoyable, and that is the same with the *GLAST Prelude* as in any work I compose.

STEIGERWALD: In what ways can science inspire art?

GASSER: The interplay between art and science in the human experience, and brain, is a complex one, and the subject of much recent literature. To be sure, the connection between music and science – mathematics in particular – has long been established, going back at least to Pythagoras, who according to legend first discerned the mathematical basis of the key musical intervals – as perfect proportions (the octave as 2:1, the 5th as 3:2, the 4th as 4:3); and countless theorists and writers from the Middle Ages to the present have pointed to the mathematical foundations of music. An alliance between music and cosmology likewise has a long, rich tradition – again extending back to Pythagoras – where the movement of the heavenly bodies was defined in musical terms, as the “music of the spheres”; this speculative association between music and the motion of the stars and planets continued to hold great sway through the late-Renaissance, under the rubric *musica mundana*. More recent history, moreover, has had its share of famous musical scientists - including Einstein (a violinist), Fermi (a pianist), and Wennher von Braun (a cellist), though less common are scientific musicians – Alexander Borodin, as a rare example, was an active research chemist throughout his life.

But to your question, there is no doubt that science has and can inspire art – as clearly evidenced here in my case, where science has not only inspired this musical work, but will soon inspire a second and larger composition to be written in celebration of GLAST, *Cosmic Reflection* (more on that later). In history, the examples of great artworks inspired or influenced by science is large – particularly in the visual arts (Leonardo comes quickly to mind); within music, the examples may be a bit more rare (e.g., Gustav Holst, *The Planets*, Philip Glass, *Einstein on the Beach*), but are seemingly on the rise. While in the past the connections between science and music have been more abstract and philosophical, the ability to discern more concrete parallels – formal, structural, aesthetic, etc. – is increasingly available to a composer. An early proponent of this more tangible connection is John Cage, and his various works involving “chance music” – as a reflection of quantum mechanics and the uncertainty principal; but the connections and means of garnering musical inspiration from science are to my mind as limitless as the composer’s imagination.

I am not a scientist, but it seems obvious to me that both scientific and musical projects operate from a mutually dependent combination of inspired ideas – often fanciful, abstract, or aesthetic – and the gritty techniques that make them translatable to others. I’ve often read how Einstein and other scientific innovators came to their ideas not first by crunching numbers, but rather by simply thinking about the world or the Universe and how it “should” be – and only then turned to the labor of mathematics or laboratory experiments to prove these ideas to themselves and others. I imagine too that Peter Michelson and Bill Atwood came to the ideas that differentiated GLAST from EGRET in a “flash” of inspiration, and only then set to the tough task of working things out with experiments and materials. So it is – in my experience – with musical composition (albeit with less grand ramifications): the idea or sonority of a section comes as a “flash” of sound or musical gesture (how it “should” be) and only then can I roll up my sleeves and figure out what notes, harmonies, and rhythms can realize that idea and make it audible to myself and others.

As such, the basis by which science can inspire art is seemingly limitless – capable of arising through the study of a scientific theory or the means by which that theory came into being; by a scientific mission (such as GLAST) or the theoretical basis by which the mission was launched (special relativity, the EM spectrum, etc.) – or both. Particularly helpful is the extent to which cutting edge physics, cosmology, etc. are being made accessible to non-scientists – not least through NASA – giving someone like me the ability to compose “depictions” of science with some intelligence. Above all, both science and art aim to reflect and better understand the Universe around us, and to share these insights with others; that science can make that job a little easier for the artist is only a good thing.

STEIGERWALD: Do you think art can inspire scientific investigation as well? If so, how?

GASSER: This is something I can only infer, not being capable of performing scientific investigation myself, but nevertheless infer I can with some confidence. That such a distinguished list of notable scientists – including GLAST’s own Project Scientist, Steve Ritz – possess musical talent, only suggests that an involvement with art, musical or otherwise, can be helpful in realizing scientific endeavors. It would be interesting to know whether Einstein gained insight about the true nature of spacetime after playing through the solo violin partitas of J.S. Bach (which surely possess their own, relative identity of space and time), but such is not inconceivable. There have been some who have speculated that throughout history great advancements in science were first suggested or inspired – whether consciously or not – by advancements in art, such as the rise of linear perspective prior to Galileo’s observations on the nature of falling bodies, etc. To me, this merely suggests that the arts and sciences are – and always have been – connected within the human experience and our constant quest to better understand the Universe we live in. As noted in my answer above, the techniques and challenges that exist in scientific and artistic projects are similar in many regards, and no doubt an intuitive scientist can gain insight by spending time with an art work – whether for mere pleasure or to gain a deeper, more technical understanding. I don’t necessarily think that a scientist can conduct a useful experiment based on the materials or structure of Beethoven’s *Große Fuge*, but he or she would no doubt be inspired to “get to work” after a serious encounter with it.

STEIGERWALD: What was your experience collaborating with Rich Melnick and the NASA team? Again, were there any specific challenges, and how did you (and the NASA team) overcome them?

GASSER: From its conception, the *GLAST Prelude* was intended to have a vibrant video compliment, featuring the kind of state-of-the-art science animation and footage that only NASA can provide. This was borne out both in the initial conversations held between Peter Michelson, Pierre Schwob, and myself, as well as in the agenda of our visit to the Goddard Space Flight Center, which as mentioned above included a meeting with the video team. How the visuals would interact with the music, on the other hand, was not explicitly discussed, and was entirely up to me. This accounts in part for the detailed narrative I developed for the *Prelude*, as well as for some of the specific themes chosen – in some cases inspired by specific still and video images I found in books and on the web (such as the 2001 video mentioned above). The musico-visual alliance was then even more solidified in the process of composition, as I constantly “saw” images and scenes as I was writing my notes and rhythms. Having no skills or background in videography, I had no idea how exactly the two mediums would come together, but I had faith that the Goddard team would figure it out – which has been demonstrated in spades!

Upon completion of the composition, and the subsequent brilliant recording made by the American Brass Quintet – to whom I owe an incredible debt of gratitude – I got busy putting my visual ideas and concepts in written form, aligning them to the timings of the ABQ’s recording; I even made a Windows Media Movie, placing text descriptions of the various visuals I imagined in timing with the music, to better help the actual placement and selection of such visuals by the Goddard team. As you might guess, I was rather detailed in my descriptions and desires – with no less than 77 distinct items enumerated for the 9 minutes of music; everything from the timing of the countdown to the exact progressions of the astronomy, EM spectrum, and GLAST instrument surveys to the launch and ascent of the Delta II was specified to the 100th of a second. Then, with hope and anticipation, I sent the materials to Goddard.

Initially, our video contact at Goddard was Liz Smith, but just at the time that the ABQ recording was completed, she left NASA to take a position at the Waitt Institute for Discovery in La Jolla. Happily, Liz and her team had already begun gathering images – based on an earlier MIDI version with visual descriptions I had sent her; most importantly, she was able to procure Rich Melnick to take her place as chief videographer for the *Prelude*. Though thrown in the middle of this rather complex and unusual project (normally the music *follows* the completion of a video, as underscore), Rich dove in with full gusto – and we are all blessed and grateful that he was able to do such a magnificent job. Rich and I had numerous conversations over the next month or so, and I confess that I gave him more than a modicum of stress with my often-unrealistic requests, but in all it was a terrific collaboration.

While my descriptions of the visuals I imagined were quite specific, I actually had very little in the way of concrete and specific footage in mind – which I naturally left up to the experts; this allowed for a true artistic collaboration, where Rich was free to “paint” the music in the visual manner he deemed best, though within the confines of the overall narrative I laid out. I thus had no real idea of what the *Prelude* would “look” like when I received the first draft a few weeks ago from Rich and his team – and from the onset I was delighted. He had captured most everything I had envisioned, with fabulous footage and animation from the Goddard team – much already created for previous GLAST videos, but some created specifically for this project; but he also incorporated visuals and interpretive concepts that I had never imagined, and that really blew me away! Not surprisingly, we had a few subsequent back-and-forths, and thus a few additional revisions, but nothing too extensive. Timing is everything, however, and the final version was completed three days before I left for Florida for the launch.

With regard to challenges, indeed there were some – that at times resulted in my needing to compromise on what I initially had in mind for the visuals. One example is during the EM

spectrum section, where I had envisioned a continually moving (and steadily intensifying) waveform at the bottom of the screen, underlying the gradually intensifying progression through the spectrum. Given the difficulties of producing such a layered approach – in combination with the telescope and data images aligned with each form – Rich was forced to convince me that another approach was needed; he had already received several “gifts” from the Goddard animation team for this project, and some limits had to be drawn. But Rich’s solution, to sequentially animate sections of a continuous spectrum model in coordination with the relevant wave-type images, works beautifully, and fully makes the point. Everything else went as well as I had hoped, and Rich’s handling of so many sections – such as the countdown, shifts in and out of the “dream sequence”, the astronomy and GLAST instrument sequences, the anthem medley section, the launch and ascent of the Delta II, etc. – is impressive to say the least. It is obvious that Rich fully rose to the challenges presented in this work, and dug deep into his own impressive creativity with masterful results, and he and his team are to be congratulated!

STEIGERWALD: Would you do something like this again?

GASSER: I’m glad you asked. In fact, as noted above, the *GLAST Prelude* is but the first of two compositions to be written in commemoration of the GLAST mission: the second, to be started later this year, will be entitled *Cosmic Reflection*, for narrator and orchestra, and will be premiered live at the Kennedy Center for the Performing Arts in Washington D.C., in conjunction with the 1st GLAST Symposium to be held in that city in fall 2009. This new work will be rather more ambitious in scope and theme, taking on no less than the entire history of the Universe! Likewise conceived in consort with Peter Michelson and Pierre Schwob, *Cosmic Reflection* will be somewhat of an updated iteration of Gustav Holst’s *The Planets*, but now taking on the full cosmic history from the Big Bang to the present and beyond – with an acknowledgement of the marvel that is the human ability to reflect upon the very Universe that gave rise to us. From a formal standpoint, the work will bear some resemblance to Prokofiev’s *Peter and the Wolf*, in that it will progress as a back-and-forth between spoken recitation and orchestral “realizations” of that verbal content. The “libretto” will be written in part by famed science writer and theoretical physicist Lawrence Krauss, and will likewise include a visual accompaniment produced by the video and animation team at Goddard. *Cosmic Reflection* will be performed as part of a symposium-sponsored concert by the Boston University Symphony Orchestra, and will be narrated by actor and playwright Carey Harrison, son of Rex Harrison. More details on the work and the concert will be released in conjunction with announcements on the GLAST Symposium.

Beyond this forthcoming work, the short answer is yes, absolutely: I would fully welcome the opportunity to continue forging a connection between musical composition and science – especially one involving aspects of cosmology, astronomy, astrophysics, etc., whether for a future NASA mission or another science-related enterprise.

STEIGERWALD: Who commissioned the work and what was his or her motivation in doing so?

GASSER: As noted above, the process that led to the composition of the *GLAST Prelude* (and the forthcoming *Cosmic Reflection*) was initially inspired by Peter Michelson, and his vision to commemorate the GLAST mission with original music. In early 2007, Peter broached the subject with his long-time friend Pierre R. Schwob, who also happens to be the founder and CEO of the Classical Archives website (www.classicalarchives.com), for which I’ve been the Artistic Director since 2002.

Pierre is an unusually accomplished and eclectic individual, with an equally intense passion for classical music and science; though not formally trained in either discipline, his knowledge of both is most impressive – and a big inspiration to me personally. Most inspiring, perhaps, is the manner in which he translates his love of science into strong activism – for example, having made a substantial endowment to the Kavli Institute for Particle Astrophysics and Cosmology (KIPAC) at Stanford University; he continues to express his dedication to KIPAC by hosting a weekly luncheon at the Stanford Faculty Club, featuring distinguished speakers from the KIPAC “tea-talk” series. Above all, Pierre is passionate about the need to instill a love of and appreciation for cutting-edge science among the wider public, and it is thus not surprising that he immediately embraced Peter’s notion of complimenting the science of GLAST with music.

To my good fortune, Pierre immediately thought of me as a candidate to create this musical compliment – by virtue of his appreciation for my abilities as a composer, as well as by my long-standing association with Stanford (receiving my Ph.D. in Musicology in 2001, and serving as an Adjunct Professor of Medieval-Renaissance Musicology). Happily Peter concurred, and the project was off and running. To support the process, I have received generous funding from Pierre, along with ample support – particularly for the forthcoming Kennedy Center performance – from the Stanford Development Office and from a number of individual donors associated with Stanford, including Peter Drake, who helped spearhead that fundraising effort. Not least, of course, is the generous artistic contribution made by Goddard’s video and animation team, enabled by the enthusiastic support of several key scientists associated with GLAST – including Peter Michelson, Steve Ritz, and Neil Gehrels.

The motivation for this commission is thus two-fold: first, as a purely aesthetic act, to celebrate the GLAST science and mission with an original musical composition – providing an artistic expression to commemorate the extensive (17-year) multi-national effort and state-of-the-art science that made GLAST possible; and second, as a vehicle of public outreach, to help fire the imagination of the public about the GLAST mission, and cutting-edge science (especially astrophysics and cosmology) in general. The latter is the especial goal of *Cosmic Reflection*, which by virtue of its broad theme (the history of the Universe) aims to inspire and motivate the public by virtue of its unique integration of symphonic music, superb visual content, and expert science writing that allows us to contemplate our origins and “home” as never before.

STEIGERWALD: What would you like the public to gain from, or understand about, your GLAST composition?

GASSER: My first hope, naturally, is that people enjoy the work. Only if the music, and the accompanying visuals, is found compelling, entertaining, moving, and enjoyable, are other objectives worth pursuing. Assuming that is the case, then I can add my hope that in some

tangible way the *GLAST Prelude* may help illuminate (or explain, excite, etc.) an aspect of the GLAST mission that other materials (written documents, academic videos, etc.) are not able to do – whether to a lay person or even to an informed scientist. Indeed, if I may, I am happy to say that following the “premiere” of the music-video at a reception gathering in Cocoa Beach prior to launch – co-sponsored by General Dynamics and Stanford University – I had several people come up to me and say that after experiencing the music video their understanding or appreciation of the GLAST mission was enhanced – as if some bell went off that hadn’t previously. Since then, several non-scientists have said that their initial challenges in understanding GLAST were markedly ameliorated after watching the music video. Finally, others have noted that the music has somehow “captured” the mission in ways that words could not, or provides a welcome emotional soundtrack to the launch and mission. All of these are delightful to hear, and as much as I can ask for. If the *GLAST Prelude*, or any musical or artistic rendering of any science mission, can help in the process of sparking new interest or passion in the science itself among the broader public – perhaps the chief goal of this entire process – then it will have done its job well. At the least, it is an honor to be able to make an effort in this regard. Go GLAST!