

Web Platform for Sharing Modeling Software in the Field of Nonlinear Optics¹

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Web platform underlying concept

The main goal is to develop a web platform where researchers with the same area of expertise can share their modeling software between each other (research hub).

Software as a service (SaaS): in contrast to the open source paradigm we focus on sharing of already installed and working programs not the program code.

Web access: for regular operations a platform user should have only web-browser.

Web platform community model

- **Developer**
the one who provides a new program, installs it
- **Web platform administrator**
the one who checks the provided software and makes the program available to regular users
- **Regular user**
the one who wants to use installed program

Web platform

an entity that makes them all cooperate

HUBzero middleware

In our installation of the web platform for nonlinear optics we use HUBzero® middleware.

HUBzero is open source solution for creating dynamic web sites for scientific research and education.

In HUBzero terms every modeling or calculating program to be shared via the platform is called **a tool**.

The concept of a tool also includes:

- some properties (tool name and description, license info, access rights, etc)
- a workflow that determines tool lifecycle

Tool lifecycle

- registration
- testing
- installation
- publishing
- updating
- retirement

HUBzero modules

- tool lifecycle management module
 - tools catalog with search engine
 - tool launching module
-
- authentication and authorization module
 - logging module
 - repository of the software codes
 - module for review and blog posting
 - module for assigning rating marks

HUBzero key technologies

- Base technologies:
 - Subversion - software versioning and revision control system
 - MySQL - database management system
 - OpenVZ - operating system-level virtualization technology
- Technologies are used to make GUI of a tool work properly in the user's browser:
 - VNC (Virtual Network Computing)
 - WebDAV (Web Distributed Authoring and Versioning)
 - WebSocket
- The Rappture toolkit - quick on-the-fly creation of the GUI for Linux

Our prototype of the web platform for nonlinear optics

Nonlinear optics is a rapidly evolving area of modern physical research and engineering with many important applications.

Development of optical devices requires complicated modeling of physical processes that occur in components of devices.

Based on HUBzero middleware we deployed a working prototype of the web platform for the library of programs in nonlinear optics.

The prototype of the platform is now under test.

Web platform prototype: login page


SINP HUB - Login

https://gridmsu29.sinp.msu.ru/login?reset=1&return=L21lbWJlcnMvMTAwMC9kYXNoYm9hcmQ=

sinp hub DISCOVER COMMUNITY ABOUT SUPPORT DEVELOPER MAIN PAGE TOOL PIPELINE

You are here: Home / Login

Login



Sign in to SINP HUB

 Keep me logged in?
[Lost username?](#)
[Forgot password?](#)
[Create an account](#)

Web platform prototype: tools catalog

The screenshot displays the 'Tools: Tool Pipeline' page on the SINP HUB. The interface includes a search bar at the top, navigation tabs (DISCOVER, COMMUNITY, ABOUT, SUPPORT, DEVELOPER MAIN PAGE, TOOL PIPELINE), and a breadcrumb trail: 'You are here: Home / Tool Pipeline / Tool Pipeline'. A 'New Tool' button is visible in the top right. Below the search bar, there are filter tabs for 'All', 'Mine', 'Published', and 'Development'. The main content area shows a table of tools with the following data:

Title	Alias	Status	Links
Stas's test tool (python) v1.0 Registered 23 May 2017	ptest	Installed 1 week ago	resource history project
Stas's test tool v1.0 Registered 23 May 2017	stest	Installed 1 week ago	resource history project
Crystal Sync2 v3.0 Registered 15 May 2017	cs2	Published 1 month ago	resource history project
Crystals Sync v1.0 Registered 24 Apr 2017	crystalssync	Installed 2 months ago	resource history project
Test Tool v1.0 Registered 27 Mar 2017	testtool	Published 3 months ago	resource history project

At the bottom of the table, there is a pagination control showing 'Start 1 End' and a 'Display #' dropdown set to '20', with 'Results 1 - 5 of 5'.

Example tool: description

Example tool purpose:

- to calculate angle of synchronism for large number of crystal types stored in a database.

Angle of synchronism is:

- a geometrical feature which specifies conditions for non-linear optical effects in crystal to become volume effects rather than point effects.

This program calculates angle of synchronism for frequency doubling as a function of temperature, crystal parameters, and frequency of incident radiation.

Example tool: initial screen

The screenshot displays a web browser window with the following elements:

- Browser Tab:** SINP HUB - Resources: Tools: S...
- Address Bar:** <https://gridmsu29.sinp.msu.ru/tools/ptest/session?sess=100>
- Navigation Menu:** *sinp hub* | DISCOVER | COMMUNITY | ABOUT | SUPPORT | DEVELOPER MAIN PAGE | TOOL PIPELINE
- Breadcrumbs:** You are here: Home / Tool Forge / Tools / Stas's test tool (python) / Session: 100 "Stas's test tool (python)"
- Section Header:** Tools: Session: 100
- Tool Interface:**
 - Title Bar:** Stas's test tool (python) [Settings] [X] Terminate [Play] Keep for later
 - Buttons:** Simulate | new input parameters [Menu]
 - Result:** Result: [Dropdown] [Download]
 - Inputs:**
 - Type of crystal: [Dropdown] 1
 - Crystal temperature: [Slider] 300K
 - Status Bar:** No results [Clear]
 - Footer:** [Lightning Bolt] [Refresh] [Fullscreen] 780 x 600

Example tool: general program output

The screenshot displays a web browser window with the URL `https://gridmsu29.sinp.msu.ru/tools/ptest/session?sess=100`. The page header includes the *sinp hub* logo and navigation links: DISCOVER, COMMUNITY, ABOUT, SUPPORT, DEVELOPER MAIN PAGE, and TOOL PIPELINE. A breadcrumb trail indicates the current location: Home / Tool Forge / Tools / Stas's test tool (python) / Session: 100 "Stas's test tool (python)".

The main content area features a dark header with the text "Tools: Session: 100". Below this is a simulation window titled "Stas's test tool (python)". The window includes a "Simulate" button, a "Terminate" button, and a "Keep for later" button. The "Result" dropdown is set to "Phase synchronism angle".

On the left side of the simulation window, there are two input fields: "Type of crystal: 1" and "Crystal temperature: 300K".

The central part of the window contains a graph with the following characteristics:

- Y-axis:** Labeled "theta", ranging from 40 to 80.
- X-axis:** Labeled "frequency (THz)", ranging from 100 to 600.
- Curve:** A blue parabolic curve opening upwards, with its minimum value of approximately 45 occurring at a frequency of about 300 THz.

At the bottom of the graph area, there is a status bar showing "1 result" and a "Clear" button. The bottom right corner of the simulation window displays a refresh icon, a circular arrow icon, and the resolution "780 x 600".

Example tool: program output details

The screenshot displays a web browser window with the URL <https://gridmsu29.sinp.msu.ru/tools/p/test/session?sess=100>. The page title is "Stas's test tool (python)". The navigation menu includes "DISCOVER", "COMMUNITY", "ABOUT", "SUPPORT", "DEVELOPER MAIN PAGE", and "TOOL PIPELINE". The breadcrumb trail shows "You are here: Home / Tool Forge / Tools / Stas's test tool (python) / Session: 100 'Stas's test tool (python)'". The main content area is titled "Tools: Session: 100".

The simulation tool interface, titled "Stas's test tool (python)", features a "Simulate" button and a "Result" dropdown menu. The graph shows the phase synchronism angle (theta) as a function of frequency (THz). The curve is parabolic, with a minimum at 171.25 THz and a phase synchronism angle of 57.5254. The input fields are set to "Type of crystal: 1" and "Crystal temperature: 300K".

frequency (THz)	theta
171.25	57.5254

Example tool: program output downloading

The screenshot displays a web browser window with the URL `https://gridmsu29.sinp.msu.ru/tools/ptest/session?sess=100`. The page header includes the *sinp hub* logo and navigation links: DISCOVER, COMMUNITY, ABOUT, SUPPORT, DEVELOPER MAIN PAGE, and TOOL PIPELINE. A breadcrumb trail reads: You are here: Home / Tool Forge / Tools / Stas's test tool (python) / Session: 100 "Stas's test tool (python)".

The main content area is titled "Tools: Session: 100" and contains a simulation tool interface for "Stas's test tool (python)". The interface features a "Simulate" button and a "Result" field displaying "Phase synchronism". Below the result is a graph with "theta" on the y-axis (ranging from 40 to 80) and "frequency (THz)" on the x-axis (ranging from 0 to 500). The graph shows a parabolic curve with its minimum at approximately 300 THz and theta ≈ 45. On the left side of the graph, there are two input fields: "Type of crystal: 1" and "Crystal temperature: 300K".

A "Download as..." menu is open over the graph, showing the following options:

- Download 1 result in the following format:
- ◆ Data as Comma-Separated Values
- ▼ Image (PS/PDF/PNG/JPEG)

A "Download" button is located at the bottom of the menu. At the bottom of the tool interface, a status bar indicates "1 result" and a "Clear" button.

Conclusion

- Web platforms for sharing modeling software is a fast-growing and promising area
- HUBzero middleware is a very convenient tool for creating dynamic web sites for scientific research
- We managed to deploy an effective and stable web platform aimed to help solve the arising problem of designing of nonlinear optical devices used for the conversion of laser light
- Prospects – to go broad and deep:
 - Existing installation: move from testing to production
 - Increase computational capacity
 - Add new features upon user's requests
 - New installations: deploy web platform for another scientific areas (e.g. high energy physics, physics of cosmic radiation)

Thank you!