

International
Online Conference



**Algebraic
and Geometric
Methods of Analysis**

dedicate to the memory
of Yuriy Trokhymchuk
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LIST OF TOPICS

- Topological methods in analysis
- Geometric problems of complex and mathematical analysis
- Algebraic methods in geometry
- Differential geometry in the whole
- Geometry and topology of differentiable manifolds
- General and algebraic topology
- Geometric and topological methods in natural sciences

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Second classical Zariski topology of multiplicative module

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Let R be a associative ring and M an multiplicative R -module. If N is a subset of an R -module M we write $N \leq M$ to indicate that N is a submodule of M .

Definition 1. Proper submodule P of the left module M is called **prime submodule**, if quotient module M/P is prime left module, ie $Ann(K/P) = Ann(M/P)$ for every nonzero submodule K/P of module M/P .

This definition can be found in such papers: [1], [2], and there are a lot of interesting results about such modules. Set of all prime submodules of module M is called prime spectrum of module M and is denoted by $Spec(M)$.

Definition 2. A non-zero submodule N of M is said to be second if for each $a \in R$, the homomorphism $N \rightarrow^a N$ is either surjective or zero [3]. More information about this class of modules can be found in [4].

Let $Spec^s(M)$ be the set of all second submodules of M . For any submodule N of M , $V^{s*}(N)$ is defined to be the set of all second submodules of M contained in N . Of course, $V^{s*}(0)$ is just the empty set and $V^{s*}(M)$ is $Spec^s(M)$. It is easy to see that for any family of submodules $N_i (i \in I)$ of M , $\cap_{i \in I} V^{s*}(N_i) = V^{s*}(\cap_{i \in I} N_i)$. Thus if $\zeta_{s*}(M)$ denotes the collection of all subsets $V^{s*}(N)$ of $Spec^s(M)$, then $\zeta_{s*}(M)$ contains the empty set and $Spec^s(M)$, and $\zeta_{s*}(M)$ is closed under arbitrary intersections. In general $\zeta_{s*}(M)$ is not closed under finite unions. Now let N be a submodule of M . We define $W^s(N) = Spec^s(M) - V^{s*}(N)$ and put $\Omega^s(M) = \{W^s(N) : N \leq M\}$. Let $\eta^s(M)$ be the topology on $Spec^s(M)$ by the sub-basis $\Omega^s(M)$. In fact $\eta^s(M)$ is the collection U of all unions of finite intersections of elements of $\Omega^s(M)$ [6]. We call this topology the second classical Zariski topology of M .

Theorem 3. *Let R be a associative Noetherian ring and let M be a cotop multiplicative R -module with finite length. Assume that the second classical Zariski topology of M and the Zariski topology of M considered in [5] coincide. Then M is a comultiplication R -module.*

Theorem 4. *Let R be a associative Noetherian ring and let M be a co-multiplication R -module with finite length. Then $Spec^s(M)$ is a spectral space (with the second classical Zariski topology).*

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