Section 9. Binary Systems as a Shared Landscape

Binary systems—whether star–planet pairs, binary stars, or any two dominant mass-like sources—are usually introduced in force-language. Each body is said to pull on the other, and the resulting motion is described as a balance or combination of forces. CUWF keeps the same observational targets but rewrites the mechanism in slope-language. A binary is a coupled, continuous collapse-generated landscape containing two basins, a separating ridge, and one or more saddle passes that regulate cross-domain accessibility.

The aim of this section is operational rather than decorative. It shows that barycentric organization, standard orbit families, Roche-lobe-like boundaries, near-coplanarity, and inspiral or merger behavior all arise naturally once the system is read as a shared terrain rather than as two independent force-centers exchanging pull.

9.1 Two Basins, One Ridge, and the Saddle Structure

A single isolated gravitating body corresponds, in the mountain dictionary of Section 3, to a landscape with one dominant basin and its surrounding slope field. A binary is the next natural case: two dominant basins coexist inside one continuous terrain. This immediately implies three structural features.

First, there are two basins, each acting as a local attractor-like region associated with one dominant source. Second, there is a ridge, or watershed-like boundary, separating the drainage domains of the two basins. Third, there are one or more saddles, or passes, that provide the lowest-access transition corridors between the two domains.

At the schematic level, the binary landscape may be written as

$$\Phi^E\_total(x) = \Phi^E\_1(x) + \Phi^E\_2(x) + \Phi^E\_couple(x)$$

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The coupling term Φ^E_couple is not an extra force. It records the fact that collapse regularization and pathway accessibility are defined on one continuous field rather than on two isolated hills. Ridge and saddle structure appear where accessibility switches between competing descent routes.

9.2 Barycentric Organization Without Two Pulling Forces

In standard teaching, the barycenter is often introduced as a bookkeeping point resulting from the balance of two forces. In CUWF, it receives a more geometric interpretation. It is the natural organizing point around which the coarse-grained shared terrain admits quasi-closed channels under the system's constraints, including angular momentum and the availability of stable pathways.

The observed gravitational tendency remains the slope of the total landscape:

$$g(x) := -\nabla\Phi^E\_total(x)$$

But binary motion is not purely downhill. It is guided persistence inside channels supported by the structure of the shared terrain.

For intuition only, one may describe the system in an effective co-rotating picture, where a centrifugal contribution behaves like an additional height term:

$$\Phi^E\_eff(x) = \Phi^E\_total(x) - (1/2)\Omega^2 |x - x\_b|^2$$

Here x_b is the barycenter location and Ω is the binary rotation rate. The precise form is less important than the structural message: under rotation-like constraints, the barycenter is the natural organizing point of the shared landscape, and orbit families appear as channel families in Φ^E_eff rather than as literal sums of two independent forces.

9.3 Orbit Families in the Binary Landscape

Once orbit has been reinterpreted as channel-supported persistence, the standard orbit families of binary systems follow naturally from landscape topology.

S-type or satellite-type orbits are those confined to the neighborhood of one basin. A ring-shaped channel exists around one basin and remains sufficiently far from the ridge that small perturbations stay inside the same domain.

P-type or circumbinary orbits are larger annular channels encircling the entire two-basin system. These lie outside the most complicated ridge and saddle region and behave as channels around a combined terrain feature.

Exchange or transition behavior occurs near the saddle neighborhood, where pathways compete and small differences in micro-topography, dissipation, or initial conditions can route trajectories into different basins. This region behaves like a separatrix neighborhood: a natural site for irregular or domain-switching motion without the need to invoke ad hoc extra forces.

The important point is that these orbit families are not added by hand. They are the expected taxonomy of motion in a two-basin landscape with ridges and saddles.

9.4 Why Multi-Body Systems Prefer a Shared Orbital Plane

In ordinary formation theory, the near-coplanarity of planetary systems is explained through rotating protoplanetary disks together with damping by gas drag and collisions. CUWF does not reject this account. It reframes it at a deeper structural layer.

A shared orbital plane is interpreted as the natural outcome of channel selection during formation, followed by entropic smoothing or collapse regularization that suppresses non-persistent degrees of freedom. During the formation epoch, the system does not explore all possible orbital configurations equally. Collapse dynamics preferentially stabilizes trajectories lying on high-accessibility, low-instability corridors of the generated landscape.

In mountain language, many possible routes exist at first, but only some become stable channels. Those stable channels tend to lie on a common sheet of the landscape, because shared-plane motion maximizes pathway compatibility and minimizes repeated cross-channel disruption.

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This is why coplanarity becomes a stability attractor rather than a geometric coincidence. Inclination dispersion behaves like a high-cost wobble degree of freedom: it creates repeated cross-domain conflict and unstable transfer behavior. Under continued smoothing and collapse stabilization, such modes are damped, leaving the system concentrated near the dominant channel sheet.

Misalignment can still survive when external coupling is strong, when the system forms in multiple epochs or partially separate domains, or when capture and scattering inject objects into alternative accessibility regions. Coplanarity is therefore typical, not absolute.

9.5 Roche-Lobe-Like Boundaries as Channel Stability Boundaries

In classical astrophysics, Roche lobes are introduced using effective potentials and equipotential surfaces. CUWF retains the geometry but changes the meaning. A Roche-lobe-like boundary is the stability boundary of channels in the shared terrain.

In the coupled landscape, the ridge behaves as a watershed surface and the saddle defines the lowest-access corridor between the two basins. When an extended structure such as an envelope, disk, or outer layer evolves under dissipation, the key question becomes whether accessible trajectories can cross the saddle corridor.

Mass transfer or overflow occurs when collapse-path accessibility, together with the local stability structure of Φ^E_total, allows trajectories to leak through the pass. A Roche-like boundary is therefore not evidence of an additional interaction. It is a topological and stability feature of the shared terrain.

9.6 Inspiral and Merger as Channel Degradation

Binary inspiral and merger are often described as progressive loss of orbital energy. CUWF expresses the same observed progression in slope-language as degradation and shrinkage of the orbit-supporting channel.

Two ingredients govern this process. The first is dissipation or pathway cost: processes that reduce the system’s ability to remain in a high-radius channel, making orbital persistence less

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accessible. The second is entropic regularization, expressed through Δ^E, which smooths and reshapes the landscape in ways that filter out non-robust ring features and favor a deeper combined basin.

Schematically, the shared landscape remains governed by a sourced-and-regularized relation such as

$$\Delta^E \Phi^E\_total = S\_E,total$$

As the channel degrades, trajectories transition from stable orbit to decaying spiral and ultimately to a merged configuration behaving as a single dominant basin. Nothing needs to pull harder as separation decreases. The available stable pathways simply close, the saddle corridors dominate transfer, and the landscape reorganizes toward one attractor.

9.7 Core Claim of Section 9

The result of this section may be stated directly. A binary system in CUWF is not best understood as two bodies exchanging primitive pull. It is a shared landscape with two basins, a separating ridge, one or more saddles, and channel families that organize motion, transfer, and merger behavior.

Barycentric motion, orbit taxonomy, near-coplanarity, Roche-like boundaries, and inspiral all follow as natural consequences of one continuous slope-based mechanism. The same force-free generator that explained single-body descent and orbit now extends coherently to coupled systems.

9.8 Transition to Later Regimes

With the shared-landscape logic of binaries established, the paper is prepared to move into even more demanding regimes, where path preference and boundary behavior must be explained without abandoning the same underlying slope-based generator.

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