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## A Talk at the 2nd ISNMP Conference

Bad Ems, 28 June to 4 July 2026

### Regular Session:

**Speaker:** Raffaele Vitolo (Università del Salento, Lecce, Italy)

**Collaborators:** P. Lorenzoni, S. Opanasenko

**Title:** *Bi-Hamiltonian systems from homogeneous operators*

**Abstract:** Many 'famous' integrable systems (KdV, AKNS, dispersive water waves etc.) have a bi-Hamiltonian pair of the following form:  $A_1 = P_1 + R_k$  and  $A_2 = P_2$ , where  $P_1, P_2$  are homogeneous first-order Hamiltonian operators and  $R_k$  is a homogeneous Hamiltonian operator of degree (order)  $k$ . The Hamiltonian property of  $P_1, P_2$  and their compatibility were given an explicit analytic form and geometric interpretation long ago (Dubrovin, Novikov, Ferapontov, Mokhov). The Hamiltonian property of  $R_k$  was studied in the past (Doyle, Potemin;  $k = 2, 3$ ) and recently revisited with interesting results. In this talk, we illustrate the analytic form and some preliminary geometric interpretation of the compatibility conditions between  $P_i$  and  $R_k$ ,  $k = 2, 3$ . See the recent papers <https://arxiv.org/abs/2602.14739>, <https://arxiv.org/abs/2407.17189>, <https://arxiv.org/abs/2311.13932>.

Joint work with P. Lorenzoni and S. Opanasenko