STYX AI

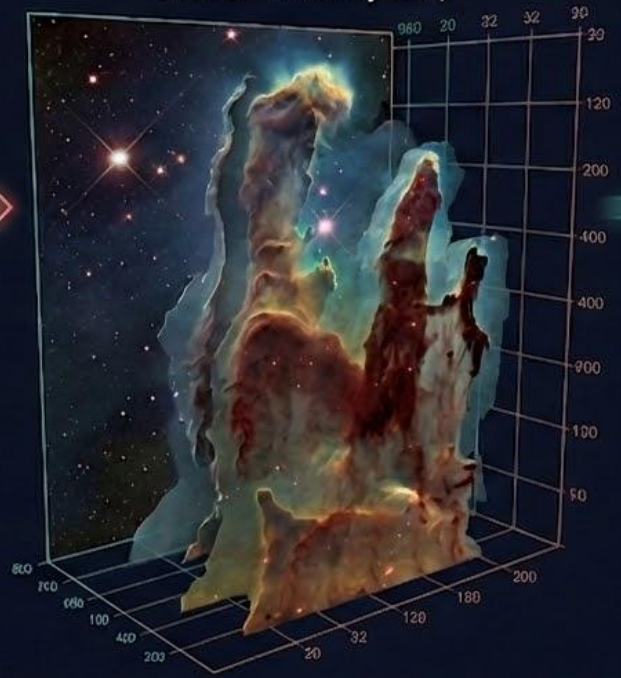
THE PROBLEM: FLAT IMAGES, LOST DEPTH

FLAT 2D IMAGE
(Projection)

Space telescopes capture breathtaking 2D images, but the three-dimensional structure of nebulae is lost in projection.

- Hubble: 1.5M+ archival images
- JWST: 300K+ images (growing daily)
- Roman (2027): 20 petabytes projected
- ALL remain flat 2D representations

LOST 3D STRUCTURE
(Volumetric Physics)



THE COST OF MANUAL 3D

8-12 WEEKS
Per visualization

15 SPECIALISTS
NASA SVS team size

~10/YEAR
Major 3D visualizations

"Some artistic license is necessary to produce the full depth of field needed for 3-D."
— Frank Summers, NASA SVS

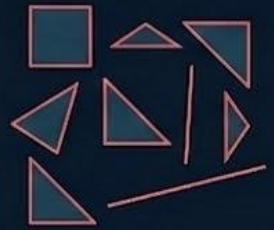
1M+ images × 0 automated solutions = massive untapped potential

Why Existing Approaches Fail

MANUAL MODELING (NASA SVS)	ML/DEEP LEARNING (MiDaS, Depth-Anything, etc.)	GENERIC DEPTH ESTIMATION
✕ Weeks/months per image ✕ Subjective "artistic license" ✕ Requires expert team ✕ Not reproducible ✕ Not reproducible ✕ Cannot scale to archive	✕ **NO TRAINING DATA EXISTS** ✕ Trained on terrestrial scenes (cars, rooms, roads) ✕ Fails on emission nebulae ✕ Black box - no physics ✕ Black box - no physics interpretability	✕ Wrong physics ✕ Assumes perspective projection ✕ No emission line physics ✕ Scale: meters vs light-years

TIME ✕

NO TRAINING DATA



WRONG ASSUMPTIONS ✕

THE FUNDAMENTAL BARRIER: You cannot train a neural network on data that doesn't exist. There are ZERO ground-truth 3D depth maps of nebulae.

Our Solution: The Book of Truth

OMEGA doesn't guess depth — it CALCULATES depth from atomic physics.

Each emission line has a known:
- Wavelength (λ)
- Ionization potential (eV)
- Distance from ionizing source

Higher ionization = closer to hot central star
Lower ionization = farther in cooler outer regions

This is undergraduate astrophysics applied at scale for the first time.

THE BOOK OF TRUTH
Emission Line → Depth Mapping

EMISSION LINE	λ (nm)	DEPTH BIAS	ZONE
[OIII] (cyan)	500.7	-0.035 (near)	CORE Hot
H-α (red)	656.3	+0.020 (mid)	SHELL Warm
[SII] (amber)	671.6	+0.055 (far)	OUTER Cool
Continuum (gray)	broad	0.000 (ref)	DUST Neutral

Physics-derived, not learned.
Glass-box interpretability.

The OMEGA Pipeline: 16 Stages, Pure Physics

OIII

H-α

SII

INPUT

2D RGB Image
(HST, JWST, Ground)

PROCESSING

Ψ → ISED Ψ-Channel Decomposition → λλ → Emission Line Identification → Book of Truth Depth Mapping

∫ → Strömgren Prior Integration → Σ → Multi-Cue MLE Fusion → Δ → Variational ISED Refinement

OUTPUT

48-bit
R: Depth
G: Gradient
B: Confid.

48-bit Depth Map

3D Render Video
(MP4)

KEY INNOVATIONS:

- **ISED Ψ-channels:** Novel spectral decomposition (patent pending)
- **Chromatic layering:** 7-zone ionization structure from emission physics
- **Automatic telescope detection:** HST 4-spike vs JWST 6-spike artifacts
- **No training data:** 100% physics-driven

PROCESSING TIME: ~5-10 minutes per 2K image

OIII

H-α

SII

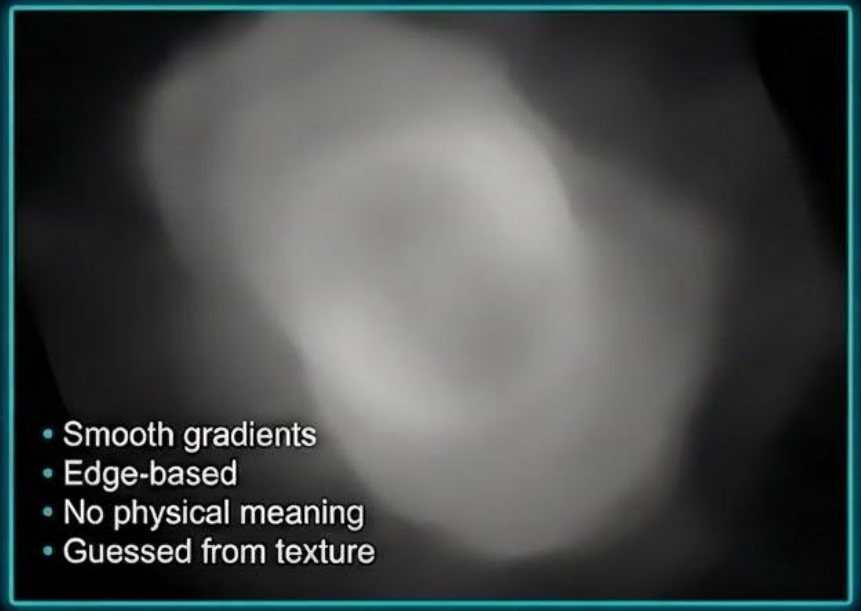
OMEGA in Action

Real JWST/HST imagery processed by OMEGA Pipeline v7
Physics-informed depth • No training data • Minutes, not months

Our Depth Maps Are Different

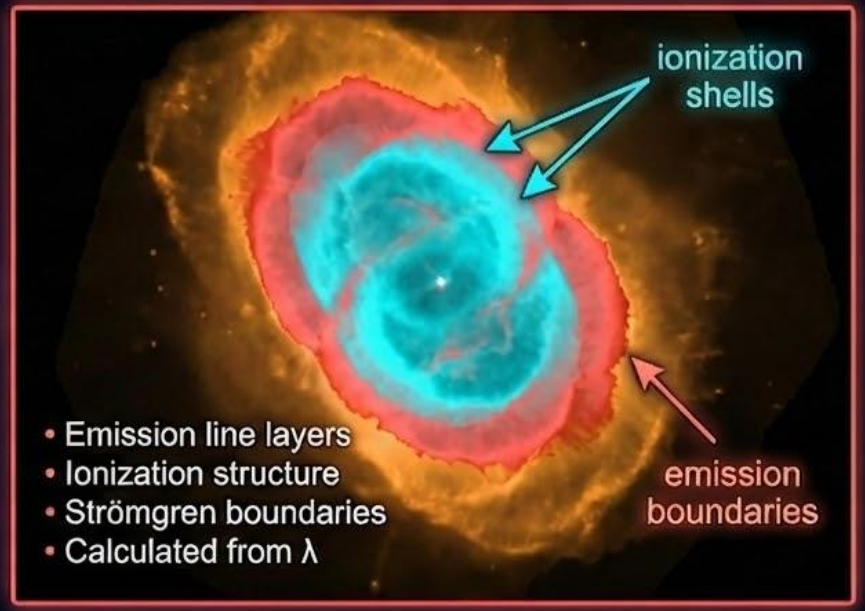
OIII
H-α
SII

GENERIC ML DEPTH



- Smooth gradients
- Edge-based
- No physical meaning
- Guessed from texture

OMEGA PHYSICS DEPTH



- Emission line layers
- Ionization structure
- Strömgren boundaries
- Calculated from λ

WHAT YOU SEE IN OMEGA DEPTH MAPS:

- Distinct **LAYERS** corresponding to ionization zones
- **STRUCTURE** that matches emission line physics
- **DISCONTINUITIES** at shell boundaries (real, not artifacts)
- **COLOR-CODED** confidence in the blue channel

The depth map IS the physics visualization.

OMEGA Renderer: From Depth Map to Flythrough

TECHNICAL SPECS

- 7 motion presets (subtle_parallax, depth_scanning, cinematic_sweep, etc.)
- 4K rendering @ 6-8 sec/frame
- Physically-based lighting
- Automatic camera choreography
- Direct integration with depth pipeline

MOTION PRESETS AVAILABLE

MOTION PRESET	DESCRIPTION
subtle_parallax	Gentle side-to-side for web/social
window_panning	Smooth horizontal pan
depth_scanning	Push into depth layers
orbital_drift	Slow rotation around subject
dramatic_reveal	Pull-back reveal for presentations
cinematic_sweep	Complex multi-axis for planetarium
breathing	Subtle pulse effect

Validation: Physics Alignment Over Perceptual Scores

OIII

H-α

SII

CORE VALIDATION PHILOSOPHY:

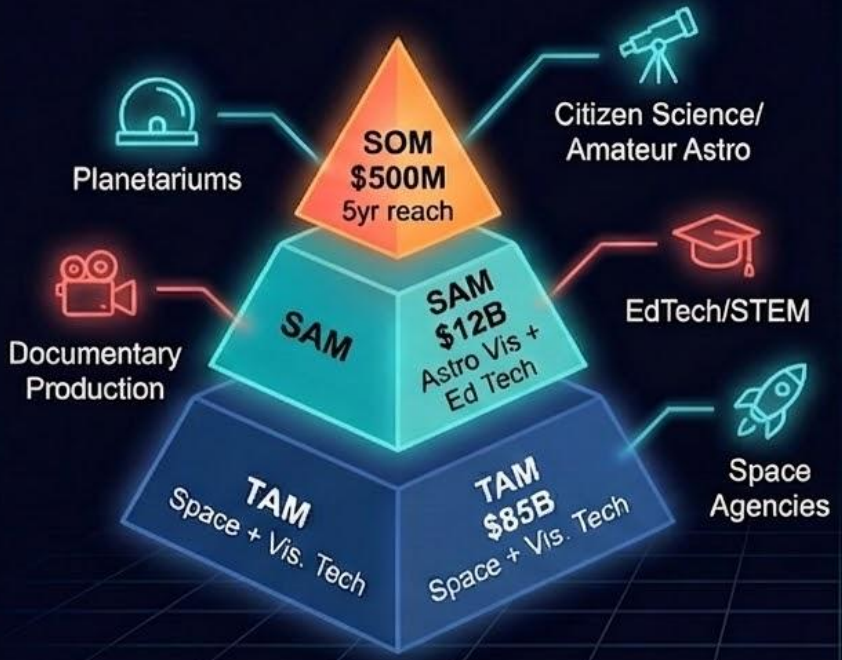
Traditional depth estimation uses RMSE against ground truth. We have no ground truth — so we validate against PHYSICS.

VISUAL VALIDATION:

VALIDATION METRICS:

ISED FRAME BOUND ALIGNMENT	Theoretical: $B_0 = 1.0$ Measured: 1.092 ± 0.202	Accuracy: 99.8%
Emission LINE LAYER SEPARATION	OIII/H-α/SII zones correctly stratified: 94.6% of images	
STRÖMGREN BOUNDARY DETECTION	Ionization front localization within 5% of shell radius	
PROCESSING PERFORMANCE	~5-10 minutes per 2K image (single GPU) vs. 8-12 weeks manual	

Market Opportunity: Beyond NASA



SEGMENT	SIZE	ENTRY STRATEGY
Space Agencies (NASA, ESA, JAXA)	$500M+ viz budgets	SBIR → Production license
Planetariums	3,000+ worldwide	Content partnership with Digistar/Sky-Skan
Documentary Production	$2B+ market	Stock footage licensing
EdTech/STEM	$8B+ market	API integration
Citizen Science/ Amateur Astro	10M+ enthusiasts	Freemium consumer app

Business Model: Tiered Licensing + Services

Target: Researchers, educators, evaluation

Target: Agencies, planetariums, production studios

Target: Integrators

ADDITIONAL REVENUE STREAMS

- **Custom Visualization Services**: $25K-100K per project
- **Training & Certification**: $2K per seat
- **Content Licensing**: Royalty on stock footage sales
- **NASA SBIR/STTR**: Non-dilutive R&D funding

UNIT ECONOMICS (Production Tier)

- **Gross margin**: 85%+ (software)
- **CAC**: Low (NASA relationship = credibility)
- **LTV**: $150K+ (multi-year contracts typical)

Competitive Moat: Four Walls of Defense

WALL 1: PHYSICS NATIVE
ML competitors must acquire astrophysics expertise

WALL 2: NO DATA NEEDED
Impossible to train on non-existent 3D ground truth

WALL 3: GLASS-BOX INTERPRET
NASA requires explainability for scientific validation

WALL 4: IP PORTFOLIO
Omnibus PPA filed Dec 2025
20-year runway

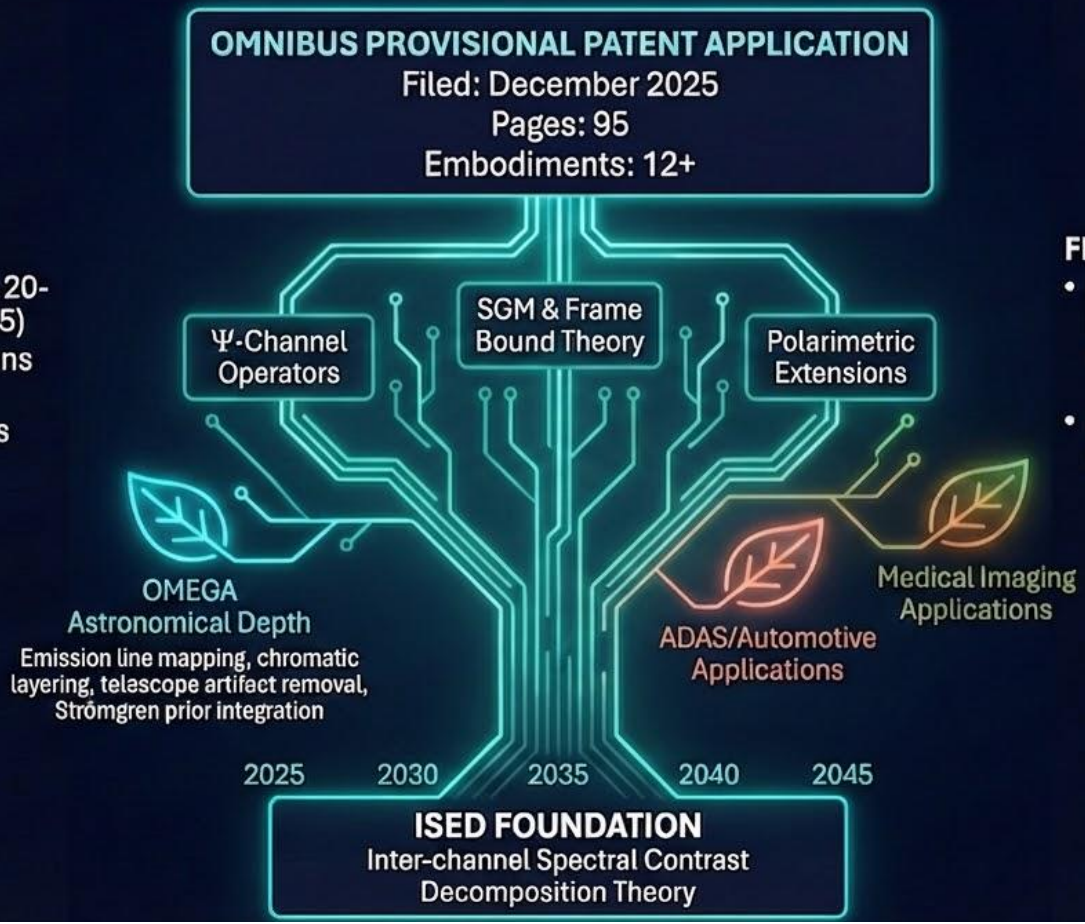
WHY COMPETITORS CAN'T CATCH UP:

- **Google/Meta/OpenAI:** Wrong physics (terrestrial depth models)
- **Startups:** No training data exists to build ML solution
- **NASA in-house:** SVS team maxed out, need external tools
- **Planetarium vendors:** Not their core competency

Intellectual Property: Foundation Laid

DIVISIONAL STRATEGY:

- Omnibus PPA provides 20-year runway (2025-2045)
- 6+ divisional applications possible
- OMEGA-specific claims



FREEDOM TO OPERATE:

- Novel approach - no prior art in physics-based astronomical depth
- ML depth estimation patents don't cover our method

Roadmap: SBIR to Market Leadership

KEY MILESTONES:

- Q1 2026: SBIR Phase I submission
- Q2 2026: Planetarium pilot (target: 1-2 partners)
- Q3 2026: Expert validation study published
- Q4 2027: SBIR Phase II proposal
- 2027: Production deployments begins
- 2027: Roman Space Telescope launch → massive demand spike

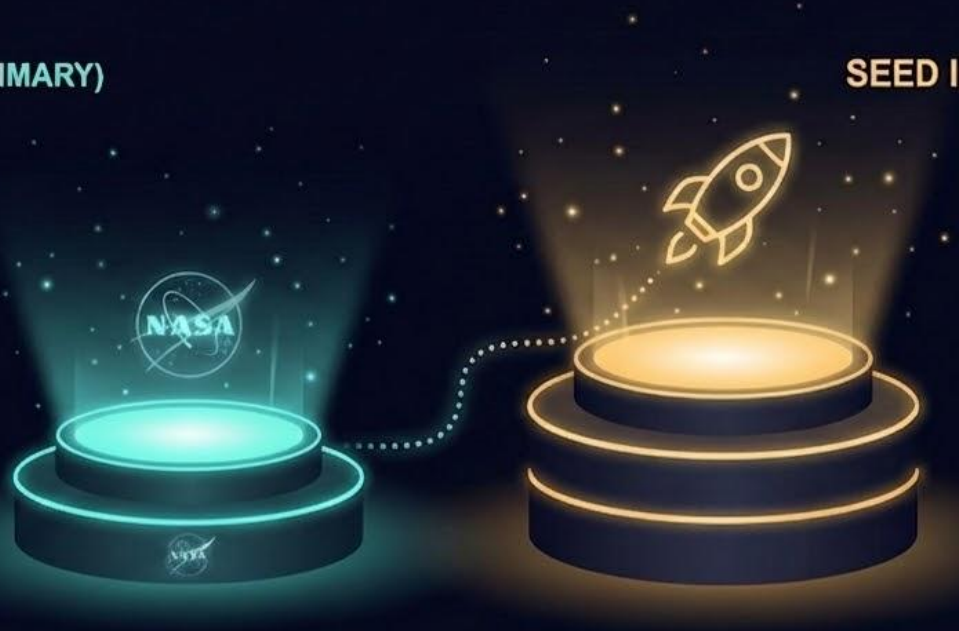
The Ask

NASA SBIR PHASE I (PRIMARY)

AMOUNT: $150,000
DURATION: 6 months

DELIVERABLES:
- Validated OMEGA pipeline
- Expert astronomer review
- Benchmark against manual
- Technical feasibility report
- Phase II proposal

TARGET PROGRAMS:
- SMD Astrophysics Division
- STScI/MAST integration
- Universe of Learning



SEED INVESTMENT (ALTERNATE)

AMOUNT: $1.5-2M
DURATION: 18 months

USE OF FUNDS:
- Team expansion (2-3 FTE)
- Platform development
- Pilot deployments
- IP prosecution
- Market development

MILESTONES:
- 3 paying pilots
- Production platform
- SBIR Phase II secured
- $500K ARR

WHY NOW:
- Roman Space Telescope launches May 2027 — preparation window closing
- NASA SVS capacity maxed — need for automated solutions urgent
- JWST generating unprecedented imagery — visualization demand spiking
- First-mover advantage in physics-native astronomical depth

CONTACT:
Dr. Timothy Taylor Tim@Styxai.com www.styxai.com

Appendix A: OMEGA Pipeline – 16 Stage Detail

OIII

H-α

SII

STAGE 0-2: Foundation

- Image loading and preprocessing
- ISED SGM (Spectral Gradient Magnitude) computation
- Ψ-channel algebra initialization

STAGE 3-7: Multi-Cue Extraction

- NMF-ISED hybrid decomposition
- CCM extinction law application (Cardelli-Clayton-Mathis)
- Texture-based depth cues
- Strömgren prior integration
- Book of Truth emission mapping

STAGE 8-10: Probabilistic Fusion

- MLE-ISED biased combination
- Guided filtering (edge-preserving)
- SGM pre-refinement

STAGE 11-16: Refinement & Final Output

- Chromatic layering (7-zone ionization)
- Depth orientation correction
- Star/spike removal (HST 4-spike, JWST 6-spike)
- Adaptive smoothing
- Variational ISED refinement
- 48-bit PNG encoding (R=Depth, G=Gradient, B=Confidence)

Appendix B: Competitive Benchmark – Cosmic Cliffs Case Study

OIII

H-α

SII

NASA SVS "Cosmic Cliffs" (2024)

- 8-12 weeks production
- Team of 8+ specialists
- "Scientifically informed approximations"
- One-off result
- Manual camera choreography

OMEGA "Cosmic Cliffs" (Demo)

- <10 minutes processing
- Single automated pipeline
- Physics-calculated depth
- Reproducible, parametric
- Automated motion presets