

Block Seminar on Harmonic Bundles II

(Institute of Mathematics, VAST)

October, 2025

This block seminar focuses on understanding wild harmonic bundles as a continuation of the previous block. Its goal is to examine the relationship between wild harmonic bundles and wild pure twistor D -modules in the case of curves. It will consist of 6 talks, each lasting 2 hours. The seminar will be conducted in a hybrid format, allowing for both in-person and online participation. Details are as follows:

Talk 1: Polarizable Hodge D -modules

Speaker: Nguyen The Hoang

Time: 8h30-10h20, October 30, 2025

Venue: Room 301-A5, Institute of Mathematics, VAST

Reference: Chapter 2, 3 in [Sab07]

- Explain the definition of Hodge D -modules on curves, the key notions are V -filtration and nearby cycles (Chap 2 in [Sab07]).
- Sketch the proof of Zucker's theorem on the global properties of Hodge D -modules on curves, using Schmid's results on variation of Hodge structures on the punctured disc (Chap 3 in [Sab07]).

Talk 2: Prolongation of ramified wild harmonic bundle on curves

Speaker: Dao Van Thinh

Time: 10h30-12h20, October 30, 2025

Venue: Room 301-A5, Institute of Mathematics, VAST

Reference: Chapter 12 in [Mo11]

- Present the \mathcal{R} -module associated with an unramifiedly good wild harmonic bundle and discuss some of its basic properties (ref. [Mo11, Section 12.1-12.4]).
- Construct the \mathcal{R} -triple $\mathfrak{T}(E)$ associated with an unramifiedly good wild harmonic bundle, and provide a characterization of $\mathfrak{T}(E)$ in the case $\dim X = 1$ (ref. [Mo11, Section 12.5-12.6]).
- Present the prolongation of a ramified wild harmonic bundle on curves (ref. [Mo11, Section 12.8]).

Talk 3: The filtered flat bundle associated to wild harmonic bundles

Speaker: Tran Phan Quoc Bao

Time: 14h00-15h50, October 30, 2025

Venue: Room 301-A5, Institute of Mathematics, VAST

Reference: Chapter 13 in [Mo11]

- Define μ_L -stable filtered flat sheaves, and construct Hermitian metrics for good filtered λ -flat bundles (ref. [Mo11, Section 13.1-13.3]).
- Present some characterizations for a harmonic bundle to be good and wild, the key results are Propositions 13.5.1 and 13.5.2 (ref. [Mo11, Section 13.5]).
- Describe the filtered flat bundle associated to wild harmonic bundles (ref. [Mo11, Section 13.6]).

Talk 4: The graded semisimple good filtered flat bundle

Speaker: Phung Ho Hai

Time: 16h00-17h50, October 30, 2025

Venue: Room 301-A5, Institute of Mathematics, VAST

Reference: Chapter 14 in [Mo11]

- Provide local constructions and basic estimates for ordinary metrics (ref. [Mo11, Sections 14.1 and 14.2]).
- Present the parabolic Chern character of good filtered λ -flat bundles, and explain the vanishing of characteristic numbers for good Deligne–Malgrange filtered bundles (ref. [Mo11, Section 14.3]).
- Explain the Kobayashi–Hitchin correspondence for graded semisimple filtered flat bundles satisfying the SPW-condition in the case of surfaces (see [Mo11, Section 14.4]).

Talk 5: Kobayashi–Hitchin correspondence and applications to algebraic meromorphic flat bundles

Speaker: Pham Thanh Tam

Time: 8h00-9h50, October 31, 2025

Venue: Room 301-A5, Institute of Mathematics, VAST

Reference: Chapter 16 in [Mo11]

- Provide a brief overview of the Kobayashi–Hitchin correspondence between good wild harmonic bundles and μ_L -polystable good filtered flat bundles with vanishing characteristic number ([Mo11, Section 16.1]).
- Discuss some applications to algebraic meromorphic flat bundles (ref. [Mo11, Sections 16.2 and 16.3]).

Talk 6: Wild harmonic bundles and wild pure twistor D-modules on curves

Speaker: Vo Anh Duc

Time: 10h00-11h50, October 31, 2025

Venue: Room 301-A5, Institute of Mathematics, VAST

Reference: Chapter 17 in [Mo11]

- Recall the notion of wild pure twistor D-modules and review some basic properties established by Sabbah (ref. [Mo11, Section 17.1]).
- Sketch the proof of the correspondence between wild pure twistor D-modules and wild harmonic bundles on curves (ref. [Mo11, Section 17.2]).

References

- [Mo11] MOCHIZUKI, T., *Wild harmonic bundles and wild pure twistor D-modules*, Astérisque, no. 340 (2011).
- [Sab07] SABBAB, C., *Hodge theory, singularities and D-modules*, Lecture notes, Luminy (2007).
- [Sim92] SIMPSON, C., Higgs bundles and local systems, *Inst. Hautes Études Sci. Publ. Math.* No. 75 (1992), 5–95.